Project Manual

VOLUME 2

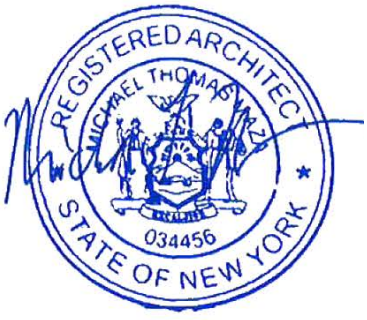
PROJECT NO.	291036-01
PROJECT TITLE:	Renovations to Relocate Admissions for Rehab of Administration Bldg – Phase 1A
DATE:	12 June 2023

State University of New York

at

Purchase College

State University Construction Fund
H. Carl McCall SUNY Building
353 Broadway
Albany, New York 12246



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SECTION 210510

GENERAL PROVISIONS FOR FIRE PROTECTION SYSTEMS WORK

1.1 SCOPE AND INTERPRETATION

A. These Specifications and accompanying Drawings provide for the furnishing and the installation of the fire protection systems, including all sprinkler heads. The specifications and Drawings require the Contractor, to provide all labor, materials, equipment and appurtenances to perform of all work pertaining or incidental thereto, which is needed to complete the Work shown on the Drawings and called for in the Specifications.

B. These Fire Protection drawings are performance based. It is contractor's responsibility to hire professional engineer, licensed and registered in State of New York. This professional engineer shall prepare the shop drawings with the signed and sealed hydraulic calculation as per NFPA 13 complying with the performance requirement of these drawings. Contractor shall submit this design and calculations to Design Engineer (Professional) for reviewing approval prior to commencing any work. The Design Engineer (Professional) reserves the right to make minor modifications to the layout. Contractor's drawings shall bear a Professional Engineer's sign and stamp. Contractor shall include in his bid the cost to conduct a new hydrant flow test, pressure test required to prepare hydraulic calculation for this project.

C. The complete fire protection system and the Work shall be so installed as to give proper and continuous service under all conditions, and shall be in accordance with the requirements of all public authorities having jurisdiction and to the complete satisfaction of the Authority. Any Work shown on the Drawings and not particularly described in the specifications, or vice versa or any Work which may be deemed necessary to complete the Contract shall be provided by the Contractor as part of this Contract.

D. For purposes of clearness and legibility, fire protection Drawings are essentially diagrammatic and size and location of equipment are drawn to scale wherever possible. The Drawings indicate size, connection points and routes of pipe. It is not intended, however, that all offsets, rises and drops are shown. Provide piping as required to fit structure, avoid obstruction, and retain clearances, headroom openings and passageways.

E. Sprinklers shown and described on the Drawings shall be connected to water supply piping in accordance with the requirements of NFPA 13-16, Standard for the Installation of Sprinkler Systems, despite any possible omission of indication of such piping on the plans.

F. Fire protection systems shall be tested in accordance with Building Code of New York State and Fire Code New York State.

G. Scope of Work: The fire protection work of this contract shall include but shall not be limited to the following systems, equipment and services:

a. Provide a complete fire protection system consisting of:

a. Sprinkler distribution and branch piping,

b. New Sprinkler heads

b. Piping: Installation of complete sprinkler systems piping from the point of connection. Piping includes among other things: sprinkler heads etc.

3. Equipment and devices furnished under other Sections of this Contract that are integrated with the fire protection system, including electrical devices for system monitoring and alarms, shall be piped by Contractor.

4. The testing of the sprinkler system shall as per Section 210530.

5. Painting requirements for the dedicated piping of a sprinkler system shall be as per Section 210530.

6. Piping, equipment supports and vibration isolation: To comprise all hangers, pipe guides, rods, beam clamps, brackets, pipe anchors, other attachments, floor flanges, masonry anchors, bolts, nuts, washers, and other items as required to fully support all piping and equipments installed under this contract. Provide spring hangers, and vibration mounts where recommended by equipment manufacturers, where required to meet noise abatement regulations and as necessary to prevent piping and equipment vibrations being transmitted to structure.

7. Instrumentation: Provide thermometers, pressure gauges and other items for all piping and equipment installed under this contract, as indicated on contract drawings and as necessary for operation, maintenance and adjustments.

8. Miscellaneous Work: Included shall be all items of materials, piping, controls, wiring and other miscellaneous items not specifically shown on Contract Drawings or called for herein but which are normally furnished and required for a complete installation of this type.

9. Sealing of Openings/penetrations: Openings left in walls, floors, ceilings or partitions shall be sealed. Penetrations into other trades work shall be sealed to an airtight condition. Penetrations through insulated systems, such as refrigerated rooms/equipment, etc, shall be insulated and sealed on both sides of penetration. Sealant on interior side of such insulated spaces/equipment shall be silicone recommended by manufacturer. Finish shall match existing adjoining finish in all respects.

10. Coordination Drawings: Contractor shall coordinate between HVAC, P&D, and Electrical work and provide coordination drawings to Design Engineer (Professional) for review and approval. The drawings, indicating ductwork, steam, hydronic & fuel piping, etc. shall be generated by Contractor. No trade should get priority in the allocation of space during coordination phase. At the completion of this phase, hold a coordination meeting to eliminate any interference among the trades that the drawings indicate and to avoid any conflicts in installing the Work.

11. Project Record Documents: For the requirements under this provision, refer to Division 1.

1.2 CODES AND STANDARDS

A. It shall be unlawful for any person to perform the work referred to under this Fire Protection Specifications and/or shown on the Fire Protection Contract Drawings unless such person is a licensed Contractor, as permitted by the NYS Building Code and unless such work is performed under the direct and continuing supervision of a licensed Contractor.

B. Where requirements for products, materials, systems, equipment, methods and other portion of the work specified herein exceed minimum requirements of regulatory agencies having jurisdiction over the construction work, contractor shall comply with such requirements specified herein, unless specifically approved otherwise by the Authority.

1.3 TORCH BURNING OPERATION

A. The storing and use of oxygen and combustible gases in conjunction with torch burning apparatus is subject to the Rules and Regulations of the Division of Fire Prevention of the Fire Department of the State of New York, latest Fire Prevention (F.P.) Directive. Fire watches shall be provided during all operations using torches for burning, cutting or welding.

B. Contractor shall apply for and obtain permits for the use and storage of such equipment on building premises. The operator of such equipment shall have a certificate of fitness issued by the Local Fire Department.

C. The cost of permits, certificates, fire watches, apparatus and other items required in the torch burning operation shall be borne by the Contractor at no additional cost to the owner.

1.4 PROTECTION OF MATERIALS AND WORK

A. Existing Building

1. Open ends of piping shall be temporarily closed by a proper fitting, until piping is approved and ready for service.

2. Motors and appurtenances shall be covered and protected during the progress of the Work.

1.5 OPENINGS AND CHASES

A. In addition to the requirements in the Article entitled Cutting, Patching and Removals of Section 017329, the following shall also apply:

Openings through exterior foundation walls shall be made watertight by the Contractor after pipes, conduits and other items passing through the wall have been installed. This building is planned and detailed, and is the intent of these specifications to provide a structure that will prevent the penetration by rodents and vermin of any vacant space where they might find a harborage. The Contractor will be held responsible for securing this condition by the closing of all points of access to such spaces, including the passage of piping and conduits, through all walls, partitions, ceilings and furred out spaces, the

closing of access to voids in hollow tile or cinder blocks. There shall be a special inspection of the building with regard to this matter before final acceptance.

1.6 INSTRUCTION FOR PERSONNEL STAFF

A. After the fire protection system has been tested, and all other items adjusted and operating properly to the satisfaction of the Authority, Contractor shall furnish a competent person to instruct the Owners' Personnel staff in the operation and maintenance of the systems. Determination of the date and time of such instruction shall be under the direction of the Owner.

1.7 SUBMITTALS

A. The Contractor shall submit shop drawings with such promptness as to cause no delay in their own work.

B. Submit shop drawings complete in every detail for items as described in subsequent sections of this specification.

C. The comments "Approved" or "Approved as Noted" rendered on shop drawings shall not be considered as a guarantee of measurements or building conditions. Where drawings are reviewed, said review does not in any way relieve responsibility, or necessity, of furnishing material or performing work as required by the Contract Drawings and Specifications.

D. "Approved as Noted" means, unless otherwise noted on the drawings to approved for construction, fabrication and/or manufacture subject the provision that the work shall be carried out in compliance with all annotations and/or corrections indicated on the shop drawings and in accordance with the requirements of the Contract Documents. Resubmission is required only if the Contractor is unable to comply with noted corrections. Resubmission must clearly indicate items varying from the noted corrections and other changes made from the previous submission. If also marked "RESUBMIT", "Approved as Noted" is invalid and a corrected submittal of the drawing is required.

1.8 CLEANING AND REPAIR

A. At the completion of the Work and before the final inspection is made the Contractor shall thoroughly flush the system in scope and leave it free from all marks, scratches, stains, and other damage. Remove all tools, debris and excess materials from the premises.

B. Contractor shall not leave sharp exposed metal edges (bottom of threaded rods, equipment supports, etc.) that could otherwise present safety hazards to the building's occupants/work staff.

END OF SECTION 210510

SECTION 210529

PIPE HANGERS AND SUPPORTS

PART 1 GENERAL

1.1 RELATED WORK

A. Section 017419 – Construction and Demolition Waste Management Disposal.

1.2 SUBMITTALS

A. Shop Drawings:

1. Details of trapeze hangers and upper hanger attachments for piping 4 inches in diameter and over. Include the number and size of pipe lines to be supported on each type of trapeze hanger.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements

1. Comply with the applicable requirements of the ASME B31 Piping Codes.

2. Unless otherwise shown or specified, comply with the requirements of the Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS) Standards SP-58, and SP-69.

3. Materials for use in Sprinkler Systems shall comply with the requirements of NFPA 13 as applicable.

PART 2 PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Pipe Hangers: Height adjustable standard duty clevis type, with cross bolt and nut.

1. Swivel ring type hangers will be allowed for sprinkler piping up to a maximum of 2 inches in size.

B. Adjustable Floor Rests and Base Flanges: Steel.

C. Hanger Rods: Mild, low carbon steel, fully threaded or threaded at each end, with two nuts at each end for positioning rod and hanger, and locking each in place.

D. Riser Clamps: Malleable iron or steel.

2.2 ANCHORS AND ATTACHMENTS

A. Sleeve Anchors (Group II, Type 3, Class 3): Molly's Div./USM Corp. Parasleeve Series, Ramset's Dynabolt Series, or Red Head/Phillips AN, HN, or FS Series.

B. Wedge Anchors (Zinc Plated, Group II, Type 4, Class 1): Hilti's Kwik Bolt Series, Molly's Div./USM Corp. Parabolt PB Series, Ramset's Trubolt T Series, or Red Head/Phillips WS Series.

C. Self-Drilling Anchors (Group III, Type 1): Ramset's RD Series, or Red Head/Phillips S Series.

D. Non-Drilling Anchors (Group VIII, Type 1): Ramset's Dynaset DS Series, Hilti's HDI Series, or Red Head/Phillips J Series.

E. Stud Anchors (Group VIII, Type 2): Red Head/Phillips JS Series or approved equal matching technical data.

F. Beam Clamps: Forged steel beam clamp, with weldless eye nut (right hand thread), steel tie rod, nuts, and washers, Grinnell's Fig No. 292 (size for load, beam flange width, and rod size required) or approved equal matching technical data.

G. Metal Deck Ceiling Bolts: B-Line Systems' Fig. B3019 or approved equal matching technical data.

2.3 FASTENERS

A. Bolts, Nuts, Washers, Lags, and Screws: Medium carbon steel; size and type to suit application; galvanized for high humidity locations, and treated wood; plain finish for other interior locations. Except where shown otherwise on the Drawings, furnish type, size, and grade required for proper installation of the Work.

2.4 SHOP PAINTING AND PLATING

A. Hangers, supports, rods, inserts and accessories used for pipe supports, unless chromium plated, cadmium plated or galvanized shall be shop coated with metal primer paint.

PART 3 EXECUTION

3.1 INSTALLATION

A. Do not hang or support one pipe from another pipe or from ductwork.

1. Do not bend threaded rod.

B. Space hangers or supports for horizontal piping on maximum center distances as listed in the following hanger schedules, except as otherwise specified, or noted on the Drawings.
1. For Threaded Steel Pipe:

PIPE SIZE (Inches)	MAXIMUM SPACING (Feet)
1 and under	8
1-1/4 and 1-1/2	9
2	10
2-1/2 and up	12

2. For Grooved End Steel Pipe:

PIPE SIZE (Inches)	MAXIMUM SPACING (Feet)
1-1/2 and under	7
2 through 4	10
5 and over	12

No pipe length shall be left unsupported between any two coupling joints.

3. For Directional Changes: Install a hanger or support close to the point of change of direction of all pipe runs in either a horizontal or vertical plane.

4. For Concentrated Loads: Install additional hangers or supports, spaced as required and directed, at locations where concentrated loads such as in-line pumps, valves, fittings or accessories occur, to support the concentrated loads.

5. For Branch Piping Runs and Runouts Over 5 feet In Length: Install a minimum of one hanger, and additional hangers if required by the hanger spacing schedules.

6. Parallel Piping Runs: Where several pipe lines run parallel in the same plane and in close proximity to each other, trapeze hangers may be submitted for approval. Base hanger spacing for trapeze type hangers on the smallest size of pipe being supported. Design the entire hanger assembly based on a safety factor of five, for the ultimate strength of the material being used.

B. Vertical Piping:

1. Support vertical risers of piping systems, by means of heavy-duty hangers installed close to base of pipe risers, and by riser clamps with extension arms at intermediate floors, with the distance between clamps not to exceed 25 feet, unless otherwise specified. Support pipe risers in vertical shafts equivalent to the aforementioned. Install riser clamps above floor slabs, with the extension arms resting on floor slabs. Provide adequate clearances for risers that are subject to appreciable expansion and contraction, caused by operating temperature ranges.

2. Support extension arms of riser clamps, secured to risers to be insulated for cold service, 4 inches above floor slabs, to allow room for insulating and vapor sealing around riser clamps.

END OF SECTION 210529

SECTION 210530

SPRINKLER SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Provide a wet sprinkler system as specified herein, as shown on the Drawings and as needed for a complete and proper installation. Product specific requirements are contained herein; Section 210510, General Provisions for Fire Protection Systems Work, shall be referred to for general requirements.

B. Work Included:

All piping, valves, hangers, equipment, etc. as specified herein, as shown on drawings and as required by local authorities.

1. Pipe and Fittings

2. Sprinkler Heads

3. Painting and Identification of Pipe

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Division 09 Painting

B. Division 22 Sections

C. Division 23 Sections

1.03 DESIGN REQUIREMENTS

A. Based on the fire protection (sprinkler) drawings provided in the Contract Documents, a third-party professional engineer licensed in NY State (not a direct employee of the contractor**)** having 5 years' experience in the design and installation of fire protection systems shall be engaged by the Contractor to provide hydraulic calculations and Drawings meeting the design parameters indicated in paragraph 1.03C below. The Drawings shall comply with applicable codes and incorporate the final pipe sizes, pipe locations, and sprinkler head locations for the fire protection system after coordination with the other trades. The prepared Drawings and calculations will be reviewed by the Design Engineer of Record to ensure conformance with the Design parameters.

B. The Contractor's engineer is responsible for filing all subsequent revisions and incorporating as-built conditions into filed plans prior to inspection by Building Department. These revisions must be filed in a timely manner to allow for full inspection of the system. Installed conditions that do not match the filed documents will be rejected. The Contractor is also responsible for securing inspection for final acceptance of the installed sprinkler system. Filed and approved Drawings must be available for the field inspection and the filing shall have been completed in sufficient time to allow for the inspection to take place while all piping is exposed.

C. Design Parameters

1. Sizes of risers, mains, sub-mains, and the originally selected pump(s) are not to be changed from those shown on the Contract Drawings unless shown to be inadequate. To make changes to these items, the Contractor's engineer must document design flaws in the original system design with hydraulic calculations prepared following the guidelines outlined in Chapter 7 of NFPA 14-16 & Chapter 11 of NFPA 13-16. Locations of risers, as well as types of sprinkler heads shown on the **C**ontract Drawings shall not be revised without approval of the original Engineer of Record**,** as they are typically located where they are needed to meet design intent, freeze protection, etc. Deviations will be allowed for sizing of branch piping and the number of sprinkler heads per branch line contingent upon availability of water supply and compliance with the sizing guidelines outlined in Section 14.5 of NFPA 13, for Light Hazard, Ordinary Hazard and Extra Hazard Occupancies. Dry sprinkler heads required to prevent freezing shall be so provided. Use of the "Pipe Schedule Method" for pipe sizing in the design of the new system is not permitted.

2. Hydraulic calculations submitted for plan approval and in support of revisions to size of branch piping and relocation and/or revision of number of sprinkler heads shall take into account and maintain a minimum safety factor of 10-psi, which is part of the original design. The 10-psi safety factor is to be applied to the incoming pressure as indicated on the pressure gauge at Fire Protection Point of Entry at the building, i.e. the available pressure as indicated by the pressure gauge is to be reduced by 10 psi and the resulting reduced pressure shall be capable to adequately supply the Contractor's sprinkler system.

1.04 SUBMITTALS

A. Submit copies of all permits and approved drawings issued by Building Department.

B. Shop Drawings

1. Complete wet sprinkler system layout indicating the locations of sprinkler heads, devices, and accessories. Include separate details of special or not easily visualized piping arrangements and inspector's test valves and connections.

2. Hydraulic calculations shall be complete and cross referenced to the appropriate drawing sheets.

3. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.

4. Pipe and fittings

C. Test Reports as specified in the Field Quality Control Article.

D. Certification of Installation: Submit certificate upon completion of sprinkler work, which indicates that work has been tested in accordance with the 2020 NYS Building Code, NFPA 13-16 and also that system is operational, complete and has no defects.

E. Certificates of Calibration for all test equipment.

F. Maintenance data: Include an instruction manual describing the operation and maintenance of the system in the maintenance manual.

G. Maintenance materials: Sprinkler heads, wrench, caps and chains.

1.05 SUPPLEMENTAL QUALITY ASSURANCE

A. Codes and Standards

1. NFPA Compliance: Install wet sprinkler systems in accordance with NFPA 13-16 and NFPA 14-16.

2. UL Compliance: Provide sprinkler products in accordance with their listings and UL standards; provide UL label on each product.

3. New York State Construction Code: Comply with the requirements of the 2020 NYS Construction Codes and with the Rules and Regulations of the Building Department, Local Fire Department and all other public authorities having jurisdiction.

4. Fire Department/Marshal Compliance: Install sprinkler systems in accordance with local regulations of the Local Fire Department.

5. All gauges, instruments and test devices shall be provided with a certificate of calibration and calibration curve or letter indicating that a minimum of five (5) test points have been calibrated. The certificate and letter must show the date of last calibration. The calibration date must be within a year of the testing date.

1.06 EXTRA MATERIALS

A. Heads: For each style and temperature range required, furnish additional sprinkler heads, amounting to six heads when fewer than 300 heads are installed and twelve heads when between 300 and 1200 heads are installed. All the spare heads will be enclosed in a steel cabinet with a special sprinkler wrench to be delivered to the Owner. Obtain a receipt.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements of the Specifications and Drawings, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

Victaulic
Viking
Reliable Automatic sprinklers
Tyco

2.02 PIPING MATERIALS

A. General

1. Provide piping materials and factory fabricated piping products of sizes, types, pressure and temperature ratings, and capacities as indicated on the final

approved Drawings and these specifications. Sizes of risers, mains, and sub-mains are not to be changed from those shown on the Contract Drawings, except as indicated in paragraph 1.03C above.

2. Provide fittings of materials that match pipe materials used in the sprinkler systems.

B. Aboveground Pipe, Within the Building

1. In buildings not exceeding 300 ft in height above grade and for pressure up to 300 psi, pipe shall be schedule 40 standard black steel as per ASTM A53, A106.

   a. Pipe sizes 2½" and above

      1) Schedule 40 piping with threaded ends, roll-grooving, or welded joints and fittings.

   b. Pipe sizes 2" and below

      1) Schedule 40 piping with threaded ends, roll-grooving, or welded joints and fittings.

2. Fittings shall be black threaded cast steel, steel or ductile iron. Pressure ratings shall be cast in or on the fittings.

3. Mechanical Coupling Type Fittings:

   a. The use of mechanical coupling type fittings on sprinkler system in lieu of threaded fittings or flanged fittings or grooved fittings is acceptable in sizes 2" to 8" inclusive. The mechanical couplings shall be self-centering and shall engage and lock the grooved pipe and/or fittings in a positive couple while allowing for some degree of angular pipe deflection, contraction and expansion. Each coupling shall consist of a malleable iron or ductile iron housing in two or more segments, a single molded composition sealing gasket, and two or more steel oval neck track bolts with hex nuts.

   b. Flexible couplings shall be of Style-77 manufactured by Victaulic Company of America, Gruvlok Fig. 7001 by Anvil, or approved equal. Entire coupling installation including pipe grooving shall be performed in accordance with the manufacturer's instructions. Only couplings, together with their respective grooved end pipe fittings having Local Fire Department approval will be accepted.

D. Pipe Escutcheons

1. Pipe escutcheons shall have inside diameter closely fitting pipe outside diameter or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Escutcheons shall be cast or sheet brass, solid or split-hinged, with brass set screw. Provide chrome finish for occupied areas exposed to view.

2. Manufacturers:
   Zurn Industries, Inc.
   McGuire Mfg. Co.
   Sioux Chief

E. Pipe Sleeves: Provide pipe sleeves of one of the following. Pipe sleeve must be appropriate type and thickness for the UL firestopping assembly selected:

1. Sheet-Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate from the following gauges: 3" and smaller, 20 gage minimum; 4" to 6", 16 gage; over 6", 14 gage minimum.

2. Steel-Pipe: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.

3. Iron-Pipe: Fabricate from cast-iron or ductile-iron pipe; remove burrs.

4. Firestop penetration materials for sealing sleeves shall be listed by Underwriters Laboratories. The materials shall be as specified in Section 078413.

5. Materials for sealing space between each pipe and sleeve through non-rated interior walls shall consist of mineral wool and sealant.

2.03 SPRINKLER HEAD

A. Provide sprinkler head of type indicated on Drawings, and in accordance with their listing.

1. Provide ordinary temperature-rated sprinklers if requirements for temperature rating of sprinkler heads as provided in Section 8.3.2 of NFPA 13-16 are complied with.

2. Quick response sprinklers shall be installed according to their listing and in light-hazard occupancies as defined in NFPA 13-16.

3. Wet or dry sprinklers that utilize O-rings as seals are not to be used on projects. O-ring sprinklers can degrade over time. These sprinkler heads can corrode, or minerals, salts, and other contaminants in water can affect the polymeric rubber O-ring seals. These factors could cause the sprinkler heads to not activate in a fire. Heads that use Teflon coated Belleville metallic seals rather than a rubber O-ring are to be used.

   Upright
   Pendent
   Recess Pendent
   Concealed Including Cover Plate
   Sidewall Horizontal – Quick Response Extended Coverage (QREC)

   a. Finishes for Upright, Pendent and Recess Pendent: chrome plate for occupied areas, cast or plain brass for unoccupied areas.

   b. Sprinkler Cabinet and Wrench: Provide steel, baked red enameled, sprinkler box with capacity to store sprinkler heads and wrench.

c. In light hazard occupancy only, quick-response extended coverage (QREC) sprinklers shall be installed in accordance with their listing. To reduce branch piping as well as the number of provided heads, quick-response extended coverage sprinklers shall be installed where indicated in drawings. Typically, gymnasium or other similar fire hazard classifications are ideal for maximizing the protection area by using sidewall horizontal quick-response extended coverage sprinklers.

d. Approved Manufacturers:
Victaulic
Viking
Reliable Automatic sprinklers
Tyco

2.04 PAINTING

A. Paints used on dedicated piping to sprinkler shall not:

1. Exceed the VOC content limits established in the Green Seal Standard GS-11 Paints, first edition, May 20, 1993.

2. Exceed the VOC content limit of 250 g/L established in the Green Seal Standard GC-03, Anti-Corrosive paints, second edition, January 7, 1997.

B. Provide colors indicated in Paragraph 3.02.C

1. First (1st) coat – Alkyd Vinyl Acrylic – Latex Primer – 1.2 Mills DFT

2. Second (2nd) coat – Semi-Gloss Vinyl Acrylic Latex – Enamel – 1.3 Mills DFT

PART 3 - EXECUTION

3.01 INSTALLATION

A. Approval of Sprinkler System: All necessary permits for work in connection with the installation of the sprinkler system shall be obtained by the Contractor before commencing any of the fire sprinkler work. Contractor will prepare and submit plans for the sprinkler system to the Building Code Compliance Division and obtain approval for same.

B. Installation of Identification

1. Install signs on sprinkler systems in accordance with the building code and local Fire Code, NFPA 13 and NFPA 14 requirements.

C. Piping Installation

1. Install pipes and pipe fittings in accordance with Article 2.02. Comply with requirements of NFPA 13 and NFPA 14 for installation of sprinkler piping materials. Install piping products where indicated, in accordance with manufacturer's written instructions and in accordance with recognized industry practices to ensure that piping systems comply with requirements and serve intended purposes.

3. Coordinate with other work including plumbing piping, as necessary to interface components of sprinkler piping properly with other work.

D. Installation of Sprinkler Head

1. Install sprinkler head at the proper position shown on the Drawings, or as required. Install concealed type sprinkler heads with factory painted white cover plate in areas with suspended ceilings. Install recessed type sprinkler head with manufacturer supply escutcheon.

2. Install sprinkler piping, heads, and all other items and accessories to clear electric lighting fixtures.

E. Installation of Pipe Escutcheons: Install pipe escutcheons on each pipe penetration through floors, walls, partitions, and ceilings. Secure escutcheon to pipe or insulation so escutcheon covers penetration hole, and is flush with adjoining surface.

F. For additional materials and method, refer to Division 09 - Painting.

G. After the finished coat of paint has been applied to the piping, this contractor shall do all pipeline identification labeling as per NFPA 13 and NFPA 14.

3.02 FIELD PAINTING

A. Paints and coatings used in the interior of building to mark piping for identification purposes shall not exceed the VOC content limits established in 2.04A.

B. Paint exposed sprinkler piping with a priming coat and two finish coats as specified in Division 09: Painting. Protect sprinkler heads during painting with small paper bags. Painting of sprinkler piping hangers, and all other items and accessories shall conform to the code requirements.

C. Painting of Dedicated Piping:

1. Dedicated piping to sprinkler system such as risers, cross-over mains and cross-over connections shall be painted red and the handles of valves fitted into the dedicated piping shall be painted yellow prior to the hydrostatic pressure test of the system. Painting shall be applied whether the pipe is ultimately concealed or remained exposed.

2. Cross-over mains, cross-over connections and risers of sprinkler systems that are exposed during alterations shall be painted red and the handles of valves serving the dedicated piping shall be painted yellow. If under filing done for the alteration work a hydrostatic pressure test is required, painting of pipe shall be done before the test.

3.03 FIELD QUALITY CONTROL/INTERDISCIPLINARY TESTS AND FUNCTIONAL PERFORMANCE TESTS

A. Cooperate with the Owner and Authorities having jurisdiction and provide all required access to facilitate all testing and inspections required for quality control and Regulatory Compliance.

B. Fire Protection Piping Flushing: Prior to connecting Sprinkler risers for flushing, flush water feed mains, lead-in connections and control portions of Fire Protection piping. After fire protection piping installation has been completed and before piping is placed in service, flush the limited fire protection system specified under this project to remove foreign substances under pressure as specified in NFPA 13. Continue flushing until water is clear, and check to ensure that debris has not clogged sprinkler heads or fire hose valves.

C. Test

1. Hydrostatic Testing: After flushing system, test fire protection piping hydrostatically, for one (1) hour period, 50 psi in excess of the system working pressure. Check system for leakage of joints. The test pressure shall be read from a gage located at the low point of each system or zone being tested.

2. Repair or replace piping system as required to eliminate leakage.

3. Test the entire fire protection installation, including fire alarm system, in accordance with the requirements of the Building Code NFPA Codes and Fire Code and give at least 2 days advance notice in writing of tests to the Fire Department and any other public authority having jurisdiction. All tests shall be performed as part of this contract.

D. Interdisciplinary Pre-Start-Up and Start-Up Tests/Inspections:

The Contractor shall conduct interdisciplinary pre-start up and start up tests/inspections (ex. verifying correct installation of sprinkler flow detectors) as per the manufacturer's start up procedures. Contractor shall submit signed start up affidavit signed by the factory authorized service representative/Contractor's P.E. certification indicating that all of the manufacturer's pre-start up and start up procedures have been successfully completed.

E. Functional Performance Tests:

Contractor shall also submit signed functional performance testing affidavit signed by the factory authorized service representative indicating that all of the manufacturer's functional performance tests (flushing, hydrostatic tests and testing of the fire alarm system activation) have been successfully completed.

3.04 SYSTEM ACCEPTANCE/FLOW TEST

B. Sprinkler System

1. The main drain valve shall be opened and remain open until the system pressure stabilizes.

2. All components of the sprinkler system and auxiliary must have been pressure tested as a composite system.

3. Discharge tests of the sprinkler system shall be conducted using the existing fire department connections.

END OF SECTION 21 05 30

SECTION 210553

IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Warning signs and labels.
2. Pipe labels.
3. Valve tags.
4. Warning tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

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

C. Valve Schedules: Valve numbering scheme.

PART 2 - PRODUCTS

2.1 WARNING SIGNS AND LABELS

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

a. Brady Corporation.
b. Brimar Industries, Inc.
c. Carlton Industries, LP.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, [1/16 inch (1.6 mm)] [1/8 inch (3.2 mm)] thick, with predrilled holes for attachment hardware.

C. Letter Color: White.

D. Background Color: Red.

E. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

H. Fasteners: Stainless-steel self-tapping screws.

I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

J. Label Content: Include caution and warning information, plus emergency notification instructions.

2.2 PIPE LABELS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Brady Corporation.
    b. Brimar Industries, Inc.
    c. Carlton Industries, LP.
    d. Champion America.
    e. Craftmark Pipe Markers.

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

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

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

E. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, 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: Size letters according to ASME A13.1 for piping.

F. Pipe-Label Colors:

1. Background Color: Safety Red.
2. Letter Color: White.

2.3 VALVE TAGS

A. Retain requirement in "Action Submittals" Article to submit numbering scheme for approval.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Brimar Industries, Inc.
c. Carlton Industries, LP.
d. Champion America.
e. Craftmark Pipe Markers.

B. 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 thick, with predrilled holes for attachment hardware.
2. Fasteners: Brass wire-link chain.
3. Valve-Tag Color: Safety Red.
4. Letter Color: White.

C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. 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.

2.4 WARNING TAGS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Brimar Industries, Inc.
c. Carlton Industries, LP.
d. Champion America.
e. Craftmark Pipe Markers.

B. Description: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Safety Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 GENERAL INSTALLATION REQUIREMENTS

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

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. Piping: Painting of piping is specified in Section 099123 "Interior Painting."

B. 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. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit a 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. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. 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 fire-suppression piping systems. List tagged valves in a valve-tag schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:

1. Valve-Tag Size and Shape:
   a. Wet-Pipe Sprinkler System: 2 inches, round.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 210553

SECTION 220500

PLUMBING GENERAL CONDITIONS

PART 1 GENERAL

1.1 WORK INCLUDED

A. Include all labor, materials, appliances and contractor services required for the furnishing, installing and testing, complete and ready for operation in a manner satisfactory to the architect all the Plumbing work shown on the drawings and specified herein.

B. Scope of work shall include, but not necessarily limited to, the following:

1. Drainage and vent systems.
2. Cold water and hot water systems.
3. Cutting and patching floor for floor drains and piping.
4. Connection to operating sanitary and water.

1.2 ACCESSIBILITY

A. Contractor shall locate all equipment, which must be serviced, operated or maintained in fully accessible positions. Equipment shall include but not be limited to valves, traps, cleanouts, motors and controllers and drain points. If required for better accessibility, furnish access doors for that purpose. Minor deviations from drawings will be allowed.

1.3 LAWS AND ORDINANCES

A. All work shall meet or exceed the latest requirements of all national, state, county, local or municipal, and other recognized authorities exercising or asserting jurisdiction over the construction work at the project.

1.4 STANDARDS

A. Materials specified by reference to a specific standard such as the American Society of Testing Materials, Underwriters Laboratories, American National Standards Institute, federal specifications, a trade standard or other similar standard shall comply with the latest revision thereof in effect at the time of bidding, except as modified by type, class or grade or modified by such reference.

1.5 INTENT OF THE DRAWINGS AND SPECIFICATIONS

A. It is the intent of these specifications to provide complete systems in good working order, ready for operation, including all accessories and items required for proper operation.
B. It shall be understood that the plumbing drawings show the general run of piping and the approximate location of all apparatus. Do not scale the drawings to determine exact positions and clearances. Obtain from the Engineer any dimensions not shown.
C. Methods of construction and details of workmanship where not specifically described herein or indicated on the drawings are subject to the Engineers approval.

1.6 PERMITS AND CERTIFICATES

A. This contractor shall obtain all necessary notices, file drawings and specifications with the departments or authorities asserting or having jurisdiction, obtain permits or licenses necessary to carry out the work.

B. The contractor shall arrange for inspections and tests of any or part of the work if so, required by authorities or local utility or service companies having jurisdiction, and pay all charges incurred. Notify Owner and Engineer 72 hours in advance of all inspections.

1.7 DELIVERY OF MATERIALS AND EQUIPMENT

A. Any damage caused by any overloading of the structure shall be repaired at no cost to the owner. Include the hoisting of all materials and equipment and assume all responsibility for such hoisting equipment.

1.8 RELATIONS WITH OTHER TRADES

A. Confer with others engaged in the construction of the building whose work might affect the installation, and arrange all parts of the work and equipment in proper relation to the work and equipment of others, with the building construction and with the architectural finish so that it will harmonize in service and appearance. Special care shall be taken in the installation of equipment and piping where concealed to assure that it does not project beyond finished lines of floors, ceilings, walls and cabinets.

1.9 APPROVED MATERIALS

A. All material and equipment shall be new, of makes and kinds specified herein, or as included in the drawings, without exception. Where one brand, make or device is shown or specified, the products of other manufacturers shall be regarded as acceptable when, in the opinion of the Engineer, it is a recognized equal considering quality, workmanship, economy of operation and suitability for the purpose intended.

B. Where such approved substitution or deviation requires a different quantity or arrangement of piping, wiring, supports, foundations, ductwork, and any other equipment or accessories normal to this equipment, furnish said changes and additions, and pay all costs for all changes to this work and the work of other trades affected by the substitution or deviation.

1.10 SHOP AND ERECTION DRAWINGS

A. Submit shop and erection drawings and obtain written approval of the same before ordering or installing any of the equipment or material. Equipment or material ordered or installed without written approval will not be accepted.

B. Shop drawings of equipment shall consist of manufacturers scale drawings, cuts or catalogs, including descriptive literature, which shall indicate the construction, including the material and physical dimensions, and complete operating data.

C. Erection drawings shall consist of scale drawings of the work including foundations in both plan and elevation. These drawings shall show clearances between units, and relation of the units to the space assigned. Make erection drawings when requested by the Engineer to supplement the diagrammatic drawings. With the exception of drawings for ductwork, erection drawings will not be required except for mechanical equipment rooms or other congested areas. The drawings shall also show the work of all other trades in the immediate vicinity of such areas. Ductwork drawings will be provided under another section of the specifications.

D. The checking of shop drawings and samples and the use of the approval stamp will be only for conformance with the design concept. The stamp of approval does not indicate approval of every detail of the drawings nor of the work and methods indicated thereon.

Shop drawings will not be accepted for review unless they are stamped and signed as having been coordinated with all trades.

E. Submit all of the following shop drawings and product data of related systems, products and accessories, grouped together to form a single submittal.
   1. Plumbing piping, drains, valves & components

1.11 RECORD DRAWINGS

A. Please refer to Div-1 specs for the record documents and formats.

1.12 TESTS

A. Include all tests specified and/or required under laws, rules and regulations of all authorities having jurisdiction.
B. All parts of the work and associated equipment shall be tested and adjusted to work properly and be left in perfect operating condition upon completion of the work. Correct defects disclosed by these tests without additional cost to the owner. Repeat tests on repaired or replaced work if deemed necessary by the Engineer.
C. Notify the Owner and Engineer at least 72 hours in advance of all tests. Furnish all necessary instruments, gauges and other equipment required for these tests.
D. Test piping and prove tight as specified and/or required, in the presence of authorities requesting witnessing of the final tests. Make tests in stages if so ordered to facilitate the work of others.
E. Test revised and altered drainage piping to point of connection with existing pipe with a flow of water equal to expected maximum discharge for 30 minutes with no leakage allowed.
F. Test new water piping with building water at building working pressure for a period of one hour with no leakage permitted.

1.13 EQUIPMENT OPERATING INSTRUCTIONS

A. Please refer to Div-1 specs for operation and maintenance.

1.14 REPLACEMENT OF DEFECTIVE WORK

A. When, in the opinion of the Engineer any material installed is substandard in appearance or function, or does not meet generally accepted standards of workmanship, all such materials shall be replaced to the satisfaction of the Engineer at no cost to the owner.

1.15 PAYMENT FOR FACILITIES

A. Please refer to Div-1 specs for the payment for facilities.

1.16 SUPERVISION

A. The contractor shall have a competent foreman in responsible charge of the work that shall be on the site during the installation of the material furnished under this specification, until the same has been put in complete operating condition and accepted by the owner.

1.17 RUBBISH

A. Please refer to Div-1 specs for cleaning requirements.

1.18 TEMPORARY USE OF EQUIPMENT

A. No equipment intended for permanent installation shall be operated for temporary purposes without written permission of and in complete agreement with stipulations set forth by the Owner.

1.19 PROTECTION

A. Protect all work and equipment against damage or theft until finally inspected, tested and accepted. Carefully store and protect materials and equipment received on site, which are not immediately installed. Close open ends of work with temporary plugs or covers during construction to prevent entry of debris.
B. Protect work and materials of all other trades from damage that might be caused by this work. Make good all damage caused to work and materials of other trades.

1.20 GUARANTEES

A. Please refer to Div-1 specs for Guarantees.

1.21 PIPE IDENTIFICATION

A. Provide vinyl identification bands, as manufactured by the William K. Brady Company, Seton Name Plate Corp. or approved equal on all piping. Bands shall not be installed on exposed piping until final painting of the piping has been completed. Band shall indicate the piping service and the direction of flow in each pipe.
B. Install bands on each side of every partition, at each valve, at each change in direction but in no case shall the bands be more than 20 feet apart on horizontal piping.

1.22 VALVE TAGS AND CHARTS

A. Install on each valve, a brass tag giving the number of that particular valve. Tags shall be two inches diameter with depressed white filled numbers three-quarters inch high. They shall be attached with a heavy brass "S" hook and a piece of brass window sash chain. The numbers shall be assigned only after consulting with Owner to determine the desired numbering system and sequence.
B. Furnish three copies of valve schedule in loose-leaf form with acetate covers. Schedule shall be divided into systems and each valve numbered within the systems shall be listed therein and the specific use shall be described. Furnish a key plan for each floor showing the valve locations.

1.23 CLEANING AND ADJUSTING

A. Brush and clean work prior to concealing, painting & acceptance.
B. Clean and repair painted or exposed work which is soiled or damaged and match adjoining work before final acceptance.
C. Remove debris from inside and outside of piping and equipment.
D. Flush out piping after installation and before final connections is made, at least twice, in a manner as described on the project specs section 221116. Make all temporary connections and provide all equipment required for the cleaning at no extra expense to the Owner.

1.24 SAFETY

A. This contractor shall be responsible for the safety of all persons performing the work of this contract.

END OF SECTION 220500

SECTION 22 05 17

SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.

1.3 ACTION SUBMITTALS

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

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.

2.2 STACK-SLEEVE FITTINGS

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

1. Smith, Jay R. Mfg. Co.
2. Zurn Industries, LLC.
3. Josam Company

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

2.3 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. HOLDRITE.
2. FERNCO.
3. GARLOCK.

B. Description: Manufactured plastic, sleeve-type, water stop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber water stop collar with center opening to match piping OD.

2.5 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Non shrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

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

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

    a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. 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."

E. 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."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

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

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and

sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

    a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves
    b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves

2. Exterior Concrete Walls below Grade:

    a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves with sleeve-seal system

        1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

    b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves with sleeve-seal system.

        1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

    a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves with sleeve-seal system.

        1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

    b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system.

        1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:

    a. Piping Smaller Than NPS 6: Sleeve-seal fittings
    b. Piping NPS 6 and Larger: Stack-sleeve fittings

5. Interior Partitions:

    a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves
    b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves

END OF SECTION 22 05 17

SECTION 22 05 18

ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Escutcheons.

1.3 ACTION SUBMITTALS

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

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, exposed-rivet hinge, and spring-clip fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

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

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated 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 type with polished, chrome-plated finish.
    c. Insulated Piping: Split-plate stamped-steel type with exposed-rivet hinge.
    d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.
    f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass finish.

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 exposed-rivet hinge.
    c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with exposed-rivet hinge.
    d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with exposed-rivet hinge.
    e. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with exposed-rivet hinge.

3.2 FIELD QUALITY CONTROL

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

END OF SECTION 22 05 18

SECTION 220523.12

BALL VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Bronze ball valves.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

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

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, and soldered ends.
   3. Set ball valves open to minimize exposure of functional surfaces.

B. 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.

C. 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.

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 B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
3. ASME B16.18 for solder-joint connections.
4. ASME B31.9 for building services piping valves.

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

D. 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.

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

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

G. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 4 and larger.
2. Hand lever: For quarter-turn valves smaller than NPS 4.

H. 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.

2.2 BRONZE BALL VALVES

A. One-Piece, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves.
b. NIBCO INC.
c. Watts; a Watts Water Technologies company.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 400 psig.
c. Body Design: One piece.
d. Body Material: Bronze.

e. Ends: Threaded.
f. Seats: PTFE.
g. Stem: Bronze.
h. Ball: Chrome-plated brass.
i. Port: Reduced.

B. One-Piece, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves.
b. NIBCO INC.
c. Watts; a Watts Water Technologies company.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: One piece.
d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Reduced.

C. Two-Piece, Bronze Ball Valves with Full Port, and Bronze or Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves.
b. Crane; Crane Energy Flow Solutions.
c. Hammond Valve.
d. Lance Valves.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Watts; a Watts Water Technologies company.
h. Zurn Industries, LLC.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Two piece.
d. Body Material: Bronze.
e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Bronze or brass.
h. Ball: Chrome-plated brass.
i. Port: Full.

D. Two-Piece, Bronze Ball Valves with Full Port and Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Valves.
    b. Crane; Crane Energy Flow Solutions.
    c. Hammond Valve.
    d. Lance Valves.
    e. Milwaukee Valve Company.
    f. NIBCO INC.
    g. Watts; a Watts Water Technologies company.

2. Description:

    a. Standard: MSS SP-110.
    b. CWP Rating: 600 psig .
    c. Body Design: Two piece.
    d. Body Material: Bronze.
    e. Ends: Threaded or soldered.
    f. Seats: PTFE.
    g. Stem: Stainless steel.
    h. Ball: Stainless steel, vented.
    i. Port: Full.

E. Two-Piece, Bronze Ball Valves with Regular Port and Bronze or Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Valves.
    b. DynaQuip Controls.
    c. Hammond Valve.
    d. Milwaukee Valve Company.
    e. NIBCO INC.
    f. Watts; a Watts Water Technologies company.

2. Description:

    a. Standard: MSS SP-110.
    b. CWP Rating: 600 psig .
    c. Body Design: Two piece.
    d. Body Material: Bronze.
    e. Ends: Threaded.
    f. Seats: PTFE.
    g. Stem: Bronze or brass.
    h. Ball: Chrome-plated brass.
    i. Port: Regular.

F. Two-Piece, Bronze Ball Valves with Regular Port and Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Apollo Valves.
    b. Hammond Valve.
    c. NIBCO INC.

d. Stockham; Crane Energy Flow Solutions.
e. Watts; a Watts Water Technologies company.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig .
c. Body Design: Two piece.
d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Regular.

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

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

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

B. 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.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. One piece, brass ball valve.
3. One piece, bronze ball valve with bronze trim.
4. Two-piece, brass ball valves with full port and stainless-steel trim.
5. Two-piece, bronze ball valves with full port and stainless-steel trim.

B. Pipe NPS 2-1/2 and Larger:

1. Steel and Iron Valves, NPS 2-1/2 to NPS 4 : May be provided with threaded ends instead of flanged ends.
2. Class 150, steel ball valves with full port.
3. Class 150, iron ball valves.

END OF SECTION 22 05 23.12

SECTION 22 05 23.14

CHECK VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Bronze swing check valves.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene-diene terpolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

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

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set check valves in either closed or open position.

B. 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.

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

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 B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B16.18 for solder joint.
5. ASME B31.9 for building services piping valves.

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

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

E. 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.

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

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

2.2 BRONZE SWING CHECK VALVES

A. Class 125, Bronze, Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Valve
   b. Apollo Valves
   c. Nibco Valve

2. Description:

   a. Standard: MSS SP-80, Type 3.
   b. CWP Rating: 200 psig.
   c. Body Design: Horizontal flow.
   d. Body Material: ASTM B 62, bronze.
   e. Ends: Threaded or soldered. See valve schedule articles.
   f. Disc: Bronze.

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 VALVE 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 check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.

F. 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 valve applications are not indicated, use the following:

B. End Connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded or soldered.

2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded.
3. For Copper Tubing, NPS 5 and Larger: Flanged.
4. For Steel Piping, NPS 2 and Smaller: Threaded.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged or threaded.
6. For Steel Piping, NPS 5 and Larger: Flanged.
7. For Grooved-End Steel Piping: Grooved.

3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller: Bronze swing check valves, Class 125, bronze disc with soldered end connections.

END OF SECTION 22 05 23.14

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Thermal-hanger shield inserts.
3. Fastener systems.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Trapeze pipe hangers and equipment supports must be sized in accordance with ASCE and spaced per plumbing code.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 ACTION SUBMITTALS

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

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Pipe stands.

C. Trapeze pipe hangers must be sized in accordance with ASCE and spaced per plumbing code.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

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

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 THERMAL-HANGER SHIELD INSERTS

A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.

B. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches beyond sheet metal shield for all piping.

2.3 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.4 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

B. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

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

G. Install hangers and supports to allow controlled thermal and seismic 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.

H. Install lateral bracing with pipe hangers and supports to prevent swaying.

I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

L. Insulated Piping:

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    b. NPS 4: 12 inches long and 0.06 inch thick.
    c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
    e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 ADJUSTING

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

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.3 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils .

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 099123 "Interior Painting."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.4 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and attachments for general service applications.

F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

G. Use padded hangers for piping that is subject to scratching.

H. Use thermal-hanger shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.

4. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of non-insulated, stationary pipes NPS 3/4 to NPS.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. C-Clamps (MSS Type 23): For structural shapes.
6. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
7. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
8. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
9. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
10. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
11. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb
    b. Medium (MSS Type 32): 1500 lb
    c. Heavy (MSS Type 33): 3000 lb

12. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

Q. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

R. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 22 05 29

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Valve tags.
5. Warning tags.

1.3 ACTION 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. Equipment Label Schedule: Include a listing of all equipment 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 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Brimar Industries, Inc.
c. Marking Services, Inc.

d. Seton Identification Products.

2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
3. Letter Color: Black.
4. Background Color: White.
5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
7. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
8. Fasteners: Stainless-steel rivets or self-tapping screws.
9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Brady Corporation.
2. Brimar Industries, Inc.
3. Seton Identification Products.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

C. Letter Color: Black.

D. Background Color: Yellow.

E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

H. Fasteners: Stainless-steel rivets or self-tapping screws.

I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

J. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

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

1. Brady Corporation.
2. Brimar Industries, Inc.
3. Seton Identification Products.

B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

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

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

E. Pipe Label Contents: Include identification of piping service using 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.

2.4 VALVE TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Brady Corporation.
2. Brimar Industries, Inc.
3. Seton Identification Products.

B. Valve Tags: 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 or S-hook.

C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. 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.

2.5 WARNING TAGS

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

1. Brady Corporation.
2. Brimar Industries, Inc.
3. Marking Sevices Inc.
4. Seton Identification Products.

B. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
   1. Size: 3 by 5-1/4 inches minimum.
   2. Fasteners: Reinforced grommet and wire or string.
   3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
   4. Color: Safety yellow background with black lettering.

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 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Piping Color Coding: Painting of piping is specified in Section 09.

B. 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 through walls, floors, ceilings, and inaccessible enclosures.
   4. At access doors, 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. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

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

D. Pipe Label Color Schedule:
1. Domestic Water Piping
   a. Background: Safety green.
   b. Letter Colors: White.

2. Sanitary Waste Piping:
   a. Background Color: Safety white.
   b. Letter Color: Black.

3.5 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.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

   a. Cold Water: 1-1/2 inches, round.
   b. Hot Water: 1-1/2 inches, round.

2. Valve-Tag Colors:

   a. Cold Water: Natural.
   b. Hot Water: Natural.

3. Letter Colors:

   a. Cold Water: Black.
   b. Hot Water: Black.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 22 05 53

SECTION 22 05 76

DRAINAGE ACCESSORIES

PART 1 GENERAL

1.01 REFERENCES

A. Comply with the applicable requirements of ASME A112.36.2M - Cleanouts, and ASME A112.1.2 - Drainage Funnels and Air Gaps.

1.02 SUBMITTALS

A. Product Data: Catalog sheets, specifications, and installation instructions for each item specified except fasteners.

1.03 MAINTENANCE

A. Special Tools: Deliver the following to the Construction Manager:
   1. Tools for Vandal Resistant Fasteners: One for each type and size.
   2. T-Handle Wrench for Cleanout Plugs: One for each type and size.

PART 2 PRODUCTS

2.01 CLEANOUT DECK PLATE

A. Standard duty floor cleanout fitting with coated cast iron body; round, polished nickel bronze scoriated top secured to cleanout plug with stainless steel vandal resistant fastener; threaded height adjustment, cast iron head, gas tight cleanout plug, and connection to match piping option selected.

B. Membrane flange and clamping collar, secured with corrosion resistant fasteners.

2.02 FASTENERS

A. Corrosion Resistant Fasteners: Brass, bronze, or Type 302 or 304 stainless steel bolts.

B. Vandal Resistant Fasteners: Torx head with center pin.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install the Work of this section in accordance with the manufacturer’s printed installation instructions, unless otherwise specified.

END OF SECTION 22 05 76

SECTION 22 07 19

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Domestic recirculating hot-water piping.
4. Roof drains and rainwater leaders.

B. Related Sections:

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. Mockups: Not Required.

D. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Mineral-Fiber, Preformed Pipe Insulation:

1. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 MASTICS

A. Materials shall be compatible with insulation materials, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.
1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
2. Service Temperature Range: 0 to 180 deg F.
3. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
4. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: 60 percent by volume and 66 percent by weight.
4. Color: White.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Color: White.

2.6 SEALANTS

A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
4. Color: White.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.7 FACTORY-APPLIED JACKETS

A. When factory-applied jackets are indicated, comply with the following:
1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 TAPES

A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
1. Width: 3 inches.
2. Thickness: 6.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.9 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:
1. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:
   1. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

   1. Verify that systems to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. 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.
3. 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.
4. Cover inserts with matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

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

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

C. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engineer of Record will perform a field quality control inspection.

B. Perform tests and inspections per manufacturer’s recommendations.

C. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.8 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
1. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.9 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. NPS 1 and Smaller: Insulation shall be one of the following:
a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

2. NPS 1-1/4 and Larger: Insulation shall be one of the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

2. NPS 1-1/2 and Larger: Insulation shall be one of the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

C. Stormwater and Overflow:

1. All Pipe Sizes: Insulation shall be one of the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inch thick.

D. Roof Drain and Overflow Drain Bodies:

a. Synthetic Rubber, 1.5 inch thick

END OF SECTION 22 07 19

SECTION 22 11 16

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.

1.3 Related Requirements:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.4 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

1.5 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

1.6 FIELD CONDITIONS

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

1. Refer to Div-1 specification for advance notice.
2. Do not interrupt water service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61 Annex G.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

B. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

E. Copper Unions:

1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

2.3 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install domestic water piping level without pitch and plumb.

C. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

F. Install piping to permit valve servicing.

G. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

K. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

L. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

M. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.2 JOINT CONSTRUCTION

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

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

C. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

D. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

3.3 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.

b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.

E. Install supports for vertical copper tubing every 10 feet.

F. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.4 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

3.5 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.

2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.7 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.8 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill and isolate system according to either of the following:

        1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
        2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

    c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    d. Repeat procedures if biological examination shows contamination.
    e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.9 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Aboveground domestic water piping, NPS 2 and smaller shall be one of the following:
1. Hard copper tube, ASTM B 88, Type L; cast-copper, solder-joint fittings; and soldered joints.

3.10 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball valves for piping NPS 2 and smaller.
2. Throttling Duty: Use ball valves for piping NPS 2 and smaller.
3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 22 11 16

SECTION 22 11 19

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Balancing Valves
   2. Temperature-actuated, point of use water mixing valves.
   3. Strainers.
   4. Water-hammer arresters.
   5. Air vents.
   6. Flexible connectors.

B. Related Requirements:
   1. Section 224713 "Drinking Fountains" for water filters for water coolers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.

   1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61 Annex G and NSF 14.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:
1. Type: Ball valve with two readout ports and memory-setting indicator.
2. Body: Brass
3. Size: Same as connected piping, but not larger than NPS 2.
4. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.4 TEMPERATURE-ACTUATED, POINT OF USE WATER MIXING VALVES

A. Thermostatic, Point of Use Water Mixing Valves:
1. Standard: ASSE 1070.
2. Pressure Rating: 125 psig minimum unless otherwise indicated.
3. Type: Exposed wall mounted thermostatically controlled, water mixing valve.
4. Material: Bronze body with corrosion-resistant interior components.
5. Connections: Threaded inlets and outlet.
6. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
7. Tempered-Water Setting: 105 F.
8. Tempered-Water Design Flow Rate:0.5-2 GPM.
9. Pressure Drop at Design Flow Rate: Maximum 20 PSI
10. Valve Finish: Rough bronze.
11. Piping Finish: Copper.
12. Inlets and Outlet: Threaded.
13. Finish: Rough or chrome-plated bronze.

2.5 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller;
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:

    a. Strainers NPS 2 and Smaller: 0.020 inch

6. Drain: Pipe plug

2.6 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:
1. Standard: ASSE 1010.
2. Type: Metal bellows
3. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.7 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating and Temperature: 125-psig minimum pressure rating at 140 deg F .
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 1/2 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.
2. Pressure Rating: 150-psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

2.8 FLEXIBLE CONNECTORS

A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig
2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.

B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig
2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install water regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.

B. Install water-control valves with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.

C. Install balancing valves in locations where they can easily be adjusted.

D. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install cabinet-type units recessed in or surface mounted on wall as specified.

E. Install Y-pattern strainers for water on supply side of each control valve

F. Install water-hammer arresters in water piping according to Plumbing drawings.

G. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

3.2 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
   1. Calibrated balancing valves.
   2. Primary, thermostatic, water mixing valves.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.3 FIELD QUALITY CONTROL

A. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

B. Prepare test and inspection reports.

   1. Inspect and test balancing valves, strainers, thermostatic mixing valves, air vents, flexible connectors, and water hammer arrestors according to manufacturer’s recommendations.

3.4 ADJUSTING

A. Set field-adjustable flow set points of balancing valves.

B. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 22 11 19

SECTION 22 13 16

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.
3. Encasement for underground metal piping.

B. Related Sections:

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water
2. Waste, Force-Main Piping: 50 psig

1.4 ACTION SUBMITTALS

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

B. Shop Drawings: For sovent drainage system. Include plans, elevations, sections, and details.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

1.7 PROJECT CONDITIONS

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

1. Refer to Dic-1 specification for advance notice requirements.
2. Do not proceed with interruption of sanitary waste service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class(es).

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: Cast Iron, Asphaltic Coating, Service Weight, ASTM A74, Bell and Spigot or No hub with Heavy-Duty Stainless-Steel Clamp joints, Cast Iron fittings.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back-to-back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

K. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

L. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 2 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.

N. Install engineered soil and waste drainage and vent piping systems as follows:

1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
2. Sovent Drainage System: Comply with ASSE 1043 and sovent fitting manufacturer's written installation instructions.
3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

O. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to sanitary sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.

P. Plumbing Specialties:
   1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
   2. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.2 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.

C. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

D. Join stainless-steel pipe and fittings with gaskets according to ASME A112.3.1.

E. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

F. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

   1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
   3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.3 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
3. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
4. Vertical Piping: MSS Type 8 or Type 42, clamps.
5. Install individual, straight, horizontal piping runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

6. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
7. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.4 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.6 CLEANING AND PROTECTION

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

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Exposed Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

3.7 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings and sovent stack fittings; hubless-piping couplings; and coupled joints.

C. Aboveground, vent piping NPS 4 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.

D. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
1. Hub and Spigot, cast-iron soil pipe and fittings; cast-iron hub-piping couplings; and coupled joints.

END OF SECTION 22 13 16

SECTION 22 13 19

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Cleanouts.
2. Through-penetration firestop assemblies.
3. Miscellaneous sanitary drainage piping specialties.
4. Flashing materials.

B. Related Requirements:

1. Section 221423 "Storm Drainage Piping Specialties" for storm drainage piping inside the building, drainage piping specialties, and drains.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."

B. Coordinate size and location of roof penetrations.

1.7 MAINTENANCE MATERIAL SUBMITTALS

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

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Cast-Iron Wall Cleanouts:
1. Standard: ASME A112.36.2M. Include wall access.
2. Size: Same as connected drainage piping.
3. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure: cast-iron plug.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
6. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
7. Wall Access: Round nickel-bronze wall-installation frame and cover.

2.2 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:
1. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
2. Size: Same as connected soil, waste, or vent stack.
3. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
4. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
5. Special Coating: Corrosion resistant on interior of fittings.

2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment Mounting:
1. Comply with requirements for vibration isolation and seismic control devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

2. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."

B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Assemble and install ASME A112.3.1, stainless-steel channel drainage systems according to ASME A112.3.1. Install on support devices so that top will be flush with surface.

F. Assemble non-ASME A112.3.1, stainless-steel channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

G. Install fixture air-admittance valves on fixture drain piping.

H. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

I. Install deep-seal traps on floor drains and other waste outlets, if indicated.

J. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

K. Install wood-blocking reinforcement for wall-mounting-type specialties.

L. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft, 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 076200 "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

H. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Leak Test: After installation, charge system 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.

3.5 PROTECTION

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

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 13 19

SECTION 221329

SANITARY SEWERAGE PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Packaged wastewater-pump units.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components, profiles, Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

   1. Include plans, elevations, sections, and mounting details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
   4. Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with manufacturer's written instructions for handling.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

2.2 PACKAGED WASTEWATER-PUMP UNITS

A. Packaged, Submersible Wastewater-Pump Units:

1. Description: Factory-assembled and -tested, automatic-operation, effluent-pump unit with basin.
2. Liberty Pumps
   ProFlo
   Zoeller Pumps
3. Pump Type: Submersible, end-suction, single-stage, overhung-impeller, submersible centrifugal pump as defined in ASME A112.3.4.
4. Pump Body and Impeller: Corrosion-resistant materials.
5. Pump Seals: Mechanical.
6. Motor: Hermetically sealed, capacitor-start type, with built-in overload protection.
7. Power Cord: Three-conductor, waterproof cable of length required, but not less than 72 inches and with grounding plug and cable-sealing assembly for connection at pump.
8. Control: Float switch.
9. Pump Discharge Piping: Factory or field fabricated, steel pipe with ASME B16.4
10. Basin: Watertight plastic with inlet pipe connection and gastight cover with vent and pump discharge connections.
11. Capacities and Characteristics:

    a. Pump Capacity: 5 gpm
    b. Total Dynamic Head: 32 feet
    c. Speed: 3450 RPM
    d. Discharge Pipe Size: 2 NPS
    e. Motor Horsepower: 1/2 hp.
    f. Electrical Characteristics:

        1) Volts: 115 V ac.
        2) Phases: Single
        3) Hertz: 60.

    g. Basin:

        1) Capacity: 4 gal.
        2) Inlet Connection: 2 NPS
        3) Vent Connection: 2 NPS

2.3 MOTORS

A. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

B. Motors for submersible pumps shall be hermetically sealed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for plumbing piping to verify actual locations of sanitary drainage and vent piping connections before sewage pump installation.

3.2 INSTALLATION

A. Pump Installation Standards:

1. Comply with ASME A112.3.4 for installation of centrifugal pumps.
2. Comply with ASME A112.3.4 for installation of progressing-cavity sewage pumps.

B. Wiring Method: Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in Section 221316 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to equipment, allow space for service and maintenance.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test, inspect, and adjust components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections:

1. Perform each visual and mechanical inspection.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Pumps and controls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup check according to manufacturer's written instructions.

3.6 ADJUSTING

A. Adjust pumps to function smoothly, and lubricate if required as recommended by manufacturer.

B. Adjust control set points.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION 22 13 29

SECTION 22 14 13

FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water.
2. Storm Drainage, Force-Main Piping: 50 psig.

1.4 ACTION SUBMITTALS

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

B. Shop Drawings: For roof drainage system. Include calculations, plans, and details.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 14, "Plastics Piping System Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

1.6 PROJECT CONDITIONS

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

1. Refer to Div-1 specification for advance notice requirements.
2. Do not proceed with interruption of storm-drainage service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service classes.

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: Cast Iron, Asphaltic Coating, Service Weight, ASTM A74, Bell and Spigot or No hub with Heavy-Duty Stainless-Steel Clamp joints, Cast Iron fittings.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations from layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

K. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

L. Install storm drainage piping at the following minimum slopes unless otherwise indicated:

1. Building Storm Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.

M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

N. Plumbing Specialties:
1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping. Comply with requirements for cleanouts specified in Section 221423 "Storm Drainage Piping Specialties."
2. Install drains in storm drainage gravity-flow piping. Comply with requirements for drains specified in Section 221423 "Storm Drainage Piping Specialties."

O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.2 JOINT CONSTRUCTION

A. Hub-and-Spigot, Cast-Iron Soil Piping Calked Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.

B. Hubless, Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

3.3 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Unshielded, non pressure transition couplings.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Individual, Straight, Horizontal Piping Runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.

6. Spacing for 10-foot pipe lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 72 inches with 3/8-inch rod.
2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.

H. Install supports for vertical copper tubing every 10 feet.

I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.6 IDENTIFICATION

A. Identify exposed storm drainage piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.7 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

3.8 CLEANING

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

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.9 PIPING SCHEDULE

A. Aboveground storm drainage piping NPS 6 and smaller shall be any of the following:
1. Hub less, cast-iron soil pipe and fittings; CISPI, hub less-piping couplings; and coupled joints.

B. Underground storm drainage piping NPS 6 and smaller shall be any of the following:
1. Hub and spigot cast-iron soil pipe and fittings; cast-iron**,** hub-piping couplings; and coupled joints.

END OF SECTION 22 14 13

SECTION 22 14 23

STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Cleanouts.

1.3 ACTION SUBMITTALS

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

1.4 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

2.2 CLEANOUTS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Watts
   b. Zurn
   c. Josam
2. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301, for cleanout test tees.
3. Size: Same as connected drainage piping.
4. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or hubless, cast-iron soil-pipe test tee as required to match connected piping.
5. Closure Plug: Countersunk, Brass plugs.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

PART 3 - EXECUTION

3.1 CONNECTIONS

A. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.2 PROTECTION

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

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 14 23

SECTION 22 42 13.13

COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Water closets.
2. Flushometer valves.
3. Toilet seats.

B. Related Requirements:

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 WALL-MOUNTED WATER CLOSETS

A. Water Closets: Wall mounted, top spud, accessible.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Standard
   b. Jacuzzi
   c. Kohler
   d. Sloan
2. Bowl:

   a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
   b. Material: Vitreous china.
   c. Type: Siphon jet.
   d. Style: Flushometer valve.
   e. Height: Standard.
   f. Rim Contour: Elongated.
   g. Water Consumption: 1.28 gal. per flush.
   h. Spud Size and Location: NPS 1-1/2 ; top.

3. Flushometer Valve: Electronic sensor type
4. Toilet Seat: Elongated, open front end.
5. Support:

   a. Standard: ASME A112.6.1M.
   b. Description: Waste-fitting assembly as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture.
   c. Water-Closet Mounting Height: Refer to architectural drawings.

B. Toilet Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Standard
   b. Jacuzzi
   c. Kohler
2. Standard: IAPMO/ANSI Z124.5.
3. Material: Plastic.
4. Type: Commercial (Heavy duty).
5. Shape: Elongated rim, open front.
6. Hinge: Self-sustaining, check.
7. Hinge Material: Noncorroding metal.
8. Seat Cover: Not required.
9. Color: White.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.

B. Examine walls and floors for suitable conditions where water closets will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.

B. Support Installation:

1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
2. Use carrier supports with waste-fitting assembly and seal.
3. Install floor-mounted, back-outlet water closets attached to building floor substrate, onto waste-fitting seals; and attach to support.
4. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.

C. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
4. Install actuators in locations that are easy for people with disabilities to reach.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

F. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

3.5 CLEANING AND PROTECTION

A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed water closets and fittings.

C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 42 13.13

SECTION 224216.13

COMMERCIAL LAVATORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Lavatories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Servicing and adjustments of automatic faucets.

PART 2 - PRODUCTS

2.1 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

A. Lavatory: Vitreous china, wall mounted, with back.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Standard
   b. Jacuzzi
   c. Kohler

2. Fixture:

   a. Standard: ASME A112.19.2/CSA B45.1.
   b. Type: For wall hanging.
   c. Nominal Size: Rectangle, Refer to Drawings.
   d. Color: White.
   e. Mounting Material: Chair carrier.

2.2 SOLID-BRASS, MANUALLY OPERATED FAUCETS

A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.

B. Lavatory Faucets: Manual-type, two-handle mixing, commercial, solid-brass valve.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Standard
   b. Jacuzzi
   c. Kohler
2. Standard: ASME A112.18.1/CSA B125.1.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
4. Body Type: Centerset.
5. Body Material: Commercial, solid brass.
6. Finish: Polished chrome plate.
7. Maximum Flow Rate: 0.5 gpm.
8. Maximum Flow: 0.25 gal. per metering cycle.
9. Mounting Type: Deck, exposed
10. Valve Handle(s): Lever
11. Spout: Rigid type
12. Spout Outlet: Laminar flow.
13. Operation: Noncompression, manual.
14. Drain: Not part of faucet.

2.3 LAMINAR-FLOW, FAUCET-SPOUT OUTLETS

A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for faucet-spout-outlet materials that will be in contact with potable water.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Standard
   b. Jacuzzi
   c. Kohler

B. Description: Chrome-plated-brass, faucet-spout outlet that produces non-aerating, laminar stream. Include external or internal thread that mates with faucet outlet for attachment to faucets where indicated and flow-rate range that includes flow of faucet.

2.4 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Loose key.

F. Risers:

1. NPS 1/2
2. Chrome-plated, rigid-copper-pipe and brass straight or offset tailpieces

2.5 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.

C. Trap:

1. Size: NPS 1-1/2 by NPS 1-1/4.
2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated, brass or steel wall flange.
3. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless-steel tube to wall; and stainless-steel wall flange.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.

B. Examine counters and walls for suitable conditions where lavatories will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install lavatories level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-mounted lavatories.

C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.

D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.
B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After completing installation of lavatories, inspect and repair damaged finishes.

B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed lavatories and fittings.

D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.13

SECTION 224216.16

COMMERCIAL SINKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. kitchen sinksSink faucets.
2. Laminar-flow, faucet-spout outlets.
3. Supply fittings.
4. Waste fittings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sinks.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sinks to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 KITCHEN SINK
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ELKAY
   b. Kohler
   c. Moen

2. Fixture:

    a. Standard: ASME A112.19.3/CSA B45.4
    b. Type: Kitchen sink, Single Bowl, Undermount
    c. Material: 304 Stainless Steel
    d. Sink Dimension: 23-1/2” x 18-1/4” x 5-3/8”
    e. Bowl Dimension: 21” x 15-3/4” x 5-3/8”
    f. Drain Location: Rear Center, 3-3/8”
    g. Number of Bowls: One
    h. Mounting: Undermount Brackets

2.2 SINK FAUCETS

A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for faucet-spout materials that will be in contact with potable water.

B. Sink Faucets: Manual type, two-lever-handle mixing valve.

1. Commercial, Solid-Brass Faucets.
    a. Kohler
    b. American Standard
    c. Moen
2. Standard: ASME A112.18.1/CSA B125.1.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
4. Body Type: Centerset.
5. Body Material: General-duty, solid brass
6. Finish: Chrome plated
7. Maximum Flow Rate: 2.2 gpm.
8. Handle(s): Lever.
9. Mounting Type: Deck, exposed.
10. Spout Type: Rigid, solid brass.
11. Vacuum Breaker: Not required.
12. Spout Outlet: Laminar flow.

2.3 LAMINAR-FLOW, FAUCET-SPOUT OUTLETS

A. NSF Standard: Comply with NSF/ANSI 61 Annex 61, "Drinking Water System Components - Health Effects," for faucet-spout-outlet materials that will be in contact with potable water.

B. Description: Chrome-plated brass, faucet-spout outlet that produces non-aerating, laminar stream. Include external or internal thread that mates with faucet outlet for attachment to faucets where indicated and flow-rate range that includes flow of faucet.

2.4 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: copper tube matching water-supply piping size. Include stainless-steel wall flange.

D. Supply Stops: brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Wheel handle.

F. Risers:

1. NPS 1/2
2. rigid-copper pipe.

2.5 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.

C. Trap:

1. Size: NPS 1-1/2.
2. Material: Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 0.032-inch- thick brass tube to wall; and chrome-plated brass or steel wall flange.
3. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless-steel tube to wall; and stainless-steel wall flange.

2.6 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.

B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install sinks level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-hung sinks.

C. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.

D. Set floor-mounted sinks in leveling bed of cement grout.

E. Install water-supply piping with stop on each supply to each sink faucet.

1. Exception: Use ball valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping."
2. Install stops in locations where they can be easily reached for operation.

F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

G. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

H. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS

A. Connect sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After completing installation of sinks, inspect and repair damaged finishes.

B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed sinks and fittings.

D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.16

SECTION 224713

DRINKING FOUNTAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes drinking fountains and related components.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of drinking fountain.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include operating characteristics, and furnished specialties and accessories.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For drinking fountains to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 DRINKING FOUNTAINS

A. Drinking Fountains:

Double bubbler wall mounted drinking fountain with bottle filling station shall be designed to meet the clearances required by ANSI A117.1 and ADA. Fountain shall be made from type 300 stainless steel with a satin finish. All seams shall be welded and ground smooth. Unit shall have stainless steel basin with anti-splash ridge and removable drain strainer. All waterways shall be constructed of copper. Unit shall be furnished with a bottom plate secured with vandal resistant screws. Furnish a screwdriver for removing bottom plate screws. Bubbler shall be chrome plated with non-removable anti-squirt feature and integral hood. Automatic stream height regulator shall be located inside unit to prevent tampering. Includes self-closing, light touch front and side push bar actuation. Unit shall include filter certified to NSF/ANSI for lead reduction with visual monitor to indicate when replacement is necessary.

Bottle Filler shall be sensor-actuated with auto shut-off timer and bottle counter, shall provide 1.1 to 1.5 GPM with laminar flow for minimal splash and shall include anti-microbial protected plastic components. Unit shall be lead-free design which meets Safe

Drinking Water Act and is certified to NSF/ANSI 61. Unit shall be Halsey Taylor HTHB-HACD, Elkay LMABFDWSSK or Acorn Aqua All1400B-VRB-BF2S-WF1 modified with copper tubing. All bubblers shall meet the requirements of the federally mandated "Reduction of Lead in Drinking Water Act". Regardless of model numbers indicated herein, provide equivalent models that meet the requirements of the act.

B. Provide Josam Co., J. R. Smith Figure 824-M31 or Wade 420-M36 floor mounted chair carrier. Floor mounted hanger plate carrier using rectangular high-strength steel uprights welded to base plates.

C. Drinking fountain trap shall meet Building Codes of New York State requirements, shall be chrome plated cast brass: 1¼" inlet by 1½" outlet by Eljer 804-1125, McGuire 201C, EBC TN140, Kohler K-8995-CP or Zurn Z8716B-PC.

D. Cold water stop shall be chrome plated cast brass 1/2" IPS angle stop.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

B. Examine walls and floors for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.

B. Set pedestal drinking fountains on floor.

C. Install recessed drinking fountains secured to wood blocking in wall construction.

D. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

E. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523.12 "Ball Valves for Plumbing Piping".

F. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

G. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

H. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Install ball shutoff valve on water supply to each fixture. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping".

D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

3.5 CLEANING

A. After installing fixtures, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

C. Provide protective covering for installed fixtures.

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

END OF SECTION 224713

SECTION 23 05 11

GENERAL PROVISIONS FOR HVAC WORK

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Provide labor, materials, tools, machinery, equipment, and services necessary to complete the HVAC Work under this Contract. All systems and equipment shall be complete in every aspect and all items of material, equipment and labor shall be provided for a fully operational system and ready for use. Coordinate the work with the work of the other trades in order to resolve all conflicts without impeding the job progress.

B. Examine the Architectural, Structural, Plumbing and Electrical Drawings and other Divisions, and Sections of the Specifications in order to determine the extent of the Work required to be completed under this Division. Failure to examine all the Contract Documents for this Project will not relieve the Contractor of his/her responsibilities to perform the Work required for a complete fully operational and satisfactory installation.

C. Start-up services shall be included in the bid.

D. All systems, equipment and services specified herein shall be provided complete and ready for use.

F. Contractor is to facilitate the coordination of the DDC control features provided by all trades, vendors, and equipment manufacturers for a complete seamlessly integrated system of operation.

1.02 RELATED WORK

A. Division 01 General Requirements

B. Division 02 to 09 Structural Sections

C. Division 26 Electrical Sections

1.04 SUBMITTALS

A. General: Unless indicated otherwise in the specific technical section, if a particular product specified in the technical section is being provided, manufacturer’s qualifications and samples (except as listed below), are not required to be submitted. Manufacturer’s product data, installation instructions, samples requiring color or texture approval, samples showing thickness and type of material, shop drawings, and calculations are to be submitted. Schedules, startup manuals, operation and maintenance manuals, and shop drawings are always required to be submitted.

B. The following Submittals are required for all Sections of Division 23-Heating, Ventilating, and Air Conditioning. Specific “Supplemental Submittals” or additional information to that listed below that are required to be submitted are defined in each individual technical section.

1. Product Data: Submit manufacturer's product data for equipment including catalog sheets or cuts, specifications, capacity, performance charts, test data, materials,

dimensions, weights, furnished specialties and accessories; and installation instructions. Submit start-up instructions where applicable.

2. Shop Drawings: Submit manufacturer's shop drawings detailing equipment assemblies and indicating dimensions, weight, loadings, required clearances, method of field assembly, components, location and size of each field connection.

C. Where indicated in the Supplemental Submittals of the technical sections, the following submittals are defined as follows:

1. Maintenance Data: Submit maintenance data and parts list. Include this data and the product data in the maintenance manual in accordance with the requirements of Division 01.

2. Test Report: Submit factory certified test results prior to shipping.

3. Certificates: Submit written affidavit stating that the Contractor has started up and demonstrated in the presence of the Owner's Representative.

D. Piping, Ductwork, and Wiring Diagrams: Submit a complete wiring diagram, ductwork layout, and piping layout of all equipment. All parts of the installation shall be indicated exactly as installed and shall be properly identified. Valve identification numbers shall agree with valve tags of Section 23 05 53: Identification for HVAC Piping and Equipment, and all piping shall be clearly shown and labeled.

E. Coordination Drawings: Provide complete coordination Drawings showing interface of all mechanical trades with the Architecture of the Building. All copies are to be signed. The Contractor is to keep a copy of the signed coordination drawing on the site.

1.05 QUALITY ASSURANCE

A. Manufacturer's Qualifications: If a particular product specified in the technical section is not being provided, provide manufacturer’s qualifications.

Provide manufacturer’s qualifications that indicate that the firms are regularly engaged in manufacture of equipment, of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than five years.

B. Codes and Standards: All equipment furnished and installed shall meet or exceed the referenced Standards and Codes in all respects – installation, performance, etc.

References and industry standards listed herein and in other HVAC Sections are applicable to the Work specified in the Section. Unless more restrictive criteria is explicitly called-out for in other HVAC Specifications or mandated by the NYS Construction Codes, the requirements described in the referenced standards below shall be deemed applicable to the Work. This includes language in the documents in the form of a recommendation or suggestion, which shall be deemed as mandatory.

1. NFPA
2. NYS CONSTRUCTION CODES (including Building Code BC, Mechanical Code MC and Fuel Gas Code FGC)
3. ASHRAE
4. SMACNA
5. ELECTRICAL IEEE STANDARDS
6. STATE DEC REGULATIONS

7. ASME
8. ANSI
9. ABMA
10. UL
11. LOCAL LAWS
12. NCPWB
13. FCI
14. EJMA
15. MSS
16. ABMA
17. IRI
18. AABC
19. NEBB
20. ARI
21. AMCA
22. ADC
23. NEMA
24. NEC
25. ASTM
26. FCI

All appliances regulated by the New York State Construction Codes shall be listed and labeled (reference MC 301.4, MC 301.6). Testing of material and equipment shall be in accordance with 28-113 of the Administrative Code (reference MC 301.5).

1.06 ACCESSIBILITY

A. Install access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.

1.07 ROUGHING-IN

A. Verify final locations for roughing work with field measurements and with the requirements of the actual equipment being connected. Coordinate with General Construction drawings.

1.08 MECHANICAL INSTALLATIONS

A. Coordinate HVAC equipment and materials installation with other building components.

B. Verify all dimensions by field measurements.

C. Arrange for chases, slots, and openings in other building components to allow for HVAC installations.

D. Coordinate the installation of required supporting devices and size of sleeves to be set in poured concrete and other structural components as they are constructed.

E. Sequence, coordinate, and integrate installations of HVAC materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning and entrance prior to the close of the building.

F. Coordinate the cutting and patching of building components to accommodate the installation of HVAC equipment and materials.

G. Where mounting heights are not detailed or dimensioned, install HVAC services and overhead equipment to provide the maximum headroom possible.

H. Install HVAC equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting and minimum of interference with other installations.

I. Coordinate the installation of HVAC materials and equipment above ceilings with suspension system, light fixtures, and all other installations and accessories.

J. Provide all rigging, disassembly and reassembly of equipment including the furnishing and installation of dunnage and all other required and necessary accessories.

1.09 COORDINATION DRAWINGS

A. Provide coordination drawings. Coordination drawings shall be completed in accordance with the CPM Schedule so as not to delay the progress of the Project, for example, the installation of any floor slab in which the placing of mechanical equipment (sleeves, inserts, conduits, and all other accessory items) is involved.

B. The coordination drawings shall be prepared in the following manner: The contractor shall prepare a set of CADD drawings drawn to the scale of 3/8"=1'-0", indicating thereon ductwork, mechanical piping plus structural and architectural background details. The elevation, location, support points, seismic restraint locations, load imposed on the structure at support and at the seismic restraint location, anchor points, and size of all lines shall be indicated. At the completion of this phase, hold a coordination meeting to eliminate any interference among the trades that the drawings indicate and to avoid any conflicts in installing the Work. Should any problems of coordination require architectural or structural change of design, this change shall be submitted to the Architecture and or engineer for approval.

C. This requirement for "Coordination Drawings" shall not be construed as authorization to make any unauthorized changes to the Drawings. All Design Drawings space allocations shall be maintained, such as ceiling height, chase walls, equipment room size, and all other items and accessories, unless prior written authorization is received from the Architecture and or engineer to change them.

D. After the set of mylars has been coordinated, and all necessary changes have been made, each Subcontractor shall sign the coordination drawings, attesting to the agreement that the work is clear.

E. Furnish (in writing, with copies to the Engineer) any information necessary to permit the Work to be installed satisfactorily and with the least possible interference or delay.

1.10 CUTTING AND PATCHING

A. Do not endanger or damage installed Work through procedures and processes of cutting and patching.

B. Arrange for repairs required to restore the work, because of damage caused as a result of HVAC installations.

C. No additional compensation will be authorized for cutting and patching Work that is necessitated by defective or non-conforming installations.

D. Perform cutting, fitting, and patching of HVAC equipment and materials required to:

1. Remove and replace defective work.

2. Remove and replace work not conforming to requirements of the Contract Documents.

3. Remove samples of installed work as specified for testing.

4. Install equipment and materials in existing structures.

5. Cut, remove and legally dispose of selected HVAC equipment, components, and materials as indicated, including, but not limited to removal of HVAC piping, heating units and trim and other HVAC items made obsolete by the new work.

6. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

E. Locate identify, and protect HVAC services passing through remodeling or demolition area and serving other areas required to be maintained operational. When transit services must be interrupted, provide temporary services for the affected areas.

1.11 MATERIALS

A. Since manufacturing methods vary, reasonable minor variations are expected; however, performance and material requirements are the minimum standards acceptable.

1.12 EQUIPMENT NOISE AND VIBRATION

A. Provide equipment and systems that, as defined herein, shall be quiet and free of apparent vibration in operation.

B. Obtain equipment that is quiet in operation as compared to other available equipment of its size, capacity, and type; install equipment so that a minimum amount of noise and/or vibration is transmitted to the building; and fabricate the duct system so that air noises generated in the system are held to an absolute minimum.

C. Adjust all the equipment RPM, noise production and vibration in order to avoid any production of resonance in any system.

D. Noise producing mechanical equipment located within 100 feet of habitable room windows shall be tested at the equipment for compliance with the design STC rating of the equipment.

1.13 EQUIPMENT GUARDS

A. Provide easily removable expanded metal guards for all belts, couplings, exposed fan inlets and outlets, and other moving parts of machinery. Provide tachometer openings in the guards at least 2" in diameter, for all belt-driven or variable speed machinery. Equipment guards shall comply with OSHA requirements.

B. Guards shall be provided where appliances, equipment, fans or other components that require service are located within 10 feet of a roof edge or open side of a walking surface and such edge or open side is located more than 30 inches above the floor, roof or grade below. The guard shall extend not less than 30 inches beyond each end of such appliances, equipment, fan or component and the top of the guard shall be located not less than 42 inches above the elevated surface adjacent to the guard. The guard shall be constructed so as to prevent the passage of a 21-inch-diameter sphere and shall comply with the loading requirements for guards specified in the New York State Building Code. (Refer to Section BC 1012, FGC 306.6, and MC 304.10 of the 2020 NYS Construction Codes).

1.14 ELECTRICAL CHANGES TO MECHANICAL EQUIPMENT

A. If any changes made in equipment submitted are approved especially as to the sizes of the motors, notify Electrical.

1.15 DELIVERY, STORAGE, AND HANDLING

A. Handle equipment carefully to prevent damage, breaking, denting, and scoring. Do not install damaged units or components; replace with new.

B. Store equipment in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

C. Comply with manufacturer's rigging and installation instructions for unloading equipment, and moving them to final location.

1.16 RECORD DOCUMENTS

A. Refer to the Division 1 for requirements.

1.17 GUARANTEES, WARRANTIES, BONDS, AND MAINTENANCE CONTROL

A. Refer to Division 00 for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements.

1. Compile and assemble the warranties specified for HVAC work into a separated set of documents, tabulated and indexed for easy reference.

2. Provide complete warranty information for each item to include product or equipment including duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

3. Unless otherwise noted in the specific sections, warranties for the equipment, workmanship and materials shall be provided for the period of one year. Exceptions include, but are not limited to, the five-(5) year warranty provided for the refrigeration compressors.

4. Manufacturers', not Contractors' warranties, shall be provided for all HVAC equipment and accessories.

5. All warranties are to start from the date of Substantial Completion.

1.18 OPERATIONS, TRAINING, AND MANUAL

A. Refer to Division 1 for procedures and requirements for preparation and submittal of operation and maintenance manuals of each HVAC equipment. Refer to individual equipment specifications for maintenance manual additional requirements. In addition, include the following information:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.

2. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shut-down, and emergency instructions; and summer and winter operating instructions.

3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassemble; aligning and adjusting instructions.

4. Servicing instructions and lubrication charts and schedules.

B. Bind all the other Sections maintenance manuals in a single final Operating and Maintenance Manual.

C. Refer to Division 1 for procedures and requirements for training on each HVAC equipment. Refer to individual equipment specifications for the additional training requirements.

1.19 PAINTING

A. Paints and coatings used in the interior of the building to cover insulation for identification purposes shall not:

1. Exceed the VOC content limits established in the Green Seal Standard GS-11 Paints, First Edition, May 20, 1993.

B. Paints and coatings used in the interior of buildings to mark piping for identification purposes shall not:

1. Exceed the VOC content limits established in the Green Seal Standard GS-11 Paints, First Edition, May 20, 1993.

2. Exceed the VOC content limit of 250 g/l established in the Green Seal Standard GC-03, Anti-Corrosive Paints, Second Edition, January 7, 1997.

C. All adhesives and sealants shall comply with the South Coast Air Quality Management District (SCAQMD) Rule #1168;. Those limits correspond to an effective date of the SCAQMD Rule #1168 of July 1, 2005 and Rule Amendment date of January 7, 2005.

1.20 ADJUSTING AND CLEANING

A. Alignment: Check alignment, and where necessary, realign equipment within recommended tolerances by the manufacturer and in presence of manufacturer's service representative and Owner's representative.

1.21 TORCH BURNING OPERATION

A. The storing and use of oxygen and combustible gases in conjunction with torch burning apparatus is subject to the Rules and Regulations of the Division of Fire Prevention of the Fire Department of Ithaca, New York, latest Fire Prevention (F.P.) Directive. Fire watches shall be provided during all operations using torches for burning, cutting or welding.

B. Contractor shall apply for and obtain permits for the use and storage of such equipment on the premises. The operator of such equipment shall have a certificate of fitness issued by the Fire Department.

C. The cost of permits, certificates, fire watches, apparatus and other items required in the torch burning operation shall be borne by the Contractor at no additional cost to Owner.

1.22 SPECIAL INSPECTIONS/TESTS

A. Special Inspections are required by the NYS Building Code for the HVAC Trade:

Item	Code Section
Fire Resistant Penetrations and joints	BC 1705.17

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which equipment is to be installed. Do not proceed with work until conditions are suitable.

3.02 INSTALLATION

A. Install equipment in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

B. Accessories: Install equipment accessories not installed at factory and shown on the Drawings.

C. Connections: Connect all equipment and accessories as recommended by manufacturer for a complete installation.

D. Contractor shall not leave sharp exposed metal edges (bottom of threaded rods, mechanical equipment supports, etc.) that could otherwise present safety hazards to the building's occupants/work staff.

E. All penetrations made into other trades work are to be sealed to air tight/watertight condition. Ensure that all penetrations into ductwork have been sealed so that they are air tight. Access doors shall be of such construction as to make an air-tight seal that will pass duct work pressure testing. Penetrations through insulated systems, such as refrigerated rooms/equipment, etc, shall be insulated and sealed on both sides of penetration. Sealant on interior side of such insulated spaces/equipment shall be silicone recommended by manufacturer.

3.03 START-UP AND DEMONSTRATION/TRAINING/SERVICE

A. Start-Up and Demonstration/Training: The Contractor shall start-up and demonstrate in the presence of the Engineer, the proper operation of all equipment provided in this Contract. The Contractor shall perform necessary Interdisciplinary Tests and Functional Performance Tests (FPT) as listed in each technical Specification Section required by the Contract. The Contractor shall also provide training to the Engineer designated Representatives.

B. Service: Provide the services of a competent field service representative to furnish service to the facility during construction and during the warranty period. Service must be performed within 48 hours from the time of notification (24 hours for emergencies).

3.04 ADJUSTING AND CLEANING

A. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.05 TESTING

A. The Contractor shall furnish energy, fuel, oil, water, air, light and electrical instruments as required for all testing.

3.06 INDOOR AIR QUALITY (IAQ) REQUIREMENTS DURING CONSTRUCTION

A. Store HVAC equipment and all parts of the HVAC system in a clean, dry location. Until HVAC equipment and system items (ducting, registers, fan coil unit’s components, fans, motors, etc.) have been installed, they shall be kept covered with plastic film or in a location where it will not be exposed to moisture, dust, or other contaminants.

B. Seal all HVAC inlets and outlets. Use of the HVAC system shall be avoided during construction until drywall construction is complete. Temporary ventilation may be installed to remove contaminants. All air inlets and outlets shall be sealed during construction. These include outside air inlets, grilles, diffusers, supply ducts, return ducts, ceiling plenums, VAV (variable-air volume) plenum intakes, and window ventilator or air conditioning units. Openings shall be sealed with plastic film and tape that can be removed cleanly.

C. Seal HVAC components during installation. For ducting runs that require several days to install, sections shall be sealed off as they are completed. Seals shall be removed prior to continuing the ducting run. Other components of the HVAC system shall be subjected to the same requirements to protect them from contamination.

D. Use temporary filtration media. If the HVAC system is to be used while construction work is being done, temporary filtration media shall be installed at each return grill. Such filtration media shall have minimum filtration efficiency (Minimum Efficiency Reporting Value-MERV per NYS MC) of 8. After Substantial Completion use new filtration with a MERV rating of 13 in areas of the work where dust producing activities are generated.

E. Inspect filters regularly. When the HVAC system is being used during construction and temporary filters are installed, filters shall be inspected weekly and replaced as needed.

F. When outdoor construction activities generate dust, combustion emissions, or other contaminants, operable windows and outside air supplies to enclosed portions of the building

shall be protected in a manner that prevent contaminants from entering the building without harming the equipment.

END OF SECTION 23 05 11

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.
B. Efficiency: Energy efficient, as defined in NEMA MG 1.
C. Service Factor: 1.15.
D. Multispeed Motors: Variable torque.
   1. For motors with 2:1 speed ratio, consequent pole, single winding.
   2. For motors with other than 2:1 speed ratio, separate winding for each speed.
E. Multispeed Motors: Separate winding for each speed.
F. Rotor: Random-wound, squirrel cage.
G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
H. Temperature Rise: Match insulation rating.
I. Insulation: Class F.
J. Code Letter Designation:
   1. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
   1. Permanent-split capacitor.
   2. Split phase.
   3. Capacitor start, inductor run.
   4. Capacitor start, capacitor run.
B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
D. Motors 1/20 HP and Smaller: Shaded-pole type.
E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 23 05 13

SECTION 23 05 17

SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. Grout.

1.3 ACTION SUBMITTALS.

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

PART 2 - PRODUCTS

2.1 SLEEVES

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

2.2 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

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

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
   1. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
   2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. 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."

E. 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."

3.2 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:
   1. Concrete Slabs above Grade:
      a. Galvanized-steel-pipe sleeves.
   2. Interior Partitions:
      a. Galvanized-steel-pipe sleeves.

END OF SECTION 230517

SECTION 23 05 18

ESCUTCHEONS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

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

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

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

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

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-brasstype with polished, chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brasstype with polished, chrome-plated finish.
f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brasstype with polished, chrome-plated finish.
g. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.
h. Bare Piping in Equipment Rooms: One-piece, cast-brasstype with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment-room floors.

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

1. One-piece, floor-plate type.

3.2 FIELD QUALITY CONTROL

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

END OF SECTION 23 05 18

SECTION 23 05 23.12

BALL VALVES FOR HVAC PIPING

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

a. Brass ball valves.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

a. Protect internal parts against rust and corrosion.
b. Protect threads, flange faces, and weld ends.
c. Set ball valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

a. Maintain valve end protection.
b. 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.

C. 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.

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:

a. ASME B1.20.1 for threads for threaded-end valves.
b. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
c. ASME B16.18 for solder-joint connections.

C. Refer to HVAC valve schedule articles for applications of valves.

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

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

F. Valves in Insulated Piping:

a. Include 2-inch stem extensions.
b. Extended operating handle of nonthermal-conductive material, and protective sleeves that allow operation of valves without breaking the vapor seals or disturbing insulation.
c. Memory stops that are fully adjustable after insulation is applied.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRASS BALL VALVES

A. One-Piece Brass Ball Valves:
1. Manufacturers: Subject to compliance with requirements, provide

products by one of the following:
Crane; Crane Energy Flow Solutions.
Jomar Valve
KITZ Corporation.
Milwaukee Valve Company.
NIBCO INC.
Powell Valves.
Stockham; Crane Energy Flow Solutions.
Watts; a Watts Water Technologies company.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 400 psig .
c. Body Design: One piece.
d. Body Material: Forged brass.
e. Ends: Threaded.
f. Seats: PTFE.
g. Stem: Brass.
h. Ball: Chrome-plated brass.
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 VALVE 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 valve tags. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

3.3 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. Select valves with the following end connections:

a. For Copper Tubing, NPS 2 and Smaller: Solder-joint valve-end
b. For Steel Piping, NPS 2 and Smaller: Threaded ends.

END OF SECTION 23 05 23.12

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Equipment supports.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 233113 "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 ACTION SUBMITTALS

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

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Fiberglass strut systems.
4. Pipe stands.
5. Equipment supports.

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

1. Detail fabrication and assembly of trapeze hangers.

1.6 Design Calculations: Calculate requirements for designing trapeze hangers INFORMATIONAL SUBMITTALS.

1.7 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

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

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. NEFCO
    b. EATON
    c. Piping Technology & Products, Inc.
    d. NATIONAL PIPE HANGER

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches beyond sheet metal shield for all insulated piping.

2.4 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.6 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi , 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.

D. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.

E. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

F. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

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

H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

I. Install hangers and supports to allow controlled thermal and seismic 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.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

N. Insulated Piping:

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    b. NPS 4: 12 inches long and 0.06 inch thick.

5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for equipment supports.

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/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with 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 no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

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

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 099123 "Interior Painting"

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and attachments for general service applications.

F. Use stainless-steel pipe hangers and corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
4. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
5. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

12. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
13. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
14. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.

P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 23 05 29

SECTION 23 05 50

VIBRATION ISOLATION

PART 1 GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Vibration Isolation for Piping: Section 230529.

1.02 DEFINITIONS

A. Ground Floor: Floor or floor slab of building resting directly on earth.

1.03 SUBMITTALS

B. Shop Drawings:
1. Details of intermediate structural steel members and method of attachment required for installation of vibration isolating devices.
2. Design Calculations: Calculations for selection of vibration isolators, design of vibration isolation bases, and selection of seismic restraints.
3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

C. Product Data:
1. Catalog sheets, specifications, and installation instructions.
2. Vibration isolator schedule showing usage.

PART 2 PRODUCTS

2.01 MANUFACTURERS/COMPANIES

A. Amber-Booth Co.

B. Korfund Dynamics Corp.

C. Mason Industries Inc.

D. Vibration Eliminator Co. Inc.

E. Vibration Mountings and Controls, Inc.

2.03 STEEL SPRING ISOLATORS

A. Types:

1. Housed Springs: Provide units with telescoping cast iron or steel housings, containing one or more springs, complete with resilient alignment inserts and a minimum 1/4-inch-thick rubber or neoprene sound deadening pad bonded to the base of housing.

B. Construction Features Required:

1. Provide limit stops for spring isolators with deflections of 2 inch or more so as to prevent undue motion during start and stop, but unrestrained movement during normal operation.
2. Hot dip galvanizes all steel parts of isolators for outdoor use, with the exception of springs. Cadmium plate or neoprene coat springs.
3. Do not use isolator leveling bolts for jacking screws.

2.07 COMBINATION RUBBER AND SPRING ISOLATORS

A. Type: Combination rubber and spring type designed for insertion in a split hanger rod for isolating equipment from the overhead construction.
   1. Approved isolators: Amber Booth Type BSSR, Korfund Type VX, Mason Industries, Type DNHS, Vibration Eliminator Co. Type SNRC and Vibration Mountings and Controls Type RSH.

PART 3 EXECUTION

3.01 INSTALLATION

A. Jack equipment bases or inertia bases into position and block or wedge before springs are loaded. After equipment is bolted in place and springs are loaded, by means of the leveling bolts, remove the temporary blocking or wedging.

3.02 APPLICATION

A. Provide vibration isolators or vibration isolation bases for mechanical equipment, piping and high velocity ductwork of type as specified.

B. Select isolation devices for uniform static deflection, in accordance with the distribution of weight and forces.
   1. Whenever rotational speed is the cause of disturbing frequency, utilize the lowest operating speed of the equipment in determining the type of isolation required.
   2. Selection shall result in uniform loading and deflection, even when equipment weight is not evenly distributed.
   3. Select springs for a total deflection greater than the selected static deflection, to provide an adequate safety factor.

RPM	MINIMUM DEFLECTION	EFFICIENCY
Up to 325	3.5	80
326 to 525	2.0	80-90*
526 to 575	1.5	90
576 to 1000	1.25	90-95*
1001 to 1200	.75	95
1201 and over	.50	95

*Lower efficiency at lowest RPM - higher efficiency at highest RPM.

3.04 FIELD QUALITY CONTROL

A. Provide equipment and apparatus required for performing inspections and tests.
   1. Notify Owner Representative a minimum of 14 days prior to equipment sound, vibration, and seismic testing.

2. Rebalance, adjust, or replace equipment with noise or vibration levels in excess of those given in the equipment specifications, or equipment manufacturer's data.

B. Field Inspections:
   1. Prior to initial operation, inspect the vibration isolators and seismic snubbers for conformance to drawings, specifications, and manufacturer's data and instructions.
      a. Check for vibration and noise transmission through connections, piping, ductwork, foundations, and walls.
      b. Check connector alignment before and after filling of system and during operation.
      c. Correct misalignment without damage to connector and in accordance with manufacturer's recommendations.

C. Spring Isolator Inspection
   1. After installation of spring isolators or protected spring isolators, and seismic restraint devices, the equipment shall rock freely on its spring isolators within limits of stops or seismic restraint devices. Eliminate or correct any interferences.

D. Tests
   1. Adjust, repair, or replace isolators as required to reduce vibration and noise transmissions to specified levels.
   2. Equipment Vibration Tests
      a. Perform vibration tests to determine conformance with vibration isolation schedule specified.

END OF SECTION 23 05 50

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Valve tags.
6. Warning tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

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

C. Equipment Label Schedule: Include a listing of all equipment 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 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch or stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.

4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
6. Fasteners: Stainless-steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information plus emergency notification instructions.

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: Pre-coiled, semirigid plastic formed to partially cover 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 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: Size letters according to ASME A13.1 for piping.

2.4 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Black.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.

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

2.5 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 or stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass beaded chain or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. 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.

2.6 WARNING TAGS

A. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Safety-yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surface 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 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 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 through 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 15 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings.

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

C. Pipe Label Color Schedule:
1. Heating Water Piping: White letters on a safety-green background.

2. Chilled-Water Piping: Black letters on a safety-orange background.

3.5 DUCT LABEL INSTALLATION

A. Install plastic-laminated self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:

1. Blue: For cold-air supply ducts.
2. Yellow: For hot-air supply ducts.
3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.

B. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.6 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 HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

a. Hot Water: 1-1/2 inches, round.

b. Chilled Water: : 1-1/2 inches, round.

3.7 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 23 05 53

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Balancing Air Systems:
2. Balancing Hydronic Piping Systems:
3. Duct leakage tests.
4. Control system verification.

1.3 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.

1.4 PREINSTALLATION MEETINGS

A. TAB Conference:, conduct a TAB conference after approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.

1. Minimum Agenda Items:

a. The Contract Documents examination report.
b. The TAB plan.
c. Needs for coordination and cooperation of trades and subcontractors.
d. Proposed procedures for documentation and communication flow.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 60days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 60days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. System Readiness Checklists: Within 90 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports.

G. Sample report forms.

H. 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.

1.6 QUALITY ASSURANCE

A. TAB Specialists Qualifications: Certified by NEBB

1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB.
2. TAB Technician: Employee of the TAB specialist and certified by NEBB as a TAB technician.

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

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.7 FIELD CONDITIONS

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

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TAB SPECIALISTS

A. Contractor shall engage NEBB certified specialist

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 for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

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

E. Examine ceiling plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump 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.
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.

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

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

I. 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.

J. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.

K. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.

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

M. Examine system pumps to ensure absence of entrained air in the suction piping.

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

O. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. 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. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
b. Duct systems are complete with terminals installed.
c. Volume, smoke, and fire dampers are open and functional.
d. Clean filters are installed.
e. Fans are operating, free of vibration, and rotating in correct direction.
f. Variable-frequency controllers' startup is complete and safeties are verified.
g. Automatic temperature-control systems are operational.
h. Ceilings are installed.
i. Windows and doors are installed.
j. Suitable access to balancing devices and equipment is provided.

2. Hydronics:

a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
b. Piping is complete with terminals installed.
c. Water treatment is complete.
d. Systems are flushed, filled, and air purged.
e. Strainers are pulled and cleaned.
f. Control valves are functioning per the sequence of operation.
g. Shutoff and balance valves have been verified to be 100 percent open.
h. Variable-frequency controllers' startup is complete and safeties are verified.
i. 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 ASHRAE 111 SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

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

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping 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 Section 233113 "Metal Ducts."

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. 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 relief-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.

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

3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
4. Obtain approval from Engineer of Record 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.
5. 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.

B. 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.

C. 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.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust 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. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.

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

C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:
1. Check highest vent for adequate pressure.
2. Check flow-control valves for proper position.
3. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
4. Verify that motor starters are equipped with properly sized thermal protection.
5. Check that air has been purged from the system.

3.8 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Adjust flow-measuring devices installed in mains and branches to design water flows.

1. Measure flow in main and branch pipes.
2. Adjust main and branch balance valves for design flow.
3. Re-measure each main and branch after all have been adjusted.

B. Adjust flow-measuring devices installed at terminals for each space to design water flows.

1. Measure flow at terminals.
2. Adjust each terminal to design flow.
3. Re-measure each terminal after it is adjusted.
4. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
5. Perform temperature tests after flows have been balanced.

C. For systems with pressure-independent valves at terminals:

1. Measure differential pressure and verify that it is within manufacturer's specified range.
2. Perform temperature tests after flows have been verified.

D. For systems without pressure-independent valves or flow-measuring devices at terminals:

1. Measure and balance coils by either coil pressure drop or temperature method.
2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

E. Verify final system conditions as follows:

1. Re-measure and confirm that total water flow is within design.
2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
3. Mark final settings

3.9 DUCT LEAKAGE TESTS

A. Witness the duct pressure testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified tolerances.

C. Report deficiencies observed.

3.10 CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify temperature control system is operating within the design limitations.
2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

C. 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. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

D. 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 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.

3.11 TOLERANCES

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

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus, or minus 10 percent.
2. Air Outlets and Inlets: Plus, or minus 10 percent.
3. Heating-Water Flow Rate: Plus, or minus 10 percent.
4. Cooling-Water Flow Rate: Plus, or minus 10 percent.

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

3.12 PROGRESS REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems balancing devices. Recommend changes and additions to systems balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.13 FINAL REPORT

A. General: Prepare a certified 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.
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. Indicated versus final performance.
    b. Notable characteristics of systems.
    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.

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. Water flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Fan coil-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 number 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 (Indicated 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.
l. Vortex 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 (Indicated 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. Water flow rate in gpm
i. Water pressure differential in feet of head or psig .
j. Entering-water temperature in deg F .
k. Leaving-water temperature in deg F .

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm
b. Entering-air temperature in deg F .
c. Leaving-air temperature in deg F .
d. Air temperature differential in deg F .
e. Entering-air static pressure in inches wg .
f. Leaving-air static pressure in inches wg .
g. Air static-pressure differential in inches wg .
h. Manifold pressure in psig .
i. High-temperature-limit setting in deg F .
j. Operating set point in Btu/h .
k. Motor voltage at each connection.
l. Motor amperage for each phase.

m. Heating value of fuel in Btu/h .

4. Test Data (Indicated and Actual Values):

a. Heat output in Btu/h .
b. Airflow rate in cfm
c. Air velocity in fpm .
d. Entering-air temperature in deg F .
e. Leaving-air temperature in deg F .
f. Voltage at each connection.
g. Amperage for each phase.

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 (Indicated 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.
c. Traverse air temperature in deg F .
d. Duct static pressure in inches wg .
e. Duct size in inches .
f. Duct area in sq. ft. .
g. Indicated airflow rate in cfm

h. Indicated velocity in fpm .
i. Actual airflow rate in cfm
j. Actual average velocity in fpm .
k. Barometric pressure in psig .

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm
b. Air velocity in fpm .
c. Preliminary airflow rate as needed in cfm
d. Preliminary velocity as needed in fpm .
e. Final airflow rate in cfm
f. Final velocity in fpm .
g. Space temperature in deg F .

I. System-Coil Reports: For water coils of terminal units, include the following:

1. Unit Data:

a. System and air-handling-unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm
b. Entering-water temperature in deg F .
c. Leaving-water temperature in deg F .
d. Water pressure drop in feet of head or psig .
e. Entering-air temperature in deg F .
f. Leaving-air temperature in deg F .

3. Test Data (Indicated and Actual Values):
a. Full-open flow rate in gpm
b. Full-open pressure in feet of head or psig .
c. Final discharge pressure in feet of head or psig .
d. Final suction pressure in feet of head or psig .
e. Final total pressure in feet of head or psig .
f. Final water flow rate in gpm
g. Voltage at each connection.
h. Amperage for each phase.

J. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.14 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Construction Manager.

B. Construction Manager shall 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.

F. Prepare test and inspection reports.

3.15 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 23 05 93

SECTION 23 07 13

DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes insulating the following duct services:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.

B. Related Sections:

1. Section 230716 "HVAC Equipment Insulation."
2. Section 230719 "HVAC Piping Insulation."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
3. Detail application of field-applied jackets.
4. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, and Plenum Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

A. Fiberglass Blanket Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C553, Type II and ASTM C1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a) Owens Corning.
b) Manson Insulation.
c) Johns Manville

B. Fiberglass Board Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

Manufacturers: Subject to compliance with requirements, provide products by one of the following:

d) Owens Corning.
e) Manson Insulation.
f) Johns Manville

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a) Certain Teed Corp.
b) Knauf/Manson Insulation.
c) Johns Manville
d) Pittsburgh Corning Corp.

1. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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

Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a) Certain Teed Corp.
b) Knauf/Manson Insulation.
c) Johns Manville
d) Pittsburgh Corning Corp.

1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F .
3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
4. Color: White.

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

Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a) Certain Teed Corp.
b) Knauf/Manson Insulation.
c) Johns Manville
d) Pittsburgh Corning Corp.

1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
2. Service Temperature Range: 0 to 180 deg F .
3. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
4. Color: White.

D. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a) Certain Teed Corp.
b) Knauf/Manson Insulation.
c) Johns Manville
d) Pittsburgh Corning Corp.

1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F .
3. Solids Content: 60 percent by volume and 66 percent by weight.
4. Color: White.

2.4 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a) Certain Teed Corp.
b) Knauf/Manson Insulation.
c) Johns Manville
d) Pittsburgh Corning Corp.

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F .
4. Color: Aluminum.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.5 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. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.

2.6 TAPES

A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

Manufacturers: Subject to compliance with requirements, provide products by one of the following:

e) Certain Teed Corp.
f) Knauf/Manson Insulation.
g) Johns Manville
h) Pittsburgh Corning Corp.

1. Width: 3 inches .
2. Thickness: 6.5 mils .
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.7 SECUREMENTS

A. Bands:

Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a) Certain Teed Corp.
b) Knauf/Manson Insulation.

c) Johns Manville
d) Pittsburgh Corning Corp.

1. Aluminum: ASTM B 209 , Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with closed seal.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, [0.106-inch-] [0.135-inch-] diameter shank, length to suit depth of insulation indicated.

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      (i) Certain Teed Corp.
      (ii) Knauf/Manson Insulation.
      (iii) Johns Manville
      (iv) Pittsburgh Corning Corp.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      i. Certain Teed Corp.
      ii. Knauf/Manson Insulation.
      iii. Johns Manville
      iv. Pittsburgh Corning Corp.

   b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

   c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.

   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      (i) Certain Teed Corp.
      (ii) Knauf/Manson Insulation.
      (iii) Johns Manville
      (iv) Pittsburgh Corning Corp.

b. See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers and products. See Section 016000 "Product Requirements."

c. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

d. Spindle: [Copper- or zinc-coated, low-carbon steel] [Aluminum] [Stainless steel], fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.

e. Adhesive-backed base with a peel-off protective cover.

2.8 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. 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.
3. 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.

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

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor insulation,
3. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor insulation, Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1. Comply with requirements in Section 078413 "Penetration Firestopping"irestopping and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Impale insulation over pins and attach speed washers.
    f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with

insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1-inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not overcompress insulation during installation.
e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1-inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped

pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.6 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.8 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply.
2. Indoor, exposed supply
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.9 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, rectangular, supply-air duct insulation shall be the following:
1. Fiberglass Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

B. Concealed, rectangular, outdoor-air duct insulation shall be the following:
1. Fiberglass Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

C. Concealed, outdoor-air and exhaust air plenum insulation shall be the following:
1. Fiberglass Board: 2 inches thick and 2-lb/cu. ft. nominal density.

D. Exposed, rectangular, supply-air duct insulation shall be the following:
1. Fiberglass Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

E. Exposed, rectangular, outdoor-air duct insulation shall be the following:
1. Fiberglass Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

F. Exposed, outdoor-air and exhaust-air plenum insulation shall be the following:
1. Fiberglass Board: 2 inches thick and 2-lb/cu. ft. nominal density.

END OF SECTION 23 07 13

SECTION 23 07 19

HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

1. Section includes insulating the following HVAC piping systems:
   1. Condensate drain piping.
   2. Chilled-water piping.
   3. Heating hot-water piping.

2. Related Sections:

   1. Section 230713 "Duct Insulation."

1.3 ACTION SUBMITTALS

1. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

2. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail insulation application at pipe expansion joints for each type of insulation.
   3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
   4. Detail removable insulation at piping specialties.
   5. Detail application of field-applied jackets.
   6. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

1. Material Test Reports: From a qualified testing agency, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

2. Field quality-control reports.

1.5 QUALITY ASSURANCE

1. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

2. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

    1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
    2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

1. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

1. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

2. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 SCHEDULING

1. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

2. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

1. Provide preformed fiber glass insulation for all new HVAC piping.

2. Products shall not contain asbestos, lead, mercury, or mercury compounds.

1. Preformed Fiberglass with factory applied ASJ jacket: High-performance insulation made from bio soluble glass fibers bonded with a thermosetting resin and produced in 36" (0.92 m) lengths with a factory-applied vapor-barrier jacket. The all-service (ASJ) vapor-retarder jacket shall include a longitudinal, self-sealing closure lap. The jacket system shall adhere to each fiberglass section using a specially formulated adhesive to ensure jacket securement.

    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        a. Johns Manville
        b. Owens Corning
        c. Frost King
    2. Preformed Pipe Insulation: Type II, Class 2, with factory-applied **ASJ** jacket.
    3. Service Temp. Range: 0F to 850F
    4. Moisture Sorption: less than 5% by weight
    5. Thermal Conductivity: less than 0.23 Btu.in/(Hr.ft^2.F)
    6. Factory fabricate shapes in accordance with ASTM C547 and ASTM C585.
    7. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 ADHESIVES

1. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

2. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        a. JOHNS MANVILLE
        b. REFLECTIX INSULATION
        c. GREENGUARD

    2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 MASTICS

1. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

    1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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

    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. JOHNS MANVILLE.
b. GREENGUARD
c. REFLECTIX INSULATION

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

3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

2.4 SEALANTS

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

2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
4. Color: White or gray.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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

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

2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 TAPES

1. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Avery Dennison Corporation, Specialty Tapes Division.
b. Compac Corporation.
c. Ideal Tape Co., Inc., an American Biltrite Company.
d. Knauf Insulation.
e. Venture Tape.

2. Width: 3 inches.

3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.

7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

2.6 SECUREMENT

1. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.

2. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

3. Wire: 0.062-inch soft-annealed, stainless steel.

PART 3 - EXECUTION

3.1 EXAMINATION

1. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

    1. Verify that systems to be insulated have been tested and are free of defects.
    2. Verify that surfaces to be insulated are clean and dry.
    3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

1. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

2. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

3. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

1. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

2. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

3. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

4. Install insulation with longitudinal seams at top and bottom of horizontal runs.

5. Install multiple layers of insulation with longitudinal and end seams staggered.

6. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

7. Keep insulation materials dry during application and finishing.

8. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

9. Install insulation with least number of joints practical.

10. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

    1. Install insulation continuously through hangers and around anchor attachments.
    2. 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 end at attachment to structure with vapor-barrier mastic.
    3. 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.
    4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

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

12. Install insulation with factory-applied jackets as follows:

    1. Draw jacket tight and smooth.
    2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
    3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

        a. For below-ambient services, apply vapor-barrier mastic over staples.

    4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
    5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

13. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

14. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

15. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

16. For above-ambient services, do not install insulation to the following:

    1. Vibration-control devices.
    2. Testing agency labels and stamps.
    3. Nameplates and data plates.

3.4 PENETRATIONS

1. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

    1. Seal penetrations with flashing sealant.
    2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
    3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
    4. Seal jacket to roof flashing with flashing sealant.

2. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

3. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

    1. Seal penetrations with flashing sealant.
    2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
    3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches .
    4. Seal jacket to wall flashing with flashing sealant.

4. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

5. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

    1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

6. Insulation Installation at Floor Penetrations:

    1. Pipe: Install insulation continuously through floor penetrations.
    2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

1. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

2. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

    1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
    2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
    3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
    4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
    5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
    6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
    7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
    8. Label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

3. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

4. Install removable insulation covers at locations indicated. Installation shall conform to the following:

    1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch , and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.

2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.

3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

4. Install insulation to flanges as specified for flange insulation application.

3.7 FIELD QUALITY CONTROL

1. Tests and Inspections:

    1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

2. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.8 PIPING INSULATION SCHEDULE, GENERAL

1. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

3.9 PIPING INSULATION SCHEDULE

1. Condensate and Equipment Drain Water:

    1. All Pipe Sizes: Insulation shall be one of the following
        a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

2. Chilled Water:

    1. NPS 3 and Smaller: Insulation shall be the following:
        a. Mineral-Fiber, Preformed Pipe, Type I Pipe Insulation: 2 inches thick.

3. Heating-Hot-Water Supply and Return, 200 Deg F and Below:

    1. NPS 12 and Smaller: Insulation shall be:
        a. Mineral-Fiber, Preformed Pipe, Type I: 2 inches thick.

END OF SECTION 23 07 19

SECTION 23 09 00

BUILDING AUTOMATION SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes control equipment and installation for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-furnished controls.

B. See "Sequences of Operation" on drawing for requirements that relate to this Section.

C. The BAS control system shall be extension of the existing Siemens Apogee or Desigo CC BAS and all controllers and software shall match existing or be latest version of existing.

1.2 RELATED DOCUMENTS

A. Drawings and Specification Sections of the Contract, including General and Supplementary Conditions, apply to this Section.
1. General Requirements Section 01 00 00
2. Section 01 00 00 – General and Special Requirements
3. Section 01 33 00 – Submittal Requirements
4. Section 01 60 00 – Materials and Equipment
5. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC
6. Section 26 05 11 – General Electrical Provisions for Electrical Work
7. Section 26 05 19 – Low Voltage Electrical Power Conductors and Cables
8. Section 26 05 29 – Hangers and Supports for Electrical Systems
9. Section 26 05 33 – Raceway and Boxes for Electrical Systems
10. Section 26 05 53 – Identification for Electrical Systems
11. Section 26 27 26 – Wiring Devices

1.3 DEFINITIONS

A. DDC: Direct digital controls

B. IP: Internet Protocol

C. I/O: Input/Output

D. LAN: Local area network.

E. TCP: Transfer Control Protocol

F. GUI: General User Interface

G. Scope Terminology
1. Provide = Furnish equipment, engineer, program and install
2. Furnish = Furnish equipment, engineer and program

3. Mount = securely fasten or pipe
4. Install = mount and wire
5. Wire = wire only

1.4 SYSTEM DESCRIPTION

A. The Building Automation System (BAS) contractor shall furnish and install a networked system of HVAC controls. The contractor shall incorporating direct digital control (DDC) for building ventilation equipment, supplemental heating and cooling equipment, and terminal units.

B. Provide networking to new DDC equipment using communication standards. The system shall not be limited to only standard protocols, but shall also be able to integrate to a wide variety of third-party devices and applications via drivers and gateways.

C. Provide standalone controls where called for on the drawings or sequences.

1.5 WORK INCLUDED

A. The installation of the control system shall be performed under the direct supervision of the controls manufacturer with the shop drawings, flow diagrams, bill of materials, component designation, or identification number and sequence of operation all bearing the name of the manufacturer.

B. Furnish a complete distributed direct digital control system in accordance with this specification section. This includes all system controllers, logic controllers, and all input/output devices. Items of work included are as follows:
1. Provide a submittal that meets the requirements below for approval.
2. Coordinate installation schedule with the mechanical contractor and general contractor.
3. Provide installation of all panels and devices unless otherwise stated.
4. Provide power for panels and control devices.
5. Provide all low voltage control wiring for the DDC system.
6. Provide miscellaneous control wiring for HVAC and related systems regardless of voltage.
7. Provide engineering and technician labor to program and commission software for each system and operator interface. Submit commissioning reports for approval.
8. Participate in commissioning for all equipment that is integrated into the BAS (Refer to Commissioning sections of the equipment or systems in other parts of this specification.)
9. Provide testing, demonstration and training as specified below.

C. This project includes but limited to the following major equipment to be tied into the existing Siemens system on site. Use the latest Siemens controllers (no other controllers will be acceptable) for the equipment in this scope of work:
1. ERV-1 & ERV-2
2. FCU-1 through 4

1.6 SYSTEM PERFORMANCE

A. Comply with the following performance requirements:
1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 5 seconds.
2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 5 seconds.

3. Object Command: Reaction time of less than 5 seconds between operator command of a binary object and device reaction.
4. Object Scan: Transmit change of state and change of analog values to control units or workstation within 5 seconds.
5. Alarm Response Time: Annunciate alarm at workstation within 2 seconds. Multiple workstations must receive alarms within five seconds of each other.
6. Program Execution Frequency: Programmable controllers shall execute DDC PI control loops, and scan and update process values and outputs at least once per second.
7. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
   a. Water Temperature: Plus or minus 1 deg F.
   b. Water Flow: Plus or minus 5 percent of full scale.
   c. Water Pressure: Plus or minus 2 percent of full scale.
   d. Space Temperature: Plus or minus 1 deg F.
   e. Ducted Air Temperature: Plus or minus 1 deg F.
   f. Outside Air Temperature: Plus or minus 2 deg F.
   g. Dew Point Temperature: Plus or minus 3 deg F.
   h. Temperature Differential: Plus or minus 0.25 deg F.
   i. Relative Humidity: Plus or minus 2 percent.
   j. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
   k. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
   l. Airflow (Terminal): Plus or minus 10 percent of full scale.
   m. Air Pressure (Space): Plus or minus 0.01-inch wg.
   n. Air Pressure (Ducts): Plus or minus 0.1-inch wg.
   o. Carbon Monoxide: Plus or minus 5 percent of reading.
   p. Carbon Dioxide: Plus or minus 50 ppm.
   q. Electrical: Plus or minus 5 percent of reading.

1.7 SUBMITTALS

A. Provide submittals for fast track items that need to be approved and released to meet the schedule of the project. Provide submissions for the following items separately:
   1. Valve schedule and cut sheets
   2. Factory mounting and wiring diagrams and cut sheets
   3. Thermostat locations

B. Provide a complete submittal with all controls system information for approval before construction starts. Include the following:

   1. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
   2. Wiring Diagrams: Power, signal, and control wiring.
   3. Details of control panel faces, including sizes, controls, instruments, and labeling.
   4. Schedule of dampers and actuators including size, leakage, and flow characteristics.
   5. If dampers are furnished by other, submit a damper actuator schedule coordinating actuator sizes with the damper schedule.
   6. Schedule of valves including leakage and flow characteristics.
   7. Written description of the Sequence of Operations.
   8. Network riser diagram showing wiring types, network protocols, locations of floor penetrations and number of control panels. Label control panels with network addresses. Show all routers, switches, hubs and repeaters.
   9. Point list for each system controller including both inputs and outputs (I/O), point numbers, controlled device associated with each I/O point, and location of I/O device.
   10. Starter and variable frequency drive wiring details of all automatically controlled motors.

11. Reduced size floor plan drawings showing locations of control panels, thermostats and any devices mounted in occupied space.

C. Product Data: Include manufacturer's technical literature for each control device indicated, labeled with setting or adjustable range of control. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated. Submit a write-up of the application software that will be used on the operator workstation including revision level, functionality and software applications required to meet the specifications.

D. Submit PICS statements for all direct digital controllers and interfaces.

E. Submit a description of the application software that will be used on the operator workstation including revision level, functionality and software applications required to meet the specifications.

F. Wiring Diagrams: Detail the wiring of the control devices and the panels. Show point-to-point wiring from field devices to the control panel. Show point-to-point wiring of hardwired interlocks. Show a ladder diagram or schematic of wiring internal to the panels, including numbered terminals. Clearly designate wiring that is done at a factory, at a panel shop or in the field.

G. Submit blank field check-out and commissioning test reports, customized for each panel or system, which will be filled out by the technician during start-up.

H. Submit sample graphics for approval before starting system commissioning.

I. Variance letter: Submit a letter detailing each item in the submission that varies from the contract specification or sequence of operation in any way.

J. After the BAS system is approved for construction, submit sample operator workstation graphics for typical systems for approval. Print and submit the graphics that the operator will use to view the systems, change setpoints, modify parameters and issue manual commands. Programming shall not commence until typical graphics are approved.

1.8 QUALITY ASSURANCE

A. Codes
1. Perform all wiring in accordance with Division 26, NEC, local codes and Owner’s requirements.
2. Uniform Building Code (UBC)
3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
4. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."
5. All equipment shall be UL listed and approved and shall meet with all applicable NFPA standards, including UL 916 - PAZX Energy Management Systems,
6. Provide UL 864 – UUKL Smoke Control, where controllers and networks are used for that purpose.
   a. Provide written approvals and certifications after installation has been completed.
7. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference and be so labeled.
8. The manufacturer of the building automation system shall provide documentation supporting compliance with ISO-9002 (Model for Quality Assurance in Production,

Installation, and Servicing) and ISO-140001 (The application of well-accepted business management principles to the environment). The intent of this specification requirement is to ensure that the products from the manufacturer are delivered through a Quality System and Framework that will assure consistency in the products delivered for this project.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

1.10 COORDINATION

A. Coordinate location of thermostats, humidistats, panels, and other exposed control components with plans and room details before installation.

B. Coordinate equipment with Section 26 00 00 “Fire Alarm" to achieve compatibility with equipment that interfaces with that system.

C. Coordinate power for control units and operator workstation with electrical contractor.

D. Coordinate equipment with provider of starters and drives to achieve compatibility with motor starter control coils and VFD control wiring.

E. Coordinate scheduling with the mechanical contractor and general contractor. Submit a schedule for approval based upon the installation schedule of the mechanical equipment.

F. Products Furnished but Not Installed Under This Section
   1. Hydronic Piping:
      a. Control Valves
      b. Temperature Sensor Wells and Sockets
      c. Flow Switches
      d. Flow Meters
   2. Refrigerant Piping
      a. Pressure and Temperature Sensor Wells and Sockets
   3. Sheetmetal accessories
      a. Dampers
      b. Airflow Stations
      c. Terminal Unit Controls

G. Products Installed but Not Furnished Under This Section
   1. Refrigeration Equipment:
      a. Refrigerant Leak Detection System
      b. Proof of flow pressure switches
   2. Rooftop Air Handling Equipment:
      a. Thermostats
      b. Duct Static Pressure Sensors

H. Integrate to equipment as called for in the sequence of operations

1.11 WARRANTY

A. Conform to the warranty requirement of the Contract Documents, General Requirements and this section or a minimum of 12 months. Provide the strictest.

B. Warranty shall cover all costs for parts, labor, associated travel, and expenses for a period of one year from completion of system demonstration.

C. Hardware and software personnel supporting this warranty agreement shall provide on-site or off-site service in a timely manner after failure notification to the vendor. The maximum acceptable response time to provide this service at the site shall be 24 hours.

D. During normal building occupied hours, failure of items that are critical for system operation shall be provided within 4 hours of notification from the Owner's Representative.

E. This warranty shall apply equally to both hardware and software.

PART 2 - PRODUCTS

2.1 ACCEPTABLE SYSTEMS

A. Provide an extension to an existing Siemens APOGEE System as installed by the Siemens Industry branch office, one other system will be accepted. (Brian Greda (973) 332-0789)

B. The vendors and products listed shall comply with these specifications. It shall not be assumed that standard products and methods will be acceptable without prior approval. Exceptions shall be noted during the bid process and documented in the submittal process.

2.2 SOFTWARE UPDATES

A. Provide an update to the operator interface software to the latest version of the type of software it is. For instance, if the existing software is Base, upgrade to the latest Base version.

B. Provide an update for each concurrent user license.

C. Provide an update for each of the existing user features, such as RENO, GO, etc.

2.3 ELECTRONIC DOCUMENTATION

A. Provide software applications and files to view documentation through the GUI.

B. Provide a CAD viewer to view all project AutoCAD documents that are made available by the Architect and Owner.

C. Provide all controls cut sheets in PDF format. Make them available to any user accessing the system over the Internet.

D. Provide a text version of the sequence of operation. Make the written sequence available from the graphic that represents each system. The sequence shall pop up in a printable format such as HTML or PDF.

2.4 CONTROLLER SOFTWARE (i.e. Building Controller software, , DDC software, Field Panel software)

A. Reuse existing software. If new controllers need updated versions of the controller software, then provide updated versions, such that at the completion of this project, the Owner has controller software licenses for all of the existing and new generations of controllers.

2.5 BUILDING CONTROLLERS (B-BC)

A. Provide all necessary hardware for a complete operating system as required. The Building Controller shall be able to operate as a standalone panel and shall not be dependent upon any higher level computer or another controller for operation.

B. Use a Siemens PX Modular and Compact Controllers (PXC).

C. This level of controller shall be used for the following types of systems:
1. Chiller plant systems
2. Heating plant systems
3. Cooling Towers
4. Pumping systems
5. VAV air handlers
6. Air handlers over 15,000 cfm
7. Systems with over 24 input/output points

D. Computing power and memory minimum:
1. A 32-bit, stand-alone, multi-tasking, multi-user, real-time 100MHz digital control microprocessor module.
2. Inputs shall be 16-bit minimum analog-to-digital resolution
3. Outputs shall be 10-bit minimum digital-to-analog resolution
4. Memory module (24 Megabyte, minimum) to accommodate all Primary Control Panel software requirements, including but not limited to, its own operating system and databases (see Controllers Software section), including control processes, energy management applications, alarm management applications, historical/trend data for points specified, maintenance support applications, custom processes, operator I/O, dial-up communications.
5. Real time clock and battery
6. Data collection/ Data Trend module sized for 10,000 data samples.
7. Flash Memory Firmware: Each Building Level Control Panel shall support firmware upgrades without the need to replace hardware.

E. Onboard or Modular hardware and connections:
1. Primary Network communication module, if needed for primary network communications.
2. Secondary Network communication module, if needed for secondary network communications.
3. RJ45 port 10/100Mbaud
4. RS485 ports for subnetworks and point expansion
5. Man to Machine Interface port (MMI)
6. USB Port

F. Input and Output Points Hardware
1. Input/output point modules as required including spare capacity.
2. Monitoring of the status of all hand-off-auto switches.
3. Monitoring of all industry standard types of analog and digital inputs and outputs, without the addition of equipment to the primary control panel.

4. Local status indication for each digital input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device. Each primary control panel shall perform diagnostics on all inputs and outputs and a failure of any input or output shall be indicated both locally and at the operator workstation.
5. Graduated intensity LEDs or analog indication of value for each analog output.

G. Code compliance
1. Approvals and standards: UL916; CE; FCC
2. Provide UL864-UUKL where called for in the sequences of operations.

H. Accessories:
1. Appropriate NEMA rated metal enclosure.
2. Power supplies as required for all associated modules, sensors, actuators, etc.

I. Keypad.
1. Where called for in the sequence of operation, or on the plans, a local keypad and display shall be provided for each controller. The keypad shall be provided for interrogating and editing data. An optional system security password shall be available to prevent unauthorized use of the keypad and display.

J. The operator shall have the ability to manually override automatic or centrally executed commands at the primary control panels via local, point discrete, on-board hand/off/auto operator override switches. If on board switches are not available, provide separate control panels with HOA switches. Mount panel adjacent to primary control panel. Provide hand/off/auto switch for each digital output, including spares.

K. Each Building Level Control Panel shall continuously perform self-diagnostics on all hardware modules and network communications. The System Level Control Panel shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication with any system.

L. Panel setup, point definitions and sequencing diagrams shall be backed up on EEPROM memory.

M. Power loss. In the event of the loss of power, there shall be an orderly shutdown of all Building Controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 30 days.

N. Building Level control panels shall provide at least two serial data communication ports for operation of operator I/O devices such as industry standard printers, operator terminals, modems and portable laptop operator's terminals. Primary control panels shall allow temporary use of portable devices without interrupting the normal communications, operation of permanently connected modems, printers or terminals.

O. Building Level Controllers shall have the capability to serve as a gateway between Modus subnetworks and the BAS. Provide software, drives and programming.

P. Isolation shall be provided at all primary control panel terminations, as well as all field point terminations to suppress induced voltage transients consistent with IEEE Standards 587-1980.

Q. Spare Capacity: Provide enough inputs and outputs to handle the equipment shown to be “future” on drawings and 10% more of each point type. Provide all hardware modules, software modules, processors, power supplies, communication controllers, etc. required to ensure adding

a point to the spare point location only requires the addition of the appropriate sensor/actuator and field wiring/tubing.

R. Environment.
1. Controller hardware shall be suitable for the anticipated ambient conditions.
2. Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures and shall be rated for operation at 0°C to 49°C (32°F to 120°F).
3. Controllers used in conditioned space shall be mounted in dust-proof enclosures and shall be rated for operation at 0°C to 49°C (32°F to 120°F).

S. Immunity to power and noise.
1. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage.
2. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).
3. Isolation shall be provided at all primary network terminations, as well as all field point terminations to suppress induced voltage transients consistent with:
   a. RF-Conducted Immunity (RFCI) per ENV 50141 (IEC 1000-4-6) at 3V.
   b. Electro Static Discharge (ESD) Immunity per EN 61000-4-2 (IEC 1000-4-2) at 8 kV air discharge, 4 kV contact.
   c. Electrical Fast Transient (EFT) per EN 61000-4-4 (IEC 1000-4-4) at 500V signal, 1 kV power.
   d. Output Circuit Transients per UL 864 (2,400V, 10A, 1.2 Joule max).
4. Isolation shall be provided at all Building Controller's AC input terminals to suppress induced voltage transients consistent with:
   a. IEEE Standard 587 1980
   b. UL 864 Supply Line Transients
   c. Voltage Sags, Surge, and Dropout per EN 61000-4-11 (EN 1000-4-11)

2.6 APPLICATION SPECIFIC CONTROLLERS

A. Each Application Level Control Panel shall operate as a stand-alone controller capable of performing its user selectable control routines independently of any other controller in the system. Each application specific controller shall be a microprocessor-based, multi-tasking, real-time digital control processor.

B. Use a Siemens DXR Controller for unique applications.

C. Provide a Application Specific Control Panel for each of the following types of equipment (if applicable):
1. Constant Air Volume (CAV) boxes
2. Chilled beams
3. Duct mounted reheat coils
4. Fan coil Units
5. Fan Powered Variable Air Volume (VAV) Boxes
6. Reheat Coils
7. Supplemental AC units
8. Variable Air Volume (VAV) Boxes
9. Other terminal equipment

D. Each Application Specific Controller shall, at a minimum, be provided with:
1. Appropriate NEMA rated enclosure
2. Floor Level network communications ability
3. Power supplies as required for all associated modules, sensors, actuators, etc.

4. Software as required for all sequences of operation, logic sequences and energy management routines.
5. A portable operator terminal connection port
6. Auxiliary enclosure for analog output transducers, isolation relays, etc. Auxiliary enclosure shall be part of primary enclosure or mounted adjacent primary enclosure
7. Each controller measuring air volume shall include provisions for manual and automatic calibration of the differential pressure transducer in order to maintain stable control and insuring against drift over time
8. Each controller measuring air volume shall include a differential pressure transducer
9. Approvals and standards: UL916; CE; FCC

E. Each Application Specific Controller shall continuously perform self-diagnostics on all hardware and secondary network communications. The Application Specific Controller shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failure to establish communication to the system.

F. Provide each Application Specific Controller with sufficient memory to accommodate point databases, operating programs, local alarming and local trending. All databases and programs shall be stored in non-volatile EEPROM, EPROM and PROM. The controllers shall be able to return to full normal operation without user intervention after a power failure of unlimited duration. Provide uninterruptible power supplies (UPSs) of sufficient capacities for all terminal controllers that do not meet this protection requirement. Operating programs shall be field-selectable for specific applications. In addition, specific applications may be modified to meet the user's exact control strategy requirements, allowing for additional system flexibility. Controllers that require factory changes of all applications are not acceptable.

G. The Application Specific Controller shall be powered from a 24 VAC source provided by this contractor and shall function normally under an operating range of 18 to 28 VAC (-25% to +17%), allowing for power source fluctuations and voltage drops. Install plenum data line and sensor cable in accordance with local code and NEC. The controllers shall also function normally under ambient conditions of 32 to 122 F (0 to 50 C) and 10% to 95%RH (non-condensing). Provide each controller with a suitable cover or enclosure to protect the intelligence board assembly.

2.7 ROUTERS

A. Provide a router for each subnetwork to connect the floor level network to the base building backbone level network. The router shall connect FLN subnetworks to TCP/IP over Ethernet.

2.8 CONTROL PANELS

A. Controllers in mechanical rooms shall be mounted in NEMA 1 enclosures.

B. Mount on walls at an approved location or provide a free standing rack.

C. Panels shall be constructed of 16 gauge, furniture-quality steel, or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with ANSI 61 gray polyester-powder painted finish, UL listed. Provide common keying for all panels.

D. Provide power supplies for control voltage power.

E. Dedicate 1 power supply to the DDC controller. Other devices shall be on a separate power supply, unless the power for the control device is derived from the controller terminations.

F. Power supplies for controllers shall be a transformer with a fuse or circuit breaker. Power supplies for other devices can be plain transformers.

G. All power supplies for 24V low voltage wiring shall be class 2 rated and less than 100VA. If low voltage devices require more amps, then provide multiple power supplies. If a single device requires more amps, then provide a dedicated power supply in a separate enclosure and run a separate, non-class 2 conduit to the device.

H. Surge transient protection shall be incorporated in design of system to protect electrical components in all DDC Controllers and operator's workstations.

I. All devices in a panel shall be permanently mounted, including network switches, modems, media converters, etc.

J. Provide a pocket to hold documentation.

2.9 GENERAL SPECIFICATIONS FOR DEVICES

A. Provide mounting hardware for all devices, including actuator linkages, wells, installation kits for insertion devices, wall boxes and fudge plates, brackets, etc.

B. If a special tool is required to mount a device, provide that tool.

2.10 SENSORS

A. Terminal Unit Space Thermostats
1. Each controller performing space temperature control shall be provided with a matching room temperature sensor.
   a. Plain Space Temperature Sensors – Wired: Where called for in the sequences or on the drawings, provide sensors with plain covers.
   b. The sensing element for the space temperature sensor shall be thermistor type providing the following.
      1) Element Accuracy: + /- 1.0°F
      2) Operating Range: 55 to 95°F
      3) Set Point Adjustment Range: 55 to 95°F
      4) Calibration Adjustments: None required
      5) Installation: Up to 100 ft. from controller
      6) Auxiliary Communications Port: as required
      7) Local LCD Temperature Display: as required
      8) Setpoint Adjustment Dial as required
      9) Occupancy Override Switch as required
   c. Auxiliary Communication Port. Each room temperature sensor shall include a terminal jack integral to the sensor assembly. The terminal jack shall be used to connect a portable operator's terminal to control and monitor all hardware and software points associated with the controller. RS-232 communications port shall allow the operator to query and modify operating parameters of the local room terminal unit from the portable operator's terminal.

2. Digital Display temperature sensor specifications – Wired:
   a. As called for in the sequences of operations or on the drawings, provide temperature sensors with digital displays.
   b. The sensing element for the space temperature sensor must be IC-based and provide the following.

1) Digitally communicating with the Application Specific Controller.
2) Mountable to and fully covering a 2 x 4 electrical junction box without the need for an adapter wall plate.
3) IC Element Accuracy: +/- 0.9°F
4) Operating Range: 55 to 95°F
5) Setpoint Adjustment Range: User limiting, selectable range between 55 and 95°F
6) Display of temperature setpoint with numerical temperature values
7) Display of temperature setpoint graphically, with a visual Hotter/Colder setpoint indication
8) Calibration: Single point, field adjustable at the space sensor to +/- 5°F
9) Installation: Up to 100 ft. from controller
10) Auxiliary Communications Port: included
11) Local OLED Temperature Display: included
12) Display of Temperature to one decimal place
13) Temperature Setpoint Adjustment included
14) Occupancy Override Function included

c. Auxiliary Communication Port. Each room temperature sensor shall include a terminal jack integral to the sensor assembly. The terminal jack shall be used to connect a portable operator's terminal to control and monitor all hardware and software points associated with the controller. RS-232 communications port shall allow the operator to query and modify operating parameters of the local room terminal unit from the portable operator's terminal.

3. Provide the following options as they are called for in the sequences or on the drawings:
   a. Setpoint Adjustment. The setpoint adjustment function shall allow for modification of the temperature by the building operators. Setpoint adjustment may be locked out, overridden, or limited as to time or temperature through software by an authorized operator at any central workstation, Building Controller, room sensor two-line display, or via the portable operator's terminal.
   b. Override Switch. An override button shall initiate override of the night setback mode to normal (day) operation when activated by the occupant and enabled by building operators. The override shall be limited to two (2) hours (adjustable.) The override function may be locked out, overridden, or limited through software by an authorized operator at the operator interface, Building Controller, room sensor two-line display or via the portable operator's terminal.
   c. Space Combination Temperature and Humidity Sensors. Each controller performing space temperature control shall be provided with a matching room temperature sensor, which also includes the ability to measure humidity for either monitoring or control purposes. The combination temperature and humidity sensors shall have the same appearance as the space temperature sensors. Humidity elements shall measure relative humidity with a +/- 2% accuracy over the range of 10 to 90% relative humidity. Humidity element shall be an IC (integrated circuit) sensing element. Humidity sensing elements shall be removable and field replaceable if needed.

B. Temperature Sensors
   1. All temperature sensors shall meet the following specifications:
      a. Accuracy: Plus or minus 0.2 percent at calibration point.
      b. Wire: Twisted, shielded-pair cable.
      c. Vibration and corrosion resistant
   2. Space temperature sensors shall meet the following specifications:
      a. 10k ohm type 2 thermisters
   3. Insertion Elements in Ducts shall meet the following specifications:
      a. Single point 10k ohm thermister
      b. Use where not affected by temperature stratification

c. The sensor shall reach more that 1/3 the distance from the duct wall
d. Junction box for wire splices

4. Averaging Elements in Ducts shall meet the following specifications:
   a. 72 inches (183 cm) long
   b. Flexible
   c. Use where prone to temperature stratification, in front of coils, or where ducts are larger than 9 sq. ft.
   d. Junction box for wire splices
5. Insertion Elements for Liquids shall meet the following specifications:
   a. Platinum RTD with 4-20mA transmitter
   b. Threaded mounting with matching well
   c. Brass well with minimum insertion length of 2-1/2 inches for pipes up to 4" diameter
   d. Brass well with insertion length of 6 inches for pipes up to 10" diameter
   e. Junction box for wire splices
6. Outside-Air Sensors Platinum RTD with 4-20mA transmitter:
   a. Watertight enclosure, shielded from direct sunlight
   b. Circulation fan
   c. Watertight conduit fitting

C. Where called for in the sequences of operations, provide the following feature on space sensors and thermostats:
   1. Security Sensors: Stainless-steel cover plate with insulated back and security screws
   2. Space sensors with setpoint adjust: Plain white plastic cover with slide potentiometer to signal a setpoint adjustment to the DDC
   3. Space Sensors with LCD display:
      a. Operator buttons for adjusting setpoints, setting fans speeds and overriding unit to on/off
      b. Graphical LCD icons for signaling heating/cooling mode, fans speed, schedule mode, actual temperature and current setpoint

D. Humidity Sensors shall meet the following specifications:
   1. Bulk polymer sensor element
   2. Accuracy: 2 percent full range with linear output
   3. Room Sensors: With locking cover matching room thermostats, span of 0 to 100 percent relative humidity
   4. Duct and Outside-Air Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity

E. ZONE SENSING (T, H, CO2)

General Specifications

1. Provide zone sensors as called for in the sequences of operations and shown on the plans.
2. One wall module in each zone shall take of all types of sensing called for in the sequences of operations for that zone. Separate wall devices in one zone for temperature, humidity and CO2 shall not be allowed.
3. Provide a plain cover, no display, no setpoint change unless called for in the sequences of operations.
4. Where called for in the sequences of operation or shown on the drawings, provide a display on the face of the thermostat cover. The display shall normally show the current sensor readings. If more than one sensor is used, then rotate the display between the readings.
   a. The display shall be an LED, OLED or backlit LCD.
   b. The display shall show the value, units and the occupied /unoccupied status

5. Where called for in the sequences of operations, provide setpoint adjustment. If not called for in the sequence, then provide a plain cover or lock out the adjustment through settings.
6. Where called for in the sequences of operation, provide an occupancy override button to allow the user to switch the zone from unoccupied to occupied.
7. Provide power for the sensor. If a special power module is required, then provide one for each sensor.
8. Provide cables to run from the wall sensor to the zone controller
   a. Wall sensors shall have a communication plug to allow an operator to plug in a portable interface and communicate with the zone controller to adjust setpoints and settings.
9. Installation:
   a. All wall modules shall be mounted on an electrical wall box with wire connection in the box.
   b. Mount wall modules according to the architectural and engineering plans.
   c. If mounting locations are not given on the plans, then mount according to the following:
      1) Sensors with plain covers, no display or adjustments: 60”AFF
      2) Sensors with display and/or adjustments: 48” AFF
      3) Insulate between the sensing elements and the interior of the wall or junction box.
      4) Do not mount where sun can shine on the sensor through a window.
      5) Do not mount where airflow can be stagnant because of furniture or other obstructions.
      6) Do not mount above or near heat sources, such as appliances, PCs, AV equipment, copiers or baseboard heat.

F. Sensing Specifications
1. Temperature specifications
   a. Element: 10k ohm type 2 thermister, or Nickel RTD or Platinum RTD with transmitter
   b. Signal: 10k ohm or 1000ohm RTD or 4-20mA or digital
   c. Element Accuracy: + /- 0.2°F
   d. Operating Range: 55 to 95°F
   e. Set Point Adjustment Range: 55 to 95°F
   f. Calibration Adjustments: None required
2. Humidity specifications
   a. Element: Bulk polymer sensor element
   b. Accuracy: 2 percent over 0-90% range with linear output
   c. Range: 0-95%
   d. Ambient operating ranges: 0 to 100 Deg. F. and 10 to 95% RH noncondensing.
   e. Signal: 0-10Vdc, 4-20mA or digital
3. CO2 Sensing specifications:
   a. Range: 0-2000ppm
   b. Signal: 4-20mA or digital
   c. Sensing element type: NDIR
   d. Response: < 3 min full scale
   e. CO2 Accuracy: Maximum +/- 50ppm + 2% of reading
   f. CO2 drift: Maximum +/- 5% of range over 5 years
   g. Calibration: Automatic comparison of dual elements
   h. Calibration adjustment: Adjustable bias set at the module
   i. Power: 24Vac or 24Vdc

G. Air Static Pressure Transmitter shall meet the following specifications:

1. Non-directional sensor with suitable range for expected input, and temperature compensated.
2. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
3. Output: 4 to 20 mA.
4. Building Static-Pressure Range: 0 to 0.25 inches wg.
5. Duct Static-Pressure Range: 0 to 5 inches wg.

H. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; proportional output 4 to 20 mA.

I. Equipment operation sensors as follows:

1. Status Inputs for Fans: Differential-pressure switch with adjustable range of 0 to 5 inches wg.
2. Status Inputs for Pumps: Differential-pressure switch piped across pump with adjustable pressure-differential range of 8 to 60 psig.
3. Status Inputs for direct drive electric motors: Current-sensing relay with current transformers, adjustable and sized for 175 percent of rated motor current.
4. Status inputs for belt drive electric motors: Current sensing transmitter with linear 4-20mA output

J. Electronic Valve/Damper Position indication: Visual scale indicating percent of travel and 0 to 10 V dc, feedback signal.

K. Water-Flow Switches: Pressure-flow switches of bellows-actuated mercury or snap-acting type, with appropriate scale range and differential adjustment, with stainless-steel or bronze paddle. For chilled-water applications, provide vapor proof type.

L. Air Differential Pressure Switches: Diaphragm type air differential pressure switches with die cast aluminum housing, adjustable setpoint, minimum 5 amp switch rating at 120VAC, SPDT switches, and the switch pressure range shall be suited for the application. Provide Dwyer or equal. These switches shall be utilized for filter status.

M. Leak detectors: Provide spot leak detectors that can be secured to the floor or secured to a drain pan. The detection shall used a microchip controlled energized probes. The detector shall operate on 24Vor less. Provide a way to adjust the height of the leak probes. The SPDT contacts shall be inside a watertight enclosure.

2.11 SMOKE DETECTORS

A. Smoke detector for each unit above 2000 cfm to be provided by fire alarm system on site. Coordinate as require for any interfacing to the BMS on control of AHU, etc. The mechanical contractor shall install the smoke detector(s). Wire it to stop the fan upon sensing smoke.

2.12 AUTOMATIC CONTROL VALVES

A. General:
1. All automatic control valves shall be fully proportioning, unless specified otherwise. The valves shall be quiet in operation and fail-safe in either normally open or normally closed position in the event of control air failure. All valves shall be capable of operating at varying rates of speed to correspond to the exact dictates of the controllers and variable load requirements. The valves shall be capable of operating in sequence with other valves and/or dampers when required by the sequence of operation. All control valves

shall be sized by the control vendor and shall be guaranteed to accommodate the flow rates as scheduled. All control valves shall be suitable for the pressure conditions and shall close against the differential pressures involved. Body pressure rating and connection type construction shall conform to fitting and valve schedules. Control valve operators shall be sized to close against a differential pressure equal to the design pump heads plus 10 percent.

2. Cold water, hot water and steam valves, throttling type, and bypass valves shall have equal percentage flow characteristics.
3. Unless otherwise specified, control valves 2 inches and smaller shall have cast iron or bronze bodies with screwed NPT connections.
4. Valves between 2-1/2 inch and 4 inch shall have cast iron bodies with flanged connections.
5. All automatic control valves installed exposed to the elements shall be provided with electric actuators with operating characteristics and accessories as described in herein. Coordinate with electrical contractor for power availability and point of connection.
6. All automatic control valves controlled by the BAS shall be furnished by the controls contractor unless noted otherwise in these documents.
7. All automatic control valves shall be installed by the mechanical trade.
8. The controls contractor shall provide wiring as follows:
   a. All line voltage power for electric valve actuators shall be wired by the controls contractor from the nearest available power panel. Coordinate with electrical trade.
   b. All wiring between the central control system (ATC/BMS) and the valve actuator shall be wired by the controls contractor.
   c. All wiring between the valve actuator and their associated thermostats, pressure switches, control devices, etc. shall be wired by the controls contractor.
   d. All wiring shall comply with code requirements. Segregate high and low voltage wiring & circuits and segregate the FAS and controls (BMS) terminals.

B. Hot Water / Condenser Water / Control Valves
1. Single-seated.
2. Fully proportioning with modulating plug or V-port inner valves.
3. Body pressure rating and connection type construction shall conform to fitting and valve schedules. The ANSI rating of the valve shall match the ANSI rating of the piping in which the valve is installed. Minimum ANSI rating shall be ANSI 125.
4. Stainless steel stems and trim.
5. Spring loaded Teflon packing
6. Quiet in operation.
7. Fail-safe in either normally open or normally closed position in the event of power failure.
8. Capable of operating in sequence with other valves and/or dampers when required by the sequence of operation.
9. Capable of operating at varying rates of speed to correspond to the exact dictates of the controller and variable load requirements.

2.13 ELECTRONIC ACTUATOR SPECIFICATION

A. ELECTRONIC VALVE ACTUATORS
1. Actuator shall be fully modulating, floating (tri-state), two position, and/or spring return as indicated in the control sequences. Specified fail safe actuators shall require mechanical spring return.
2. Modulating valves shall be positive positioning, responding to a 2-10VDC or 4-20mA signal. There shall be a visual valve position indicator.
3. The actuator shall have the capability of adding auxiliary switches or feedback potentiometer if specified.

4. Actuator shall provide minimum torque required for proper valve close-off. The actuator shall be designed with a current limiting motor protection. A release button (clutch) or handle on the actuator shall be provided to allow for manual override (except when actuator is spring return type).
5. Actuators shall be UL listed.

B. ELECTRONIC DAMPER ACTUATORS
1. Actuator shall be direct coupled (over the shaft), enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The actuator-to-shaft clamp shall use a "V" bolt and "V" shaped, toothed cradle to attach to the damper shaft for maximum holding strength. Single bolt or set screw type fasteners are not acceptable.
2. Actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator. End switches to deactivate the actuator at the end of rotation or magnetic clutch are not acceptable.
3. For power-failure/safety applications, a mechanical, spring return mechanism shall be used.
4. Actuators with spring return mechanisms shall be capable of either clockwise or counterclockwise spring return operation by simply changing the mounting orientation.
5. Proportional actuators shall accept a 2-10VDC, 4-20mA signal, or be of the 2 point floating type and provide a 2-10VDC actuator position feedback signal.
6. All actuators shall have an external manual gear release (clutch) or manual crank to aid in installation and for allowing manual positioning when the actuator is not powered.
7. All actuators shall have an external direction of rotation switch to aid in installation and to allow proper control response.
8. Actuators shall be provided with a factory-mounted 3-foot electrical cable and conduit fitting to provide easy hook-up to an electrical junction box.
9. Actuators shall be listed under Underwriters Laboratories Standard 873 and Canadian Standards Association. They must be manufactured under ISO 9001.

PART 3 - EXECUTION

3.1 EXAMINATION

A. The project plans shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the architect/engineer for resolution before rough-in work is started.

B. The contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the engineer for resolution before rough-in work is started.

C. The contractor shall examine the drawings and specifications for other parts of the work. If head room or space conditions appear inadequate—or if any discrepancies occur between the plans and the contractor’s work and the plans and the work of others—the contractor shall report these discrepancies to the engineer and shall obtain written instructions for any changes necessary to accommodate the contractor’s work with the work of others.

3.2 INSTALLATION

A. Provide all relays, switches, sources of emergency and UPS battery back-up electricity and all other auxiliaries, accessories and connections necessary to make a complete operable system in accordance with the sequences specified. All field wiring shall be by this contractor.

B. Install controls so that adjustments and calibrations can be readily made. Controls are to be installed by the control equipment manufacturer.

C. Mount surface-mounted control devices on brackets to clear the final finished surface on insulation.

D. Install equipment level and plumb.

E. Install control valves horizontally with the power unit up.

F. Unless otherwise noted, install wall mounted thermostats and humidistat 60” above the floor measured to the center line of the instrument, or as otherwise directed by the Architect.

G. Install averaging elements in ducts and plenums in horizontal crossing or zigzag pattern.

H. Install outdoor sensors in perforated tube and sunshield.

I. Install damper motors on outside of duct in protected areas, not in locations exposed to outdoor temperatures.

J. Install labels and nameplates on each control panel listing the name of the panel referenced in the graphics and a list of equipment numbers served by that panel.

K. Furnish hydronic instrument wells, valves, and other accessories to the mechanical contractor for installation.

L. Furnish automatic dampers to mechanical contractor for installation.

3.3 ELECTRICAL WIRING SCOPE

A. This contractor shall be responsible for power that is not shown on the electrical drawings, to controls furnished by this contractor. If power circuits are shown on the electrical drawings, this contractor shall continue the power run to the control device. If power circuits are not shown, this contractor shall coordinate with the electrical contractor to provide breakers at distribution panels for power to controls. This contractor is then responsible for power from the distribution panel.
   1. Coordinate panel locations. If enclosures for panels are shown on the electrical drawings, furnish the enclosures according to the electrician’s installation schedule.

B. This contractor shall not be responsible for power to control panels and control devices that are furnished by others, unless it is part of the control interlock wiring.

C. Refer to Coordination section for what devices this contractor is responsible to mount and which are turned over to others to mount.

D. This contractor shall be responsible for wiring of any control device that is furnished as part of this section of specification.

E. Wiring for controls furnished by others:
   1. Provide control wiring for HVAC controls furnished by others. Wiring may include, but not limited to, interlocks, standalone thermostats, safeties and remote control devices such as valves, sensors, etc.

F. Interlock wiring shall be run in separate conduits from BAS associated wiring.

G. Provide network wiring for equipment that is called to be integrated to the BAS.

3.4 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. All low voltage control wiring shall be class 2. Control wiring that is not class 2 shall be run in separate conduits from class 2 wiring.

B. Floor level network wiring between terminal units can be combined with thermostat and other low voltage wiring in the same conduit. All other network wiring shall be in dedicated conduits.

C. Install raceways, boxes, and cabinets according to Division 26 Section "Raceways and Boxes."

D. Install building wire and cable according to Division 26 Section "Conductors and Cables."

E. Installation shall meet the following requirements:

1. Conceal cable and conduit, except in mechanical rooms and areas where other conduit and piping are exposed.
2. Install exposed cable in raceway or conduit.
3. Install concealed cable using plenum rated cable.
4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
7. All wiring in lab areas shall be in conduit.
8. All unsupported risers shall be rigid steel conduit. Supported risers shall be EMT.

F. Rigid conduit shall be steel, hot dip galvanized, threaded with couplings, ¾ inch minimum size, manufactured in accordance with ANSI C-80-1. Electrical metallic tubing (EMT) with compression fittings or intermediate metallic conduit (IMC) may be used as conduit or raceway where permitted by the NEC.

G. Concealed control conduit and wiring shall be provided in all spaces except in the Mechanical Equipment Rooms and in unfinished spaces. Install in parallel banks with all changes in directions made at 90 degree angles.

H. Install conduit adjacent to machine to allow service and maintenance.

I. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

J. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

K. Ground equipment.

3.5 COMMUNICATION WIRING

A. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer’s installation recommendations for all communication cabling.

B. Do not install communication wiring in raceway and enclosures containing Class 1 wiring.

C. Maximum pulling, tension, and bend radius for cable installation, as specified by the cable manufacturer, shall not be exceeded during installation.

D. Contractor shall verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.

E. Cable bundling:
1. RS485 cabling run open air in accessible areas can be bundled with other class 2 low voltage cabling.
2. RS485 cabling run between terminal units in conduits above ceilings or under floors or in inaccessible areas can be bundled with other class 2 low voltage cabling.
3. RS485 cabling run between floors shall be in a communication only conduit.
4. RS485 conduit run long distances between utility rooms or between buildings shall be in a communication only conduit.
5. Ethernet cabling shall be in a communication only conduit.
6. Ethernet and RS485 can be run together.
7. Fiber optics can be run with Ethernet and RS485 cabling as long as the conduit is bent to fiber optic standards and junction boxes are sized for fiber optic use.

F. FLN Cabling
1. FLN cabling shall be low capacitance, 20-24 gauge, twisted shielded pair.
2. The shields shall be tied together at each device.
3. The shield shall be grounded at one end only and capped at the other end.

G. Ethernet Cabling
1. Ethernet shall not be run with any Class 1 or low voltage Class 2 wiring.
2. CAT6, unshielded twisted pair (UTP) cable shall be used for BAS Ethernet.
3. Solid wire shall be used for long runs, between mechanical rooms and between floors. Stranded cable can be used for patch cables and between panels in the same mechanical room up to 50 feet away.
4. When the BAS Ethernet connects to an Owner’s network switch, document the port number on the BAS As-builts.

H. When a cable enters or exits a building, a lightning arrestor must be installed between the lines and ground. The lighting arrestor shall be installed according to the manufacturer’s instructions.

I. All runs of communication wiring shall be unspliced length when that length is commercially available.

J. All communication wiring shall be labeled to indicate origination and destination data.

K. Grounding of coaxial cable shall be in accordance with NEC regulations article on “Communications Circuits, Cable, and Protector Grounding.”

3.6 IDENTIFICATION

A. Match the existing wiring and conduit identification methods.

3.7 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment, and retest.
3. Calibration test controllers by disconnecting input sensors and stimulating operation with compatible signal generator.

B. Engage a factory-authorized service representative to perform startup service.

C. Replace damaged or malfunctioning controls and equipment.

1. Start, test, and adjust control systems.
2. Demonstrate compliance with requirements, including calibration and testing, and control sequences.
3. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.

3.8 SYSTEM CHECKOUT AND STARTUP

A. Inspect each termination in the MER control panels and devices to make sure all wires are connected according to the wiring diagrams and all termination are tight.

B. After the controls devices and panels are installed and power is available to the controls, perform a static checkout of all the points, including the following:
1. Inspect the setup and reading on each temperature sensor against a thermometer to verify its accuracy.
2. Inspect the setup and reading on each humidity sensor against a hygrometer to verify its accuracy.
3. Inspect the reading on each CO2 sensor using a calibration kit to verify the sensor range accuracy matches the DDC setup.
4. Inspect the reading of each status switch to verify the DDC reads the open and close correctly.
5. Command each relay to open and close to verify its operation.
6. Command each 2-position damper actuator to open and close to verify operation.
7. Command each 2-position valve to open and close to verify operation.
8. Ramp each modulating actuator to 0%, 25%, 50%, 75% and 100% to verify its operation.
9. Ramp each modulating output signal, such as a VFD speed, to verify its operation.
10. Test each safety device with a real life simulation, for instance check freezestats with ice water, water detectors with water, etc.

C. Document that each point was verified and operating correctly. Correct each failed point before proceeding to the dynamic startup.

D. Verify that each DDC controller communicates on its respective network correctly.

E. After all of the points are verified, and power is available to the mechanical system, coordinate a startup of each system with the mechanical contractor. Include the following tests:
1. Start systems from DDC.
2. Verify that each setpoint can be met by the system.
3. Change setpoints and verify system response.

4. Change sensor readings to verify system response.
5. Test safety shutdowns.
6. Verify time delays.
7. Verify mode changes.
8. Adjust filter switches and current switches for proper reactions.
9. Adjust proportional bands and integration times to stabilize control loops.

F. Perform all program changes and debugging of the system for a fully operational system.

G. Verify that all graphics at the operator workstations correspond to the systems as installed. Verify that the points on the screens appear and react properly. Verify that all adjustable setpoints and manual commands operate from the operator workstations.

H. After the sequence of operation is verified, setup the trends that are listed in the sequence of operations for logging and archiving for the commissioning procedure.

3.9 SYSTEM COMMISSIONING, DEMONSTRATION AND TURNOVER

A. The BAS Contractor shall prepare and submit for approval a complete acceptance test procedure including submittal data relevant to point index, functions, sequence, inter-locks, and associated parameters, and other pertinent information for the operating system. Prior to acceptance of the BAS by the Owner and Engineer, the BAS contractor shall completely test the BAS using the approved test procedure.

B. After the BAS contractor has completed the tests and certified the BAS is 100% complete, the Engineer shall be requested, in writing, to approve the satisfactory operation of the system, sub-systems and accessories. The BAS contractor shall submit Maintenance and Operating manuals at this time for approval. An acceptance test in the presence of the Engineer and Owner's representative shall be performed. The Owner will then shake down the system for a fixed period of time (30 days).

C. The BAS contractor shall fix punch list items within 30 days of acceptance.

D. When the system performance is deemed satisfactory in whole or in part by these observers, the system parts will be accepted for beneficial use and placed under warranty.

3.10 PROJECT RECORD DOCUMENTS

A. Project Record Documents: Submit three (3) copies of record (as-built) documents upon completion of installation. Submittal shall consist of:
1. Project Record Drawings. As-built versions of the submittal shop drawings provided as AutoCAD compatible files in electronic format and as 11 x 17 inch prints.
2. Testing and Commissioning Reports and Checklists. Completed versions of reports, checklists, and trend logs used to meet requirements in the Control System Demonstration and Acceptance section of this specification.
3. Operation and Maintenance (O & M) Manual.
    a. Operator’s Manual with procedures for operating control systems, logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing setpoints and variables.
    b. Documentation of all programs created using custom programming language, including setpoints, tuning parameters, and object database.
    c. Graphic files, programs, and database on electronic media.
    d. List of recommended spare parts with part numbers and suppliers.

e. Licenses, guarantees, and warranty documents for equipment and systems.

B. Provide updated versions of Operating manuals.

3.11 TRAINING

A. At a time mutually agreed upon, during System commissioning as stated above, the BAS contractor shall give 4-hours of onsite training on the operation of all BAS equipment. Describe its intended use with respect to the programmed functions specified. Operator orientation of the automation system shall include, but not be limited to:
1. Explanation of drawings and operator's maintenance manuals.
2. Walk-through of the job to locate all control components.
3. Operator workstation and peripherals.
4. DDC Controller and ASC operation/sequence.
5. Operator control functions including scheduling, alarming, and trending.
6. Explanation of adjustment, calibration and replacement procedures.

END OF 23 09 00

SECTION 23 20 06

HYDRONIC SPECIALTIES

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. Pipe and Pipe Fittings: Section 232113.

1.2 SUBMITTALS

A. Product Data: Catalog sheets, specifications, and installation instructions for each item specified.

PART 2 PRODUCTS

2.1 VALVES

A. Ball Valves: Comply with requirements specified in Section 230523 “General-duty valves for HVAC piping.”

2.2 A. Manual Air Vents:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AMTROL, Inc.
    b. Armstrong Pumps, Inc.
    c. Bell & Gossett; a Xylem brand.
    d. Taco, Inc.
2. Body: Bronze.
3. Internal Parts: Nonferrous.
4. Operator: Screwdriver or thumbscrew.
5. Inlet Connection: NPS 1/2.
6. Discharge Connection: NPS 1/8.
7. CWP Rating: 150 psig.
8. Maximum Operating Temperature: 225 deg F.

2.3 Y-Pattern Strainers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. NIBCO
    b. Watts
    c. Midland Industries
    d. Zurn

2. Body: ASTM A 126, Class B, Bronze with bolted cover and bottom drain connection

3. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger
4. Strainer Screen: Stainless-steel, 40-mesh strainer, or perforated stainless-steel basket.
5. CWP Rating: 125 psig.

PART 3 EXECUTION

3.1 VALVE APPLICATIONS

A. Install shut off-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.

3.2 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

END OF SECTION 23 20 06

SECTION 23 21 13

HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes pipe and fitting materials and joining methods for the following:

1. Hot-water heating piping.
2. Chilled-water piping.
3. Air-vent piping.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following:
1. Drawn temper copper tubing
2. Wrought copper pipes and fittings
3. Copper type ‘K’ pipes

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Other building services.
3. Structural members.

B. Welding certificates.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:

1. Hot-Water Heating Piping: 200 deg F
2. Chilled-Water Piping: 200 deg F
3. Air-Vent Piping: 200 deg F

2.2 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. Wrought-Copper Unions: ASME B16.22.

2.3 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

E. 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.

F. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.4 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. THE SPRUCE

b. WM.HENDERSON
c. NIBCO
d. JMF
e. MCMASTER-CARR
f. SWAGELOK

2. Description:

a. Standard: ASSE 1079.
b. Pressure Rating: 125 psig minimum at 180 deg F .
c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. THE SPRUCE
   b. WM.HENDERSON
   c. NIBCO
   d. JMF
   e. MCMASTER-CARR
   f. SWAGELOK
2. Description:

   a. Standard: ASSE 1079.
   b. Factory-fabricated, bolted, companion-flange assembly.
   c. Pressure Rating: 125 psig minimum at 180 deg F
   d. End Connections: Solder-joint copper alloy and threaded ferrous

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. THE SPRUCE
   b. WM.HENDERSON
   c. NIBCO
   d. JMF
   e. MCMASTER-CARR
   f. SWAGELOK
2. Description:

   a. Nonconducting materials for field assembly of companion flanges.
   b. Pressure Rating: 150 psig
   c. Gasket: Neoprene or phenolic.
   d. Bolt Sleeves: Phenolic or polyethylene.
   e. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. THE SPRUCE
   b. WM.HENDERSON
   c. NIBCO
   d. JMF
   e. MCMASTER-CARR
   f. SWAGELOK
2. Description:

   a. Standard: IAPMO PS 66.

b. Electroplated steel nipple, complying with ASTM F 1545.
c. Pressure Rating: 300 psig at 225 deg F
d. End Connections: Male threaded
e. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2 and smaller shall be any of the following:

1. Type L drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

B. Chilled-water piping, aboveground, NPS 2 and smaller, shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

C. Air-Vent Piping:

1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.
2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

3.2 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to Section 230523.12 "Ball Valves for HVAC Piping,"

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.

T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.3 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4 :Use dielectric flanges.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.4 HANGERS AND SUPPORTS

A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Spring hangers to support vertical runs.
3. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4 : Maximum span, 7 feet .
2. NPS 1 : Maximum span, 7 feet .
3. NPS 1-1/2 : Maximum span, 9 feet .
4. NPS 2 : Maximum span, 10 feet .
5. NPS 2-1/2 : Maximum span, 11 feet .
6. NPS 3 and Larger: Maximum span, 12 feet .

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4 : Maximum span, 5 feet ; minimum rod size, 1/4 inch .
2. NPS 1 : Maximum span, 6 feet ; minimum rod size, 1/4 inch .
3. NPS 1-1/4 :)Maximum span, 7 feet ; minimum rod size, 3/8 inch .
4. NPS 1-1/2 : Maximum span, 8 feet ; minimum rod size, 3/8 inch .
5. NPS 2 : Maximum span, 8 feet ; minimum rod size, 3/8 inch .
6. NPS 2-1/2 : Maximum span, 9 feet ; minimum rod size, 3/8 inch .
7. NPS 3 and Larger: Maximum span, 10 feet ; minimum rod size, 3/8 inch .

E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

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

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.

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

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

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

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.6 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

3.7 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
3. Set temperature controls so all coils are calling for full flow.
4. Verify lubrication of motors and bearings.

END OF SECTION 23 21 13

SECTION 23 31 13

METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Sheet metal materials.
3. Sealants and gaskets.
4. Hangers and supports.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible”: Guidelines for Mechanical Systems."

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. adhesives.
2. Sealants and gaskets.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, and vibration isolation.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.
    f. Perimeter moldings.

B. Welding certificates.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

E. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Traverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

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 Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

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. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. VOC: Maximum 395 g/L.
10. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
11. Maximum Static-Pressure Class: 10-inch wg , positive or negative.
12. Service: Indoor or outdoor.
13. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

D. 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.

2.5 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

D. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

G. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

H. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

I. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

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 round and flat-oval ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. 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.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 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."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Unconditioned Space, Exhaust Ducts: Seal Class A.
4. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class A.
5. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
6. Conditioned Space, Exhaust Ducts: Seal Class A.
7. Conditioned Space, Return-Air Ducts: Seal Class A.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

C. Hangers Exposed to View: Threaded rod and angle or channel supports.

D. 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 interval of 16 feet.

E. 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.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. All new ducts shall be tested in compliance with the SMACNA – HVAC AIR DUCT LEAKAGE TEST MANUAL for leakage class 4.

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. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
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, air wash systems, spray eliminators, 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. Outside air Duct, Dedicated exhaust, and ventilation components.

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, or duct accessories.
4. 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.
5. Provide drainage and cleanup for wash-down procedures.

6. 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.

3.9 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.10 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Supply Ducts:

1. Ducts Connected to Fan Coil Units

a. Pressure Class: Positive 2-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 4

C. Return Ducts:

1. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative 2-inch wg
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 4

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

a. Pressure Class: Negative 2-inch wg
b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
c. SMACNA Leakage Class for Rectangular: 4

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Fan Coil Units:

a. Pressure Class: Positive or negative 2-inch wg
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 4

F. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel coated with zinc chromate

2. Stainless-Steel Ducts:

a. Exposed to Airstream: Match duct material.
b. Not Exposed to Airstream: Galvanized

3. Aluminum Ducts: galvanized sheet steel coated with zinc chromate.

G. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

   a. Velocity 1000 fpm or Lower:

      1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
      2) Mitered Type RE 4 without vanes.

   b. Velocity 1000 to 1500 fpm:

      1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
      2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
      3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

   c. Velocity 1500 fpm or Higher:

      1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
      2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
      3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

   a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
   b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
   c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

   a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

      1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
      2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
      3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
      4) Radius-to Diameter Ratio: 1.5.

   b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
   c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

4. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

    a. Velocity 1000 fpm or Lower: 90-degree tap.
    b. Velocity 1000 to 1500 fpm: Conical tap.
    c. Velocity 1500 fpm or Higher: 45-degree lateral.

H. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

    a. Rectangular Main to Rectangular Branch: 45-degree entry.
    b. Rectangular Main to Round Branch: Spin in.

END OF SECTION 23 31 13

SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Manual volume dampers.
2. Control dampers.
3. Fire dampers.
4. Flange connectors.
5. Duct silencers.
6. Flexible connectors.
7. Flexible ducts.
8. Duct accessory hardware.
9. Turning vanes

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.
b. Manual volume damper installations.
c. Control-damper installations.
d. Fire-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
e. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

B. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Comply with manufacturer’s installation recommendations.

B. 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.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Exposed-Surface Finish: Mill phosphatized.

B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and finish for exposed ducts.

C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. 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.

G. Description: Gravity balanced.

H. Maximum Air Velocity: 1250 fpm

I. Maximum System Pressure: 2-inch wg

J. Frame: Hat-shaped, 0.05-inch- thick, galvanized sheet steel, with welded corners or mechanically attached mounting flange.

K. Blades: Multiple single-piece blades, center pivoted, maximum 6-inch width, 0.025-inch- thick, roll-formed aluminum with sealed edges.

L. Blade Action: Opposed.

M. Blade Seals: Neoprene, mechanically locked.

N. Blade Axles:

1. Material: Nonferrous metal
2. Diameter: 0.20 inch

O. Tie Bars and Brackets: Aluminum.

P. Return Spring: Adjustable tension.

Q. Bearings: Steel ball.

R. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators.
4. Chain pulls.
5. Screen Mounting: Front mounted in sleeve.
    a. Sleeve Thickness: 20 gage minimum.
    b. Sleeve Length: 6 inches minimum.
6. Screen Mounting: Rear mounted.
7. Screen Material: Galvanized steel
8. Screen Type: Bird.
9. 90-degree stops.

2.3 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. GREENHECK
    b. AWV
    c. Tuttle and Bailey
2. Standard leakage rating with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
    a. Frame: Hat-shaped, 0.094-inch- thick, galvanized sheet steel.
    b. Mitered and welded corners.
    c. Flanges for attaching to walls and flangeless frames for installing in ducts.
4. Blades:

a. Multiple or single blade.
b. Parallel- or opposed-blade design.
c. Stiffen damper blades for stability.
d. Galvanized-steel, 0.064 inch thick.

5. Blade Axles: Nonferrous metal.
6. Bearings:

a. Oil-impregnated bronze.
b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

7. Tie Bars and Brackets: Galvanized steel.

B. Jackshaft:

1. Size: 0.5-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

C. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.4 CONTROL DAMPERS

A. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

B. Frames:

1. Hat shaped.
2. 0.094-inch- thick, galvanized sheet steel.
3. Mitered and welded corners.

C. Blades:

1. Multiple blades with maximum blade width of 6 inches.
2. Parallel or opposed.
3. Galvanized-steel.
4. 0.064 inch thick single skin.
5. Blade Edging: Closed-cell neoprene.
6. Blade Edging: replaceable rubber seals.

D. Blade Axles: 1/2-inch- diameter; nonferrous metal; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F.

E. Bearings:

1. Oil-impregnated bronze.
2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
3. Thrust bearings at each end of every blade.

2.5 FIRE DAMPERS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. GREENHECK
   b. BAKER
   c. AIRE TECHNOLOGIES

B. Type: Static; rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.

D. Fire Rating: 1-1/2 hours.

E. Frame: Curtain type with blades inside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.39 inch thick, as indicated, and of length to suit application.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.

I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

K. Heat-Responsive Device: Electric, replaceable fusible link and switch package, factory installed, 165 deg F rated.

L. General Requirements: Label according to UL 555 by an NRTL.

M. Frame: Hat-shaped, 0.094-inch- thick, galvanized sheet steel, with interlocking, gusseted corners and mounting flange.

N. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- thick, galvanized sheet steel.

O. Leakage: Class I

P. Rated pressure and velocity to exceed design airflow conditions.

Q. Mounting Sleeve: Factory-installed, 0.039-inch- thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.

2.6 FLANGE CONNECTORS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. GREENHECK
   b. ROYAL METAL DUCT
   c. BAKER

B. Description: Roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.7 DUCT SILENCERS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Vibro Acoustic
   b. Dynasonics.
   c. Ruskin

B. General Requirements:

1. Factory fabricated.
2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Shape:

1. Rectangular straight with splitters or baffles.
2. Round straight with center bodies or pods.
3. Rectangular elbow with splitters or baffles.
4. Round elbow with center bodies or pods.
5. Rectangular transitional with splitters or baffles.

D. Rectangular Silencer Outer Casing: ASTM A 653/A 653M, G90, galvanized sheet steel, 0.034 inch thick.

E. Round Silencer Outer Casing: ASTM A 653/A 653M, G90, galvanized sheet steel.

1. Sheet Metal Thickness for Units up to 24 Inches in Diameter: 0.034 inch thick.
2. Sheet Metal Thickness for Units 26 through 40 Inches in Diameter: 0.040 inch thick.
3. Sheet Metal Thickness for Units 42 through 52 Inches in Diameter: 0.05 inch thick.
4. Sheet Metal Thickness for Units 54 through 60 Inches in Diameter: 0.064 inch thick.

F. Inner Casing and Baffles: ASTM A 653/A 653M, G90 galvanized sheet metal, 0.034 inch thick, and with 1/8-inch- diameter perforations.

G. Special Construction:
1. High transmission loss to achieve STC 45.

H. Connection Sizes: Match connecting ductwork unless otherwise indicated.

I. Principal Sound-Absorbing Mechanism:

1. Controlled impedance membranes and broadly tuned resonators without absorptive media.
2. Film-lined type with fill material.

a. Fill Material: Moisture-proof nonfibrous material.
b. Erosion Barrier: Polymer bag enclosing fill, and heat sealed before assembly.

3. Lining: Mylar

J. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.

1. Joints: Lock formed and sealed or flanged connections.
2. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
3. Reinforcement: Cross or trapeze angles for rigid suspension.

K. Accessories:
1. Factory-installed end caps to prevent contamination during shipping.

L. Source Quality Control: Test according to ASTM E 477.
1. Record acoustic ratings, including dynamic insertion loss and generated-noise power levels with an airflow of at least 2000-fpm face velocity.
2. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg static pressure, whichever is greater.

M. Capacities and Characteristics:

1. Refer to schedules on drawings.

2.8 FLEXIBLE CONNECTORS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. SOUTHERN PIPE & SUPPLY
b. AIR SPACE
c. GREENHECK
d. AWV
e. ROYAL METAL DUCT
f. BAKER

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd. .
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F .

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd. .
2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F .

4. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
5. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
6. Minimum Additional Travel: 50 percent of the required deflection at rated load.
7. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
8. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
9. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
10. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.9 FLEXIBLE DUCTS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. DUCT SHOP
   b. GREENHECK
   c. H & C Flex

B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 10 to plus 160 deg F.
4. Insulation R-value: Comply with ASHRAE 90.1

C. Flexible Duct Connectors:
1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches.

2.10 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.11 CONTROL DAMPERS

Manufacturers: RUSKIN
GREENHECK
HONEYWELL

A. Low-leakage rating**,** with linkage outside airstream**,** and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

B. Frames:

1. Hat shaped.
2. 0.094-inch- thick, galvanized sheet steel.
3. Interlocking, gusseted corners.

C. Blades:

1. Multiple blades with maximum blade width of 8 inches.
2. Opposed-blade design.
3. Galvanized-steel.
4. 0.0747-inch- thick dual skin.
5. Blade Edging: Closed-cell neoprene.
6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

D. Blade Axles: 1/2-inch- diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F.

E. Bearings:

1. Oil-impregnated bronze.
2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
3. Thrust bearings at each end of every blade.

2.12 TURNING VANES

1. Turning vanes shall be an engineered, true airfoil design with smoothly-rounded entry nose and extended trailing edge for high efficiency performance.

2. Generated sound power level shall not exceed 54 decibels in band 4 at 2,000 FPM-duct 24 x 24.

3. Acceptable Manufactures: Aero-Dyne Sound Control Company, High Efficiency Profile, H-E-P.

4. Fabricate assemblies with the Aero-Dyne Side Rail support system. Install vanes on design centers of 2.4 inches across the full diagonal dimension of the elbow. Tabbed or slotted dimple fasteners are not acceptable.

5. Submittals are required; proposed substitution shall include independent performance test data for pressure loss and generated sound power levels.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire dampers according to UL listing.

H. Connect ducts to duct silencers.

I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Upstream and downstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. Control devices requiring inspection.
8. Elsewhere as indicated.

J. Install access doors with swing against duct static pressure.

K. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

L. Install flexible connectors to connect ducts to equipment.

M. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

N. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

O. Connect diffusers or light troffer boots to ducts directly or with maximum 36-inch lengths of flexible duct clamped or strapped in place.

P. Connect flexible ducts to metal ducts with draw bands.

Q. Install duct test holes where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.

END OF SECTION 23 33 00

SECTION 23 37 13.13

AIR DIFFUSERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   A. Rectangular and square ceiling diffusers.
   B. Linear slot diffusers.

B. Related Requirements:

   A. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.
   B. Section 233713.23 "Air Registers and Grilles" for adjustable-bar register and grilles, fixed-face registers and grilles, and linear bar grilles.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

   A. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
   B. Diffuser Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples: For each exposed product and for each color and texture specified. Actual size of smallest diffuser indicated.

C. Samples for Initial Selection: For diffusers with factory-applied color finishes. Actual size of smallest diffuser indicated.

D. Samples for Verification: For diffusers, in manufacturer's standard sizes to verify color selected. Actual size of smallest diffuser indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

   A. Ceiling suspension assembly members.
   B. Method of attaching hangers to building structure.

C. Size and location of initial access modules for acoustical tile.
D. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
E. Duct access panels.

B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 RECTANGULAR AND SQUARE CEILING DIFFUSERS

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

a) TITUS

b) GREENHECK

c) TUTTLE AND BAILEY

B. Devices shall be specifically designed for variable-air-volume flows.

C. Material: Aluminum.

D. Finish: Baked enamel, white.

E. Face Size: 24 by 24 inches.

F. Face Style: Three cone.

G. Mounting: T-bar.

H. Pattern: Fixed.

I. Dampers: Radial opposed blade.

2.2 LINEAR SLOT DIFFUSERS

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

a) TITUS

b) GREENHECK

c) TUTTLE AND BAILEY

B. Devices shall be specifically designed for variable-air-volume flows.

C. Material - Shell: Aluminum, no insulated.

D. Material - Pattern Controller and Tees: Aluminum.

E. Finish - Face and Shell: Baked enamel, Coordinate color with Architects during construction.

F. Finish - Pattern Controller: Baked enamel, Coordinate color with Architects during construction.

G. Finish - Tees: Baked enamel, color selected by Architect.

H. Slot Width: Refer to Diffusers and Grilles schedule on drawings.

I. Number of Slots: One.

J. Length: 48 inches.

K. Accessories: T-bar slot.

2.3 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

END OF SECTION 23 37 13.13

SECTION 23 72 00

AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Packaged energy recovery units.

1.3 PERFORMANCE REQUIREMENTS (not used).

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: For air-to-air energy recovery equipment. Include plans, elevations, sections, details, and attachments to other work.

   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, elevations, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

   1. Suspended ceiling components.
   2. Structural members to which equipment or suspension systems will be attached.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-to-air energy recovery equipment to include in maintenance manuals.

1.7 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. Filters: One set(s) of each type of filter specified.

1.8 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ARI Compliance:

1. Capacity ratings for air-to-air energy recovery equipment shall comply with ARI 1060, "Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment."

C. ASHRAE Compliance:

1. Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
2. Capacity ratings for air-to-air energy recovery equipment shall comply with ASHRAE 84, "Method of Testing Air-to-Air Heat Exchangers."

D. UL Compliance:

1. Packaged heat recovery ventilators shall comply with requirements in UL 1812, "Ducted Heat Recovery Ventilators"; or UL 1815, "Nonducted Heat Recovery Ventilators."

1.9 COORDINATION

A. Coordinate layout and installation of air-to-air energy recovery equipment and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 PACKAGED ENERGY RECOVERY UNITS

A. Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

B. Housing: Manufacturer's standard construction with corrosion-protection coating and exterior finish, gasketed and calked weathertight, hinged access doors with neoprene gaskets for inspection and access to internal parts, minimum 1-inch- thick thermal insulation, knockouts for electrical and piping connections, and lifting lugs.

C. Heat Recovery Device: Enthalpy Wheel

D. Supply and Exhaust Fans: Forward-curved, centrifugal flexible duct connections.

1. Motor and Drive: Belt driven with adjustable sheaves; motor mounted on adjustable base.
2. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
3. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
4. Spring isolators on each fan having 1-inch static deflection.

E. Disposable Panel Filters:
   1. The outdoor and exhaust air filters shall be 1-inch deep, 30% efficient disposable filters. Filter rack shall be internal to the unit and factory installed.

F. Accessories:
   1. Low-Leakage, Isolation Dampers: Double-skin, airfoil-blade, galvanized-steel dampers with compressible jamb seals and extruded-vinyl blade edge seals, in opposed-blade arrangement with cadmium-plated steel operating rods rotating in sintered bronze bearings mounted in a single galvanized-steel frame, with operating rods connected with a common linkage, and electric damper operator factory wired. Leakage rate shall not exceed 5 cfm/sq. ft. at 1-inch w and 9 cfm/sq. ft. at 4-inch wg.
   2. Duct flanges.
   3. Rubber-in-shear isolators for ceiling-mounted units.
   4. Hinged access doors with quarter-turn latches.

2.2 CAPACITIES AND CHARACTERISTICS

Refer to mechanical equipment schedules for capacities and characteristics

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine casing insulation materials and filter media before air-to-air energy recovery equipment installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for electrical services to verify actual locations of connections before installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install heat wheels so supply and exhaust airstreams flow in opposite directions and rotation is away from exhaust side to purge section to supply side.

B. Install floor-mounted units on 4-inch- (100-mm-) high concrete base designed to withstand, without damage to equipment, seismic force required by code.

C. Suspended Units: Suspend and brace units from structural-steel support frame using threaded steel rods and spring hangers. Comply with requirements for vibration isolation devices specified in Section 230550 "Vibration Isolation."

D. Install units with clearances for service and maintenance.

E. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

3.3 CONNECTIONS

A. Comply with requirements for ductwork specified in Section 233113 "Metal Ducts."

B. Install electrical devices furnished with units but not factory mounted.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Adjust seals and purge.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
4. Set initial temperature and humidity set points.
5. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

D. Air-to-air energy recovery equipment will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain air-to-air energy recovery units.

END OF SECTION 23 72 00

SECTION 23 82 19

FAN COIL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Ducted fan coil units and accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

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

B. Shop Drawings:

   1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

   1. Suspended ceiling components.
   2. Structural members to which fan coil units will be attached.
   3. Method of attaching hangers to building structure.
   4. Size and location of initial access modules for acoustical tile.
   5. Items penetrating finished ceiling, including the following:

      a. Lighting fixtures.
      b. Air outlets and inlets.
      c. Speakers.
      d. Sprinklers.
      e. Access panels.

   6. Perimeter moldings.

B. Field quality-control reports.

C. Sample Warranty: Refer to Div-1 Specifications regarding Warranties and Guaranties.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fan coil units to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Maintenance schedules and repair part lists for motors, coils, integral controls, and filters.

1.6 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. Fan Coil Unit Filters: Furnish spare filters for each filter installed.

1.7 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.8 COORDINATION

A. Coordinate layout and installation of fan coil units and suspension system components with other construction that penetrates or is supported by ceilings, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Factory-packaged and -tested units rated according to AHRI 440, ASHRAE 33, and UL 1995.

2.2 DUCTED FAN COIL UNITS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. TRANE
    b. CARRIER
    c. DAIKIN
    d. YORK

B. Fan Coil Unit Configurations: Row split.

1. Four (4) pipe system with One (1) Cooling Coil and One (1) Heating coil.

C. Coil Section Insulation: 1/2-inch minimum thick, foil-faced glass fiber complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.

1. Surface-Burning Characteristics: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84 by a qualified testing agency.
2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Main and Auxiliary Drain Pans: Stainless steel. Fabricate pans and drain connections to comply with ASHRAE 62.1.

E. Chassis: Galvanized steel where exposed to moisture, with powder-coat finish and removable access panel. Floor-mounting units shall have levelled screws.

F. Cabinets: Steel with baked-enamel finish in manufacturer's standard paint color.
1. Return-Air Plenum: Sheet metal plenum finished to match the chassis.
2. Dampers: Galvanized steel with extruded-vinyl blade seals, flexible-metal jamb seals, and interlocking linkage.

G. Filters: Minimum arrestance and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2 and all addendums.

H. MERV Rating: 8 when tested according to ASHRAE 52.2.
1. Pleated Cotton-Polyester Media: More than 90 percent arrestance and MERV 8.

I. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain.

J. Direct-Driven Fans: Double width, forward curved, centrifugal; with permanently lubricated, multispeed motor resiliently mounted in the fan inlet. Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.

1. Motors: Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

K. Factory, Hydronic Piping Package: ASTM B 88, Type L copper tube with wrought-copper fittings and brazed joints. Label piping to indicate service, inlet, and outlet.

1. Two-Piece Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.

2. Calibrated-Orifice Balancing Valves: Bronze body, ball type; 125-psig working pressure, 250 deg F maximum operating temperature; with calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, threaded ends, and a memory stop to retain set position.
3. Y-Pattern Hydronic Strainers: Cast-iron body (ASTM A 126, Class B); 125-psig working pressure; with threaded connections, bolted cover, perforated stainless-steel basket, and bottom drain connection. Include minimum NPS 1/2 hose-end, full-port, ball-type blowdown valve in drain connection.
4. Wrought-Copper Unions: ASME B16.22.

L. Control devices and operational sequence are specified in Section 230900 "Building Automation System."

M. Basic Unit Controls:

1. Control voltage transformer.

2. Temperature sensor tied back with BMS controls
3. Unoccupied-period-override push button.
4. Data entry and access port.

a. Input data includes room temperature, and humidity set points and occupied and unoccupied periods.
b. Output data includes room temperature and humidity, supply-air temperature, entering-water temperature, operating mode, and status.

N. DDC Terminal Controller by Siemens

O. Electrical Connection: Factory wire motors and controls for a single electrical connection.

P. Capacities and Characteristics: Refer to mechanical equipment schedules on drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, to receive fan coil units for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping and electrical connections to verify actual locations before fan coil unit installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fan coil units’ level and plumb.

B. Install fan coil units to comply with NFPA 90A.

C. Suspend fan coil units from structure with elastomeric hangers. Vibration isolators are specified in Section 230548.13 "Vibration Controls for HVAC Piping and Equipment."

D. Verify locations of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above finished floor.

E. Install new filters in each fan coil unit within two weeks after turn over to owner.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

1. Install piping adjacent to machine to allow service and maintenance.
2. Connect piping to fan coil unit factory hydronic piping package. Install piping package if shipped loose.
3. Connect condensate drain to indirect waste.

    a. Install condensate trap of adequate depth to seal against fan pressure. Install cleanouts in piping at changes of direction.

B. Connect supply-air and return-air ducts to fan coil units with flexible duct connectors specified in Section 233300 "Air Duct Accessories." Comply with safety requirements in UL 1995 for duct connections.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain fan coil units.

END OF SECTION 23 82 19

SECTION 260511

GENERAL PROVISIONS FOR ELECTRICAL WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including Specification Sections, apply to this section.

1.2 REFERENCE STANDARDS

A. Compliance with the following standards (latest edition) shall be required:

1. NEMA National Electrical Manufacturers Association.
2. NFPA National Fire Protection Association.
3. ANSI American National Standards Institute.
4. NEC National Electrical Code, NFPA 70.
5. UL Underwriters Laboratories.

1.3 DESCRIPTION OF WORK

A. Drawings are diagrammatic and are a graphic representation of contract requirements to the best available standards at the scale required. Sizes and locations of equipment are shown to scale where possible, but may be distorted for clarity on the Drawings. Final locations of outlets and equipment shall be as shown in enlarged details and as approved by the Architect or his representative.

B. Single line diagrams, riser diagrams, and schematic diagrams generally indicate equipment connections to be used for various systems. System conduit and wiring shall be as required for actual systems installed on this project. Provide all work shown on diagrams whether or not it is duplicated on the plans.

C. Where the word "provide" is used, the meaning shall be that the item or product shall be furnished, delivered, and installed/erected/ applied/connected for its intended use and as required for the completed Work. Furnish means to supply and deliver to project site, ready for installation. Install means to place in position for service or use.

1.4 SCOPE OF WORK

A. The Specifications and the accompanying Drawings are intended to secure the provision of all material, labor, equipment, and services necessary to install complete, test, and make ready for operation the electrical systems in accordance with the specifications and drawings. All systems shall be complete with necessary auxiliaries, including pull boxes, offsets to clear interferences, and supports, which are not shown but are needed to make each system complete. All work described in the specifications and not shown on the Drawings, or vice versa, shall be furnished in complete working order, including items not mentioned but necessary for completion of the system. Contractor shall provide the most comprehensive and costly alternative, should there be a conflict in the drawings and/or specifications.

B. The work includes but is not limited to the following:
   1. Raceways and installation components.
   2. Wires and Cable.
   3. Panelboards, circuit breakers.
   4. Safety and disconnect switches.
   5. Control equipment.
   6. Control wiring system.
   7. Grounding.
   8. Telecommunications (voice and data) wiring and conduit systems.
   9. Fire Alarm system.
   10. Testing. (100%)
   11. Furnishing and setting of all sleeves through the walls where required, including fireproof sealing.
   12. Cutting, drilling and boring associated with electrical work, repair, patch and paint.
   13. Prime painting, where required for electrical equipment and installation.
   14. Restoration of electrical service in affected adjoining areas which are to continue to function.
   15. Provisions for temporary light and power for all power connections.
   16. Final connections of all equipment.

C. Related Work:

1. Section 017419 – Construction and Demolition Waste Management Disposal.

1.5 QUALITY ASSURANCE

A. The complete installation shall be in accordance with the applicable requirements and standards of National Electrical Manufacturers Association (NEMA), National Fire Protection Association (NFPA), local inspection agency, along with state and local municipal codes and all applicable codes and authorities having jurisdiction. All work necessary to comply with these requirements shall be performed by the Contractor at no extra cost to the Owner.

B. All electrical equipment, materials, and appliances shall have the listing of Underwriter's Laboratories, Inc., and shall bear labels attesting to UL listing.

1.6 SUBMITTALS

A. The Contractor shall submit shop drawings with such promptness as to cause no delay in his own work or that of another contractor.

B. Submit shop drawings complete in every detail for items as described in subsequent sections of this specification.

C. The comments "Approved" or "approved as Noted" rendered on shop drawings shall not be considered as a guarantee of measurements or building conditions. Where drawings are reviewed, said review does not in any way relieve responsibility, or necessity, of furnishing material or performing work as required by the Contract Drawings and Specifications.

D. "Approved as Noted" means, unless otherwise noted on the drawings to approved for construction, fabrication and/or manufacture subject the provision that the work shall be carried out in compliance with all annotations and/or corrections indicated on the shop drawings and in accordance with the requirements of the Contract Documents. Resubmission is required only if the Contractor is unable to comply with noted corrections. Resubmission must clearly indicate items varying from the noted corrections and other changes made from the previous submission. If also marked "RESUBMIT", "Approved as Noted" is invalid and a corrected submittal of the drawing is required.

1.7 COORDINATION OF WORK WITH OTHER TRADES

A. The work of this Section shall be coordinated with the work of all other Contracts and shall be so arranged that there will be no delay in the proper installation and completion of all work.

B. Scaled and figured dimensions with respect to the items are approximate only; sizes of equipment have been taken from typical equipment items of the class indicated. Before proceeding with work, the Contractor shall carefully check all dimensions and sizes and shall assume full responsibility for the fitting-in of equipment and materials to the building and to meet architectural and structural conditions.

C. Coordinate work with other disciplines. Confer with other contractors whose work might affect this installation; and arrange all parts of this work and equipment in proper relation to the work and equipment of others, with the building construction and with architectural finish so that this work will harmonize in service, appearance, and function.

D. Examine all work prepared by others to receive the work of this Section and report any defects affecting installation to the General Contractor for correction. Commencement of work will be constructed as complete acceptance of preparatory work by others.

E. Exposed piping shall be installed to provide the maximum amount of headroom but in no case shall piping be installed less than seven feet six inches clear (7'-6") above the finished floor. Piping installed in areas where hung ceilings or other furred spaces are indicated shall be installed concealed.

F. Verify locations of all electrical equipment with the Drawings and interior details and finishes. In centering outlets and locating boxes and outlets, allow for overhead pipes, ducts, trim, paneling, hung ceilings and the like and correct any inaccuracy resulting from failure to do so without expense to Owner.

G. The Contractor shall coordinate all ceiling work with the General Contractor and shall determine ceiling type prior to the purchasing and installation of speakers, smoke detectors, exit lights or any other ceiling mounted electrical elements. Electrical work shall also be coordinated with location of diffusers, sprinklers and other mechanical work.

H. Coordination Drawings: The contractor shall develop the coordination drawings. The specified order in which the trade contractors impose their work on the coordination drawings is not intended to grant priority to any one trade contractor in the allocation of space. At the completion of this phase, hold a coordination meeting to eliminate any interference among the trades that the drawings indicate and to avoid any conflicts in installing the Work.

1. 9 INSPECTION AND TESTS

A. At the time of the final inspection and tests, all connections at the panels and all splices, etc., must have been completed. All fuses must be in place and the circuits continuous from service switches to all receptacles, outlets, motors, etc. Each entire wiring system must test free from short circuits and grounds. When wiring systems are "Megger" tested, the insulation resistance between conductors and between conductors and grounds, based on maximum load, shall not be less than that required by the NETA-ATS and local authorities having jurisdiction. A written record (five copies) of all test data shall be supplied to the Architect. Perform all tests as stated in the NETA-ATS. The tests shall cover but not be limited to the following:

1. Power distribution system.
2. Fire alarm and smoke detection systems.
3. All low voltage and communications systems.

B. Provide all necessary testing equipment, instruments, and skilled personnel for the tests. If in the opinion of the Architect, the results of such tests show that the work has not complied with the requirements of the specifications or drawings, the Contractor shall make all additions or changes necessary to put the system in proper working condition and shall pay for all expenses and for all subsequent tests which are necessary to determine whether the work is satisfactory. Any additional work or subsequent tests shall be carried out at the convenience of the Owner prior to final payment.

1.10 PERMITS, CERTIFICATES AND FEES

A. Obtain and deliver a final Certificate of Approval from the applicable inspection authority having jurisdiction. Make delivery to the Architect for transmittal to the Owner upon completion of the work and before final payment. Pay all charges made by the inspection authority and include their cost in the bid.

B. This work shall include the procurement of and payment for all permits, certificates and fees for the performance of the electrical work in compliance with codes, applicable laws and municipal regulations including those from local utilities for services.

1.11 PROTECTION, MAINTENANCE AND PRODUCT HANDLING OF ELECTRICAL EQUIPMENT

A. Electrical equipment shall be delivered and stored at the site, properly packed and crated until finally installed. Store materials in spaces as designated. Investigate each space through which equipment must be moved. If necessary, equipment shall be shipped from manufacturer in crated sections of size suitable for moving through restricted spaces.

B. Provide effective protection against damage for all material and equipment during shipment and storage at the project site. Cover all stored equipment to exclude dust and moisture. Place stored conduit on dunnage with caps on exposed ends.

C. Uninstalled equipment and materials shall be adequately protected against loss or theft; damage caused by water, paint, fire, plaster, moisture, acids, fumes, dust or other environmental conditions; or physical damage; during delivery, storage, installation and shutdown conditions. The Contractor shall replace any damaged or stolen material without extra cost to the Owner.

D. Provide effective protection for all material and equipment against damage that may be caused by environmental conditions. Do no work when conditions or temperature in area or moisture on materials or substrates are not in accordance with material manufacturer's recommend conditions for installation.

E. This Contractor shall be responsible for the maintenance of all installed equipment and systems until final acceptance by the Architect and the Owner. The operation of the equipment by the Owner does not constitute an acceptance of the work. Work will be accepted only after the Contractor has adjusted his equipment, demonstrated that it fulfills the requirements of the drawings and specifications, and has furnished all required certificates.

F. This Contractor shall guarantee in writing to the Owner that all work installed by him shall be free of defects in workmanship and materials and that all apparatus will develop the capacities and characteristics as indicated, and that, if during a period of one year from date of final approval of work by the Architect, any defects in workmanship, materials or performance appear, he will remedy them without any cost to the Owner. Guarantee requirements shall consist of the afore-stated and other requirements, as established under applicable contract documents.

G. After cabinets and boxes are installed, cover openings to prevent entrance of water and foreign materials. Close conduit openings with temporary metal or plastic caps, including those terminated in cabinets.

H. Protect all rough and finished floors and other finished surfaces from damage, which may be caused by construction materials and methods with tarpaulins, chip pans and oil-proof floor covering. Protect finished surfaces from welding and cutting splatters with baffles and splatter blankets. Protect finished surfaces from paint droppings, adhesive and other marring agents with drop cloths. Protect other surfaces with appropriate protective measures.

I. Have materials delivered to site. Unload and store materials in designated location, and protect from damage. Deliver materials to their point of installation.

J. Deliver materials to project site in manufacturer's original unopened containers with manufacturer's name and product identification clearly marked thereon.

1.12 DELIVERY AND RECEIVING

A. Where items cannot be immediately placed in their final position, this Contractor shall store and protect all Owner-furnished items until the time of their final installation. He shall be responsible for the care and protection of the items until acceptance by the Owner.

1.13 ACCESSIBILITY AND MEASUREMENTS

A. All work shall be installed so as to be readily accessible for operation, maintenance and repair. Minor deviations from the plans may be made to accomplish this, subject to the approval of the Architect.

B. Before ordering any material or doing any work, the Contractor shall verify all measurements at the Building, and shall be responsible for the correctness of same as related to the work under this Contract.

1.14 TEMPORARY LIGHT AND POWER

A. Contractor shall use the existing switchboard and provide temporary breakers to obtain the the temporary lighting and power during construction.

B. The Contractor shall furnish, install and maintain the temporary lighting and power system for all trades. Provide temporary power as directed. The use of electricity shall be kept to a minimum.

C. If other contractors require overtime to complete their work, the General Contractor shall require payment for his standby labor as necessary.

D. Provide all wiring, supports, lamp sockets, receptacle sockets and any other materials, supplies or equipment necessary for temporary light and power system.

E. Ground fault protection required by OSHA for temporary receptacle circuits shall be accomplished by providing branch circuit panels containing ground fault protection circuit breakers or ground fault protection type receptacles.

F. Provide a grounding conductor connection to each receptacle-grounding terminal. Minimum size branch circuit and grounding conductors shall be No. 10 AWG.

1.15 IDENTIFICATION NAMEPLATES

A. Identify and mark all electrical equipment to meet OSHA standards and as specified herein.

B. Furnish a nameplate for each separately installed feeder switch and circuit breaker, each individual panel, dry-type transformer; disconnect switch, push-button station, controller, manual motor starter, and equipment enclosure.

C. Unless otherwise noted, nameplates shall be black laminate with white letters of uniform size consisting of reasonably large capital letters, 3/16” minimum.

D. Inscription shall consist of name and number of equipment as shown on the Drawings and as approved by the Architect.

1.16 NAMES AND TRADE NAMES

A. Where trade and manufacturers' names are specified or indicated on the drawings, they are intended to indicate the standard of material or articles required. This shall not remove the responsibility of the Contractor from verifying the equipment's compliance with all rules and regulations governing the use of such equipment. No purchase of any equipment shall be done without written authorization if such equipment will not abide with all rules and regulations covering its intended use.

1.17 MATERIAL AND WORKMANSHIP

A. All material shall be new and of the best quality and shall have the Underwriters Laboratories label attached. The Label shall be of the type for the intended application. The work throughout shall be executed in the best and most thorough manner under the direction of, and to the satisfaction of the Architect, who will interpret the meaning of the drawings and specifications. The Architect shall have the power to reject any work or material, which, in his opinion, is not in full accordance therewith.

B. If, after installation, operation of the equipment proves to be unsatisfactory to the Owner by reason of defects, errors or omissions, the Owner reserves the right to operate equipment until it can be removed from service for correction by Contractor. Contractor shall pay for damages to work of other trades caused by this defective equipment and its replacement.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION (NOT APPLICABLE)

END OF SECTION 260511

SECTION 260519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Building wires and cables rated 2000 V and less.
2. Wires and cables for PV systems rated 2000 V and less.
3. Connectors, splices, and terminations rated 2000 V and less.

B. Related Work:

Section 017419 – Construction and Demolition Waste Management Disposal.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: Indicate type, use, location, and termination locations.

C. Sustainable Design Submittals:

1. Product Data: For solvents and adhesives, indicating VOC content.
Laboratory Test Reports: For solvents and adhesives, indicating compliance with requirements for low-emitting materials.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

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

1. General Cable Technologies Corporation.
2. Service Wire Co.
3. Southwire Company.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Comply with UL 1277, UL 1685, and NFPA 70 for Type TC-ER cable used in VFC circuits.

E. Conductors: Copper, complying with NEMA WC 70/ICEA S-95-658.
1. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN/THWN-2.
2. PV Conductor Insulation: Comply with UL 4703.

F. Cable: Comply with NEMA WC 70/ICEA S-95-658 for metal-clad cable, Type MC and mineral-insulated, metal-sheathed cable, Type MI with ground wire.

2.2 CONNECTORS AND SPLICES

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

1. O-Z/Gedney; a brand of Emerson Industrial Automation.
2. Thomas & Betts Corporation; A Member of the ABB Group.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

D. Feeders Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.

E. Exposed Branch Circuits: Type THHN/THWN-2, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway or Metal-clad cable, Type MC. MC cable shall not be allowed for homeruns back to the electricals.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

H. Branch Circuits Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway or Metal-clad cable, Type MC. MC cable shall not be allowed for homeruns back to the electricals.

I. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test conductors feeding the following services for compliance with requirements.

    a. All distribution board feeders.

2. Perform all applicable tests from NETA ATS.

3. Perform each of the following visual and electrical tests:

    a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
    b. Test bolted connections for high resistance using one of the following:

1) A low-resistance ohmmeter.
2) Calibrated torque wrench.
3) Thermographic survey.

c. Inspect compression applied connectors for correct cable match and indentation.
d. Inspect for correct identification.
e. Inspect cable jacket and condition.
f. Insulation-resistance test on each conductor with respect to ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
g. Continuity test on each conductor and cable.
h. Uniform resistance of parallel conductors.

4. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scanning for each panelboard and splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.

a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

5. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch and panelboard 11 months after date of Substantial Completion.

C. Cables will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

SECTION 260526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes grounding and bonding systems and equipment.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 INFORMATIONAL SUBMITTALS

A. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:

1. Grounding arrangements and connections for separately derived systems.

B. Qualification Data: For testing agency and testing agency's field supervisor.

C. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. ERICO International Corporation.
2. Harger Lightning & Grounding.
3. O-Z/Gedney; a brand of Emerson Industrial Automation.
4. Thomas & Betts Corporation; A Member of the ABB Group.

2.2 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.3 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Armored and metal-clad cable runs.
8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
9. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a

separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

G. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

H. Metallic Fences: Comply with requirements of IEEE C2.

1. Grounding Conductor: Bare copper, not less than No. 8 AWG.
2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
3. Barbed Wire: Strands shall be bonded to the grounding conductor.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

C. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

D. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

END OF SECTION 260526

SECTION 260529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

B. Related Requirements:

1. Section 260548.16 "Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

C. Related Work:

1. Section 017419 – Construction and Demolition Waste Management Disposal.

1.2 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:

a. Hangers.
b. Steel slotted support systems.
c. Nonmetallic support systems.
d. Trapeze hangers.
e. Clamps.
f. Turnbuckles.
g. Sockets.
h. Eye nuts.
i. Saddles.
j. Brackets.

2. Include rated capacities and furnished specialties and accessories.
3. Trapeze hangers. Include product data for components.
4. Steel slotted-channel systems.
5. Nonmetallic slotted-channel systems.

6. Equipment supports.

7. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which hangers and supports will be attached.
3. Size and location of initial access modules for acoustical tile.
4. Items penetrating finished ceiling, including the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.
    f. Projectors.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M.
2. AWS D1.2/D1.2M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame Rating: Class 1.
2. Self-extinguishing according to ASTM D 635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4 factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit; a part of Atkore International.
b. B-line, an Eaton business.
c. Thomas & Betts Corporation; A Member of the ABB Group.
d. Unistrut; Part of Atkore International.

2. Material: Galvanized steel.

3. Channel Width: 1-5/8 inches.
4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
5. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
8. Channel Dimensions: Selected for applicable load criteria.

B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Hilti, Inc.
2) Simpson Strong-Tie Co., Inc.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) B-line, an Eaton business.
2) Hilti, Inc.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems unless requirements in this Section are stricter.

B. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

E. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMTs and RMCs may be supported by openings through structure members, according to NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete." Anchor equipment to concrete base as follows:

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Section 099123 "Interior Painting" and Section 099600 "High-Performance Coatings" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

B. Related Work:

1. Section 017419 – Construction and Demolition Waste Management Disposal.
2. Section 018113 – Sustainable Design Requirements.
3. Section 018119 – Construction Indoor Air Quality Requirements.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Sustainable Design Submittals:

1. Product Data: For solvents and adhesives, indicating VOC content.
2. Laboratory Test Reports: For solvents and adhesives, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

D. Samples: For wireways and surface raceways]and for each color and texture specified, 12 inches long.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

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

1. Allied Tube & Conduit; a part of Atkore International.
2. FSR Inc.
3. O-Z/Gedney; a brand of Emerson Industrial Automation.
4. Republic Conduit.
5. Thomas & Betts Corporation; A Member of the ABB Group.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. EMT: Comply with ANSI C80.3 and UL 797.

E. FMC: Comply with UL 1; zinc-coated steel.

F. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:

a. Material: Steel.
b. Type: Setscrew or compression.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

H. Joint Compound for GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Allied Tube & Conduit; a part of Atkore International.
   2. AFC Cable Systems; a part of Atkore International.
   3. Thomas & Betts Corporation; A Member of the ABB Group.

B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. LFNC: Comply with UL 1660.

D. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.

E. RTRC: Comply with UL 1684A and NEMA TC 14.

F. Fittings for LFNC: Comply with UL 514B.

G. Solvents and Adhesives: As recommended by conduit manufacturer.

   1. Low VOC Content for PVC conduit and fittings. Coordinate with the project's VOC reporting form for maximum acceptable g/L value.
   2. Low-Emitting Material Requirements: As recommended by solvent and adhesive manufacturer and that complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

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

   1. B-line, an Eaton business.
   2. MonoSystems, Inc.
   3. Wiremold / Legrand.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.

   1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. MonoSystems, Inc.
b. Panduit Corp.
c. Wiremold / Legrand.

C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. MonoSystems, Inc.
b. Panduit Corp.
c. Wiremold / Legrand.

2.5 BOXES, ENCLOSURES, AND CABINETS

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

1. Erickson Electrical Equipment Company.
2. FSR Inc.
3. O-Z/Gedney; a brand of Emerson Industrial Automation.
4. Thomas & Betts Corporation; A Member of the ABB Group.
5. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. Metal Floor Boxes:

1. Material: sheet metal.
2. Type: Fully adjustable or Semi-adjustable.
3. Shape: Rectangular.

4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Nonmetallic Floor Boxes: Nonadjustable, round or rectangular, as note on plans.

1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

I. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.

1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

J. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

K. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

L. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

M. Device Box Dimensions: 4 inches by 2-1/8 inches by 2-1/8 inches deep.

N. Gangable boxes are allowed.

O. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 for indoor and Type 3R for outdoor with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Fiberglass.
3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

P. Cabinets:

1. NEMA 250, Type 1 for indoor and Type 3R for outdoor, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.6 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of fiberglass.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Nordic Fiberglass, Inc.
   b. Quazite: Hubbell Power Systems, Inc.

2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC".
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.7 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
2. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include but are not limited to the following:

   a. Loading dock.
   b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
   c. Mechanical rooms.

3. Concealed in Ceilings and Interior Walls and Partitions: EMT.

4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
5. Damp or Wet Locations: GRC.
6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

B. Minimum Raceway Size: 3/4-inch trade size.

C. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

D. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches of enclosures to which attached.

I. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.

2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

J. Stub-ups to Above Recessed Ceilings:

1. Use EMT or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

Q. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

S. Surface Raceways:

1. Install surface raceway with a minimum 2-inch radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

T. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

U. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

V. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

W. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

    a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

X. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

Y. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

Z. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

AA. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

BB. Locate boxes so that cover or plate will not span different building finishes.

CC. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

DD. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

EE. Set metal floor boxes level and flush with finished floor surface.

FF. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.4 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260544

SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

C. Related Work:

1. Section 017419 – Construction and Demolition Waste Management Disposal.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For paints and coatings, indicating VOC content.
2. Laboratory Test Reports: For paints and coatings, indicating compliance with requirements for low-emitting materials.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

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

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

D. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

E. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Johnson Bros. Roll Forming Co.
b. Swagelok Company
c. MOCAP LLC

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Advance Products & Systems, Inc.
b. Metraflex Company (The).
c. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless steel.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. HOLDRITE.
b. Presealed Systems.
c. Morris Coupling Co.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Copps Industries, Inc..
b. Key Resin Co.
c. Wyo-Ben, Inc.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
2. Sealant shall have a low VOC content. Coordinate with the project's VOC reporting form for maximum acceptable g/L value.
3. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Anti-Seize Technology, A.S.T. Industries, Inc.
b. Ellsworth Adhesives
c. Everkem Diversified Products

C. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

   a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
   b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

SECTION 260553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes identification of electrical materials, equipment, and installations. It includes requirements for electrical identification components including but not limited to the following:

1. Buried electrical line warnings.

2. Identification labeling for raceways, cables, and conductors.

3. Operational instruction signs.

4. Warning and caution signs.

5. Equipment labels and signs.

B. Refer to other Division 26 sections for additional specific electrical identification associated with specific items.

C. Related Work:

1. Section 017419 – Construction and Demolition Waste Management Disposal.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 SUBMITTALS

A. Product Data for each type of product specified.

B. Samples of each color, lettering style, and other graphic representation required for identification materials; samples of labels and signs.

1.4 QUALITY ASSURANCE

A. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."

B. ANSI Compliance: Comply with requirements of ANSI Standard A13.1, "Scheme for the Identification of Piping Systems," with regard to type and size of lettering for raceway and cable labels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. American Label mark Co.
2. Ideal Industries, Inc.
3. Panduit Corp.
4. Seton Name Plate Co.
5. Standard Signs, Inc.
6. W.H.Brady, Co.

2.2 ELECTRICAL IDENTIFICATION PRODUCTS

A. Adhesive Marking Labels for Raceway; Pre- printed, flexible, self-adhesive labels with legend indicating voltage and service.

B. Label Size: as follows:

1. Raceways Larger than 1-Inch: 1-1/8 inches high by 8 inches long.

C. Color: Black legend on orange background.

D. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tapes not less than 3 mils thick by 1 inch to 2 inches in width.

E. Pre-tensioned Flexible Wraparound Colored Plastic Sleeves for Raceway and Cable Identification: Flexible acrylic bands sized to suit the raceway diameter and arranged to stay in place by pre- tensioned gripping action when coiled around the raceway or cable.

F. Underground Line Marking Tape: Permanent, bright-colored, continuous-printed, plastic tape compounded for direct-burial service not less than 6 inches wide by 4 mils thick. Printed legend indicative of general type of underground line below.

G. Wire/Cable Designation Tape Markers: Vinyl or vinyl-cloth, self- adhesive, wraparound, cable/conductor markers with preprinted numbers and letter.

H. Engraved, Plastic-Laminated Labels, Signs, and Instruction Plates: Engraving stock melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 square inches, or 8 inches in length; 1/8-inch thick for larger sizes. Engraved legend in white letters on black face and punched for mechanical fasteners.

I. Baked-Enamel Warning and Caution Signs for Interior Use: Preprinted aluminum signs, punched for fasteners, with colors, legend, and size appropriate to the location.

J. Exterior Metal-Backed Butyrate Warning and Caution Signs: Weather-resistant, non-fading, preprinted cellulose acetate butyrate signs with 20-gage, galvanized steel backing, with colors,

legend, and size appropriate to the location. Provide 1/4-inch grommets in corners for mounting.

K. Fasteners for Plastic-Laminated and Metal Signs: Self-tapping stainless steel screws or number 10/32 stainless steel machine screws with nuts and flat and lock washers.

L. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self- locking nylon cable ties, 0.18-inch minimum width, 50-lb minimum tensile strength, and suitable for a temperature range from minus 50 deg F to 350 deg F. Provide ties in specified colors when used for color-coding.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in submittals and as required by code.

B. Install identification devices in accordance with manufacturer's written instructions and requirements of NEC.

C. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

3.2 CONDUIT IDENTIFICATION:

A. Identify high-voltage feeder conduits (over 600 V) by words "DANGER-HIGH VOLTAGE" in black letters 2 inches high, stenciled at 10-foot intervals over continuous painted orange background.

1. The following areas shall be identified:

i. On entire surface of exposed conduits.

B. Identify Junction, Pull, and Connection Boxes: Code-required caution sign for boxes shall be pressure-sensitive, self-adhesive label indicating system voltage in black, preprinted on orange background. Install on outside of box cover. Also label box covers with identity of contained circuits. Use pressure- sensitive plastic labels at exposed locations and similar labels or plasticized card stock tags at concealed boxes.

C. Underground Electrical Line Identification: During trench backfilling, for exterior underground power, install continuous underground plastic line marker, located directly above line at 6 to 8 inches below finished grade. Where multiple lines installed in a common trench or concrete envelope, do not exceed an overall width of 16 inches; install a single line marker.

D. Conductor Color Coding: Provide color-coding for secondary service, feeder, and branch circuit conductors throughout the project secondary electrical system as follows:

208/120 Volts	Phase	480/277 Volts
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray

Green	Ground	Green

E. Apply warning, caution, and instruction signs and stencils as follows:

1. Install warning, caution, or instruction signs where required by NEC, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic- laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.

F. Install equipment/system circuit/device identification as follows:

1. Apply equipment identification labels of engraved plastic- laminate on each major unit of electrical equipment and electrical system. Provide single line of text, with 1/2-inch-high lettering on 1-1/2-inch-high label (2-inch-high where two lines are required), white lettering in black field. Text shall match terminology and numbering of the Contract Documents and shop drawings. Apply labels for each unit of the following categories of electrical equipment.

i. Pull and connection boxes.

ii. Access doors and panels for concealed electrical items.

iii. Electrical switchgear and switchboards.

iv. Electrical substations.

G. Install labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

END OF SECTION 260553

SECTION 260923

LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Time switches.
2. Photoelectric switches.
3. Standalone daylight-harvesting switching controls.
4. Indoor occupancy sensors.
5. Outdoor motion sensors.
6. Lighting contactors.
7. Emergency shunt relays.

B. Related Requirements:

1. Section 262726 "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

C. Related Work:

1. Section 017419 – Construction and Demolition Waste Management Disposal.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Interconnection diagrams showing field-installed wiring.
2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 INDOOR OCCUPANCY SENSORS

A. General Requirements for Sensors:

1. Wall, Ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
2. Dual technology.
3. Separate power pack.
4. Hardwired connection to switch
5. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.
6. Operation:

    a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
    b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

7. Sensor Output: Sensor is powered from the power pack.
8. Mounting:

    a. Sensor: Suitable for mounting in any position in a standard device box or outlet box.
    b. Relay: Externally mounted through a 1/2 inch knockout in a standard electrical enclosure.
    c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

9. Bypass Switch: Override the "on" function in case of sensor failure.
10. Automatic Light-Level Sensor: Adjustable from 0.1 to 200 fc; turn lights off when selected lighting level is present.
11. Maximum Humidity: 90 percent, non-condensing.

B. Dual-Technology Type, Recessed Mounted: Detect occupants in coverage area using PIR and microphonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; nRM series with microphonics or comparable product by one of the following:
    a. Bryant Electric
    b. Cooper Industries, Inc
    c. Hubbell Building Automation

d. Intermatic, Inc
e. Leviton Manufacturing
f. Lithonia Lighting
g. Wattstopper

2. Sensitivity Adjustment: Separate for each sensing technology.
3. Detector Sensitivity: Detect occurrences of 6 inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. inch and detect a person of average size and weight moving not less than 12 inch in either a horizontal or a vertical manner at an approximate speed of 12 inch/s
4. Detection Coverage (Standard Range): Detect occupancy anywhere within a circular area of 450 sq. ft.when mounted on a 108 inch high ceiling.
5. Detection Coverage (Extended Range): Detect occupancy anywhere within a circular area of 1800 sq. ft. when mounted on a 108 inch high ceiling.
6. Operating Temperature: Minus 4 to plus 140 deg F
7. Maximum Humidity: 90 percent, non-condensing.

C. Dual-Technology Type, Wall Mounted: Detect occupants in coverage area using PIR and microphonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; nWV series with microphonics or comparable product by one of the following:
   a. Bryant Electric
   b. Cooper Industries, Inc
   c. Hubbell Building Automation
   d. Intermatic, Inc
   e. Leviton Manufacturing
   f. Lithonia Lighting
   g. Wattstopper

2. Sensitivity Adjustment: Separate for each sensing technology.
3. Detector Sensitivity: Detect occurrences of 6 inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. inch and detect a person of average size and weight moving not less than 12 inch in either a horizontal or a vertical manner at an approximate speed of 12 inch/s
4. Detection Coverage: Detect occupancy anywhere within a 120-degree pattern centered on the sensor over an area of 1600 sq. ftwhen mounted 96 to 120 inch above finished floor.
5. Operating Temperature: [14 to 140 deg F (Minus 10 to plus 60 deg C)] [Minus 4 to plus 140 deg F
6. Maximum Humidity: 90 percent, non-condensing.

D. Power Pack:

1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; rPP20series or comparable product by sensor manufacturer.
2. Dry contacts Rating: 120 V(ac), 16 A tungsten, standard ballast electronic ballast and 1/2 hp at 120 V(ac) with integrated overcurrent protection for load side faults.
3. LED status lights to indicate load status.
4. Plenum rated.
5. Relay Type: Latching.
6. Class 2 Power Supply: 15 V(dc), 40 mA power source for sensors.
7. Operating Temperature: Minus 4 to plus 122 deg
8. Maximum Humidity: 90 percent, non-condensing.

9. Wireless Communication:

    a. Dual 900 MHz IEEE 802.15.4 based and 2.4 GHz, Version 4.0+ Bluetooth.
    b. Security: AES-128 bit.

2.2 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

A. Bryant Electric
Cooper Industries, Inc
Hubbell Building Automation
Intermatic, Inc
Leviton Manufacturing
Lithonia Lighting
Wattstopper

A. General Requirements for Sensors: Low-voltage, automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox using hardwired low-voltage connection.

1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application
2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
3. Operating Ambient Conditions: Dry interior conditions, 32 to 140 deg F
4. Separate power pack.
5. Programmable "off" time-delay selector at up to 30 minutes.
6. Field Adjustable Control Mode:

    a. Auto On / Auto Off (Fully Automatic).
    b. Manual On (initial state) to Override On (with expiration timer).
    c. Auto On (initial state) to Override On (with expiration timer).
    d. Manual On / Automatic Off (Semi-Automatic).
    e. Manual On (initial state) to Fully Automatic.
    f. Predictive Off Switch (returns zone to auto-on unless person remained in room after an off switch press).

B. Wall-Switch Sensor Tag WS1:

1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 2100 sq. ft.
2. Sensing Technology: Dual technology - PIR and ultrasonic.
3. Switch Type: SP, field selectable automatic "on," or manual "on" automatic "off."
4. Voltage: Dual voltage, 120 and 277 V; dual-technology type.
5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
7. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

C. Wall-Switch Sensor Tag WS2:

1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 2100 sq. ft.
2. Sensing Technology: Dual technology - PIR and ultrasonic.
3. Switch Type: Raise/lower dimmer controls
4. Capable of controlling load in three-way application.
5. Voltage: 15 to 24 V(dc), 3 mA, Class 2..
6. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
7. Operating Temperature: Minus 4 to plus 122 deg F.
8. Color: Shall be selected by Architect.
9. Faceplate: Color matched to switch.

D. Power Pack

1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight; Acuity Brands Lighting, Inc.; rPP20 series or comparable product by sensor manufacturer.
2. Dry contacts Rating: 120] V(ac), 16 A tungsten, standard ballast electronic ballast and 1/2 hp at 120 V(ac) with integrated overcurrent protection for load side faults.
3. LED status lights to indicate load status.
4. Plenum rated.
5. Relay Type: Latching.
6. Class 2 Power Supply: 15 V(dc), 40 mA power source for sensors.
7. Operating Temperature Minus 4 to plus 122 deg F
8. Maximum Humidity: 90 percent, non-condensing.
9. Wireless Communication:

    a. Dual 900 MHz IEEE 802.15.4 based and 2.4 GHz, Version 4.0+ Bluetooth.
    b. Security: AES-128 bit.

2.3 DIGITAL WALL CONTROL STATIONS

A. Cooper Industries, Inc.
Leviton Manufacturing Co., Inc.
nLiGHT(Acuity Controls)

B. Description: Manual controls for on/off, dimming and lighting scene selection compatible with Occupancy and Photosensor control power packs allowing user override of indoor electrical lighting levels.

C. Wired, Digital Wall Controls:

1. Switch Configuration: Four scene, four button
2. Operating Temperature: Minus 4 to plus 140 deg F
3. Maximum Humidity: 90 percent, non-condensing.
4. Switch Output: Digital signal compatible with power pack.
5. Wiring: Two RJ-45 ports for Category 5e, UTP wiring to power pack.
6. Color: Shall be selected by architect.

2.4 LIGHTING CONTACTORS

A. ABB
ASCO Power Technologies

Eaton
Leviton Manufacturing
Square D

B. Description: Electrically operated and mechanically held, combination-type lighting contactors with nonfused disconnect, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as scheduled, matching the NEMA type specified for the enclosure.

C. Interface with DDC System for HVAC: Provide hardware interface to enable the DDC system for HVAC to monitor and control lighting contactors.

1. Monitoring: On-off status.
2. Control: On-off operation.

2.5 EMERGENCY SHUNT RELAY

A. Lighting Control and Design
WattStopper
nLiGHT(Acuity Controls)

B. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.

1. Coil Rating: 120 V.

2.6 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION

A. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 3/4 inch.

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate lighting control devices and perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Lighting control devices will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

SECTION 262416

PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Electronic grade panelboards.

B. Related Work:

1. Section 017419 – Construction and Demolition Waste Management Disposal.

1.2 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 DEFINITIONS

ATS: Acceptance testing specification.
GFCI: Ground-fault circuit interrupter.
GFEP: Ground-fault equipment protection.
HID: High-intensity discharge.
MCCB: Molded-case circuit breaker.
SPD: Surge protective device.
VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.

5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of NRTL listing for SPD as installed in panelboard.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include wiring diagrams for power, signal, and control wiring.
9. Key interlock scheme drawing and sequence of operations.
10. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.7 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. Keys: Two spares for each type of panelboard cabinet lock.
2. Circuit Breakers Including GFCI and GFEP Types: Two spares for each panelboard.
3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.8 QUALITY ASSURANCE

Manufacturer Qualifications: ISO 9001 or 9002 certified.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.10 FIELD CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

    a. Ambient Temperature: Not exceeding minus 22 deg F 23 deg F to plus 104 deg F.
    b. Altitude: Not exceeding 6600 feet.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

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

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Construction Manager's written permission.
3. Comply with NFPA 70E.

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.

1. SPD Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA PB 1.

D. Comply with NFPA 70.

E. Enclosures: Flush and Surface-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.

    a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
    b. Outdoor Locations: NEMA 250, Type 3R.
    c. Kitchen and Wash Down Areas: NEMA 250, Type 4X, stainless steel.
    d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2. Height: 84 inches maximum.
3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Door-in-door trims shall cover all live parts and shall have no exposed hardware.
4. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
5. Finishes:

    a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    b. Back Boxes: Same finish as panels and trim.

F. Incoming Mains:

1. Location: Convertible between top and bottom.
2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.

G. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.

    a. Plating shall run entire length of bus.
    b. Bus shall be fully rated the entire length.

2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
6. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and listed and labeled by an NRTL acceptable to authority having jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on Drawings. Connectors shall be sized for double-sized or parallel conductors as indicated on Drawings. Do not mount neutral bus in gutter.

7. Split Bus: Vertical buses divided into individual vertical sections.

H. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Terminations shall allow use of 75 deg C rated conductors without derating.
3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
7. Subfeed (Double) Lugs: Mechanical type type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
8. Gutter-Tap Lugs: Mechanical type type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.
9. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

I. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

J. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

1. Percentage of Future Space Capacity: 20 percent.

K. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

2.2 PERFORMANCE REQUIREMENTS

A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1.

2.3 POWER PANELBOARDS

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

1. Eaton.
2. Siemens Energy.
3. Square D; by Schneider Electric.

B. Panelboards: NEMA PB 1, distribution type.

Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches high, provide two latches, keyed alike.

C. Mains: Circuit breaker or lugs only.

D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

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

1. Eaton.
2. Siemens Energy.
3. Square D; by Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

F. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

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

1. Eaton.
2. Siemens Energy.
3. Square D; by Schneider Electric.

B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:

a. Inverse time-current element for low-level overloads.
b. Instantaneous magnetic trip element for short circuits.
c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

    1) Instantaneous trip.
    2) Long- and short-time pickup levels.
    3) Long and short time adjustments.
    4) Ground-fault pickup level, time delay, and I squared T response.

3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
4. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
5. Subfeed Circuit Breakers: Vertically mounted.
    a. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    b. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
    c. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    d. Shunt Trip: 24-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
    e. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
    f. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
    g. Multipole units enclosed in a single housing with a single handle.
    h. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.6 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Directory card inside panelboard door, mounted in metal frame with transparent protective cover.

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

D. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Install panelboards and accessories according to NEMA PB 1.1.

C. Equipment Mounting:
   1. Attach panelboard to the vertical finished or structural surface behind the panelboard.

D. Mount top of trim 90 inches] above finished floor unless otherwise indicated.

E. Mount panelboard cabinet plumb and rigid without distortion of box.

F. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

G. Mounting panelboards with space behind is recommended for damp, wet, or dirty locations. The steel slotted supports in the following paragraph provide an even mounting surface and the recommended space behind to prevent moisture or dirt collection.

H. Mount surface-mounted panelboards to steel slotted supports 5/8 inch in depth. Orient steel slotted supports vertically.

I. Install overcurrent protective devices and controllers not already factory installed.
   1. Set field-adjustable, circuit-breaker trip ranges.
   2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

J. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

K. Install filler plates in unused spaces.

L. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

M. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6 Circuit Breakers and Paragraph 7.19.1 Surge Arrestors, Low-Voltage. Do not perform optional tests. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.

c. Instruments and Equipment:

1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.

1. Measure loads during period of normal facility operations.
2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.6 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

SECTION 262726

WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Isolated-ground receptacles.
4. Tamper-resistant receptacles with USB chargers
5. Snap switches and wall-box dimmers.
6. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

B. Related Work:

1. Section 017419 – Construction and Demolition Waste Management Disposal.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. UTP: Unshielded twisted pair.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Receptacles for Owner-Furnished Equipment: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

1.8 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. Service/Power Poles: One for every 10, but no fewer than one.
2. Floor Service-Outlet Assemblies: One for every 10, but no fewer than one.
3. Poke-Through, Fire-Rated Closure Plugs: One for every five floor service outlets installed, but no fewer than two.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Eaton (Arrow Hart).
2. Hubbell Incorporated; Wiring Device-Kellems.
3. Leviton Manufacturing Co., Inc.

B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.

2.3 STRAIGHT-BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.

B. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.

2. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

C. Tamper Resistant Duplex Convenience Receptacles, 125 V, 20 A, with two USB chargers: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, UL1310 and USB BC 1.2 battery charging specifications.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton (Arrow Hart) – Model no. TR7746W
b. Hubbell Incorporated; Wiring Device-Kellems – Model no. USB20X2W
c. Leviton Manufacturing Co., Inc. – Model no. - T5832W

2.4 GFCI RECEPTACLES

A. General Description:

1. Straight blade, feed-through type.
2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.

2.5 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.

B. Isolated-Ground, Single Convenience Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.

2. Description:

   a. Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.6 CONTROLLED RECEPTACLES

A. Convenience Receptacles, NEMA approved controlled symbol and “controlled” pad printed on the face of the receptacle provides permanent easy recognition of controlled outlet. It shall meet the latest NEC® 406.3 code and CA Title 24 and ASHRAE 90.1 Energy Efficiency standards. 125 V, 20 A: Contractor shall provide power pack and control wiring to the occupancy sensor as required.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.

2.7 CORD AND PLUG SETS

A. Description:

1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.8 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

1. Single Pole:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Eaton (Arrow Hart).
2) Hubbell Incorporated; Wiring Device-Kellems.
3) Leviton Manufacturing Co., Inc.

2. Three Way:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Eaton (Arrow Hart).
2) Hubbell Incorporated; Wiring Device-Kellems.
3) Leviton Manufacturing Co., Inc.

3. Four Way:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Eaton (Arrow Hart).
2) Hubbell Incorporated; Wiring Device-Kellems.
3) Leviton Manufacturing Co., Inc.

C. Pilot-Light Switches, 20 A:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.

2. Description: Single pole, with neon-lighted handle, illuminated when switch is "off."

D. Key-Operated Switches, 120/277 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.

2. Description: Single pole, with factory-supplied key in lieu of switch handle.

2.9 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.

2.10 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.035-inch- thick, satin-finished, Type 302 stainless steel.
3. Material for Unfinished Spaces: Smooth, high-impact thermoplastic.
4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, thermoplastic with lockable cover.

2.11 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular or Round, die-cast aluminum with satin finish.

D. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 jacks for UTP cable complying with requirements in Section 271500 "Communications Horizontal Cabling."

2.12 POKE-THROUGH ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Pass & Seymour/Legrand (Pass & Seymour).
2. Thomas & Betts Corporation; A Member of the ABB Group.
3. Wiremold / Legrand.

B. Description:

1. Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
2. Comply with UL 514 scrub water exclusion requirements.
3. Service-Outlet Assembly: Flush type with four simplex receptacles and space for four RJ-45 jacks complying with requirements in Section 271500 "Communications Horizontal Cabling."
4. Size: Selected to fit nominal 4-inch cored holes in floor and matched to floor thickness.
5. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
6. Closure Plug: Arranged to close unused 4-inch cored openings and reestablish fire rating of floor.
7. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of four, four-pair cables that comply with requirements in Section 271500 "Communications Horizontal Cabling."

2.13 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.
3. Isolated-Ground Receptacles: Orange.
4. Wiring Devices connected via the UPS System: Blue.

B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

    a. Cut back and pigtail, or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
2. Test Instruments: Use instruments that comply with UL 1436.
3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Wiring device will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 262726

SECTION 262813

FUSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600 V ac and less for use in the following:

a. Control circuits.
b. Motor-control centers.
c. Panelboards.
d. Switchboards.
e. Enclosed controllers.
f. Enclosed switches.

B. Related Work:

1. Section 017419 – Construction and Demolition Waste Management Disposal.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.
4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in PDF format.
5. Coordination charts and tables and related data.
6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit in PDF format.
4. Coordination charts and tables and related data.

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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.6 FIELD CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Bussmann; Eaton

Mersen USA

B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

1. Type RK-1: [250] [600]-V, zero- to 600-A rating, 200 kAIC
2. Type RK-5: [250] [600]-V, zero- to 600-A rating, 200 kAIC
3. Type CC: 600-V, zero- to 30-A rating, 200 kAIC, fast acting.
4. Type CD: 600-V, 31- to 60-A rating, 200 kAIC, fast acting.
5. Type J: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
6. Type L: 600-V, 601- to 6000-A rating, 200 kAIC, time delay.
7. Type T: [250-V, zero- to 1200-A] [600-V, zero- to 800-A] rating, 200 kAIC, very fast acting.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Feeders: Class RK1, fast acting, Class RK5, fast acting.
2. Control Transformer Circuits: Class CC, time delay, control transformer duty.
3. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field Construction Manager

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 262816

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Receptacle switches.
4. Shunt trip switches.
5. Molded-case circuit breakers (MCCBs).
6. Molded-case switches.
7. Enclosures.

B. Related Work:

1. Section 017419 – Construction and Demolition Waste Management Disposal.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of NRTL listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Submit on translucent log-log graph paper.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Manufacturer's field service report.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Submit on translucent log-log graph paper.

1.7 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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Fuse Pullers: Two for each size and type.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NFPA 70.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

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

1. Notify Architect no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Architect's written permission.
4. Comply with NFPA 70E.

1.10 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

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

1. Eaton.
2. Siemens Industry, Inc.
3. Square D; by Schneider Electric.

B. Type GD, General Duty, Single Throw, 240-V ac, 800 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with cartridge fuse interiors to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

F. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
6. Hookstick Handle: Allows use of a hookstick to operate the handle.
7. Lugs: Compression type, suitable for number, size, and conductor material.
8. Service-Rated Switches: Labeled for use as service equipment.
9. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac.

2.2 NONFUSIBLE SWITCHES

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

1. Eaton.
2. Siemens Industry, Inc.
3. Square D; by Schneider Electric.

B. Type GD, General Duty, Single Throw, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

F. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Hookstick Handle: Allows use of a hookstick to operate the handle.
6. Lugs: Compression type, suitable for number, size, and conductor material.
7. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac.

2.3 SHUNT TRIP SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Bussmann, an Eaton business.

B. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

C. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power transformer of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.

D. Accessories:

1. Oiltight key switch for key-to-test function.
2. Oiltight red ON pilot light.
3. Isolated neutral lug; 200 percent rating.
4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
5. Form C alarm contacts that change state when switch is tripped.
6. Three-pole, double-throw, fire-safety and alarm relay; 24-V dc coil voltage.
7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.

2.4 MOLDED-CASE CIRCUIT BREAKERS

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

1. Eaton.
2. Siemens Industry, Inc.
3. Square D; by Schneider Electric.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I^2t response.

F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

G. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

H. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

I. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

J. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system, specified in Section 260913 "Electrical Power Monitoring and Control."
6. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
7. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
8. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
9. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.

10. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
11. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
12. Electrical Operator: Provide remote control for on, off, and reset operations.
13. Accessory Control Power Voltage: Integrally mounted, self-powered 120-V ac.

2.5 MOLDED-CASE SWITCHES

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

1. Eaton.
2. Siemens Industry, Inc.
3. Square D; by Schneider Electric.

B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

C. Features and Accessories:

1. Standard frame sizes and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
6. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.
7. Alarm Switch: One NO contact that operates only when switch has tripped.
8. Key Interlock Kit: Externally mounted to prohibit switch operation; key shall be removable only when switch is in off position.
9. Zone-Selective Interlocking: Integral with ground-fault shunt trip unit; for interlocking ground-fault protection function.
10. Electrical Operator: Provide remote control for on, off, and reset operations.
11. Accessory Control Power Voltage: Integrally mounted, self-powered.

2.6 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Kitchen and Wash-Down Areas: NEMA 250, Type 4X stainless.
4. Other Wet or Damp, Indoor Locations: NEMA 250, [Type 4] <Insert type>.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
6. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
    c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 262816

SECTION 26 51 00

INTERIOR LIGHTING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior lighting fixtures, lamps, and drivers.
2. Lighting fixture supports.

B. Related Sections:

1. Section 260923 – Lighting Control Devices
2. Section 262726 - Wiring Devices
3. Section 265219 – Exit Lighting

1.2 REFERENCES

A. National Fire Protection Association (NFPA):

B. NFPA 70, “National Electrical Code”, (NEC)

C. Illuminating Engineering Society of North America (IESNA):

1. IES Approved Method for Life Performance Testing of General Lighting Incandescent Filament Lamps, LM-49.
2. IES Approved Method for Electrical and Photometric Measurements of General Service Incandescent Filament Lamps, LM-45.
3. IES Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products, LM-79.
4. IES Approved Method for Measuring Lumen Maintenance of LED Light Sources, LM-80.
5. IES Approved Method for Characterization of LED Light Engines and LED Lamps for Electrical and Photometric Properties as a Function of Temperature, LM-82.
6. IES Projecting Long Term Lumen Maintenance of LED Products, TM-21-11

D. American National Standards Institute (ANSI):

1. ANSI C78.377, Specifications for the Chromaticity of Solid State Lighting Products.
2. ANSI C81 Series, Electric Lamp Bases and Holders.

E. National Electric Manufacturer’s Association (NEMA):

1. NEMA FA1, “Outdoor Flood Lighting Equipment”.
2. NEMA SH5, “Tubular Steel, Aluminum and Prestressed Concrete Roadway Lighting Poles”.

F. Underwriter’s Laboratories (U.L.) Standards.

G. Codes: Materials and installations shall be in accordance with the latest revision of the National Electrical Code and any applicable Federal, State and local codes and regulations.

H. Listing: All luminaires shall be manufactured in strict accordance with the appropriate and current requirements of the National Electrical Code as verified by Underwriters’ Laboratories, Inc. (U.L.), or tested to UL standards by other nationally recognized testing agency as acceptable to Building Officials and Code Administrators International (BOCAI); the International Conference of Building Officials (ICBO); or other relevant code authority recognized by the jurisdiction within which the project is being

constructed. Such a listing shall be provided for each luminaire type, and the appropriate label or labels shall be affixed to each luminaire in a location as required by code or law.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. LED: Light-emitting Diode

D. Lumen: Measured output of lamp and luminaire, or both.

E. Luminaire: Complete lighting fixture, including driver and lamp.

F. LED Light Engine: a combination of an LED module and the associated control gear (driver).

1.4 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Emergency lighting units including battery and charger.
3. Energy-efficiency data.
4. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.
5. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.

    a. Testing Agency Certified Data: For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by manufacturer.
    b. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Shop Drawings: For nonstandard or custom lighting fixtures. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Samples: For each lighting fixture indicated in the Interior Lighting Fixture Schedule. Each Sample shall include the following:

1. Lamps and drivers, installed.
2. Cords and plugs.
3. Pendant support system.

D. Installation instructions.

E. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Lighting fixtures.
2. Suspended ceiling components.

3. Partitions and millwork that penetrate the ceiling or extends to within 12 inches (305 mm) of the plane of the luminaires.
4. Ceiling-mounted projectors.
5. Structural members to which suspension systems for lighting fixtures will be attached.
6. Other items in finished ceiling including the following:

    a. Air outlets and inlets.
    b. Speakers.
    c. Sprinklers.
    d. Smoke and fire detectors.
    e. Occupancy sensors.
    f. Access panels.

7. Perimeter moldings.

F. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.

G. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures and/or LED light engine from manufacturer.

H. Field quality-control reports.

I. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

J. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910, complying with the IESNA Lighting Measurements Testing & Calculation Guides.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NFPA 70.

D. FM Global Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

E. LED Luminaires shall be photometrical tested in accordance with IESNA LM-79 Standard

F. Life and operation of LED modules shall be tested in accordance with IESNA LM-80 Standard

G. White LEDs shall be binned to a minimum chromaticity in accordance with ANSI/NEMA/ANSLG C78.377-2015 Standard

1.6 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 WARRANTY

A. Luminaire and lamp vendors shall provide warranty and level of support consistent with industry practice and expectations regardless of point of actual sale and/or chain of sale. Vendor shall provide warranty

against loss of performance and defects in materials and workmanship for the period as indicated in the following sections. All warranties shall commence on the date the installation is turned over to the project owner.

1. Warranty for LED Luminaires: Entire LED luminaire shall be provided with a minimum 5-Year Manufacturer's warranty unless otherwise noted in the lighting fixture schedule. The Warranty shall commence on the date the LED luminaire installation is turned over to the project owner.

2. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

3. Warranty Period for Emergency Lighting Unit Batteries: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide product indicated in the Lighting Fixture Schedule in the drawings.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

E. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

G. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

H. Diffusers and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

   a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
   b. UV stabilized.

2. Glass: Annealed crystal glass unless otherwise indicated.

I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

J. Factory-Applied Labels: Include recommended lamps and drivers. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:

a. "USE ONLY" and include specific lamp type and wattage.
b. CCT and CRI for all luminaires.

2.3 LED LUMINAIRES AND DRIVERS

A. LED luminaire shall be constructed and heat-sinked to maintain LED performance as reported by LED manufacturer and exhibited in IESNA LM-79 and LM-80 test reports.

B. LEDs shall be of the color temperature and Color Rendering Index (CRI) as specified on the drawings. Minimum LED performance shall be 70% lumen maintenance at 50,000 hours operation at a forward current up to 700mA with junction temperature maintained at or below 135° C.

C. LED drivers shall be integral or remote type as specified on the drawings and shall provide continuous current matched to LED array requirements. Driver shall be High Power Factor (HPF) with <20% total harmonic distortion (THD) full load, Driver performance shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR Part 15.

2.4 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.

E. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 EXECUTION

3.1 INSTALLATION

A. Lighting fixtures:

1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
2. Install lamps in each luminaire.

B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

C. Remote Mounting of Drivers/Power Supplies: Distance between the driver/power supply and fixture shall not exceed that recommended by ballast/power supply manufacturer. Verify, with driver/power supply manufacturers, maximum distance between ballast/driver/power supply and luminaire.

D. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.

1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches (150 mm) from lighting fixture corners.
2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.
4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

E. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.4 STARTUP SERVICE

A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in LED lamps/luminaires intended to be dimmed, for at least 100 hours at full voltage.

END OF SECTION

SUNY PURCHASE - ADMIN BUILDING CMFT FITOUT PURCHASE, NY	TLP PROJECT NUMBER: 21050.00	TLP ISSUE DATE: 09/30/2022

LIGHTING FIXTURE SCHEDULE

TYPE	MTG.	DESCRIPTION	LIGHT SOURCE			WATTAGE (W)	VOLTS	DIMMING PROTOCOL/RANGE	MANUFACTURER	CATALOG NUMBER
			DELIVERED LUMENS OR LAMP NO. DESIGNATION	COLOR/CCT	OPTICS					
A1	RECESSED	LED SLOT, NOMINAL 4 INCH APERTURE X MAXIMUM 5 INCH RECESS DEPTH, EXTRUDED ALUMINUM HOUSING, PROVIDE CONTINUOUS LENGTH AS INDICATED ON ARCHITECTURAL DRAWINGS, FLUSH WHITE ACRYLIC LENS, INTEGRAL DRIVER, OVERALL PAINT FINISH TO BE SELECTED BY DESIGN PROFESSIONAL. FOR INSTALLATION IN GRID CEILINGS.	725 LMS/FT	3500K	-	9.3/FT	-	0-10V/10%	FINELITE AXIS FOCAL POINT NEO-RAY/COOPER	HP-4-R-D-[LENGTH]-H-935-F-95LF-[VOLTAGE]-SC-FC-10%-[GRID]-FE-[FINISH] BMRLED-750-80-35-FL-[LENGTH]-W-UNV-DP-1-[MOUNTING] SEEM 2 SERIES DEFINE 3 SERIES
A1A	RECESSED	SAME AS TYPE A1 EXCEPT FOR TRIMLESS INSTALLATION IN DRYWALL CEILING	725 LMS/FT	3500K	-	9.3/FT	-	0-10V/10%	FINELITE AXIS FOCAL POINT NEO-RAY/COOPER	HP-4-R-D-[LENGTH]-H-935-F-95LF-[VOLTAGE]-SC-FC-10%-SF-FE-[FINISH] BMRLED-750-80-35-FL-[LENGTH]-W-UNV-DP-1-[MOUNTING] SEEM 2 SERIES DEFINE 3 SERIES
A2	-	DELETED FROM PROJECT	-	-	-	-	-	-	-	-
A15	RECESSED	LED PERIMETER SLOT, NOMINAL 4 INCH APERTURE X 7-1/4 INCH MAXIMUM RECESS DEPTH, EXTRUDED ALUMINUM HOUSING AND TRIM FLANGE, PROVIDE LENGTH OF LUMINIAIRE FOR CONTINUOUS RUNS AS SHOWN ON DRAWINGS, PROVIDE TELESCOPING ENDS FOR WALL-TO-WALL RUN LENGTHS, SNAP-IN FROSTED ACRYLIC LENS WITH 4 INCH REGRESS, HIGH REFLECTANCE WHITE PAINTED REFLECTOR, INTEGRAL DRIVER. FOR TRIMLESS INSTALLATION IN DRYWALL CEILING.	774 LMS/FT	3500K	-	9.3/FT	-	0-10V/10%	FINELITE AXIS FOCAL POINT MARK LIGHTING/ACUITY	HP-WS-4W-4D-[LENGTH]-S-935-[MOUNTING]-SF-TXL-L-FE-R-SW BBPRLED-500-80-35-RG3-[LENGTH]-W-UNV-DP-1-DS-TS(2) SEEM 4 SERIES SPR LED SERIES
A17	RECESSED	LED DOWNLIGHT, NOMINAL 4 INCH APERTURE X MAXIMUM 7 INCH RECESS DEPTH, CLEAR DIFFUSE SPUN ALUMINUM REFLECTOR AND TRIM, INTEGRAL DRIVER.	1000 LMS	3500K	1.0 S/MH	9	120-277	0-10V/10%	GOTHAM/ACUITY FOCAL POINT PORTFOLIO/COOPER	EVO4-35/10-AR-MD-LSS-MOVLT-GZ10 ID+4.5 SERIES LD4B SERIES
B1	PENDANT	LED SLOT, NOMINAL 1 -1/4 INCH APERTURE X MAXIMUM 2-1/4 INCH TALL, EXTRUDED ALUMINUM HOUSING, PROVIDE CONTINUOUS LENGTH AS INDICATED ON ARCHITECTURAL DRAWINGS, FLUSH WHITE ACRYLIC LENS, INTEGRAL DRIVER, OVERALL PAINT FINISH TO BE RAL 090 80 90 (YELLOW). REFER TO ARCHITECTURAL DRAWINGS FOR MOUNTING HEIGHTS.	300 LMS/FT	3500K	-	4/FT	-	0-10V/10%	FINELITE AXIS FOCAL POINT MARK LIGHTING/ACUITY	E2-ID (MOD DIRECT ONLY)-L-[LENGTH]-NA-(MOD 300LM/FT DIRECT)-935-NA-F-96LG-[VOLTAGE]-SC-APC-FE-C4 (FIXTURE) RAL 090 80 90 (FINISH) SCD-300-80-35-FL-[LENGTH]-[FINISH]-UNV-DP-1-CA(L) SEEM 1 SERIES SLOT 1 SERIES
B2	PENDANT	LED SLOT, NOMINAL 3-1/2 INCH APERTURE X MAXIMUM 4-1/2 INCH TALL, EXTRUDED ALUMINUM HOUSING, PROVIDE CONTINUOUS RUN LENGTH AS INDICATED ON ARCHITECTURAL DRAWINGS, FLUSH WHITE ACRYLIC LENS, INTEGRAL DRIVER, OVERALL WHITE PAINT FINISH. REFER TO ARCHITECTURAL DRAWINGS FOR MOUNTING HEIGHTS.	842 LMS/FT	3500K	-	6.8/FT	-	0-10V/10%	FINELITE AXIS FOCAL POINT NEO-RAY/COOPER	HP-X-P-ID-[LENGTH]-S-S-935-WSO-F-[VOLTAGE]-DC-FC-10%-FA100-C4-FE-SW TB3DLED-750-80-35-SO-[LENGTH]-[FINISH]-UNV-DP-1-CA(L) SEEM 2 SERIES DEFINE 3 SERIES
B17	PENDANT	LED DOWNLIGHT CYLINDER, NOMINAL 4- INCH DIAMETER X 10 INCH TALL EXTRUDED ALUMINUM HOUSING, CLEAR DIFFUSE SPUN ALUMINUM REFLECTOR,INTEGRAL DRIVER, OVERALL WHITE PAINT FINISH. REFER TO ARCHITECTURAL DRAWINGS FOR MOUNTING HEIGHTS	750 LMS	3500K	25 DEG	8	277	0-10V/10%	GOTHAM/ACUITY ALPHABET LUCIFER	ICO4CC-35/07-AR-LSS-25D-MVOLT-GZ10-JBXCC-CCAN-[CORD LENGTH] BETA4 SERIES CY4 SERIES
C1	PENDANT	LED INDIRECT PENDANT, NOMINAL 1-1/2 INCH DIAMETER EXTRUDED ALUMINUM HOUSING, PROVIDE CONTINUOUS LENGTH AS INDICATED ON ARCHITECTURAL DRAWINGS, INTEGRAL DRIVER, OVERALL SATIN ALUMINUM FINISH. REFER TO ARCHITECTURAL DRAWINGS FOR MOUNTING HEIGHT	494 LMS/FT	4000k	BW	4.4/FT	-	0-10V/1%	FINELITE LUMENWERX	HP-2-P-I-[LENGTH]-B-NA-940-WSO-NA-98LG-[VOLTAGE]-SC-FC-10%-FA100-C4-FE-SA VIA1.5P-I-NA-NA-WIO2-SW-80-NA-500-35-XX-UNV-D1-1C-ACC (3NPC-72-B-PCB-NA)-B
D17	SURFACE	LED UNDERCABINET TASKLIGHT, NOMINAL 3 INCH WIDE X 1 INCH TALL EXTRUDED ALUMINUM HOUSING, PROVIDE CONTINUOUS RUN LENGTHS USING AS MANY LONGEST LENGTHS POSSIBLE, DIFFUSE ACRYLIC LENS, OVERALL MATTE WHITE PAINT FINISH, AND WIRING MODULE FOR HARDWIRE INSTALLATION, INTEGRAL DRIVER. FOR INSTALLATION ON UNDERSIDE OF OVERHEAD CABINETS. REFER TO ARCHITECTURAL DRAWINGS FOR MOUNTING DETAILS.	500 LMS/FT	3500K	-	7/FT	120	-	TECH LIGHTING LITHONIA/ACUITY WAC	700UCF-[LENGTH]-9-3-W-LED + 700UCSB-W UCLD SERIES BARLIGHT SERIES

SUNY PURCHASE - ADMIN BUILDING CMFT FITOUT PURCHASE, NY	TLP PROJECT NUMBER: 21050.00	TLP ISSUE DATE: 09/30/2022

LIGHTING FIXTURE SCHEDULE

TYPE	MTG.	DESCRIPTION	LIGHT SOURCE			WATTAGE (W)	VOLTS	DIMMING PROTOCOL/RANGE	MANUFACTURER	CATALOG NUMBER
			DELIVERED LUMENS OR LAMP NO. DESIGNATION	COLOR/CCT	OPTICS					
G1	RECESSED	LED ADJUSTABLE DOWNLIGHT, NOMINAL 2 INCH DIAMETER APERTURE X 3 INCH MAXIMUM RECESS DEPTH, MAXIMUM 25 DEGREE TILT, DIE-CAST ALUMINUM TRIM, WHITE PAINT FINISH TO BE CONFIRMED BY DESIGN PROFESSIONAL, REMOTE DRIVER PER EVERY 6 FIXTURES LOCATED IN ACCESSIBLE LOCATION. ALL FIXTURES TO BE AIMED PERPENDICULAR TO FLOOR.	450LMS	3500K	55 DEG	4.5	24	0-10V/1%	FLEXA NA	JL6E-1-2-2-3-AL4010 FLEXA-60-PRO-CC-10VR (WIRED IN SERIES; 6 FIXTURES / DRIVER) R01050-W0A (MOUNTING PLATE) MN6-1-35-D (FIXTURE)
H1	-	DELETED FROM PROJECT	-	-	-	-	-	-	-	-
H1A	TRACK	LED TRACKHEAD, NOMINAL 3 INCH DIAMETER X 7-1/2 INCH TALL ALUMINUM HOUSING, FIELD CHANGEABLE OPTIC, MAXIMUM 355 DEGREE ROTATION, 90 DEGREE VERTICAL TILT, SOFTENING GLASS LENS, OVERALL WHITE PAINT FINISH, INTEGRAL DRIVER. COMPATIBLE WITH TRACK 'T1'	1020 LMS	3500K		16	120	0-10V/	INTENSE CONTECH LUMENPULSE	 CTL SERIES LATSM3-A-120-L13-35K-CR80-M-MWH-b-MWH-1C-AWH-PH-SL
T1	PENDANT	SINGLE CIRCUIT TRACK, NOMINAL 1-1/2 INCH WIDE X 1 INCH TALL EXTRUDED ALUMINUM HOUSING, PROVIDE LENGTHS AS SHOWN ON DRAWINGS, OVERALL SILVER FINISH. PROVIDE POWER FEEDS, TRACK CONNECTORS, ENDS CAPS, SUSPENSION STEMS, AND OTHER ACCESSORIES AS REQUIRED FOR A COMPLETE, OPERABLE, AND CODE COMPLIANT SYSTEM. TRACK TO BE COMPATIBLE WITH APPROVED TRACK HEADS.	-	-	-	-	120	0-10V	INTENSE CONTECH LUMENPULSE	ICT TRACK SYSTEM - SV CTL SERIES GESA120 1C TRACK SYSTEM

GENERAL NOTES:

1. ALL LIGHTING FIXTURES, LAMPS AND RELATED DEVICES FURNISHED UNDER THIS CONTRACT SHALL CARRY THE APPROVAL LABEL OF UL OR ETL FOR THE SPECIFIC APPLICATION IN WHICH THEY ARE USED.

2. THE STATEMENT "FINISH TO BE SELECTED BY DESIGN PROFESSIONAL" SHALL BE INTERPRETED TO MEAN THAT THE FINISH OF THE LUMINAIRE SHALL MATCH THE APPEARANCE OF A PAINT CHIP, COLOR NUMBER, OR METAL SWATCH FURNISHED BY THE DESIGN PROFESSIONAL DURING THE SUBMITTAL REVIEW PROCESS.

3. CONTRACTOR SHALL CONFIRM FIXTURE VOLTAGES, CEILING TRIMS, AND MOUNTING HARDWARE ARE COMPATIBLE WITH THEIR APPLICATION AS DETERMINED BY THE DESIGN PROFESSIONAL PRIOR TO ORDERING FIXTURES.

4. CONTRACTOR SHALL PROVIDE ALL MOUNTING HARDWARE AS REQUIRED FOR FIXTURE INSTALLATION.

5. CONTRACTOR SHALL VERIFY ALL FINAL RUN LENGTHS FOR INTEGRATED MILLWORK LIGHTING EQUIPMENT WITH APPROVED MILLWORK SHOP DRAWINGS.

6. DIMMING RANGES IDENTIFIED IN THE LIGHTING FIXTURES INDICATE THE REQUIRED LOW END DIMMING. ALL LIGHTING EQUIPMENT IDENTIFIED AS DIMMABLE SHALL PROVIDE SMOOTH, CONTINUOUS DIMMING FROM 100% POWER OUTPUT TO THE LOW-END PERCENTAGE OF POWER OUTPUT IDENTIFIED IN THE FIXTURE SCHEDULE.

7. ALL DIMMABLE FLUORESCENT AND LED LAMPS SHALL BE BURNED CONTINUOUSLY FOR 100 HOURS AT FULL OUTPUT PRIOR TO FOCUSING OF FIXTURES AND COMMISSIONING OF CONTROL SYSTEMS.

8. LED CHROMATICITY AND COLOR RENDERING INDEX (CRI):
WHITE LEDs SHALL MEET, AT A MINIMUM, CHROMATICITY STANDARDS SET BY ANSI/NEMA/ANSLG C78.377-2015.

UNLESS OTHERWISE NOTED, THE COLOR RENDERING INDEX (CRI) FOR LED EQUIPMENT SHALL MEET THE FOLLOWING MINIMUM REQUIREMENTS:
- EXTERIOR LUMINAIRES >/_ 70 CRI
- INTERIOR LUMINAIRES >/_ 80 CRI

9. LED LUMEN MAINTENANCE (L70):
LED LUMEN MAINTENANCE SHALL BE MEASURED IN ACCORDANCE WITH IESNA LM-80 STANDARDS. PHOTOMETRIC TESTING FOR SOLID STATE LUMINAIRES SHALL BE IN ACCORDANCE WITH IESNA LM-79 STANDARDS.

UNLESS OTHERWISE NOTED, THE LUMEN MAINTENANCE (L70) RATED LIFETIME FOR LED EQUIPMENT SHALL MEET THE FOLLOWING MINIMUM REQUIREMENTS:
- INTEGRATED LED CHIP-BASED LUMINAIRES >/_ 50,000 HOURS
- LINEAR FLUORESCENT LED TUBES >/_ 35,000 HOURS
- SCREW-BASE, GU10 BASE & PIN BASE LED LAMPS >/_ 25,000 HOURS
- WEDGE-BASE LED LAMPS >/_ 8,000 HOURS

10. LED WARRANTY:
UNLESS OTHERWISE INDICATED, ALL LIGHTING EQUIPMENT WITH INTEGRATED LED LIGHT ENGINES SHALL PROVIDE A MINIMUM 5-YEAR MANUFACTURER WARRANTY ON THE LED LIGHT ENGINE AND ASSOCIATED DRIVER(S). ALL SELF-CONTAINED LED LAMPS (SCREW-BASE, PIN-BASE) SHALL PROVIDE A MINIMUM 3-YEAR WARRANTY ON THE LAMP MODULE.

11. CONTRACTOR SHALL SELECT, FURNISH AND INSTALL THE CORRECT SIZE OF SECONDARY WIRING FROM REMOTE TRANSFORMERS AND/OR REMOTE BALLASTS AS REQUIRED TO KEEP VOLTAGE DROP IN THE SECONDARY WIRING BELOW 3% OF RATED VOLTAGE.

12. CONTRACTOR SHALL PROVIDE LABOR AND EQUIPMENT FOR FOCUSING OF ADJUSTABLE FIXTURES AND PRESETTING OF LIGHTING CONTROL SYSTEMS. FOCUSING AND PRESETTING SHALL BE DONE IN THE PRESENCE OF THE DESIGN PROFESSIONAL. CONTRACTOR SHALL FOCUS LIGHTING AFTER DARK IF DIRECTED BY THE OWNER'S REPRESENTATIVE. UNLESS OTHERWISE NOTED, CONTRACTOR SHALL PROVIDE AT LEAST ONE DAY OF A FACTORY-TRAINED AND CERTIFIED TECHNICIAN TO PROVIDE WARRANTY START UP AND PROGRAMMING FOR ALL LIGHTING CONTROL SYSTEMS AND PROGRAMMABLE LIGHTING FIXTURES.

13. CONTRACTOR SHALL PROVIDE THE FOLLOWING WITH THEIR BID:

A. THE UNIT PRICE, WITHOUT LAMP, FOR EACH LIGHTING FIXTURE TYPE LISTED WITHIN THE LIGHTING FIXTURE SCHEDULE. THE UNIT PRICE SHALL BE FOR ONE OF THE LISTED MANUFACTURER'S FOR THAT PARTICULAR FIXTURE. THE MANUFACTURER SHALL BE IDENTIFIED. SUBSTITUTIONS FOR FIXTURES PROVIDED BY MANUFACTURERS NOT LISTED IN THE SCHEDULE ARE NOT ACCEPTABLE. SEE BELOW FOR REQUIREMENTS ASSOCIATED WITH SUBMITTING LIGHTING FIXTURE SUBSTITUTIONS
B. THE TOTAL QUANTITY OF EACH FIXTURE TYPE WITH THE EXTENDED COST FOR THAT QUANTITY
C. THE UNIT PRICE, TYPE, AND QUANTITY OF LAMPS

14. WITHIN 21 DAYS OF CONTRACT AWARD, THE CONTRACTOR SHALL FURNISH SUBMITTALS FOR ALL SPECIFIED LIGHTING FIXTURES FOR REVIEW BY THE DESIGN PROFESSIONAL. THE SUBMITTALS SHALL INCLUDE LUMINAIRE CATALOG CUTS, SUBMITTAL SHEETS, OR MANUFACTURERS SHOP DRAWINGS INDICATING THE FOLLOWING:

A. MANUFACTURER'S NAME AND COMPLETE CATALOG NUMBEI
B. FIXTURE TYPE, DIMENSIONS AND FINISHES
C. FIXTURE PHOTOMETRIC TEST DATA FROM AN INDEPENDENT TEST LABORATOR
D. FIXTURE ACCESSORIES, COMPONENTS, AND HARDWARE WHEN SPECIFIEI
E. LAMP TYPE, QUANTITY, WATTAGE, LUMEN OUTPUT, RATED LIFE, COLOR TEMPERATURE, COLOR RENDERING INDEX AND BEAM SPREAD AS APPLICABLI
F. BALLAST TYPE AND FIXTURE VOLTAGE

SUBMITTALS FOR LIGHTING FIXTURES MOUNTED WITHIN ARCHITECTURAL COVES OR CASEWORK, VARIABLE LENGTH FIXTURES, AND FOR NON-STANDARD, OR CUSTOM FIXTURES, SHALL ALSO INCLUDE SCALED DRAWINGS SHOWING THE LAYOUT AND DIMENSIONS OF ALL FIXTURE COMPONENTS AND ACCESSORIES, THE METHOD OF INSTALLATION, AND A COMPLETE BILL OF MATERIALS.

15. LIGHTING FIXTURE SUBSTITUTION REQUESTS MUST BE SENT TO AND RECEIVED BY THE LIGHTING DESIGNER FOR REVIEW 14 DAYS PRIOR TO BID DATE. FAILURE TO SUBMIT WITHIN THIS DEADLINE SHALL CONSTITUTE A GUARANTEE THAT THE SPECIFIED FIXTURES WILL BE SUPPLIED. THE SUBMITTAL SHALL INCLUDE THE FOLLOWING:

A. HARD COPIES OF THE SUBMITTALS REQUIRED ABOVE FOR BOTH THE SPECIFIED FIXTURE AND THE PROPOSED SUBSTITUTION.
B. ONE NON-RETURNABLE WORKING SAMPLE OF THE PROPOSED SUBSTITUTE FIXTURE WITH CORD & PLUG CONNECTION FOR 120 VOLT OPERATION, AND SPECIFIED LAMP(S)
C. CONTRACTOR'S STATEMENT INDICATING THE EFFECT OF THE SUBSTITUTION ON THE CONSTRUCTION SCHEDULE COMPARED TO THE SCHEDULE WITHOUT THE APPROVAL OF THE PROPOSED SUBSTITUTION.
D. CONTRACTOR'S CERTIFICATION STATING THAT THE PROPOSED SUBSTITUTION CONFORMS TO THE REQUIREMENTS OF THE CONTRACT DOCUMENTS IN EVERY RESPECT AND IS APPROPRIATE FOR THE APPLICATIONS INDICATED IN THE DOCUMENTS
E. CONTRACTOR'S CERTIFICATION STATING THAT ANY MODIFICATIONS TO ANY BUILDING SYSTEM OR EQUIPMENT THAT MAY RESULT FROM THE PROPOSED LIGHTING FIXTURE SUBSTITUTION WILL BE DESIGNED AND CONSTRUCTED AT THE CONTRACTOR'S EXPENSE
F. CONTRACTOR'S WAIVER OF RIGHTS TO ADDITIONAL PAYMENT OR TIME THAT MAY BECOM NECESSARY SHOULD THE PROPOSED SUBSTITUTION FAIL TO PERFORM IN A MANNER THAT MATCHES THE SPECIFIED FIXTURE
G. CONTRACTOR-NET UNIT PRICE FOR THE SPECIFIED FIXTURE AND FOR THE PROPOSED SUBSTITUTE FIXTURE.

REVIEW ONE ROUND OF VALUE ENGINEERING LIGHTING SUBMITTAL PROPOSED BY THE CONTRACTOR FOR THE BID PACKAGE.

DEFINITIONS:

1. CORRELATED COLOR TEMPERATURE (CCT): THE ABSOLUTE TEMPERATURE, MEASURED IN DEGREES KELVIN, OF A BLACKBODY RADIATOR HAVING CHROMATICITY RESEMBLING THAT OF AN ELECTRIC LIGHT SOURCE. FOR LED SOURCES CCT SHALL NOT DEVIATE FROM THE REFERENCE COLOR TEMPERATURE BY NO MORE THAN THREE MACADAM ELLIPSES, AS DEFINED BY NEMA/ANSI/IANSLG C78.377-2015.

2. COLOR RENDERING INDEX (CRI): MEASURE OF COLOR SHIFT OBJECTS UNDERGO WHEN ILLUMINATED BY AN ELECTRIC LIGHT SOURCE AS COMPARED WITH THE COLOR OF THE SAME OBJECTS ILLUMINATED BY A REFERENCE SOURCE AT THE SAME COLOR TEMPERATURE. CRI VALUES FOR ELECTRIC LIGHT SOURCES RANGE FROM APPROXIMATELY 20 (LOW PRESSURE SODIUM) TO 99 (HALOGEN). CRI VALUES FOR LED SOURCES SHALL BE MEASURED AFTER 6000 HOURS AND SHALL NOT DEVIATE MORE THAN 3 POINTS FROM THE RATED VALUE.

3. LED LIGHT ENGINE: THE COMBINED LED LIGHT SOURCE AND ITS ASSOCIATED ELECTRONIC DRIVER. THE LED LIGHT ENGINE MAY HAVE AN INTEGRAL DRIVER OR THE DRIVER MAY BE HOUSED IN A SEPARATE ENCLOSURE.

4. LED DRIVER: CONTROL DEVICE THAT MAINTAINS CONSTANT AMOUNT OF CURRENT TO THE LED LIGHT SOURCE. LED DRIVERS GENERALLY OPERATE AT 12VDC OR 24VDC. SOME DRIVERS ARE DESIGNED TO ACCEPT BRANCH CIRCUIT VOLTAGE RANGING FROM 120VAC THROUGH 277VAC OR MAY REQUIRE A SEPARATE TRANSFORMER.

5. TRANSFORMER: ELECTROMAGNETIC OR ELECTRONIC DEVICE THAT STEPS DOWN PRIMARY VOLTAGE TO A LOWER SECONDARY VOLTAGE. GENERALLY SECONDARY VOLTAGE WILL BE 12V OR 24V.

6. DIMMING: THE REDUCTION OF LIGHT INTENSITY OF A LIGHT SOURCE. ALL SOURCES SHALL HAVE A SMOOTH, FLICKER-FREE AND CONTINUOUS DIMMING CURVE. LED SOURCES MAY BE DIMMED BY EITHER CONSTANT CURRENT REDUCTION (CCR) OR BY PULSE WIDTH MODULATION (PWM) DIMMING FOR CONSTANT CURRENT DRIVERS.

7. RATED LUMEN MAINTENANCE LIFE: THE ELAPSED OPERATING TIME OVER WHICH AN LED LIGHT SOURCE WILL MAINTAIN THE PERCENTAGE OF ITS INITIAL LUMEN OUTPUT.
L70: TIME, IN HOURS, TO 70% LUMEN MAINTENANCE
L50: TIME, IN HOURS, TO 50% LUMEN MAINTENANCE

the lighting practice

CMFT Building
SUNY Purchase

Lighting Fixture Cut Sheets

Construction Documents

14 April 2023

philadelphia
public ledger building
600 chestnut street, suite 772
philadelphia, pa 19106
t 215 238 1644
f 215 238 1674

new york
115 broadway, 5th floor
new york, ny 10006
t 646 838 4385

www.thelightingpractice.com

Submitted by:	
Type:	ect:
Ordering Info:	

FINELITE® Lighting

High Performance 4" Aperture (HP-4) Recessed

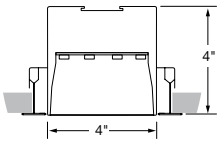
High Performance 4" Aperture is a patented, linear LED luminaire family. HP-4 delivers excellent performance using an advanced optical design and mid-power LEDs. Achieving 90% of initial light output at 100,000+ hours and backed by a 10-year performance-based warranty on all standard components.

This product is enrolled in the International Living Future Institute (ILFI) Declare 2.0 Program and is third-party verified with options achieving **Red List Approved** and **Declared** status.

Note: see page 6 for all aesthetic options

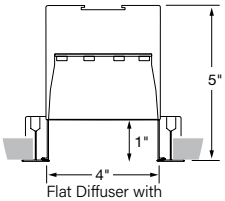
CROSS SECTIONS

Recessed



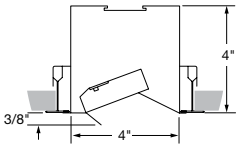
Flush Downlight Diffuser (standard)

Regressed



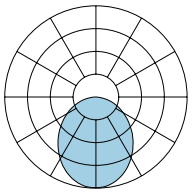
Flat Diffuser with 1" Regressed

Wall Wash Recessed

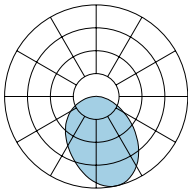


Kicker (standard)

OPTIC OPTIONS



Standard Downlight Optic (**F**)



Downlight Asymmetric Optic (**DAO**)

ALSO AVAILABLE IN

Pendant (**D, ID, I**)

Wall Mount (**WM**)

Surface Mount (**SM**)

Fine TUNE GENERATION 1 Option Available

Declare. Third Party Verified

A brand of legrand

the lighting practice

Catalog Information: HP-4-R-D-[LENGTH]-H-935-F-95LF-[VOLTAGE]-SC-FC-10%-[GRID]-FE-[FINISH]

Date: 09/30/2022

Fixture Type:

A1

Submitted by:	
Type:	ect:
Ordering Info:	

FINELITE® Lighting

Clear Form

High Performance 4" Aperture (HP-4) Recessed

BODY TYPE

Platform	Series Name	Luminaire Type	Luminaire Distribution	Total Length of Run
◉ HP - High Performance	◉ 4	◯ R - Recessed ◯ R RG - Recessed Regressed (Wall Wash not available)	◯ D - Direct ◯ WW-D - Wall Wash Direct	_____ Minimum 2' section length. Increments accurate to 1/16" (±1/32"), standard. 12' maximum section length.

OUTPUT and LED TYPE

Downlight Output (Flush)	LED CRI/CCT
◯ S - Standard (381 lm/ft) ◯ B - Boosted (479 lm/ft) ◯ H - High (725 lm/ft) ◯ V - Very High (932 lm/ft) ◯ TL - Tailored:_____ lm/ft* * Specify lm/ft of outputs between Standard (S) and Very High (V). Consult factory for tailored lumen output outside of this range.	◯ 830 - 80 CRI, 3000K ◯ 835 - 80 CRI, 3500K ◯ 840 - 80 CRI, 4000K ◯ 930 - 90 CRI, 3000K ◯ 935 - 90 CRI, 3500K ◯ 940 - 90 CRI, 4000K ◯ 8TW - 80 CRI, Tunable White ◯ 9TW - 90 CRI, Tunable White

MECHANICAL/OPTICAL OPTIONS

Downlight	Reflector System
◯ F - Flush (standard) ◯ DL - 1" Drop Down Lens ◯ DSO - Downlight Spread Optic [2,8] ◯ DAO-L - Downlight Asymmetric Optic Left [2,8] ◯ DAO-R - Downlight Asymmetric Optic Right [2,8] ◯ FO - Fully Open for Wall Wash only ◯ K - Kicker for Wall Wash only [3] ◯ RG-D - Flat Diffuser with 1" Regress [1] ◯ RG-WCB - White Cross Blade Baffle [1] ◯ RG-LHE - Hollowed Ellipse Louver [1] ◯ RG-LHC - Hex Louver [1]	◯ 96LG - 96 Low Gloss White ◯ SSA - Semi-Specular Aluminum for Wall Wash only

ELECTRICAL OPTIONS

Voltage	Circuiting [4]
◯ 120 - 120 Voltage ◯ 277 - 277 Voltage ◯ 347 - 347 Voltage	◉ SC - Single Circuit* * Battery, Night Light, and Emergency to Generator circuits are in addition to the normal luminaire circuit(s)

ELECTRICAL OPTIONS

Driver Selection

0-10V Driver Options
- ◯ FC-10% - 0-10V 10% [5] (standard)
- ◯ FC-1% - 0-10V 1% [5]
- ◯ OSR-10% - Osram OTi, 0-10V 10% [5]
- ◯ OSR-1% - Osram OTi, 0-10V 1% [5]
- ◯ ELD-10V-0% - EldoLED SOLOdrive, 0-10V 0.1%
- ◯ OSR-10V-TW - Osram OTi, 0-10V 10% *(Tunable White)* [5]

DALI Driver Options
- ◯ FC-DALI-1% - DALI 1%
- ◯ OSR-DALI-1% - Osram Dexal, 1%
- ◯ ELD-DALI-0% - EldoLED SOLOdrive, 0.1%
- ◯ ELD-DALI-TW - EldoLED DUALdrive LightShape, 0.1% *(Tunable White)*

DMX Driver Options
- ◯ FIN-DMX - Finelite DMX 1% *(Tunable White - FineTune Controls Only)* [6]
- ◯ ELD-DMX - EldoLED POWERdrive, 0.1%
- ◯ ELD-DMX-TW - EldoLED POWERdrive, 0.1% *(Tunable White)*

Lutron Driver Options
- ◯ LUT-ES1 - Lutron, Ecosystem 1%
- ◯ LUT-2W - Lutron, 2-wire (120V only) 1%
- ◯ LUT-TW - Lutron T-Series, EcoSystem 0.1% *(Tunable White)*

See Page 3 for additional driver options and details

MOUNTING OPTIONS

Ceiling Hardware Type

- ◯ C1 - 1" T-Bar
- ◯ C1T - 1" Tegular
- ◯ C2 - 9/16" T-Bar
- ◯ C2T - 9/16" Tegular
- ◯ C3 - Screw Slot
- ◯ C3F - Flush Screw Slot
- ◯ SF - Spackle Flange
- ◯ VF - Visible Flange
- ◯ TZ6 - Tech Zone 6" _____ (C1, C2, C2T, C3, C3F)

OTHER OPTIONS

Endcap Style	Finish	Emergency Style (Optional) Clear Selection	Integrated Sensor (Optional) Clear Selection	Special Options (Optional) Clear Selection
◉ FE - Flat Endcap (standard)	◯ SW - Signal White (standard) ◯ FB - Finelite Black ◯ SA - Satin Aluminum ◯ #### - RAL Color Code [7]	◯ LGD18W - Legrand 18W Brand Battery Back-up ◯ LGD10W - Legrand 10W Brand Battery Back-up ◯ EM/GEN - Emergency to Generator ◯ NL - Night Light ◯ BSL722 - Bodine Battery Back up ◯ BSL310LP - Bodine Battery Back up Low Profile ◯ GTD - Generator Transfer Device ◯ ALCR - Automatic Load Control Relay	◯ OBO - Occupancy [8] ◯ OBD - Daylight [8] ◯ W601 - Wattstopper Wireless [10] Sensor ◯ OBE - Enlighted [9] ◯ REE - Remote Enlighted [11]	◯ CP - Chicago Plenum ◯ FLX - Flex Whip ◯ RLA - Red List Approved ◯ RLD - Declared

[1] Recessed Regressed only
[2] Not available with Regressed or Curves
[3] Kicker standard in Signal White. Customer Custom color kickers have a surcharge
[4] Contact factory for switching options
[5] Add DTO to gain "Dim to Off" functionality (FC-10% - DTO)
[6] B & V outputs only
[7] 20 business days lead time for color
[8] Not available with Wall Wash
[9] Enlighted components installed by Finelite, provided by others
[10] LMFS-601 w/ 0-10V driver(s) and LMFI-111, up to 6 drivers may be connected. LMFS-601 w/ Dali driver, only 1 driver can be connected
[11] Enlighted for Wall Wash fixtures. Enlighted Control Unit & Sensor Cable installed for Remote mounting sensor.

the lighting practice

Catalog Information: HP-4-R-D-[LENGTH]-H-935-F-95LF-[VOLTAGE]-SC-FC-10%-[GRID]-FE-[FINISH]

Date: 09/30/2022
Fixture Type:

A1

FINELITE® Lighting

High Performance 4" Aperture (HP-4) Recessed

SUPPLEMENTARY DRIVER PAGE

0-10V Driver Options	
FC-10%	Factory Choice, 0-10V 10% Dimming (Linear)
FC-10%-DTO	Factory Choice, 0-10V 10% Dimming, Dim-to-Off (Linear)
FC-1%	Factory Choice, 0-10V 1% Dimming (Linear)
FC-1%-DTO	Factory Choice, 0-10V 1% Dimming, Dim-to-Off (Linear)
ELD-10V-0%	EldoLED SOLOdrive, 0-10V 0.1% Dimming (Linear)
ELD-10V-1%	EldoLED ECOdrive, 0-10V 1% Dimming (Linear)
OSR-10V-TW	Osram OTi, 0-10V 10% Dimming, *Tunable White* (Linear)
OSR-10V-TW-DTO	Osram OTi, 0-10V 10% Dimming, Dim-to-Off, *Tunable White* (Linear)
OSR-10%	Osram OTi, 0-10V 10% Dimming (Linear)
OSR-10%-DTO	Osram OTi, 0-10V 10% Dimming, Dim-to-Off (Linear)
OSR-1%	Osram OTi, 0-10V 1% Dimming (Linear)
OSR-1%-DTO	Osram OTi, 0-10V 1% Dimming, Dim-to-Off (Linear)

DALI Driver Options	
FC-DALI-1%	Factory Choice, DALI 1% Dimming (Logarithmic)
OSR-DALI-1%	Osram Dexal, DALI 1% Dimming (Logarithmic)
ELD-DALI-0%	EldoLED SOLOdrive, DALI 0.1% Dimming (Logarithmic)
ELD-DALI-1%	EldoLED ECOdrive, DALI 1% Dimming (Logarithmic)
ELD-DALI-TW	EldoLED DUALdrive Light Shape, DALI 0.1% Dimming, *Tunable White* (Logarithmic Dimming, Linear CCT Control)

DMX Driver Options	
FIN-DMX	Finelite, DMX 1% Dimming, *Tunable White* - **FineTUNE Controls Only** (Linear)
ELD-DMX	EldoLED POWERdrive, DMX 0.1% Dimming (8 Bit, 1CH) (Linear)
ELD-DMX-16	EldoLED POWERdrive, DMX 0.1% Dimming (16 Bit, 2CH) (Linear)
ELD-DMX-TW	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (8 Bit, 2CH - CH1 Warm / CH2 Cool) (Linear)
ELD-DMX-TW16	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (16 Bit, 4CH - CH1, 2 Warm / CH3, 4 Cool) (Linear)

Lutron Driver Options	
LUT-ES1	Lutron, Ecosystem 1% Dimming
LUT-2W	Lutron, 2-wire (120V only) 1% Dimming
LUT-TW	Lutron T-Series, EcoSystem 0.1% Dimming, *Tunable White*

Submitted by:	
Type:	ect:
Ordering Info:	

FINELITE® Lighting

High Performance 4" Aperture (HP-4) Recessed

SPECIFICATIONS

BODY TYPE

CONSTRUCTION: Precision-cut 6061-T6 extruded aluminum body. Internal joiner system, plug-together wiring, standard.

LENGTHS: Any length, 2' minimum, in increments down to 1/16" (±1/32"). 12' maximum section length. Hollowed Ellipse Louver (**LHE**), Hex Louver (**LHC**), and White Cross Blade Baffle (**WCB**) are available in 1' increments.

MITERED CORNERS[1]: Illuminated corners of greater than 60° and less than 180° in a single plane, available with Flush Diffuser, Bottom Glow Diffuser, Regressed Diffuser, White Cross Blade Baffle[2] or Wall Wash. Corners not available with Wall Wash (**WW-D**), Hollowed Ellipse Louver (**LHE**), Hex Louver (**LHC**) or 1" Drop Down Lens. Consult factory for tailored lighting options.

OUTPUT AND LED TYPE

LIGHT OUTPUT: Four lumen packages available, Standard (**S**), Boosted Standard (**B**), High (**H**), and Very High (**V**). For lengths 3' and greater, the uplight and downlight can be specified with different lumen packages and dual controls. For Tailored Outputs outside of range from Standard (**S**) to Very High (**V**), consult factory. Light engines are replaceable.

MECHANICAL/OPTICAL OPTIONS

DOWNLIGHT OPTION: 12' maximum diffuser length. Flush frost white snap-in diffuser standard, 73% transmissive, 99% diffusion. Internal secondary diffusers at corners ensure visually seamless, uniform, continuous illumination. Available with Flush (**F**), 1" Drop Down Lens (**DL**), White Cross Blade Baffle (**WCB**)[3,4], Ellipse Louver (**LHE**)[3], Hex Louver (**LHC**)[3], Downlight Spread Optic (**DSO**), Downlight Asymmetric Optic Left and Right (**DAO-L, DAO-R**), and Regressed downlight diffusers (**RG**)[3]. 1" Drop Down Lens made of acrylic. Available with a solid endcap or an endcap with a diffuse filler to continue the luminous aesthetic. Downlight Spread Optic (**DSO**) & Downlight Asymmetric Optic (**DAO**) are an extruded lenses with a subtle ribbed appearance providing desired improved optical performance. Consult factory for more tailored lumen outputs.

LUMEN MAINTENANCE: 90% of initial light output (L90) at 100,000+ hours; 70% of initial light output (L70) at 200,000+ hours.

REFLECTORS: Die-formed 20-gauge cold-rolled steel reflectors finished in 96LG High Reflectance white powder coat paint. The standard Semi-Specular Aluminum (**SSA**) Kicker (**K**) reflector delivers light high on the vertical surface. The Kicker reflector can be easily removed for open distribution (**FO**).

ELECTRICAL OPTIONS

STATIC WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed wire controlling uplight and downlight together (power and dimming). Specify dual feed wires for independent control of uplight and downlight. 14-gauge feed wire used when luminaire current exceeds 5 amps.

TUNABLE WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed. 14-gauge feed used when luminaire current exceeds 5 amps. DMX and power feed at same location (standard). DMX feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths.

STATIC WHITE DRIVER: Replaceable 120V, 277V, and 347V constant current reduction dimming driver standard. Can be wired dimming or non-dimming. 0-10V dimming controls with a range of 10%- 100% standard. Dimming to 1% available. Separate dimming for uplight and downlight available. Driver is fully accessible from below the ceiling.
- **Power Factor:** ≥ 0.9
- **Total Harmonic Distortion (THD):** <20%
- **Expected driver lifetime:** 100,000 hours

LUTRON DRIVER OPTIONS:
- **LUT-ES1 (LDE1)** - (Hi-lume 1% EcoSystem with Soft-On, Fade-to-Black dimming (LDE1 series))
- **LUT-2W (LTEA2W)** - (Hi-lume 1% 2-wire, 120V forward phase dimming (LTEA series)).

TUNABLE WHITE DRIVER: Replaceable LED driver. Driver is accessible from below the ceiling. 120V, 277V, and 347V.
- **Power factor:** ≥0.90
- **Total Harmonic Distortion (THD):** <20%
- **Dimming Range:** 100%-10%
- **Expected driver lifetime:** 100,000 hours
- **FineTune DMX:** 1%

LUTRON TUNABLE WHITE DRIVER OPTION:
LUT-TW (0.1% T-Series 2-Channel Digital Tunable White (PSQ Series)).

MOUNTING OPTIONS

HANGING HARDWARE:
- **Recessed T-Bar:** Standard bracket design works with most lay-in ceiling types. Brackets secure luminaire to the ceiling grid from above. Tie-in T-Bar brackets connect the luminaire to the T-Bar for securing to structure. Consult local codes for tie-wire recommendations.
- **Recessed Spackle Flange:** Drywall surfaces (walls or ceilings): 1/4" - 20 stud and nut (provided by others). Mounted with three equidistant suspension points.

Continued

[1] Not available with Wall Wash
[2] White Cross Blade (WCB) baffles not available with custom angles. Available in 90 degrees only
[3] Recessed-Regressed only
[4] White Cross Blade Baffle (WCB) currently not advisable for drywall

FINELITE Lighting

High Performance 4" Aperture (HP-4) Recessed

SPECIFICATIONS

TUNABLE WHITE DMX HANGING HARDWARE: For grid ceiling applications the dual GridBox™ mounting is supplied (standard). For hard ceiling applications the ceiling mounting box is supplied (standard). DMX feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths. Available DMX pendant feed lengths are 5' (standard), 12', and 30'.

TUNABLE WHITE DMX INTERCONNECTION CABLES: Luminaires are pre-wired with plug-and-play interconnection cables to support easy plug-together joining of fixture runs. If a non-FineTune DMX system has been specified, a DMX to RJ45 converter is provided.

OTHER OPTIONS

ENDCAPS: Flat endcaps (**FE**) at each end of run add 1/16" to each end of luminaire. Drop Down Lens Illuminated Endcap (**DE**) includes diffuse element to continue luminance of drop lens.

EMERGENCY STYLE: Optional emergency to generator/inverter wiring, internal generator transfer switch, nightlight wiring, step-dimming driver, backup battery.

Backup Battery		
	Legrand 18W	**Legrand 10W/ Bodine BSL310LP**
HP4-R-D		
Min. Housing Length	8'	4'
EM Lumen Output	1854	1102
EM Section Illum.	2'	2' or 4'
HP4-R-WW-D		
Min. Housing Length	8'*	4'*
EM Lumen Output	2000	1189
EM Section Illum.	4'	4'

* Minimum fixture housing length for battery pack approved without sensor

Bodine GTD and Legrand ALCR Min. Length	
Configuration	**Min Length**
Generator	D-2'
Generator + OCC	D-2'
Daylight	D-2'
Generator + Daylight	D-2'

TUNABLE WHITE ELECTRICAL OPTIONS[6]:
- **TW Driver Options 0-10V:** EM/GEN, GTD or Battery Back up
- **FineTune DMX:** EM/GEN or Battery Back up
- **DMX:** Battery Back up
- **DALI:** EM/GEN, GTD or Battery Back up
- **LUTRON:** EM/GEN, GTD or Battery Back up

INTEGRATED SENSORS: Integrated PIR (Passive Infrared) Occupancy (**OBO**) or Daylight Sensors (**OBD**) available with Flush and Bottom Glow downlight diffusers. PIR sensors not recommended for stairwell applications. Refer to Occupancy Sensor & Daylight Sensor tech sheet and the Embedded Intelligence landing page for more information and additional sensor options.

FINISHES: Finelite Signal White (**SW**) powder coat, Finelite Black (RAL 9005) with semi gloss fine texture (**FB**), and Satin Aluminum (**SA**) are standard. Optional Adder: 185 RAL colors[7] are available.

LABELS: Luminaire and electrical components are ETL-listed conforming to UL 1598 in the U.S.A. and CAN/CSA C22.2 No. 250.0 in Canada. In accordance with NEC Code 410.130 (G), this luminaire contains an internal driver disconnect. UL 924 and UL 2108 - PoE options available on request.These fixtures are rated for Damp Location. IC Rated. Finelite products use electronic components that are RoHS compliant, and the mechanical components of the luminaire have been verified to not knowingly contain any restricted substances listed per RoHS Directive 2015/863. Consult factory for tailored lighting options. Finelite makes the specification process easy when putting healthier products on your projects. Simply add – **RLA** (Red List Approved) or – **RLD** (Declared Label) to your part number.

WEIGHT[8]: R - 2.8 lb/ft; WW-R - 2.9 lb/ft

DLC QUALIFIED: Configurations of this product are listed on the DLC Qualified Products List (QPL). www.designlights.org/search

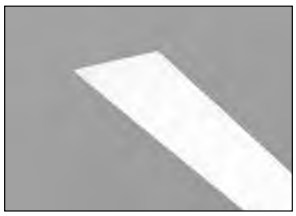
WARRANTY: 10-year performance-based warranty on all standard components. Optional accessories such as emergency battery packs are covered by their individual manufacturer warranties.

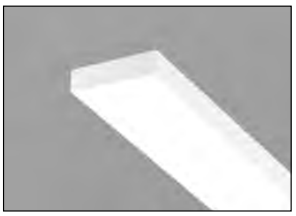
[6] Consult Finelite for Generator Transfer Device and Battery Backup fit
[7] 20 business days lead time for color
[8] Excludes Battery Backup and Generator Transfer Device weight

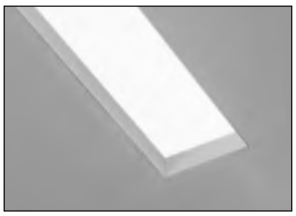
FINELITE® Lighting

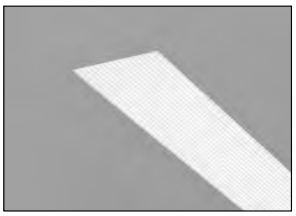
High Performance 4" Aperture (HP-4) Recessed

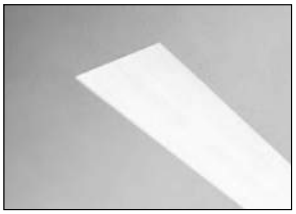
AESTHETIC OPTIONS

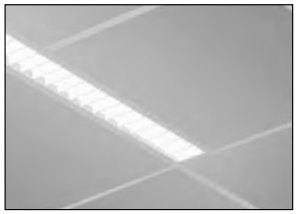

Flush Diffuser (**F**)

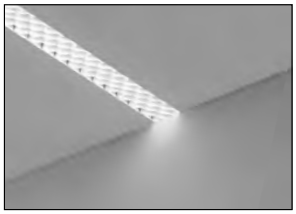

1" Drop Down Lens (**DL**)

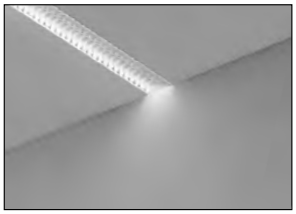

Flat Diffuser with 1" Regressed (**RG-D**)

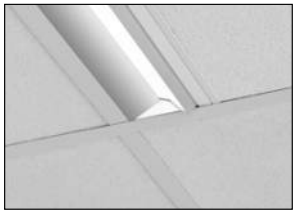

Downlight Spread Optic (**DSO**)
Externally flush


Downlight Asymmetric Optic (**DAO**)
Externally flush


White Cross Blade Baffle[1] (**RG-WCB**)


Hex Louver[1] (**RG-LHC**)

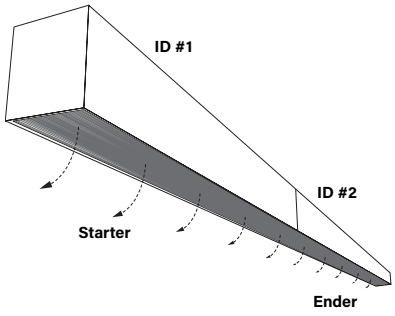

Hollowed Ellipse Louver[1] (**RG-LHE**)


Kicker (**K**) - Wall Wash only

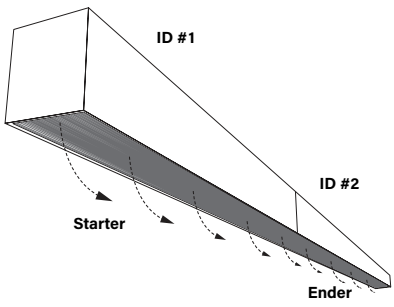
DOWNLIGHT ASYMMETRIC OPTIONS

Use this tool to understand how to specify Downlight Asymmetric for your project. The diagrams below show a linear run from power feed to ender. Specify DAO-L distributes light to the left or DAO-R distributes light to the right.

Downlight Asymmetric Optic Left (DAO-L)



Downlight Asymmetric Optic Right (DAO-R)



PREINSTALLED LABEL

For DAO, Preinstalled label on diffuser shows direction of light. Remove after installation.

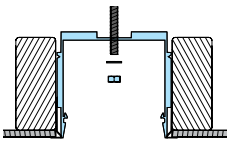
[1] Regressed only

FINELITE® Lighting

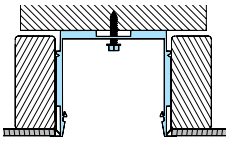
High Performance 4" Aperture (HP-4) Recessed

HARD CEILING MOUNTING OPTIONS

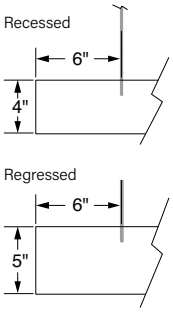
Threaded Rod Option



Screw Mount Option

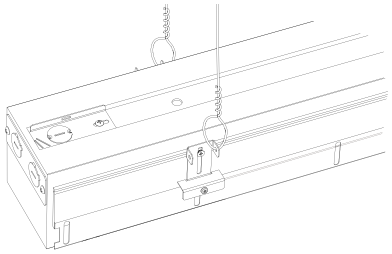


Mounting Location for Securing to Structure



Two mounting options: threaded rod and screw mounting options. Mounting locations are located on each end of the luminaire. Mounting location is 6" away from each end of luminaire.

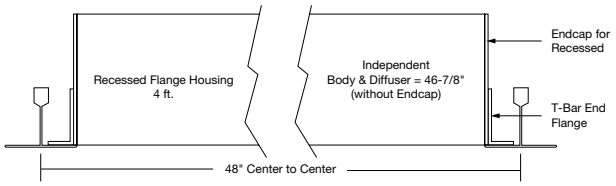
T-BAR INSTALLATION



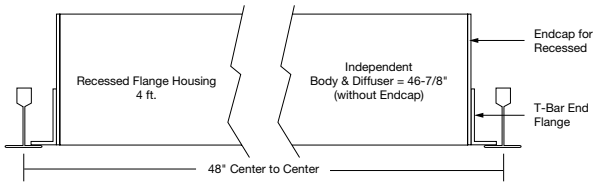
HP-4 R for T-Bar installations comes standard with a splice plate at the end of the luminaire. Mounting brackets (supplied) secure the luminaire to T-Bar and provide support to structure location. All even foot length (2, 4, 6, ...) luminaire runs are reduced in length by an appropriate amount to fit within typical 2x2 and 2x4 T-Bar grid systems. For uncommon T-Bar systems please consult factory.

GRID LENGTH DETAIL - 4' EXAMPLE

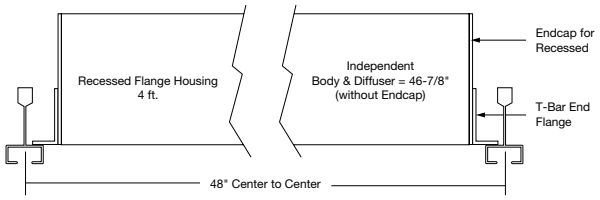
1" T-Bar



9/16" T-Bar

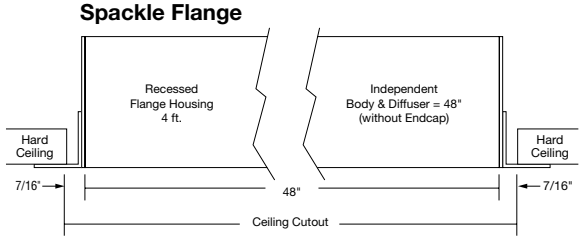


9/16" Screw Slot

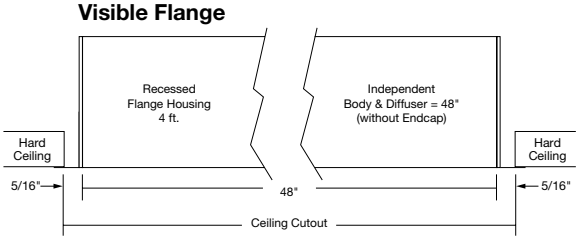


HARD CEILING LENGTH DETAIL - 4' EXAMPLE

Spackle Flange



Visible Flange

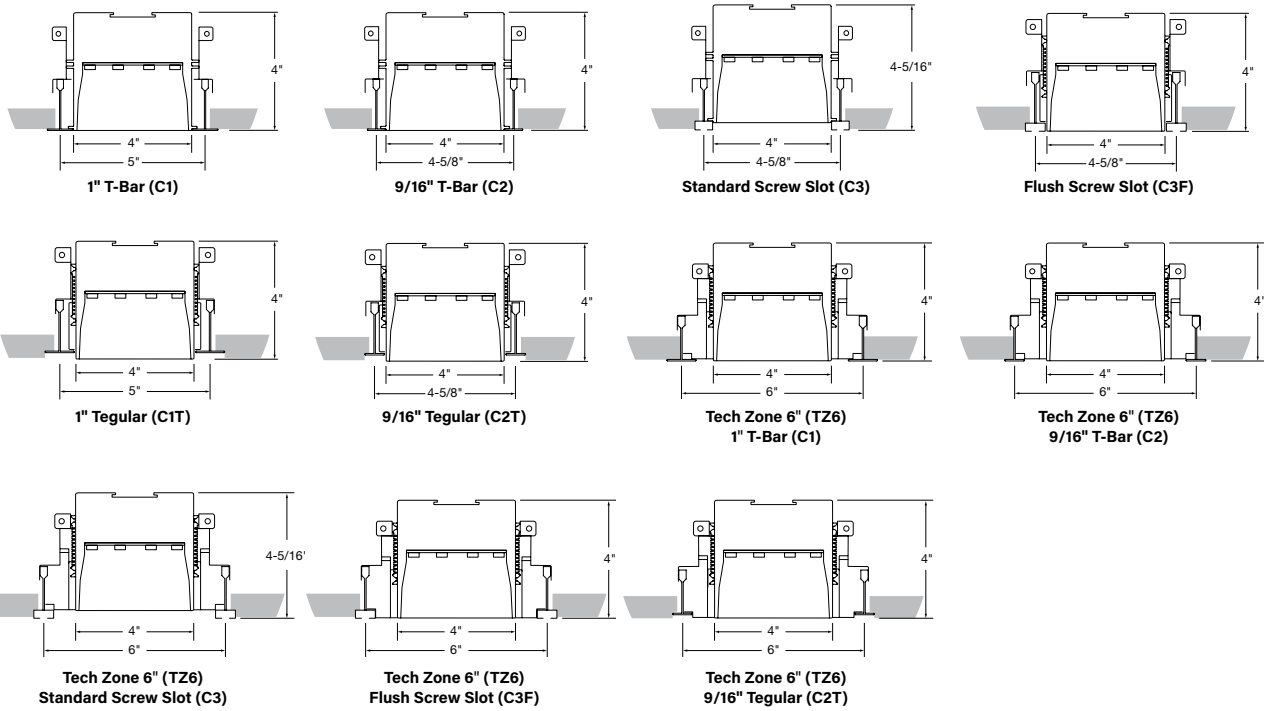


FINELITE® Lighting

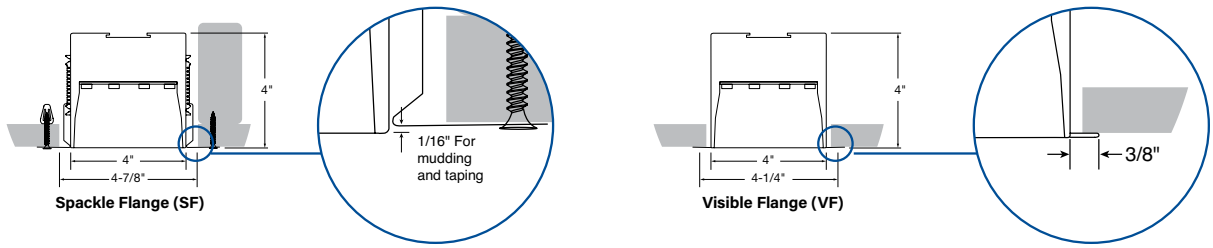
High Performance 4" Aperture (HP-4) Recessed

RECESSED MOUNTING TYPES - T-BAR

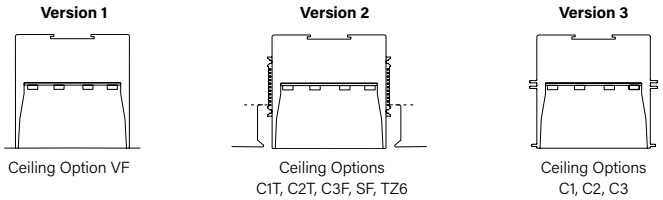
Rough-In Dimensions



RECESSED MOUNTING TYPES - CUTOUT DIMENSIONS



HOUSING



Note: +/- 1/16"

the lighting practice

Catalog Information: HP-4-R-D-[LENGTH]-H-935-F-95LF-[VOLTAGE]-SC-FC-10%-[GRID]-FE-[FINISH]

Date: 09/30/2022

Fixture Type:

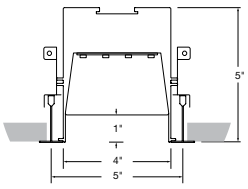
A1

FINELITE® Lighting

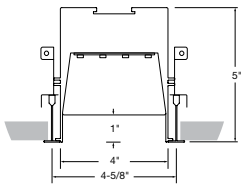
High Performance 4" Aperture (HP-4) Recessed

REGRESSED MOUNTING TYPES - T-BAR

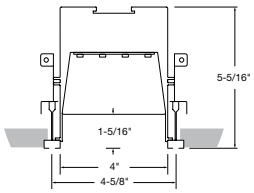
Rough-In Dimensions



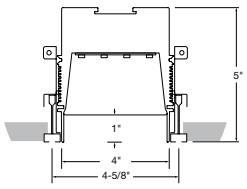
1" T-Bar (C1)



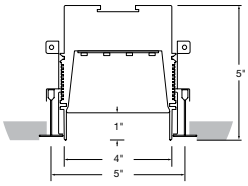
9/16" T-Bar (C2)



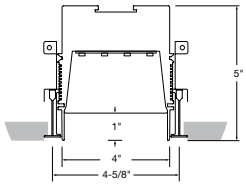
Standard Screw Slot (C3)



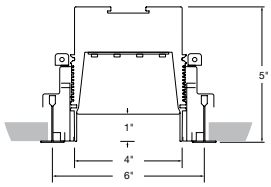
Flush Screw Slot (C3F)



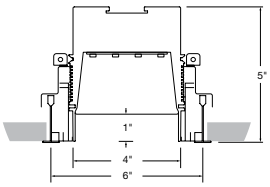
1" Tegular (C1T)



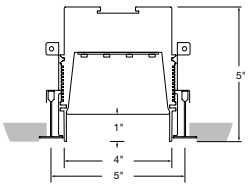
9/16" Tegular (C2T)



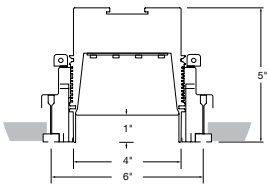
Tech Zone 6" (TZ6)
1" T-Bar (C1)



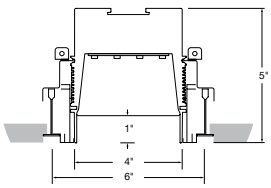
Tech Zone 6" (TZ6)
9/16" T-Bar (C2)



Tech Zone 6" (TZ6)
Standard Screw Slot (C3)

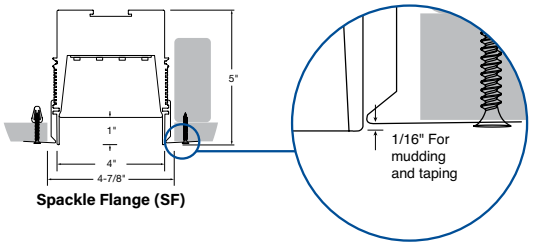


Tech Zone 6" (TZ6)
Flush Screw Slot (C3F)

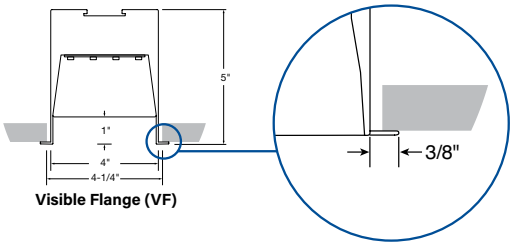


Tech Zone 6" (TZ6)
9/16" Tegular (C2T)

REGRESSED MOUNTING TYPES - CUTOUT DIMENSIONS



Spackle Flange (SF)

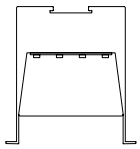


Visible Flange (VF)

Regressed Lens: Regressed lens version is 5" tall with a lens that is regressed 1" from ceiling line.

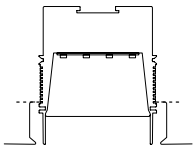
HOUSING

Version 1



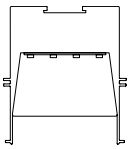
Ceiling Option VF

Version 2



Ceiling Options
C1T, C2T, C3F, SF, TZ6

Version 3



Ceiling Options
C1, C2, C3

Note: +/- 1/16"

Submitted by:	
Type:	ect:
Ordering Info:	

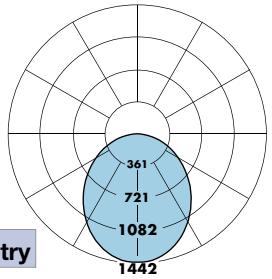
FINELITE® Lighting

High Performance 4" Aperture (HP-4) Recessed

Recessed Photometry - 4' Luminaire 3500K

HP4-R-D-4'-V-835
Downlight: Flush Diffuser

Efficacy: 101 lm/W
Total luminaire output: 3726 lumens (932 lm/ft)
37 watts (9.3 W/ft)
Peak Candela Value: 1442 @ 0º
CRI: 80 / CCT: 3500K
ITL LM79 Report 85128



Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire			
S [1]	B [1]	H [1]	V [2]
1525	1917	2898	3726

Light Output, 3500K, 80 CRI (Lumens Per Foot)			
S [1]	B [1]	H [1]	V [2]
381	479	725	932

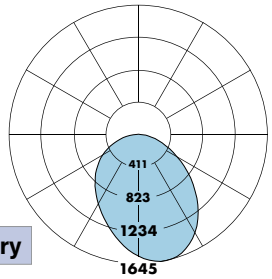
Power, 3500K (Watts Per Foot)			
S [1]	B [1]	H [1]	V [2]
3.6	4.6	7.1	9.3

Efficacy, 3500K, 80 CRI (Lumens Per Watt)			
S [1]	B [1]	H [1]	V [2]
105	104	102	101

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL reports: 85128

HP4-R-D-4'-V-835-DAO
Downlight: Downlight Asymmetric Optic

Efficacy: 109 lm/W
Total luminaire output: 3884 lumens (971 lm/ft)
35.6 watts (8.9 W/ft)
Peak Candela Value: 1645 @ 12.5º
CRI: 80 / CCT: 3500K
ITL LM79 Report 94331



Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire			
S [1]	B [1]	H [1]	V [2]
1590	1999	3021	3884

Light Output, 3500K, 80 CRI (Lumens Per Foot)			
S [1]	B [1]	H [1]	V [2]
397	500	755	971

Power, 3500K (Watts Per Foot)			
S [1]	B [1]	H [1]	V [2]
3.5	4.4	6.8	8.9

Efficacy, 3500K, 80 CRI (Lumens Per Watt)			
S [1]	B [1]	H [1]	V [2]
114	113	111	109

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL reports: 94331

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**), 4000K, 90 CRI
Lumen Adjustment Factor: 0.789
Total Light Output: 3021 lm x 0.789 = 2384 lm
Total Light Output per Foot: 755 lm/ft x 0.789 = 596 lm/ft.
watts/foot: 6.8 W/ft.

$$\textbf{Efficacy} = \frac{596\ \frac{\text{lm}}{\text{ft.}}}{6.8\ \frac{\text{W}}{\text{ft.}}} = 88\ \text{lm/W}$$

Submitted by:	
Type:	ect:
Ordering Info:	

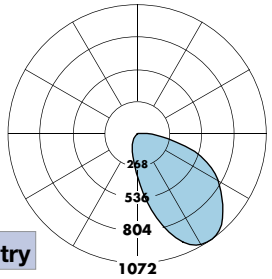
FINELITE® Lighting

High Performance 4" Aperture (HP-4) Recessed

Recessed Photometry - 4' Luminaire 3500K

HP4-R-WW-D-K-4'-V-835
Downlight: With Kicker

Efficacy: 92 lm/W
Total luminaire output: 1816 lumens (454 lm/ft)
21.5 watts (5.4 W/ft)
Peak Candela Value: 1072 @ 35°
CRI: 80 / CCT: 3500K
ITL LM79 Report 85130



Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire			
S [1]	**B [1]**	**H [1]**	**V [2]**
743	935	1412	1816

Light Output, 3500K, 80 CRI (Lumens Per Foot)			
S [1]	**B [1]**	**H [1]**	**V [2]**
186	234	353	454

Power, 3500K (Watts Per Foot)			
S [1]	**B [1]**	**H [1]**	**V [2]**
2.0	2.5	3.8	5.0

Efficacy, 3500K, 80 CRI (Lumens Per Watt)			
S [1]	**B [1]**	**H [1]**	**V [2]**
91	92	92	92

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL reports: 85130

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

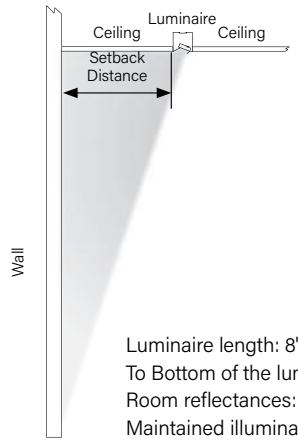
High Output (**H**), 4000K, 90 CRI
Lumen Adjustment Factor: 0.789
Total Light Output: 1412 lm x 0.789 = 1114 lm
Total Light Output per Foot: 353 lm/ft x 0.789 = 279 lm/ft.
watts/foot: 3.8 W/ft.

$$\textbf{Efficacy} = \frac{279\ \frac{\text{lm}}{\text{ft.}}}{3.8\ \frac{\text{W}}{\text{ft.}}} = 73\ \text{lm/W}$$

High Performance 4" Aperture (HP-4) Recessed

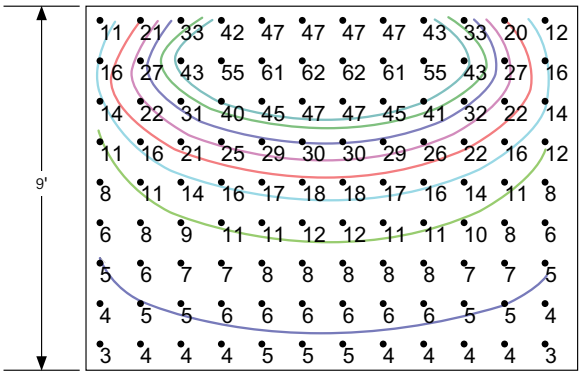
WALL WASH RECESSED - SETBACK INFO AND APPLICATION DATA

HP4-R-WW-D-K-4'-V-835
Downlight: With Kicker
Total luminaire output: 1450 lumens (363 lm/ft)
19.1 watts (4.8 W/ft)
CRI: 80 / CCT: 3500K



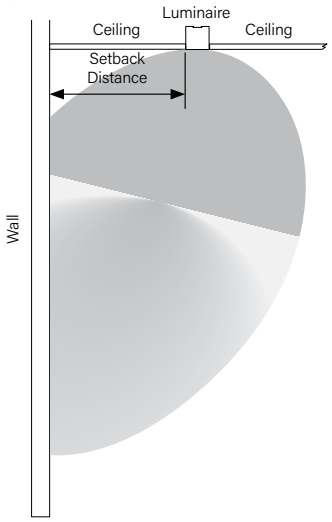
Luminaire length: 8'
To Bottom of the luminaire: 9'-0"
Room reflectances: 80-50-20
Maintained illuminance levels: LLF 0.90"

Setback Distance - 2'

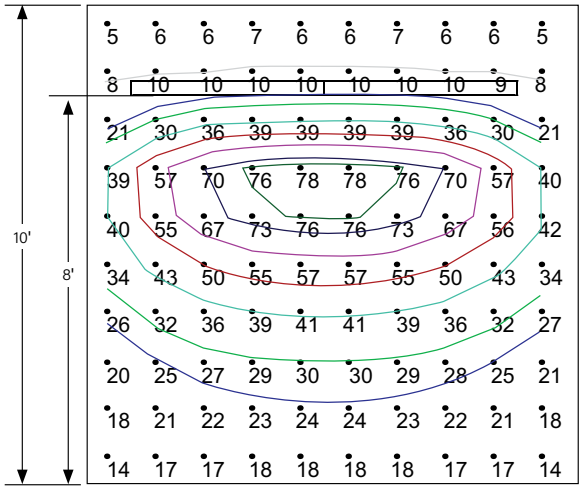


DOWNLIGHT ASYMMETRIC OPTIC - SETBACK INFO AND APPLICATION DATA

HP4-R-D-4ft-V-835-DAO
Downlight: DAO
Total luminaire output: 3884 lumens (971 lm/ft)
35.6 watts (8.9 W/ft)
CRI: 80 / CCT: 3500K



Setback Distance - 2'



Catalog Information: HP-4-R-D-[LENGTH]-H-935-F-95LF-[VOLTAGE]-SC-FC-10%-[GRID] -FE-[FINISH]

Date: 09/30/2022
Fixture Type:

A1

FINELITE® Lighting

0-10V Tunable White

Finelite's award-winning, contractor friendly Tunable White luminaires are available at low cost, with powerful and simple 0-10V tuning and intensity controls.

TUNABLE WHITE FEATURES

- CCT range: 2700K - 6500K
- Dimming Range: 100% to 10%
- CRI Options: 80 CRI or 90 CRI

LUMINAIRE FAMILY MODIFICATIONS/RESTRICTIONS

	Section Lengths									
Recessed Direct	2'	3'	4'	5'	6'	7'	8'	9'	10'	11'	12'
Output S,B,H,V Single Circuit	Rows can be comprised of 2'-12' sections. Tailored lengths available.										
Integral Battery Backup (BSL310LP)							✓		✓		✓

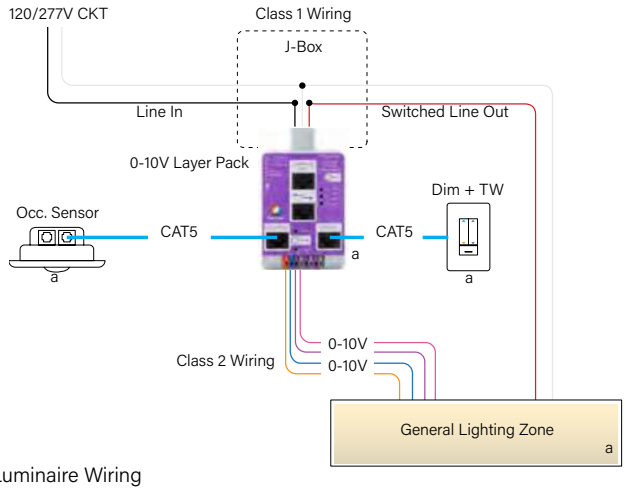
PHOTOMETRY

Apply a power adjustment factor to calculate wattage usage

POWER	CONVERSION FACTOR
	1.1X

(Example: a 50 watt luminaire in static white would draw 55 watts using 0-10V Tunable White)

WIRING DIAGRAM - DIMMABLE TO 10%

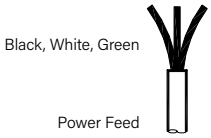


Luminaire Wiring

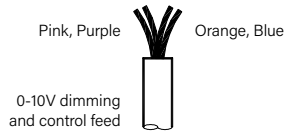
- **Purple** (+) / **Pink** (-) control wires are for intensity control
- **Orange** (+) / **Blue** (-) control wires are for Tunable White control

Note:
Load or Dim to Off options available.

DUAL FEED DETAIL



WIRING LEGEND		
Black	Hot	Line Voltage
White	Neutral	Line Voltage
Green	Ground	



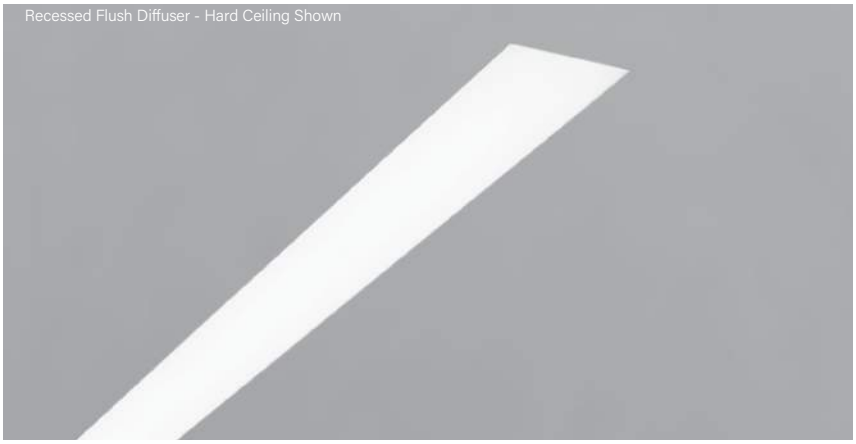
WIRING LEGEND		
Pink	Dimming	0-10V DC
Purple	Dimming	0-10V DC
Orange	TW	0-10V DC
Blue	TW	0-10V DC

Tunable White LUMINAIRES

Submitted by:	
Type:	ect:
Ordering Info:	

FINELITE® Lighting

High Performance 4" Aperture (HP-4) Recessed



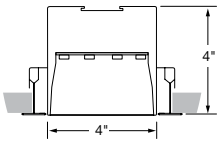
High Performance 4" Aperture is a patented, linear LED luminaire family. HP-4 delivers excellent performance using an advanced optical design and mid-power LEDs. Achieving 90% of initial light output at 100,000+ hours and backed by a 10-year performance-based warranty on all standard components.

This product is enrolled in the International Living Future Institute (ILFI) Declare 2.0 Program and is third-party verified with options achieving **Red List Approved** and **Declared** status.

Note: see page 6 for all aesthetic options

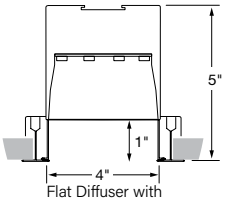
CROSS SECTIONS

Recessed



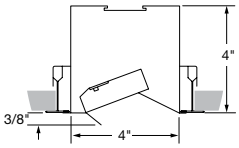
Flush Downlight Diffuser (standard)

Regressed



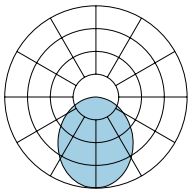
Flat Diffuser with 1" Regressed

Wall Wash Recessed

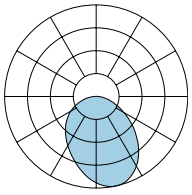


Kicker (standard)

OPTIC OPTIONS



Standard Downlight Optic (**F**)



Downlight Asymmetric Optic (**DAO**)

ALSO AVAILABLE IN

Pendant (**D, ID, I**)

Wall Mount (**WM**)

Surface Mount (**SM**)

Protected by one or more US Patents: 8915613; D702,391; D702,390; D700,732

the lighting practice

Catalog Information: HP-4-R-D-[LENGTH]-H-935-F-95LF-[VOLTAGE]-SC-FC-10%-SF-FE-[FINISH]

Date: 09/30/2022
Fixture Type:

A1A

Submitted by:	
Type:	ect:
Ordering Info:	

FINELITE® Lighting

Clear Form

High Performance 4" Aperture (HP-4) Recessed

BODY TYPE

Platform	Series Name	Luminaire Type	Luminaire Distribution	Total Length of Run
◉ HP - High Performance	◉ 4	◯ R - Recessed ◯ R RG - Recessed Regressed (Wall Wash not available)	◯ D - Direct ◯ WW-D - Wall Wash Direct	_____ Minimum 2' section length. Increments accurate to 1/16" (±1/32"), standard. 12' maximum section length.

OUTPUT and LED TYPE

Downlight Output (Flush)	LED CRI/CCT
◯ S - Standard (381 lm/ft) ◯ B - Boosted (479 lm/ft) ◯ H - High (725 lm/ft) ◯ V - Very High (932 lm/ft) ◯ TL - Tailored:_____ lm/ft* * Specify lm/ft of outputs between Standard (S) and Very High (V). Consult factory for tailored lumen output outside of this range.	◯ 830 - 80 CRI, 3000K ◯ 835 - 80 CRI, 3500K ◯ 840 - 80 CRI, 4000K ◯ 930 - 90 CRI, 3000K ◯ 935 - 90 CRI, 3500K ◯ 940 - 90 CRI, 4000K ◯ 8TW - 80 CRI, Tunable White ◯ 9TW - 90 CRI, Tunable White

MECHANICAL/OPTICAL OPTIONS

Downlight	Reflector System
◯ F - Flush (standard) ◯ DL - 1" Drop Down Lens ◯ DSO - Downlight Spread Optic [2,8] ◯ DAO-L - Downlight Asymmetric Optic Left [2,8] ◯ DAO-R - Downlight Asymmetric Optic Right [2,8] ◯ FO - Fully Open for Wall Wash only ◯ K - Kicker for Wall Wash only [3] ◯ RG-D - Flat Diffuser with 1" Regress [1] ◯ RG-WCB - White Cross Blade Baffle [1] ◯ RG-LHE - Hollowed Ellipse Louver [1] ◯ RG-LHC - Hex Louver [1]	◯ 96LG - 96 Low Gloss White ◯ SSA - Semi-Specular Aluminum for Wall Wash only

ELECTRICAL OPTIONS

Voltage	Circuiting [4]
◯ 120 - 120 Voltage ◯ 277 - 277 Voltage ◯ 347 - 347 Voltage	◉ SC - Single Circuit* * Battery, Night Light, and Emergency to Generator circuits are in addition to the normal luminaire circuit(s)

ELECTRICAL OPTIONS

Driver Selection

0-10V Driver Options
- ◯ FC-10% - 0-10V 10% [5] (standard)
- ◯ FC-1% - 0-10V 1% [5]
- ◯ OSR-10% - Osram OTi, 0-10V 10% [5]
- ◯ OSR-1% - Osram OTi, 0-10V 1% [5]
- ◯ ELD-10V-0% - EldoLED SOLOdrive, 0-10V 0.1%
- ◯ OSR-10V-TW - Osram OTi, 0-10V 10% *(Tunable White)* [5]

DALI Driver Options
- ◯ FC-DALI-1% - DALI 1%
- ◯ OSR-DALI-1% - Osram Dexal, 1%
- ◯ ELD-DALI-0% - EldoLED SOLOdrive, 0.1%
- ◯ ELD-DALI-TW - EldoLED DUALdrive LightShape, 0.1% *(Tunable White)*

DMX Driver Options
- ◯ FIN-DMX - Finelite DMX 1% *(Tunable White - FineTune Controls Only)* [6]
- ◯ ELD-DMX - EldoLED POWERdrive, 0.1%
- ◯ ELD-DMX-TW - EldoLED POWERdrive, 0.1% *(Tunable White)*

Lutron Driver Options
- ◯ LUT-ES1 - Lutron, Ecosystem 1%
- ◯ LUT-2W - Lutron, 2-wire (120V only) 1%
- ◯ LUT-TW - Lutron T-Series, EcoSystem 0.1% *(Tunable White)*

See Page 3 for additional driver options and details

MOUNTING OPTIONS

Ceiling Hardware Type

- ◯ C1 - 1" T-Bar
- ◯ C1T - 1" Tegular
- ◯ C2 - 9/16" T-Bar
- ◯ C2T - 9/16" Tegular
- ◯ C3 - Screw Slot
- ◯ C3F - Flush Screw Slot
- ◯ SF - Spackle Flange
- ◯ VF - Visible Flange
- ◯ TZ6 - Tech Zone 6" _____ (C1, C2, C2T, C3, C3F)

OTHER OPTIONS

Endcap Style	Finish	Emergency Style (Optional) Clear Selection	Integrated Sensor (Optional) Clear Selection	Special Options (Optional) Clear Selection
◉ FE - Flat Endcap (standard)	◯ SW - Signal White (standard) ◯ FB - Finelite Black ◯ SA - Satin Aluminum ◯ #### - RAL Color Code [7]	◯ LGD18W - Legrand 18W Brand Battery Back-up ◯ LGD10W - Legrand 10W Brand Battery Back-up ◯ EM/GEN - Emergency to Generator ◯ NL - Night Light ◯ BSL722 - Bodine Battery Back up ◯ BSL310LP - Bodine Battery Back up Low Profile ◯ GTD - Generator Transfer Device ◯ ALCR - Automatic Load Control Relay	◯ OBO - Occupancy [8] ◯ OBD - Daylight [8] ◯ W601 - Wattstopper Wireless [10] Sensor ◯ OBE - Enlighted [9] ◯ REE - Remote Enlighted [11]	◯ CP - Chicago Plenum ◯ FLX - Flex Whip ◯ RLA - Red List Approved ◯ RLD - Declared

[1] Recessed Regressed only
[2] Not available with Regressed or Curves
[3] Kicker standard in Signal White. Customer Custom color kickers have a surcharge
[4] Contact factory for switching options
[5] Add DTO to gain "Dim to Off" functionality (FC-10% - DTO)
[6] B & V outputs only
[7] 20 business days lead time for color
[8] Not available with Wall Wash
[9] Enlighted components installed by Finelite, provided by others
[10] LMFS-601 w/ 0-10V driver(s) and LMFI-111, up to 6 drivers may be connected. LMFS-601 w/ Dali driver, only 1 driver can be connected
[11] Enlighted for Wall Wash fixtures. Enlighted Control Unit & Sensor Cable installed for Remote mounting sensor.

the lighting practice

Catalog Information: HP-4-R-D-[LENGTH]-H-935-F-95LF-[VOLTAGE]-SC-FC-10%-SF-FE-[FINISH]

Date: 09/30/2022
Fixture Type:

A1A

FINELITE Lighting

High Performance 4" Aperture (HP-4) Recessed

SUPPLEMENTARY DRIVER PAGE

0-10V Driver Options	
FC-10%	Factory Choice, 0-10V 10% Dimming (Linear)
FC-10%-DTO	Factory Choice, 0-10V 10% Dimming, Dim-to-Off (Linear)
FC-1%	Factory Choice, 0-10V 1% Dimming (Linear)
FC-1%-DTO	Factory Choice, 0-10V 1% Dimming, Dim-to-Off (Linear)
ELD-10V-0%	EldoLED SOLOdrive, 0-10V 0.1% Dimming (Linear)
ELD-10V-1%	EldoLED ECOdrive, 0-10V 1% Dimming (Linear)
OSR-10V-TW	Osram OTi, 0-10V 10% Dimming, *Tunable White* (Linear)
OSR-10V-TW-DTO	Osram OTi, 0-10V 10% Dimming, Dim-to-Off, *Tunable White* (Linear)
OSR-10%	Osram OTi, 0-10V 10% Dimming (Linear)
OSR-10%-DTO	Osram OTi, 0-10V 10% Dimming, Dim-to-Off (Linear)
OSR-1%	Osram OTi, 0-10V 1% Dimming (Linear)
OSR-1%-DTO	Osram OTi, 0-10V 1% Dimming, Dim-to-Off (Linear)

DALI Driver Options	
FC-DALI-1%	Factory Choice, DALI 1% Dimming (Logarithmic)
OSR-DALI-1%	Osram Dexal, DALI 1% Dimming (Logarithmic)
ELD-DALI-0%	EldoLED SOLOdrive, DALI 0.1% Dimming (Logarithmic)
ELD-DALI-1%	EldoLED ECOdrive, DALI 1% Dimming (Logarithmic)
ELD-DALI-TW	EldoLED DUALdrive Light Shape, DALI 0.1% Dimming, *Tunable White* (Logarithmic Dimming, Linear CCT Control)

DMX Driver Options	
FIN-DMX	Finelite, DMX 1% Dimming, *Tunable White* - **FineTUNE Controls Only** (Linear)
ELD-DMX	EldoLED POWERdrive, DMX 0.1% Dimming (8 Bit, 1CH) (Linear)
ELD-DMX-16	EldoLED POWERdrive, DMX 0.1% Dimming (16 Bit, 2CH) (Linear)
ELD-DMX-TW	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (8 Bit, 2CH - CH1 Warm / CH2 Cool) (Linear)
ELD-DMX-TW16	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (16 Bit, 4CH - CH1, 2 Warm / CH3, 4 Cool) (Linear)

Lutron Driver Options	
LUT-ES1	Lutron, Ecosystem 1% Dimming
LUT-2W	Lutron, 2-wire (120V only) 1% Dimming
LUT-TW	Lutron T-Series, EcoSystem 0.1% Dimming, *Tunable White*

Submitted by:	
Type:	ect:
Ordering Info:	

FINELITE® Lighting

High Performance 4" Aperture (HP-4) Recessed

SPECIFICATIONS

BODY TYPE

CONSTRUCTION: Precision-cut 6061-T6 extruded aluminum body. Internal joiner system, plug-together wiring, standard.

LENGTHS: Any length, 2' minimum, in increments down to 1/16" (±1/32"). 12' maximum section length. Hollowed Ellipse Louver (**LHE**), Hex Louver (**LHC**), and White Cross Blade Baffle (**WCB**) are available in 1' increments.

MITERED CORNERS[1]: Illuminated corners of greater than 60° and less than 180° in a single plane, available with Flush Diffuser, Bottom Glow Diffuser, Regressed Diffuser, White Cross Blade Baffle[2] or Wall Wash. Corners not available with Wall Wash (**WW-D**), Hollowed Ellipse Louver (**LHE**), Hex Louver (**LHC**) or 1" Drop Down Lens. Consult factory for tailored lighting options.

OUTPUT AND LED TYPE

LIGHT OUTPUT: Four lumen packages available, Standard (**S**), Boosted Standard (**B**), High (**H**), and Very High (**V**). For lengths 3' and greater, the uplight and downlight can be specified with different lumen packages and dual controls. For Tailored Outputs outside of range from Standard (**S**) to Very High (**V**), consult factory. Light engines are replaceable.

MECHANICAL/OPTICAL OPTIONS

DOWNLIGHT OPTION: 12' maximum diffuser length. Flush frost white snap-in diffuser standard, 73% transmissive, 99% diffusion. Internal secondary diffusers at corners ensure visually seamless, uniform, continuous illumination. Available with Flush (**F**), 1" Drop Down Lens (**DL**), White Cross Blade Baffle (**WCB**)[3,4], Ellipse Louver (**LHE**)[3], Hex Louver (**LHC**)[3], Downlight Spread Optic (**DSO**), Downlight Asymmetric Optic Left and Right (**DAO-L, DAO-R**), and Regressed downlight diffusers (**RG**)[3]. 1" Drop Down Lens made of acrylic. Available with a solid endcap or an endcap with a diffuse filler to continue the luminous aesthetic. Downlight Spread Optic (**DSO**) & Downlight Asymmetric Optic (**DAO**) are an extruded lenses with a subtle ribbed appearance providing desired improved optical performance. Consult factory for more tailored lumen outputs.

LUMEN MAINTENANCE: 90% of initial light output (L90) at 100,000+ hours; 70% of initial light output (L70) at 200,000+ hours.

REFLECTORS: Die-formed 20-gauge cold-rolled steel reflectors finished in 96LG High Reflectance white powder coat paint. The standard Semi-Specular Aluminum (**SSA**) Kicker (**K**) reflector delivers light high on the vertical surface. The Kicker reflector can be easily removed for open distribution (**FO**).

ELECTRICAL OPTIONS

STATIC WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed wire controlling uplight and downlight together (power and dimming). Specify dual feed wires for independent control of uplight and downlight. 14-gauge feed wire used when luminaire current exceeds 5 amps.

TUNABLE WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed. 14-gauge feed used when luminaire current exceeds 5 amps. DMX and power feed at same location (standard). DMX feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths.

STATIC WHITE DRIVER: Replaceable 120V, 277V, and 347V constant current reduction dimming driver standard. Can be wired dimming or non-dimming. 0-10V dimming controls with a range of 10%- 100% standard. Dimming to 1% available. Separate dimming for uplight and downlight available. Driver is fully accessible from below the ceiling.
- **Power Factor:** ≥ 0.9
- **Total Harmonic Distortion (THD):** <20%
- **Expected driver lifetime:** 100,000 hours

LUTRON DRIVER OPTIONS:
- **LUT-ES1 (LDE1)** - (Hi-lume 1% EcoSystem with Soft-On, Fade-to-Black dimming (LDE1 series))
- **LUT-2W (LTEA2W)** - (Hi-lume 1% 2-wire, 120V forward phase dimming (LTEA series)).

TUNABLE WHITE DRIVER: Replaceable LED driver. Driver is accessible from below the ceiling. 120V, 277V, and 347V.
- **Power factor:** ≥0.90
- **Total Harmonic Distortion (THD):** <20%
- **Dimming Range:** 100%-10%
- **Expected driver lifetime:** 100,000 hours
- **FineTune DMX:** 1%

LUTRON TUNABLE WHITE DRIVER OPTION:
LUT-TW (0.1% T-Series 2-Channel Digital Tunable White (PSQ Series)).

MOUNTING OPTIONS

HANGING HARDWARE:
- **Recessed T-Bar:** Standard bracket design works with most lay-in ceiling types. Brackets secure luminaire to the ceiling grid from above. Tie-in T-Bar brackets connect the luminaire to the T-Bar for securing to structure. Consult local codes for tie-wire recommendations.
- **Recessed Spackle Flange:** Drywall surfaces (walls or ceilings): 1/4" - 20 stud and nut (provided by others). Mounted with three equidistant suspension points.

Continued

[1] Not available with Wall Wash
[2] White Cross Blade (WCB) baffles not available with custom angles. Available in 90 degrees only
[3] Recessed-Regressed only
[4] White Cross Blade Baffle (WCB) currently not advisable for drywall

FINELITE Lighting

High Performance 4" Aperture (HP-4) Recessed

SPECIFICATIONS

TUNABLE WHITE DMX HANGING HARDWARE: For grid ceiling applications the dual GridBox™ mounting is supplied (standard). For hard ceiling applications the ceiling mounting box is supplied (standard). DMX feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths. Available DMX pendant feed lengths are 5' (standard), 12', and 30'.

TUNABLE WHITE DMX INTERCONNECTION CABLES: Luminaires are pre-wired with plug-and-play interconnection cables to support easy plug-together joining of fixture runs. If a non-FineTune DMX system has been specified, a DMX to RJ45 converter is provided.

OTHER OPTIONS

ENDCAPS: Flat endcaps (**FE**) at each end of run add 1/16" to each end of luminaire. Drop Down Lens Illuminated Endcap (**DE**) includes diffuse element to continue luminance of drop lens.

EMERGENCY STYLE: Optional emergency to generator/inverter wiring, internal generator transfer switch, nightlight wiring, step-dimming driver, backup battery.

Backup Battery		
	Legrand 18W	**Legrand 10W/ Bodine BSL310LP**
HP4-R-D		
Min. Housing Length	8'	4'
EM Lumen Output	1854	1102
EM Section Illum.	2'	2' or 4'
HP4-R-WW-D		
Min. Housing Length	8'*	4'*
EM Lumen Output	2000	1189
EM Section Illum.	4'	4'

* Minimum fixture housing length for battery pack approved without sensor

Bodine GTD and Legrand ALCR Min. Length	
Configuration	**Min Length**
Generator	D-2'
Generator + OCC	D-2'
Daylight	D-2'
Generator + Daylight	D-2'

TUNABLE WHITE ELECTRICAL OPTIONS[6]:
- **TW Driver Options 0-10V:** EM/GEN, GTD or Battery Back up
- **FineTune DMX:** EM/GEN or Battery Back up
- **DMX:** Battery Back up
- **DALI:** EM/GEN, GTD or Battery Back up
- **LUTRON:** EM/GEN, GTD or Battery Back up

INTEGRATED SENSORS: Integrated PIR (Passive Infrared) Occupancy (**OBO**) or Daylight Sensors (**OBD**) available with Flush and Bottom Glow downlight diffusers. PIR sensors not recommended for stairwell applications. Refer to Occupancy Sensor & Daylight Sensor tech sheet and the Embedded Intelligence landing page for more information and additional sensor options.

FINISHES: Finelite Signal White (**SW**) powder coat, Finelite Black (RAL 9005) with semi gloss fine texture (**FB**), and Satin Aluminum (**SA**) are standard. Optional Adder: 185 RAL colors[7] are available.

LABELS: Luminaire and electrical components are ETL-listed conforming to UL 1598 in the U.S.A. and CAN/CSA C22.2 No. 250.0 in Canada. In accordance with NEC Code 410.130 (G), this luminaire contains an internal driver disconnect. UL 924 and UL 2108 - PoE options available on request.These fixtures are rated for Damp Location. IC Rated. Finelite products use electronic components that are RoHS compliant, and the mechanical components of the luminaire have been verified to not knowingly contain any restricted substances listed per RoHS Directive 2015/863. Consult factory for tailored lighting options. Finelite makes the specification process easy when putting healthier products on your projects. Simply add – **RLA** (Red List Approved) or – **RLD** (Declared Label) to your part number.

WEIGHT[8]: R - 2.8 lb/ft; WW-R - 2.9 lb/ft

DLC QUALIFIED: Configurations of this product are listed on the DLC Qualified Products List (QPL). www.designlights.org/search

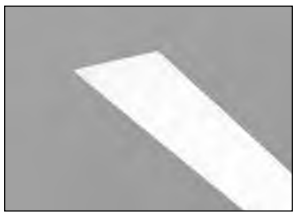
WARRANTY: 10-year performance-based warranty on all standard components. Optional accessories such as emergency battery packs are covered by their individual manufacturer warranties.

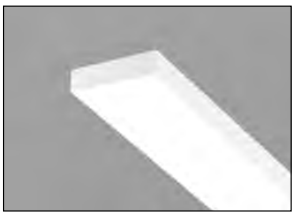
[6] Consult Finelite for Generator Transfer Device and Battery Backup fit
[7] 20 business days lead time for color
[8] Excludes Battery Backup and Generator Transfer Device weight

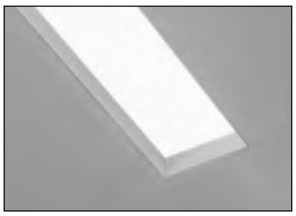
FINELITE® Lighting

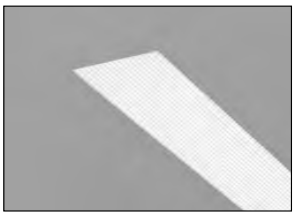
High Performance 4" Aperture (HP-4) Recessed

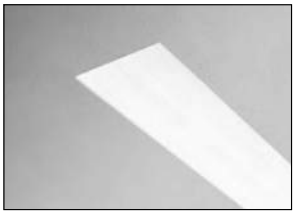
AESTHETIC OPTIONS

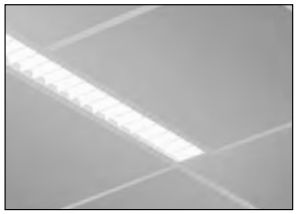

Flush Diffuser (**F**)

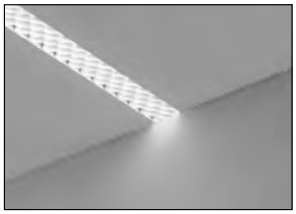

1" Drop Down Lens (**DL**)

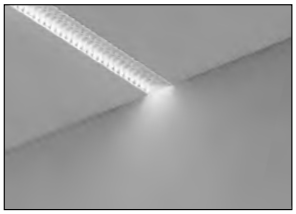

Flat Diffuser with 1" Regressed (**RG-D**)

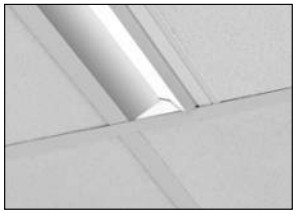

Downlight Spread Optic (**DSO**)
Externally flush


Downlight Asymmetric Optic (**DAO**)
Externally flush


White Cross Blade Baffle[1] (**RG-WCB**)


Hex Louver[1] (**RG-LHC**)

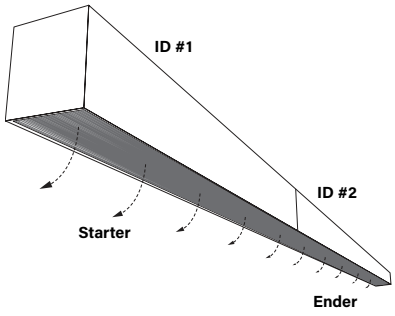

Hollowed Ellipse Louver[1] (**RG-LHE**)


Kicker (**K**) - Wall Wash only

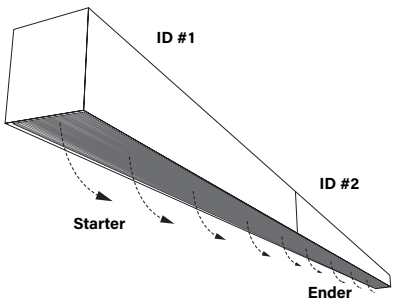
DOWNLIGHT ASYMMETRIC OPTIONS

Use this tool to understand how to specify Downlight Asymmetric for your project. The diagrams below show a linear run from power feed to ender. Specify DAO-L distributes light to the left or DAO-R distributes light to the right.

Downlight Asymmetric Optic Left (DAO-L)



Downlight Asymmetric Optic Right (DAO-R)



PREINSTALLED LABEL

For DAO, Preinstalled label on diffuser shows direction of light. Remove after installation.

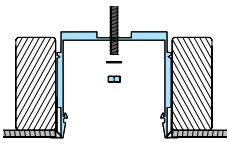
[1] Regressed only

FINELITE® Lighting

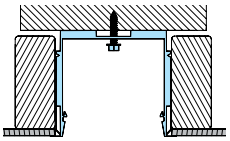
High Performance 4" Aperture (HP-4) Recessed

HARD CEILING MOUNTING OPTIONS

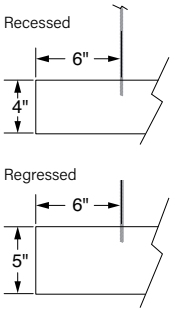
Threaded Rod Option



Screw Mount Option

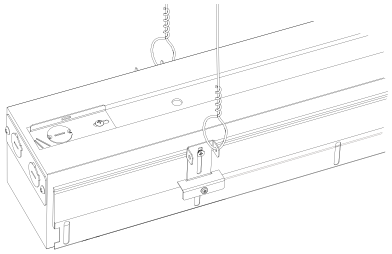


Mounting Location for Securing to Structure



Two mounting options: threaded rod and screw mounting options. Mounting locations are located on each end of the luminaire. Mounting location is 6" away from each end of luminaire.

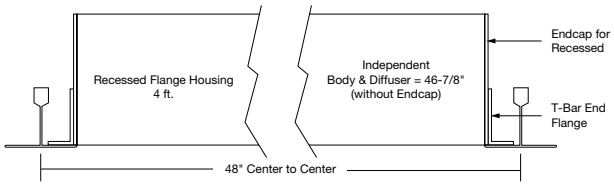
T-BAR INSTALLATION



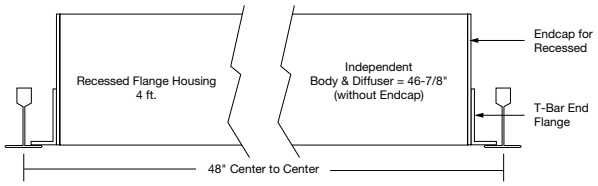
HP-4 R for T-Bar installations comes standard with a splice plate at the end of the luminaire. Mounting brackets (supplied) secure the luminaire to T-Bar and provide support to structure location. All even foot length (2, 4, 6, ...) luminaire runs are reduced in length by an appropriate amount to fit within typical 2x2 and 2x4 T-Bar grid systems. For uncommon T-Bar systems please consult factory.

GRID LENGTH DETAIL - 4' EXAMPLE

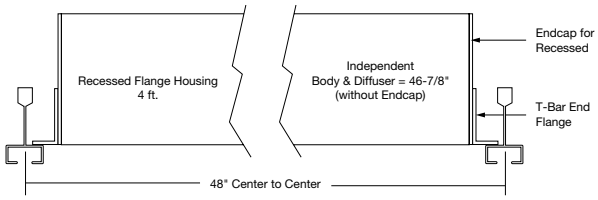
1" T-Bar



9/16" T-Bar

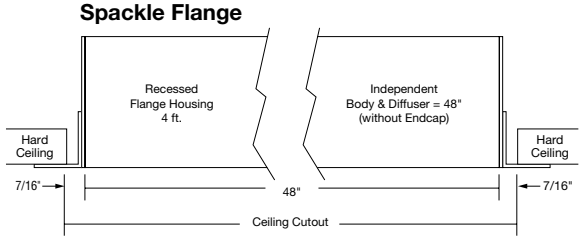


9/16" Screw Slot

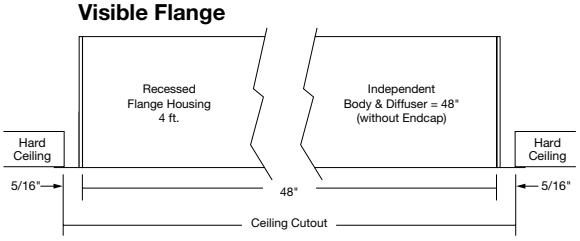


HARD CEILING LENGTH DETAIL - 4' EXAMPLE

Spackle Flange



Visible Flange

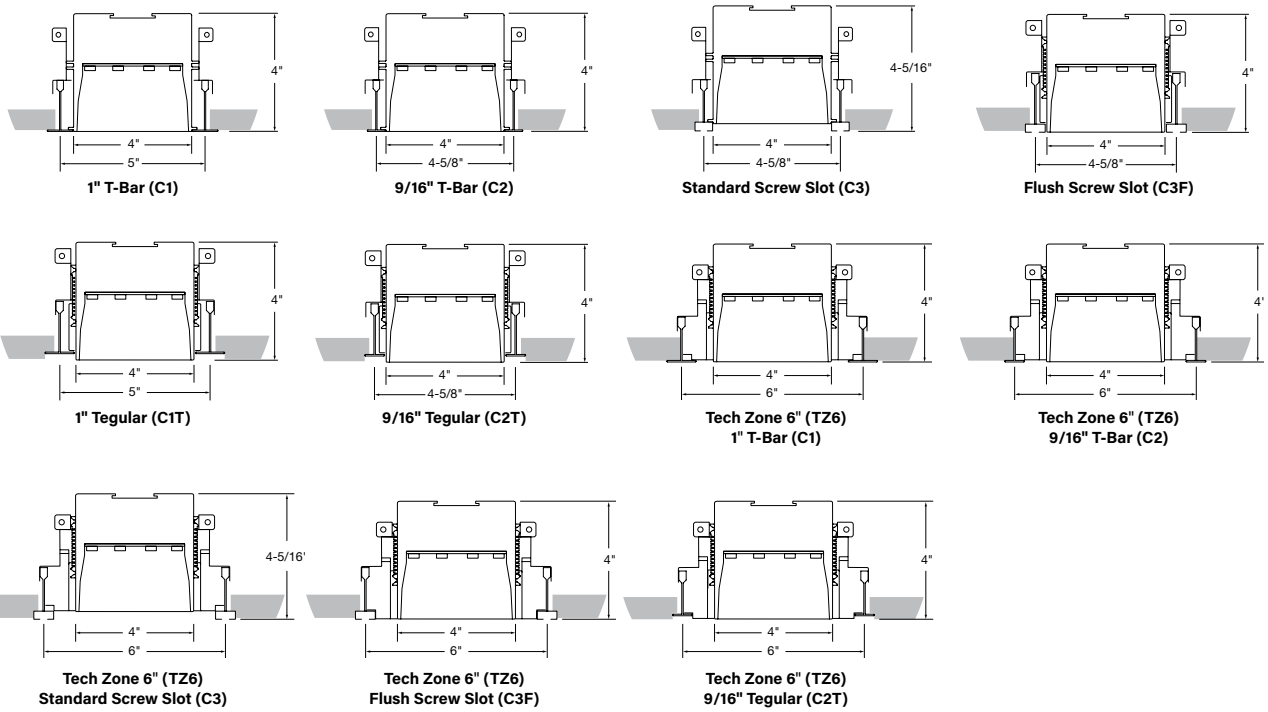


FINELITE Lighting

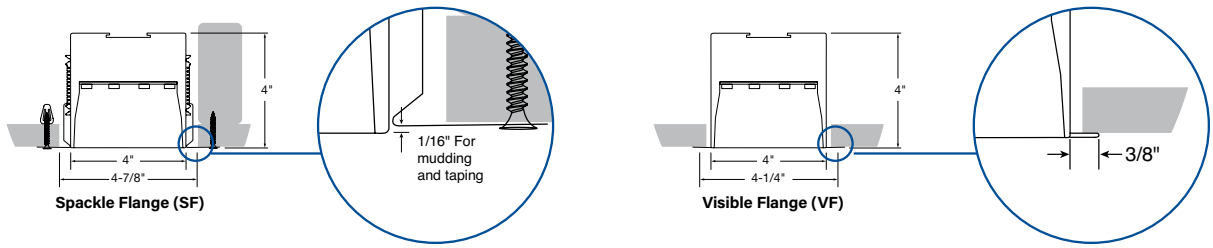
High Performance 4" Aperture (HP-4) Recessed

RECESSED MOUNTING TYPES - T-BAR

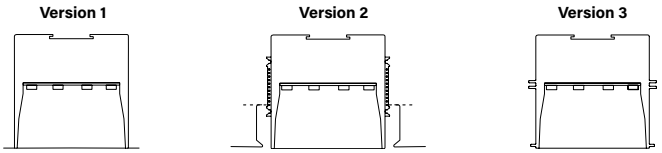
Rough-In Dimensions



RECESSED MOUNTING TYPES - CUTOUT DIMENSIONS



HOUSING



Note: +/- 1/16"

the lighting practice

Catalog Information: HP-4-R-D-[LENGTH]-H-935-F-95LF-[VOLTAGE]-SC-FC-10%-SF-FE-[FINISH]

Date: 09/30/2022
Fixture Type:

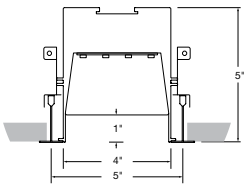
A1A

FINELITE® Lighting

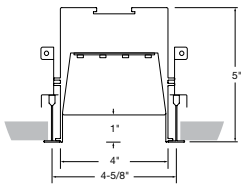
High Performance 4" Aperture (HP-4) Recessed

REGRESSED MOUNTING TYPES - T-BAR

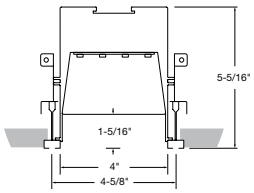
Rough-In Dimensions



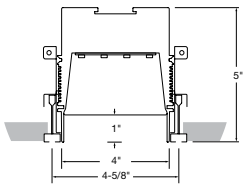
1" T-Bar (C1)



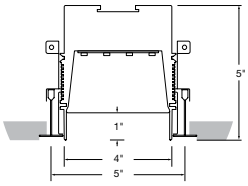
9/16" T-Bar (C2)



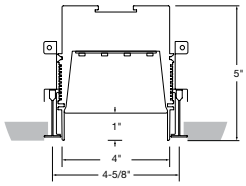
Standard Screw Slot (C3)



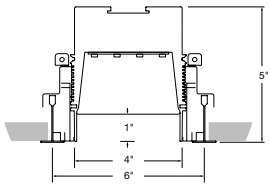
Flush Screw Slot (C3F)



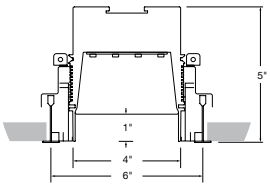
1" Tegular (C1T)



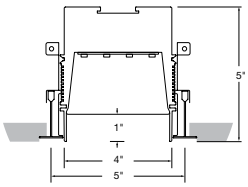
9/16" Tegular (C2T)



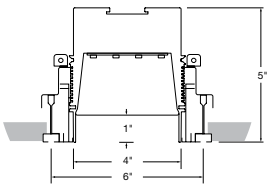
Tech Zone 6" (TZ6)
1" T-Bar (C1)



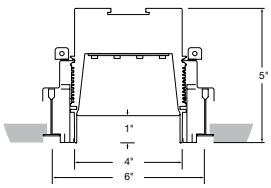
Tech Zone 6" (TZ6)
9/16" T-Bar (C2)



Tech Zone 6" (TZ6)
Standard Screw Slot (C3)

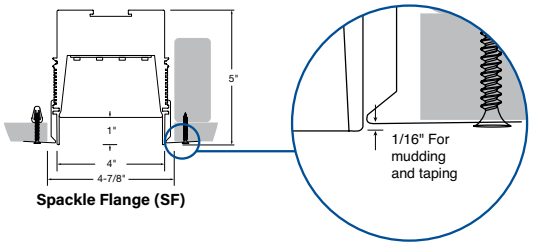


Tech Zone 6" (TZ6)
Flush Screw Slot (C3F)

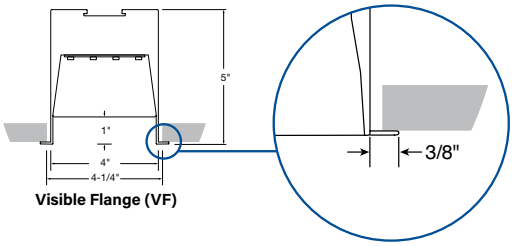


Tech Zone 6" (TZ6)
9/16" Tegular (C2T)

REGRESSED MOUNTING TYPES - CUTOUT DIMENSIONS



Spackle Flange (SF)

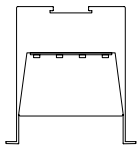


Visible Flange (VF)

Regressed Lens: Regressed lens version is 5" tall with a lens that is regressed 1" from ceiling line.

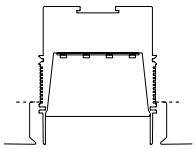
HOUSING

Version 1



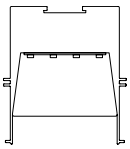
Ceiling Option VF

Version 2



Ceiling Options
C1T, C2T, C3F, SF, TZ6

Version 3



Ceiling Options
C1, C2, C3

Note: +/- 1/16"

the lighting practice

Catalog Information: HP-4-R-D-[LENGTH]-H-935-F-95LF-[VOLTAGE]-SC-FC-10%-SF-FE-[FINISH]

Date: 09/30/2022
Fixture Type:

A1A

Submitted by:	
Type:	ect:
Ordering Info:	

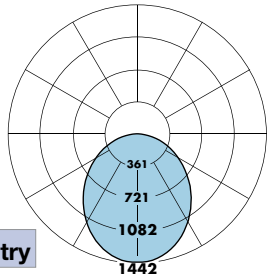
FINELITE® Lighting

High Performance 4" Aperture (HP-4) Recessed

Recessed Photometry - 4' Luminaire 3500K

HP4-R-D-4'-V-835
Downlight: Flush Diffuser

Efficacy: 101 lm/W
Total luminaire output: 3726 lumens (932 lm/ft)
37 watts (9.3 W/ft)
Peak Candela Value: 1442 @ 0º
CRI: 80 / CCT: 3500K
ITL LM79 Report 85128



Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire			
S [1]	B [1]	H [1]	V [2]
1525	1917	2898	3726

Light Output, 3500K, 80 CRI (Lumens Per Foot)			
S [1]	B [1]	H [1]	V [2]
381	479	725	932

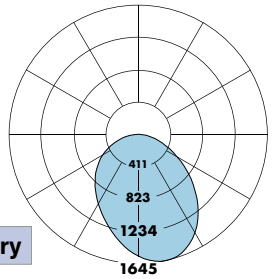
Power, 3500K (Watts Per Foot)			
S [1]	B [1]	H [1]	V [2]
3.6	4.6	7.1	9.3

Efficacy, 3500K, 80 CRI (Lumens Per Watt)			
S [1]	B [1]	H [1]	V [2]
105	104	102	101

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL reports: 85128

HP4-R-D-4'-V-835-DAO
Downlight: Downlight Asymmetric Optic

Efficacy: 109 lm/W
Total luminaire output: 3884 lumens (971 lm/ft)
35.6 watts (8.9 W/ft)
Peak Candela Value: 1645 @ 12.5º
CRI: 80 / CCT: 3500K
ITL LM79 Report 94331



Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire			
S [1]	B [1]	H [1]	V [2]
1590	1999	3021	3884

Light Output, 3500K, 80 CRI (Lumens Per Foot)			
S [1]	B [1]	H [1]	V [2]
397	500	755	971

Power, 3500K (Watts Per Foot)			
S [1]	B [1]	H [1]	V [2]
3.5	4.4	6.8	8.9

Efficacy, 3500K, 80 CRI (Lumens Per Watt)			
S [1]	B [1]	H [1]	V [2]
114	113	111	109

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL reports: 94331

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**), 4000K, 90 CRI
Lumen Adjustment Factor: 0.789
Total Light Output: 3021 lm x 0.789 = 2384 lm
Total Light Output per Foot: 755 lm/ft x 0.789 = 596 lm/ft.
watts/foot: 6.8 W/ft.

$$\textbf{Efficacy} = \frac{596\ \frac{\text{lm}}{\text{ft.}}}{6.8\ \frac{\text{W}}{\text{ft.}}} = 88\ \text{lm/W}$$

the lighting practice

Catalog Information: HP-4-R-D-[LENGTH]-H-935-F-95LF-[VOLTAGE]-SC-FC-10%-SF-FE-[FINISH]

Date: 09/30/2022
Fixture Type:

A1A

Submitted by:	
Type:	ect:
Ordering Info:	

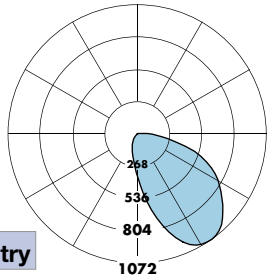
FINELITE® Lighting

High Performance 4" Aperture (HP-4) Recessed

Recessed Photometry - 4' Luminaire 3500K

HP4-R-WW-D-K-4'-V-835
Downlight: With Kicker

Efficacy: 92 lm/W
Total luminaire output: 1816 lumens (454 lm/ft)
21.5 watts (5.4 W/ft)
Peak Candela Value: 1072 @ 35°
CRI: 80 / CCT: 3500K
ITL LM79 Report 85130



Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire			
S [1]	**B [1]**	**H [1]**	**V [2]**
743	935	1412	1816

Light Output, 3500K, 80 CRI (Lumens Per Foot)			
S [1]	**B [1]**	**H [1]**	**V [2]**
186	234	353	454

Power, 3500K (Watts Per Foot)			
S [1]	**B [1]**	**H [1]**	**V [2]**
2.0	2.5	3.8	5.0

Efficacy, 3500K, 80 CRI (Lumens Per Watt)			
S [1]	**B [1]**	**H [1]**	**V [2]**
91	92	92	92

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL reports: 85130

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

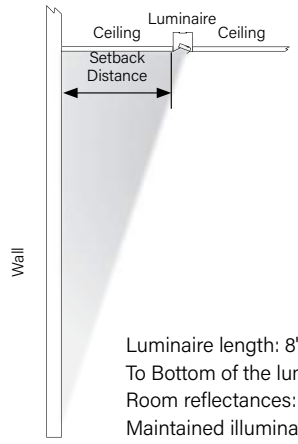
High Output (**H**), 4000K, 90 CRI
Lumen Adjustment Factor: 0.789
Total Light Output: 1412 lm x 0.789 = 1114 lm
Total Light Output per Foot: 353 lm/ft x 0.789 = 279 lm/ft.
watts/foot: 3.8 W/ft.

$$\textbf{Efficacy} = \frac{279\ \frac{\text{lm}}{\text{ft.}}}{3.8\ \frac{\text{W}}{\text{ft.}}} = 73\ \text{lm/W}$$

High Performance 4" Aperture (HP-4) Recessed

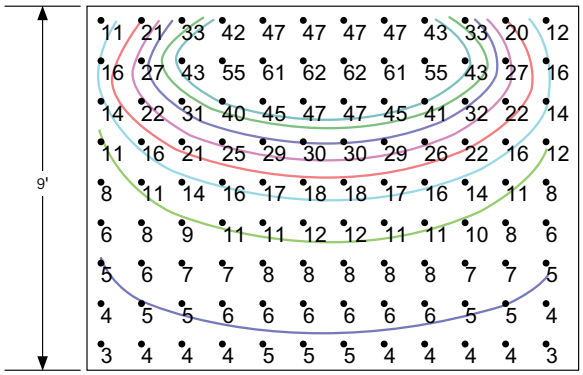
WALL WASH RECESSED - SETBACK INFO AND APPLICATION DATA

HP4-R-WW-D-K-4'-V-835
Downlight: With Kicker
Total luminaire output: 1450 lumens (363 lm/ft)
19.1 watts (4.8 W/ft)
CRI: 80 / CCT: 3500K



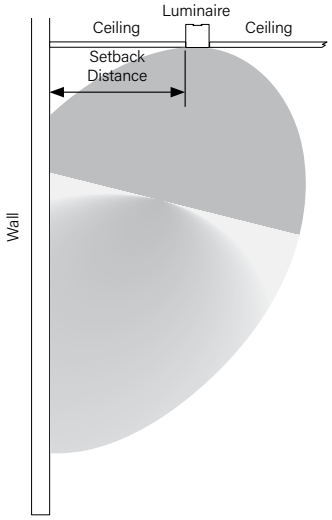
Luminaire length: 8'
To Bottom of the luminaire: 9'-0"
Room reflectances: 80-50-20
Maintained illuminance levels: LLF 0.90"

Setback Distance - 2'

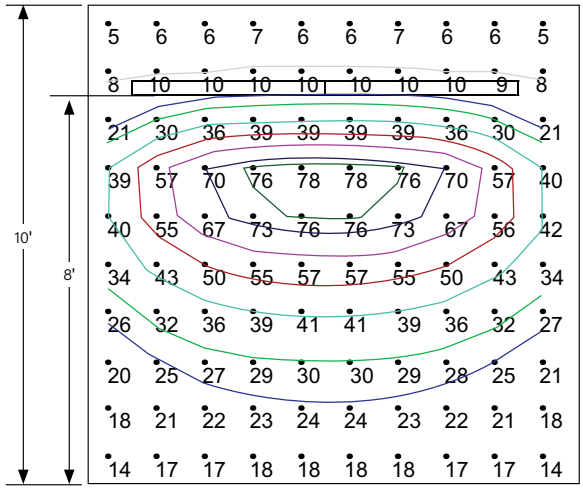


DOWNLIGHT ASYMMETRIC OPTIC - SETBACK INFO AND APPLICATION DATA

HP4-R-D-4ft-V-835-DAO
Downlight: DAO
Total luminaire output: 3884 lumens (971 lm/ft)
35.6 watts (8.9 W/ft)
CRI: 80 / CCT: 3500K



Setback Distance - 2'



FINELITE® Lighting

0-10V Tunable White

Finelite's award-winning, contractor friendly Tunable White luminaires are available at low cost, with powerful and simple 0-10V tuning and intensity controls.

TUNABLE WHITE FEATURES

- CCT range: 2700K - 6500K
- Dimming Range: 100% to 10%
- CRI Options: 80 CRI or 90 CRI

LUMINAIRE FAMILY MODIFICATIONS/RESTRICTIONS

	Section Lengths									
Recessed Direct	2'	3'	4'	5'	6'	7'	8'	9'	10'	11'	12'
Output S,B,H,V Single Circuit	Rows can be comprised of 2'-12' sections. Tailored lengths available.										
Integral Battery Backup (BSL310LP)							✓		✓		✓

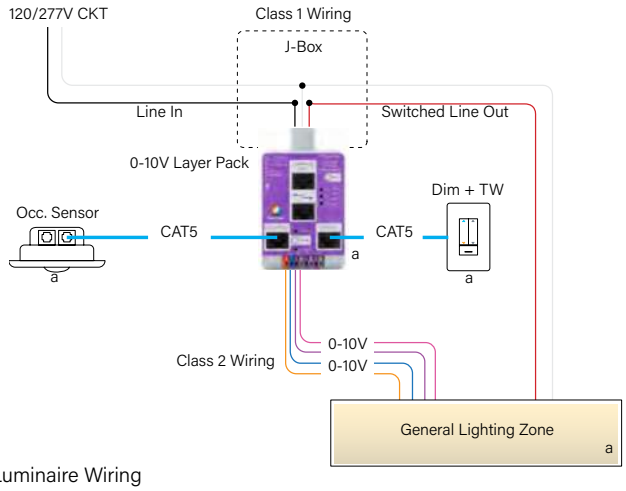
PHOTOMETRY

Apply a power adjustment factor to calculate wattage usage

POWER	CONVERSION FACTOR
	1.1X

(Example: a 50 watt luminaire in static white would draw 55 watts using 0-10V Tunable White)

WIRING DIAGRAM - DIMMABLE TO 10%

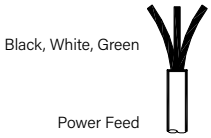


Luminaire Wiring

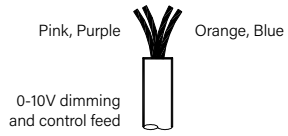
- **Purple** (+) / **Pink** (-) control wires are for intensity control
- **Orange** (+) / **Blue** (-) control wires are for Tunable White control

Note:
Load or Dim to Off options available.

DUAL FEED DETAIL



WIRING LEGEND		
Black	Hot	Line Voltage
White	Neutral	Line Voltage
Green	Ground	



WIRING LEGEND		
Pink	Dimming	0-10V DC
Purple	Dimming	0-10V DC
Orange	TW	0-10V DC
Blue	TW	0-10V DC

Tunable White LUMINAIRES

Submitted by:	
Type:	ject:
Ordering Info:	

High Performance Perimeter Slot (HP-WS)

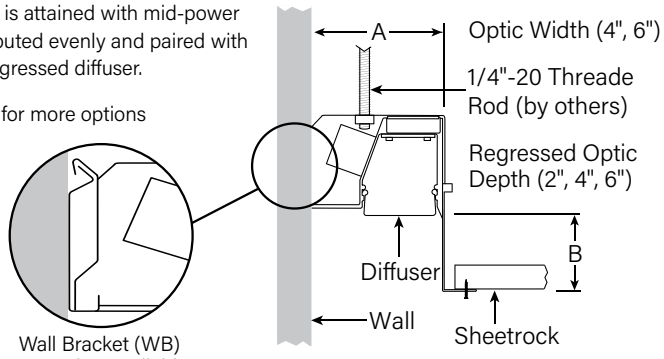
The High Performance Perimeter Slot (HP-WS) creates a wash of ambient and vertical illumination at the transition between the wall and the ceiling plane. Available in 2', 3', 4', & 8' sections with telescoping options that can be combined to make longer runs, and 2", 4", and 6" regressed optic options.

This Product is enrolled in the International Living Future Institute (ILFI) Declare 2.0 Program and is third-party verified with options achieving Red List Approved and Declared status.

CROSS SECTIONS

Distribution is attained with mid-power LEDs distributed evenly and paired with a precise regressed diffuser.

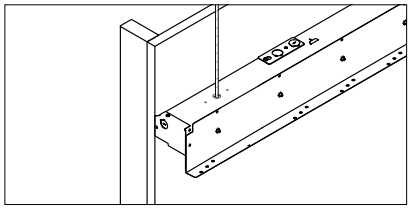
See page 6 for more options



Wall Bracket (WB) Mounting Available

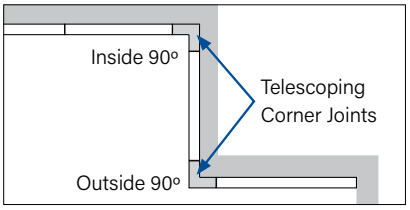
FEATURES

POST-CEILING THREADED-ROD (TR) MOUNTING INSTALLATION



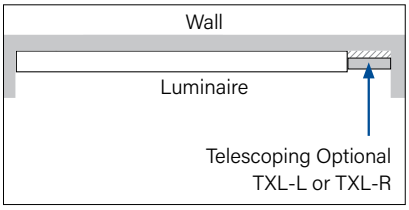
Allows a luminaire to be installed after ceiling framing is complete.

FULLY ILLUMINATED 90º CORNERS



Fully illuminated 90º corners with telescoping standard. Refer to page 3 for telescoping lengths on inside and outside corners.

STRAIGHT RUNS WITH OPTIONAL TELESCOPING



Optional telescoping section adds up to 12 inches for a straight run. Telescope section mounts securely to wall.

Catalog Information: HP-WS-4W-4D-[LENGTH]-S-935-[MOUNTING]-SF-TXL-L-FE-R-SW

Date: 09/30/2022
Fixture Type:

A15

Submitted by:

Type: ect:

Ordering Info:

FINELITE lighting

Clear Form

High Performance Perimeter Slot (HP-WS)

BODY TYPE

Platform	Series Name	Optic Width	Regressed Optic Depth	Total Length of Run
◉ **HP** - High Performance	◉ **WS** - Perimeter Slot	○ **4W** - 4" Width ○ **6W** - 6" Width	○ **2D** - 2" Depth ○ **4D** - 4" Depth ○ **6D** - 6" Depth	_____ 2', 3', 4', 8', multiples standard. Telescoping available for fractional lengths

OUTPUT and LED TYPE

Light Output
○ **S** - Standard ○ **B** - Boosted Standard ○ **H** - High ○ **V** - Very High ○ **TL** - Tailored: _____...1/ft* * Specify lm/ft of outputs between Standard (S) and Very High (V). Consult factory for tailored lumen output outside of this range.

OUTPUT and LED TYPE

LED CRI/CCT
○ **830** - 80 CRI, 3000K ○ **835** - 80 CRI, 3500K ○ **840** - 80 CRI, 4000K ○ **930** - 90 CRI, 3000K ○ **935** - 90 CRI, 3500K ○ **940** - 90 CRI, 4000K ○ **8TW** - 80 CRI, Tunable White ○ **9TW** - 90 CRI, Tunable White

MECHANICAL/OPTICAL OPTIONS

Reflector System
◉ **SW** - Signal White

ELECTRICAL OPTIONS

Voltage	Circuiting
○ **120** - 120 Voltage ○ **277** - 277 Voltage ○ **347** - 347 Voltage	○ **SC** - Single Circuit* One single circuit in a run ○ **MC** - Multi-Circuit* More than one switch leg or zone. Factory shop drawings required * Battery, Night Light, and Emergency to Generator circuits are in addition to the normal luminaire circuit(s)

ELECTRICAL OPTIONS

Driver Selection

0-10V Driver Options

- ○ **FC-10%** - 0-10V 10%[1] (standard)
- ○ **FC-1%** - 0-10V 1%[1]
- ○ **OSR-10%** - Osram OTi, 0-10V 10%[1]
- ○ **OSR-1%** - Osram OTi, 0-10V 1%[1]
- ○ **ELD-10V-0%** - EldoLED SOLOdrive, 0-10V 0.1%
- ○ **OSR-10V-TW** - Osram OTi, 0-10V 10% *(Tunable White)*[1]

DALI Driver Options

- ○ **FC-DALI-1%** - DALI 1%
- ○ **OSR-DALI-1%** - Osram Dexal, 1%
- ○ **ELD-DALI-0%** - EldoLED SOLOdrive, 0.1%
- ○ **ELD-DALI-TW** - EldoLED DUALdrive LightShape, 0.1% *(Tunable White)*

DMX Driver Options

- ○ **FIN-DMX** - Finelite DMX 1% *(Tunable White - FineTUNE Controls Only)*[2]
- ○ **ELD-DMX** - EldoLED POWERdrive, 0.1%
- ○ **ELD-DMX-TW** - EldoLED POWERdrive, 0.1% *(Tunable White)*

Lutron Driver Options

- ○ **LUT-ES1** - Lutron, Ecosystem 1%
- ○ **LUT-2W** - Lutron, 2-wire (120V only) 1%
- ○ **LUT-TW** - Lutron T-Series, EcoSystem 0.1% *(Tunable White)*

See Page 3 for additional driver options and details

MOUNTING OPTIONS

Mounting Method	Hardware
○ **TR** - Threaded Rod[3] ○ **WB** - Wall Bracket[4]	○ **C1** - 1" T-Bar ○ **C2** - 9/16" T-Bar ○ **C3** - Screw Slot ○ **SF** - Spackle Flange ○ **C1T** - 1" Tegular ○ **C2T** - 9/16" Tegular

OTHER OPTIONS

End Condition Left[5]	End Condition Right[5]	Finish	Emergency Style (Optional)	Sensor (Optional)	Special Options (Optional)
○ **FE-L** - Flat Endcap (standard) ○ **PE-L** - Pocket Slot ○ **TXL-L** - Telescoping	○ **FE-R** - Flat Endcap (standard) ○ **PE-R** - Pocket Slot ○ **TXL-R** - Telescoping	◉ **SW** - Signal White (standard)	○ **FAC CHO** - Factory Choice Battery Back-up ○ **EM/GEN** - Emergency to Generator ○ **NL** - Night Light ○ **BSL310LP** - Bodine Battery Back up Low Profile ○ **GTD** - Generator Transfer Device ○ **ALCR** - Automatic Load Control Relay	○ **REE** - Remote Enlighted[6]	○ **CP** - Chicago Plenum[7] ○ **RLA** - Red List Approved ○ **RLD** - Declared

[1] Add DTO to gain "Dim to Off" functionality (FC-10% - DTO)
[2] B & V outputs only
[3] Pre- or post-ceiling
[4] Pre-ceiling only
[5] The end condition on each side can be specified with different hardware options to accommodate different installation features. See page 3 for more information.
[6] Enlighted Control Unit & Sensor Cable installed for Remote mounting sensor.
[7] Only available with C1, C2, and C3 mounting hardware with Finelite Gridbox

the lighting practice

Catalog Information: HP-WS-4W-4D-[LENGTH]-S-935-[MOUNTING]-SF-TXL-L-FE-R-SW

Date: 09/30/2022

Fixture Type:

A15

High Performance Perimeter Slot (HP-WS)

SUPPLEMENTARY DRIVER PAGE

0-10V Driver Options	
FC-10%	Factory Choice, 0-10V 10% Dimming (Linear)
FC-10%-DTO	Factory Choice, 0-10V 10% Dimming, Dim-to-Off (Linear)
FC-1%	Factory Choice, 0-10V 1% Dimming (Linear)
FC-1%-DTO	Factory Choice, 0-10V 1% Dimming, Dim-to-Off (Linear)
ELD-10V-0%	EldoLED SOLOdrive, 0-10V 0.1% Dimming (Linear)
ELD-10V-1%	EldoLED ECOdrive, 0-10V 1% Dimming (Linear)
OSR-10V-TW	Osram OTi, 0-10V 10% Dimming, *Tunable White* (Linear)
OSR-10V-TW-DTO	Osram OTi, 0-10V 10% Dimming, Dim-to-Off, *Tunable White* (Linear)
OSR-10%	Osram OTi, 0-10V 10% Dimming (Linear)
OSR-10%-DTO	Osram OTi, 0-10V 10% Dimming, Dim-to-Off (Linear)
OSR-1%	Osram OTi, 0-10V 1% Dimming (Linear)
OSR-1%-DTO	Osram OTi, 0-10V 1% Dimming, Dim-to-Off (Linear)

DALI Driver Options	
FC-DALI-1%	Factory Choice, DALI 1% Dimming (Logarithmic)
OSR-DALI-1%	Osram Dexal, DALI 1% Dimming (Logarithmic)
ELD-DALI-0%	EldoLED SOLOdrive, DALI 0.1% Dimming (Logarithmic)
ELD-DALI-1%	EldoLED ECOdrive, DALI 1% Dimming (Logarithmic)
ELD-DALI-TW	EldoLED DUALdrive Light Shape, DALI 0.1% Dimming, *Tunable White* (Logarithmic Dimming, Linear CCT Control)

DMX Driver Options	
FIN-DMX	Finelite, DMX 1% Dimming, *Tunable White* - **FineTUNE Controls Only** (Linear)
ELD-DMX	EldoLED POWERdrive, DMX 0.1% Dimming (8 Bit, 1CH) (Linear)
ELD-DMX-16	EldoLED POWERdrive, DMX 0.1% Dimming (16 Bit, 2CH) (Linear)
ELD-DMX-TW	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (8 Bit, 2CH - CH1 Warm / CH2 Cool) (Linear)
ELD-DMX-TW16	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (16 Bit, 4CH - CH1, 2 Warm / CH3, 4 Cool) (Linear)

Lutron Driver Options	
LUT-ES1	Lutron, Ecosystem 1% Dimming
LUT-2W	Lutron, 2-wire (120V only) 1% Dimming
LUT-TW	Lutron T-Series, EcoSystem 0.1% Dimming, *Tunable White*

High Performance Perimeter Slot (HP-WS)

SPECIFICATIONS

BODY TYPE

CONSTRUCTION: Precision cut 6061-T6 extruded aluminum visible flange. Internal joiner system, plug-together wiring standard. Steel sheet metal galvanized and powder coated body.

LENGTHS: Standard 2', 3', 4', and 8' section lengths can be combined to make longer runs. Optional telescoping sections on straight runs add a minimum of 1" up to 12" at the end of the luminaire. Contact factory for corner details and availability. Telescoping sections are available on either or both ends of the luminaire.

90º CORNERS : Illuminated 90° inside and outside corners. Standard with telescoping sections. Tapered optics is standard with inside corners.

OUTPUT AND LED TYPE

LIGHT OUTPUT: Four lumen packages available, Standard (**S**), Boosted Standard (**B**), High (**H**), and Very High (**V**). For lengths 3' and greater, the uplight and downlight can be specified with different lumen packages and dual controls. For Tailored Outputs outside of range from Standard (**S**) to Very High (**V**), consult factory. Light engines are replaceable.

MECHANICAL/OPTICAL OPTIONS

LUMEN MAINTENANCE: 90% of initial light output (L90) at 100,000+ hours; 70% of initial light output (L70) at 200,000+ hours.

REFLECTORS: Finelite Signal White powder coat finish standard.

ELECTRICAL OPTIONS

STATIC WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed controlling uplight and downlight together (power and dimming). Specify dual feeds for independent control of uplight and downlight. 14-gauge feed used when luminaire current exceeds 5 amps.

TUNABLE WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed. 14-gauge feed used when fixture current exceeds 5 amps. DMX and power feed at same location (standard). DMX feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths.

STATIC WHITE DRIVER: Replaceable 120V, 277V, and 347V constant current reduction dimming driver standard. Can be wired dimming or non-dimming. 0-10V dimming controls with a range of 100%-10% standard. Dimming to 1% available. Separate dimming for uplight and downlight available. Driver is fully accessible from below the ceiling.
- **Power Factor:** ≥ 0.9
- **Total Harmonic Distortion (THD):** <20%
- **Expected driver lifetime:** 100,000 hours

LUTRON STATIC DRIVER OPTIONS:
- **LUTES1 (LDE1)** (Hi-lume 1% EcoSystem with Soft-On, Fade-to-Black dimming (LDE1 series))
- **LUT2W (LTES2W)** (Hi-lume 1% 2-wire, 120V forward phase dimming (LTEA series)).

TUNABLE WHITE DRIVER: Replaceable LED driver. Driver is accessible from below the ceiling. 120V, 277V, and 347V.
- **Power factor:** ≥0.90
- **Total Harmonic Distortion (THD):** <20%
- **Dimming Range:** 100%-10%
- **Expected driver lifetime.:** 100,000 hours
- FineTUNE DMX is 1%

LUTRON TUNABLE WHITE DRIVER OPTION: LUT-TW (0.1% T-Series 2-Channel Digital Tunable White (PSQ Series)).

MOUNTING OPTIONS

HANGING HARDWARE: The standard mounting (Threaded Rod - TR) option eliminates the need to install luminaires prior to the slot being framed. Luminaire mounts on threaded rods. Gasket runs length of luminaire ensuring a clean finish at the wall. Optional mounting includes a wall bracket that is attached to the wall. Luminaires are then snapped onto the bracket. Luminaire installation that uses the mounting bracket must be performed before the perimeter slot framing is built.

TUNABLE WHITE DMX HANGING HARDWARE: For grid ceiling applications the dual GridBox™ mounting is supplied (standard). For hard ceiling applications the ceiling mounting box is supplied (standard). DMX feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths. Available DMX pendant feed lengths are 5' (standard), 12', and 30'.

TUNABLE WHITE DMX INTERCONNECTION CABLES: Luminaires are pre-wired with plug-and-play interconnection cables to support easy plug-together joining of fixture runs. If a non-FineTUNE DMX system is specified, a DMX to RJ45 adapter is provided.

OTHER OPTIONS

ENDCAPS: The luminaire can terminate in three different end conditions to accommodate project needs. Endcaps are made of 20-guage die-formed powder-coated steel. Flat (standard) Endcap adds 1/8", Pocket Slot Endcap adds 1-1/4", and for Telescoping Endcap refer to telescoping section below.

END CONDITIONS:
FLAT (standard) (**FE-L** or **FE-R**): Is used when the luminaire terminates at a wall. Adds 1/8" per endcap to overall length of the luminaire.

Continued

High Performance Perimeter Slot (HP-WS)

SPECIFICATIONS

POCKET SLOT (**PE-L** or **PE-R**): Includes the necessary hardware to accommodate ceiling materials when the luminaire doesn't terminate at a wall. Adds 1-1/4" for Spackle Flange and 1" for T-Bar per endcap to overall length of the luminaire.

TELESCOPING (**TXL-L** or **TXL-R**): Provides up to 12" of additional illuminated section to accommodate variances in the built-in wall slot. Telescoping available on both ends of 4' and 8' luminaire sections. Adds a minimum of 1" per end to overall section length. Telescoping only available at one end of 2' and 3' luminaire sections. Adds a minimum of 2" to overall length of 2' sections and a minimum of 1" to overall length of 3' sections. Telescoping is standard with corners. Telescoping section must end at wall and be secured with bracket (provided).

EMERGENCY STYLE: Optional emergency to generator/inverter wiring, internal generator transfer switch, nightlight wiring, backup battery. Factory-choice low-profile backup battery available. Chicago Plenum Option available (includes telescoping luminaries). 8' minimum luminaire length for low profile battery pack. Backup batteries deliver 1519 lumens. Half of a 4' section will be illuminated in emergency mode. Optional fusing is available.

Tunable White ELECTRICAL OPTIONS [8]:
- **TW Driver Options 0-10V:** EM/GEN, GTD or Battery Back up
- **FineTUNE DMX:** EM/GEN or Battery Back up
- **DMX:** Battery Back up
- **DALI:** EM/GEN, GTD or Battery Back up
- **LUTRON:** EM/GEN, GTD or Battery Back up

FINISHES: Finelite Signal White powder coat finish standard. Optional adder: 185 colors available using RAL color chart. Custom color applies to the visible T-Bar flange.

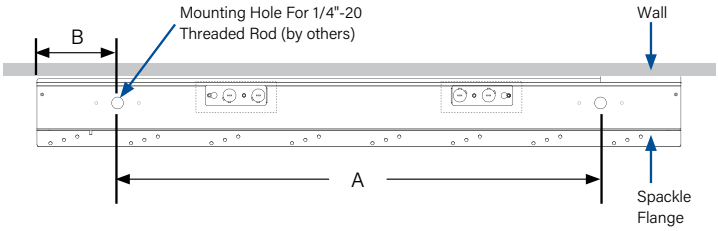
LABELS: Luminaire and electrical components are ETL-listed conforming to UL 1598 in the U.S.A. and CAN/CSA C22.2 No. 250.0 in Canada. In accordance with NEC Code 410.130 (G), this luminaire contains an internal driver disconnect. UL 924 and UL 2108 - PoE options available on request. IC-Rated. Damp Location. These fixtures are rated for Damp Location. Finelite products use electronic components that are RoHS compliant, and the mechanical components of the luminaire have been verified to not knowingly contain any restricted substances listed per RoHS Directive 2015/863. Consult factory for tailored lighting options. Finelite makes the specification process easy when putting healthier products on your projects. Simply add – **RLA** (Red List Approved) or – **RLD** (Declared Label) to your part number.

WEIGHT: 5.6 lb/ft

WARRANTY: 10-year performance-based warranty on all standard components. Optional accessories such as emergency battery packs are covered by their individual manufacturer warranties.

High Performance Perimeter Slot (HP-WS)

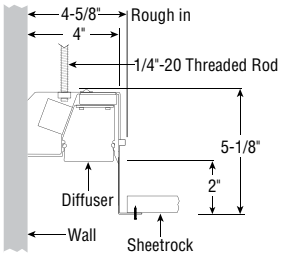
THREADED-ROD (TR) MOUNTING LOCATION



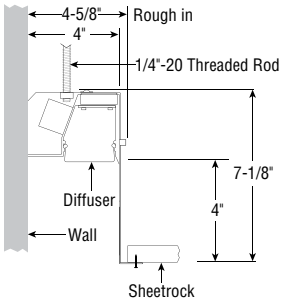
MOUNTING HOLE LOCATION TABLE		
LUMINAIRE LENGTH	A (in)	B (in)
2'	18	3
3'	30	3
4'	36	6
8'	84	6

THREADED-ROD (TR) MOUNTING CROSS SECTIONS

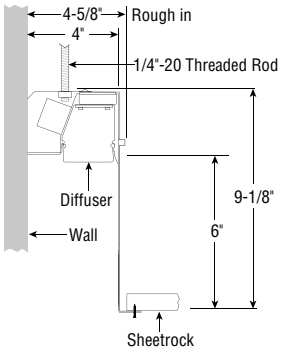
4"W x 2"D



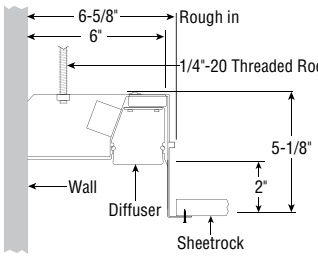
4"W x 4"D



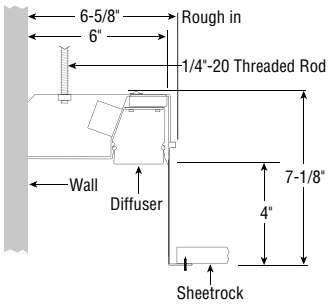
4"W x 6"D



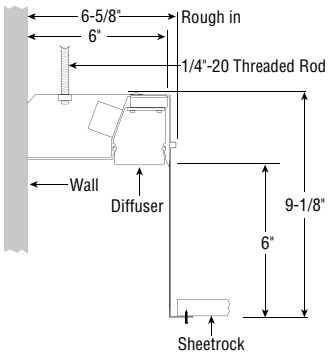
6"W x 2"D



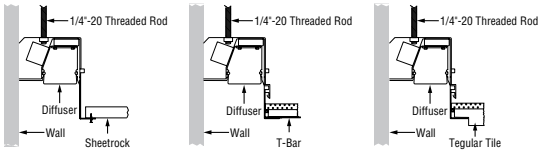
6"W x 4"D



6"W x 6"D

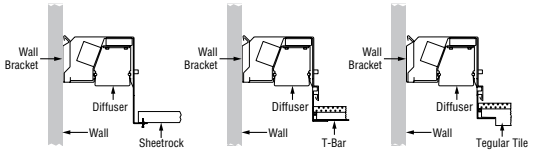


CEILING TYPES — THREADED-ROD (TR) MOUNTING



(SF) (C1, C2, C3) (C1T, C2T)

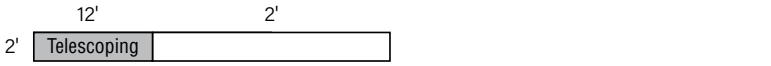
WALL BRACKET (WB) MOUNTING



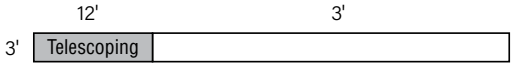
(SF) (C1, C2, C3) (C1T, C2T)

High Performance Perimeter Slot (HP-WS)

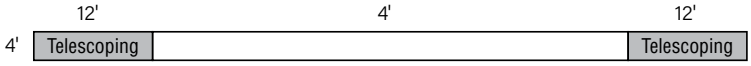
RUN LENGTHS



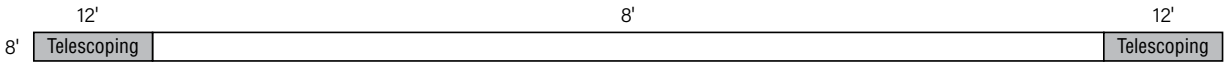
Telescoping Section (optional) adds a minimum of 2" and a maximum of 12". Only one end can be extended.



Telescoping Section (optional) adds a minimum of 1" and a maximum of 12". Only one end can be extended.



Telescoping Sections (optional) adds a minimum of 1" and a maximum of 12". Both ends can be extended.

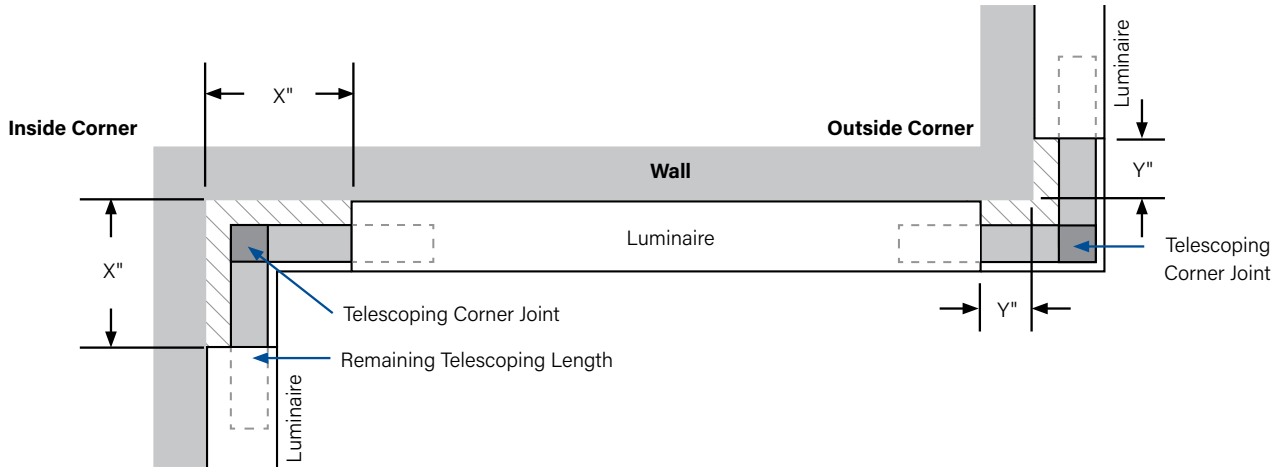


Telescoping Sections (optional) adds a minimum of 1" and a maximum of 12". Both ends can be extended.
Standard 2', 3', 4', and 8' section can be combined to make longer runs.

Endcaps Information
The **Flat Endcap** adds 1/8" per endcap to the section length.
The **Pocket Slot Endcap** adds 1-1/4" for Spackle Flange and 1" for T-Bar per endcap to the section length.

The **Telescoping Endcap** adds:
- A minimum of 2" to a 2' section
- A minimum of 1" to a 3' section
- A minimum of 1" to 4' and 8' sections

90º INSIDE AND OUTSIDE FULLY ILLUMINATED CORNER MEASURING DETAILS

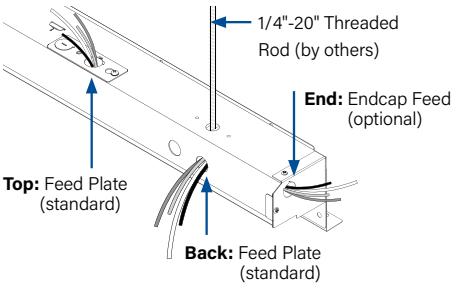


	Measurement From End of Luminaire to Wall			
	Inside Corner		Outside Corner	
Luminaire Width Configuration	X" Min	X" Max	Y" Min	Y" Max
4W	8"	14"	1"	8"
6W	10"	16"	1"	7"

Notes
- Inside and outside corners ship standard with telescoping.
- Telescoping is optional for straight runs.

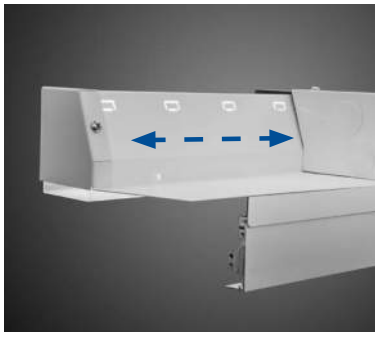
High Performance Perimeter Slot (HP-WS)

FEED OPTIONS



Refer to installation instructions for feed hole measurements.

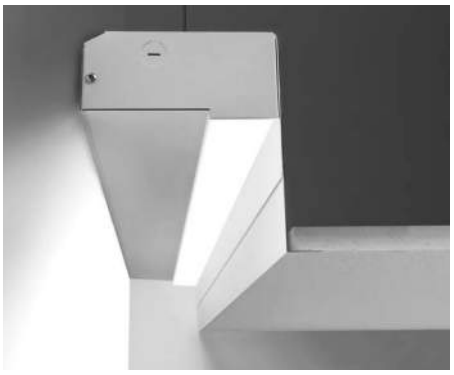
TELESCOPING (TXL-L or TXL-R)



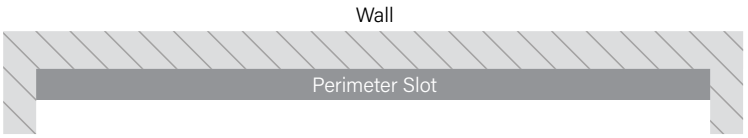
TAPERED OPTIC STANDARD WITH 90º INSIDE CORNERS

ENDCAP OPTIONS

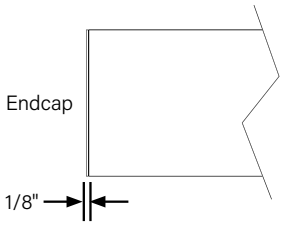
STANDARD FLAT (FE-L or FE-R)



Adds 1/8" per endcap to the section length. Spackle Flange version shown, T-Bar available.

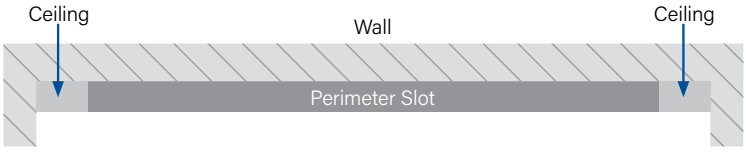


Flat end condition for when luminaire terminates at a vertical surface such as a wall.

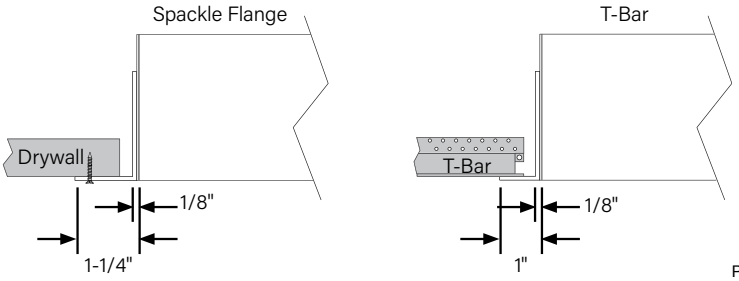


POCKET SLOT (PE-L or PE-R)

Adds 1-1/4" for Spackle Flange and 1" for T-Bar (includes endcap dimension 1/8") per endcap to the housing length on shop drawings. T-Bar version shown, Spackle Flange available.



Pocket slot end condition for when slot terminates before meeting additional vertical wall surface.



Submitted by:	
Type:	ect:
Ordering Info:	

FINELITE lighting

High Performance Perimeter Slot (HP-WS)

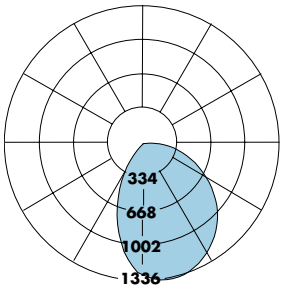
Photometry - 4' Luminaire 3500K

4"W x 2"D
Very High Output - 120V

Efficacy: 84 lumens per watt
Total luminaire output: 3097 lumens (774 lm/ft)
37 watts (9.3 W/ft)
Peak Candela Value: 1333 @ 15°

CRI: 80 / CCT: 3500K
ITL LM79 Report 86712

Wall



CandELA distribution

	0.0	45	90	135	180	Flux
0	1235	1235	1235	1235	1235	
5	1280	1264	1229	1198	1168	116
15	1333	1280	1172	1002	903	321
25	1323	1241	1060	746	586	460
35	1258	1150	909	489	297	519
45	1144	1020	735	248	60	502
55	967	859	555	49	2	436
65	741	654	375	3	0	344
75	514	437	204	2	0	233
85	295	232	52	1	0	

Complete LM79 LED Photometry etry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire				
	S [1]	**B** [1]	**H** [1]	**V** [2]
4"W x 2"D	1268	1594	2409	3097

Light Output, 3500K, 80 CRI (Lumens Per Foot)				
	S [1]	**B** [1]	**H** [1]	**V** [2]
4"W x 2"D	317	398	602	774

Power, 3500K, 80 CRI (Watts Per Foot)				
	S [1]	**B** [1]	**H** [1]	**V** [2]
4"W x 2"D	3.6	4.6	7.1	9.3

Efficacy, 3500K, 80 CRI (Lumens Per Watt)				
	S [1]	**B** [1]	**H** [1]	**V** [2]
4"W x 2"D	88	87	85	84

Notes
– Refer to LM-79 reports for other configurations.

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**) 4000K, 90 CRI

Lumen Adjustment Factor: 0.789

Total Light Output: 2409 lm x 0.789 = 1901 lm

Total Light Output per Foot: 602 lm/ft x 0.789 = 475 lm/ft.

watts/foot: 7.1 W/ft.

$$\textbf{Efficacy} = \frac{475\ \frac{\text{lm}}{\text{ft.}}}{7.1\ \frac{\text{W}}{\text{ft.}}} = 67\ \text{lm/W}$$

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 86712

Submitted by:	
Type:	ect:
Ordering Info:	

0-10V Tunable White

Finelite's award-winning, contractor friendly Tunable White luminaires are available at low cost, with powerful and simple 0-10V tuning and intensity controls.

TUNABLE WHITE FEATURES

- CCT range: 2700K - 6500K
- Dimming Range: 100% to 10%
- CRI Options: 80 CRI or 90 CRI

LUMINAIRE FAMILY MODIFICATIONS/RESTRICTIONS

	Section Lengths			
HP-WS	**2'**	**3'**	**4'**	**8'**
Output S,B,H,V Single Circuit	Rows can be comprised of 2',3',4',& 8' sections. Tailored lengths available.			
Integral Battery Backup (BSL310LP)			✓	✓

EN/GEN sections available for all body lengths

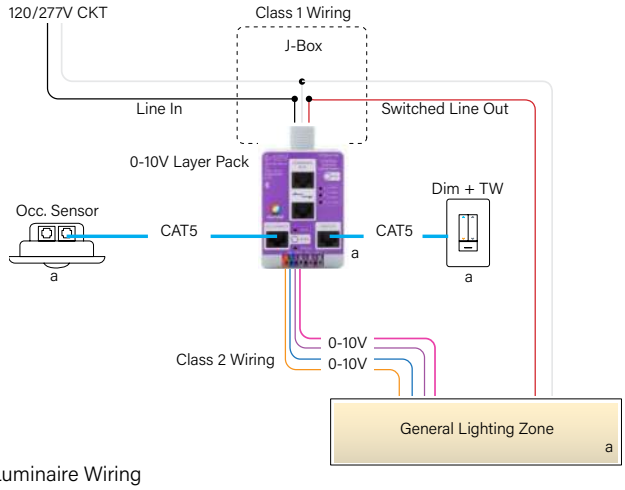
PHOTOMETRY

Apply a power adjustment factor to calculate wattage usage

POWER	CONVERSION FACTOR
	1.1X

(Example: a 50 watt luminaire in static white would draw 55 watts using 0-10V Tunable White)

WIRING DIAGRAM - DIMMABLE TO 10%

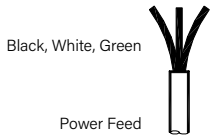


Luminaire Wiring

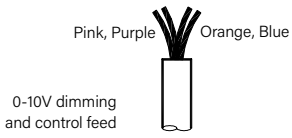
- **Purple** (+) / **Gray** (-) control wires are for intensity control
- **Orange** (+) / **Blue** (-) control wires are for Tunable White control

Note:
Load or Dim to Off options available.

DUAL FEED DETAIL



WIRING LEGEND		
Black	Hot	Line Voltage
White	Neutral	Line Voltage
Green	Ground	



WIRING LEGEND		
Pink	Dimming	0-10V DC
Purple	Dimming	0-10V DC
Orange	TW	0-10V DC
Blue	TW	0-10V DC

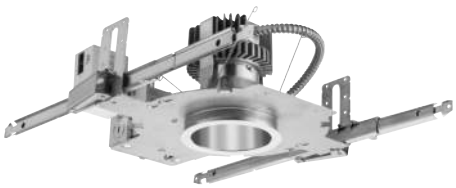
gotham® | EVO®

Multiple Layers of Light

Luminaire Type:

Catalog Number:

General Illumination Round Downlight 4"



OVERVIEW

Feature Set

- Bounding Ray™ optical design
- Unitized optics mechanically attach the light engine to the lower reflector for complete optical alignment.
- 45° cutoff to source and source image
- Fully serviceable and upgradeable lensed LED light engine
- 70% lumen maintenance at 60,000 hours
- 2.5 SDCM; 85 CRI typical, 90+ CRI optional
- Fixtures are wet location, covered ceiling
- Available with 10% dimming, 1% dimming, or dim to dark
- Batwing distribution with feathered edges provides even illumination on horizontal and vertical surfaces
- ENERGY STAR® certified product

Distribution

Superior Perfomance

Nominal Lumens	250	500	750	1000	1500	2000	2500	3000	3500
Delivered Lumens	271	573	808	1001	1527	1994	2580	3110	3612
Wattage	3.1	7.2	7.9	8.8	13.7	19.5	25.7	31.2	38.4
Lumens per Watt	87.4	79.6	102.3	113.8	111.5	102.3	100.4	99.7	94.1

COMPLEMENTARY PRODUCTS

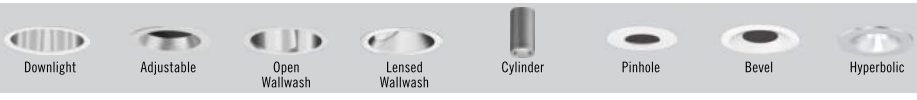
Coordinated Apertures I Multiple Layers of Light

General Illumination Layer I EVO

High Center Beam Layer I Incito

EVO + Incito — Multiple Layers of Light

Core



Healthcare

Special Applications

the lighting practice

Catalog Information: EVO4-35/10-AR-MD-LSS-MOVLT-GZ10

Date: 09/30/2022

Fixture Type:

A17

ORDERING INFORMATION

A+ Capable options indicated by this color background.

Design2Ship Quick Ship Program: Options in green text qualify for Design2Ship — 5 business days from order entry to ship. Refer to Design2Ship Brochure for complete program details. **Maximum Order Quantity: 100 units; 50 for Chicago Plenum.**

Luminaire Type:

Catalog Number:

EXAMPLE: EV04 35/25 AR MWD LSS 120 EZ1

Series	Color Temperature	Nominal Lumen Values	Reflector & Flange Color	Trim Style	Distribution	Finish	Voltage
EV04	27/ 2700 K	02 250 lumens	AR Clear	(blank) Self-flanged	MD Medium (0.9 s/mh)	LSS Semi-specular	MVOLT
	30/ 3000 K	05 500 lumens	PR Pewter	FL Flangeless	MWD Medium wide (1.0 s/mh)	LD Matte-diffuse	120
	35/ 3500 K	07 750 lumens	WTR Wheat		WD Wide (1.2 s/mh)	LS Specular	277
	40/ 4000 K	10 1000 lumens	GR Gold				347[2,3]
	50/ 5000 K	15 1500 lumens	WR[1] White				
		20 2000 lumens	BR[1] Black				
		25 2500 lumens	WRAMF[1] White Anti-microbial				
		30 3000 lumens					
		35 3500 lumens					

Driver[4]		Control Interface		Options	
GZ10	0-10V driver dims to 10%	NLT[6]	nLight® dimming pack controls	SF	Single Fuse. Specify 120V or 277V
GZ1	0-10V driver dims to 1%	NLTER[2,6,10]	nLight® dimming pack controls emergency circuit	TRW[7]	White painted flange
EZ10	eldoLED 0-10V ECOdrive. Linear dimming to 10% min.	NLTAIR2[13]	nLight® Air enabled	TRBL[8]	Black painted flange
EZ1	eldoLED 0-10V ECOdrive. Linear dimming to 1% min.	NLTAIRER2[2,10,13]	nLight® AIR Dimming Pack Wireless Controls. Controls fixtures on emergency circuit	EL[9]	Emergency battery pack, 10W, with integral test switch
EZB	eldoLED 0-10V SOLOdrive. Logarithmic dimming to <1%.	NLTAIREM2[2,13]	nLight® AIR Dimming Pack Wireless Controls. Controls fixtures on emergency circuit with battery pack options.	ELR[9]	Emergency battery pack, 10W, with remote test switch
EDAB[4]	eldoLED SOLOdrive DALI. Logarithmic dimming to <1%.	EXA1	XPoint Wireless, eldoLED 0-10V ECOdrive. Linear dimming to 1%. Refer to XPoint tech sheet.	ELSD[9]	Emergency battery pack, 10W, with self-diagnostics, integral test switch
EDXB[4]	eldoLED POWERdrive DMX with RDM (remote device management). Square Law dimming to <1%. Minimum 1000 lumens. Includes termination resistor. Refer to DMXR Manual.	EXAB	XPoint Wireless, eldoLED 0-10V SOLOdrive. Logarithmic dimming to <1%. Refer to XPoint tech sheet.	ELRSD[9]	Emergency battery pack, 10W, with self-diagnostics, remote test switch
ECOS2[5]	Lutron® Hi-Lume® 2-wire forward-phase driver.120V only. Minimum dimming level 1%. Min: 1000LM; Max: 2500LM			E10WCP[9]	Emergency battery pack, 10W Constant Power, CA Title 20 compliant with integral test switch
ECOD[5]	Lutron Ecosystem digital Hi-Lume 1% soft-on, fade to black. Min: 250LLM; Max: 4000LM.			E10WCPR[9]	Emergency battery pack, 10W Constant Power, CA Title 20 compliant with remote test switch
				N80[11]	nLight® Lumen Compensation
				BGTD	Bodine generator transfer device. Specify 120V or 277V.
				90CRI	High CRI (90+)
				CP[12]	Chicago Plenum. Specify 120V or 277V for 5000lm and above.
				RRL__	RELOC®-ready luminaire connectors enable a simple and consistent factory installed option across all ABL luminaire brands. Refer to RRL for complete nomenclature.

ACCESSORIES — order as separate catalog numbers (shipped separately)

SCA4	Sloped ceiling adapter. Degree of slope must be specified (5D, 10D, 15D, 20D, 25D, 30D). Ex: SCA4 10D. Refer to TECH-190.
CTA4-8 YK	Ceiling thickness adapter (extends mounting frame to accommodate ceiling thickness up to 5"). Adds ~4" to fixture height.
ISD BC	0-10V wallbox dimmer. Refer to ISD-BC.

ORDERING NOTES

1. Not available with finishes.
2. Not available with emergency battery pack options.
3. Supplied with factory installed step down transformer.
4. Refer to TECH-240 for compatible dimmers.
5. Not available with nLight® and XPoint options.
6. Must specify voltage.
7. For use with different reflector finish only (i.e. AR, PR, WTR, GR options). Not applicable with WR (white reflector) or FL (flangeless) option.
8. For use with different reflector finish only (i.e. AR, PR, WTR, GR options). Not applicable with BR (black reflector) or FL (flangeless) option.
9. 11" of plenum depth or top access required for battery pack maintenance.
10. ER for use as UL924 Emergency Operation via power sense lead. Will require an emergency hot feed and normal hot feed. EM for use as UL924 Emergency Operation via power interrupt detection.
11. Fixture begins at 80% light level. Must be specified with NLT or NLTER. Only available with EZ10 and EZ1 drivers.
12. Not available with ELR, HAO, EXA1, or EXAB options.
13. Not available DALI or DMX drivers. Not available with CP or N80 options. Not recommended for metal ceiling installations.

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SPECIFICATIONS

Optical Assembly

Fully serviceable and upgradeable lensed LED light engine suitable for field maintenance or service from below the ceiling.

Optical design is a Bounding Ray™ design with 45° cutoff to source and source image. Top-down flash characteristic for superior glare control.

Unitized optics shall have mechanical attachment of the light engine to the lower reflector for complete optical alignment.

Electrical

The luminaire shall operate from a 50 or 60 Hz ±3 Hz AC line over a voltage ranging from 120 VAC to 277 VAC. The fluctuations of line voltage shall have no visible effect on the luminous output.

The luminaire shall have a power factor of 90% or greater at all standard operating voltages and full luminaire output.

Sound Rated A+. Driver shall be >80% efficient at full load across all input voltages.

Input wires shall be 18AWG, 300V minimum, solid copper.

Controls

Luminaire shall be equipped with interface for nLight wired or wireless network with integral power supply as per specification.

Dimming

The luminaire shall be capable of continuous dimming without perceivable stroboscopic flicker as measured by flicker index (ANSI/IES RP-16-10) over a range of 100 – 10%, 100 – 1.0% or 100 – 0.1% of rated lumen output with a smooth shut off function to step to 0%.

eldoLED LED drivers shall conform to IEEE P1789 standards. Alternatively, manufacturers must demonstrate conformance with product literature and testing which demonstrates this performance. Systems that do not meet IEEE P1789 will not be considered.

Driver is inaudible in 24dB environment, and stable when input voltage conditions fluctuate over what is typically experienced in a commercial environment.

Construction

Luminaire housing shall be constructed of 16-gauge galvanized steel and have preinstalled telescopic mounting bars with maximum 32" and minimum 15" extension and 4" vertical adjustment.

Luminaires shall be suitable for installation in ceilings up to 1½" thick. (specify ceiling thickness adapter to extend frame to accommodate ceiling thickness up to 2").

Tool-less adjustments shall be possible after installation.

The assembly and manufacturing process for the luminaire shall be designed to assure all internal components are adequately supported to withstand mechanical shock and vibration.

25°C ambient temperature standard (1/2" clearance on all sides from non-combustible materials in non-IC applications, unless marked spacing noted otherwise). For use in insulated ceilings, a 3" clearance on all sides from insulation is required (unless marked spacing noted otherwise).

Listings

Fixtures are CSA certified to meet US and Canadian Standards: All fixtures manufactured in strict accordance with the appropriate and current requirements of the "Standards for Safety" to UL, wet location covered ceiling. Luminaire configurations are Energy Star certified through testing in EPA–recognized laboratories, with the results reviewed by an independent, accredited certification organization. Visit www.energystar.gov for specific configurations listed.

Photometrics

LEDs tested to LM-80 standards. Measured by IESNA Standard LM-79-08 in an accredited lab. Lumen output shall not decrease by more than 30% over the minimum operational life of 60,000 hours.

Color appearance from luminaire to luminaire of the same type and in all configurations, shall be consistent both initially and at 6,000 hours and operate within a tolerance of <2.5 MacAdam ellipse as defined by a point at the intersection of the CCT line and the black body locus line in CIE chromaticity space.

Warranty

5-year limited warranty. Complete warranty terms located at: www.acuitybrands.com/support/warranty/terms-and-conditions

Note:

Actual performance may differ as a result of end user environment and application.

All values are design or typical values, measured under laboratory conditions at 25 °C.

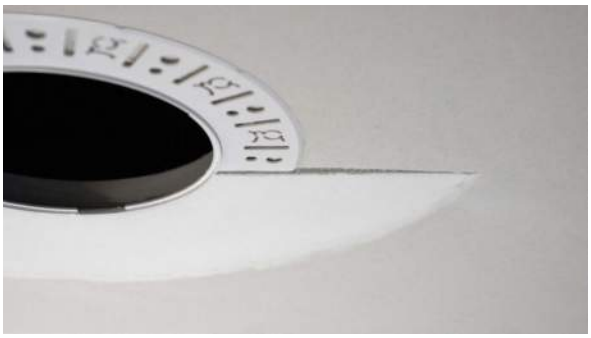
A+ Capable Luminaire

This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® control networks when ordered with drivers marked by a shaded background*
- This luminaire is part of an A+ Certified solution for nLight® control networks, providing advanced control functionality at the luminaire level, when selection includes driver and control options marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.

*See ordering tree for details



Partially finished mud ring, showing cross-section detail.

An EVO downlight requires only approximately 3" of plaster to finish.

EVO with flangeless trim

Flangeless Installation

Gotham's flangeless option utilizes a micro-thin polymer mud ring that minimizes the amount of drywall compound required to finish the ceiling. The end result is a virtually undetectable flangeless downlight installation.

The polymer mud ring is installed independent of the of the recessed frame, therefore floating with the ceiling. This innovation minimizes any surface cracks during reflector installation, ceiling movement and any future service to the recessed frame, wiring, electronics, etc.

Tables of Use

EVO - eldoLED Driver Default Dimming Curve			
Nomenclature	Min Dimming	Driver Dim Curve	Control Dim Curve
EZ10	10%	Linear	Linear/Logarithmic
EZ1	1%	Linear	Linear/Logarithmic
EXA1	1%	Linear	Linear/Logarithmic
EZB	<1%	Logarithmic	Linear
EDAB	<1%	Logarithmic	Linear
EXAB	<1%	Logarithmic	Linear
EDXB	<1%	Logarithmic	Linear

Distributions	
Distribution	Beam
MD	51
MWD	57
WD	73

CCT/CRI Multiplier Table		
CRI	CCT	Multiplier
80	2700K	0.96
	3000K	1.00
	3500K	1.00
	4000K	1.01
	5000K	1.07
90	2700K	0.80
	3000K	0.83
	3500K	0.85
	4000K	0.87
	5000K	0.91

Reflector Finish Multiplier	
Reflector Finish	Multiplier
LS - Specular	1
LSS - Semi Specular	0.956
WR - White	0.87
LD - Matte Diffuse	0.85
BR - Black	0.73

Driver		Control Provided (note: 347V/UVOLT versions provided with 347 option selected)				
Nomenclature	Description	NLT	NLTER	NLTAIR2	NLTAIR2ER	NLTAIREM2
GZ10	0-10V driver dims to 10%	nPP16 D EFP	nPP16 D ER EFP	RPP20 D 24V G2	RPP20 D 24V ER G2	RPP20 D 24V ER G2
GZ1	0-10V driver dims to 1%	nPP16 D EFP	nPP16 D ER EFP	RPP20 D 24V G2	RPP20 D 24V ER G2	RPP20 D 24V ER G2
EZ10	eldoLED 0-10V ECOdrive	nPS 80 EZ	nPS 80 EZ ER	RPP20 D 24V G2	RPP20 D 24V ER G2	RPP20 D 24V ER G2
EZ1	eldoLED 0-10V ECOdrive	nPS 80 EZ	nPS 80 EZ ER	RPP20 D 24V G2	RPP20 D 24V ER G2	RPP20 D 24V ER G2
EZB	eldoLED 0-10V SOLOdrive	nPS 80 EZ	nPS 80 EZ ER	RPP20 D 24V G2	RPP20 D 24V ER G2	RPP20 D 24V ER G2

How to Estimate Delivered Lumens in Emergency Mode

Delivered Lumens = 1.25 x P x LPW

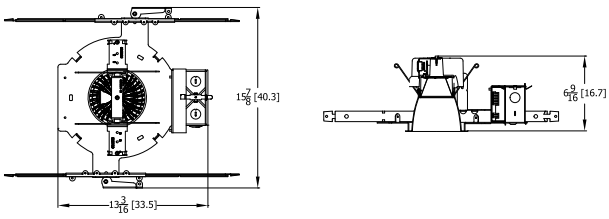
P = Output power of emergency driver. P = 10W for PS1055CP

LPW = Lumen per watt rating of the luminaire. This information is available on the ABL luminaire spec sheet.

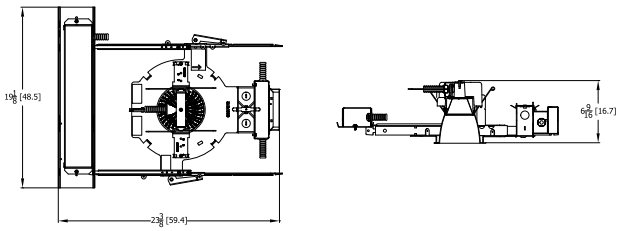
DIMENSIONAL DATA

Aperture: 4-5/16" (11)	Ceiling Opening: 5-1/8" (13) self-flanged
Overlap trim: 5-7/16" (13.8)	5-1/4" (13.3) flangeless

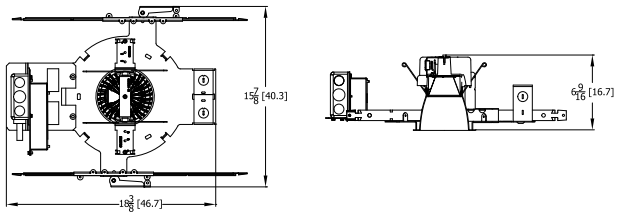
Standard



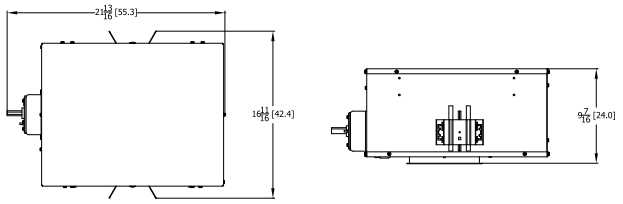
Battery Pack



CP Standard



CP Enclosed For Use With Battery Pack & nLight



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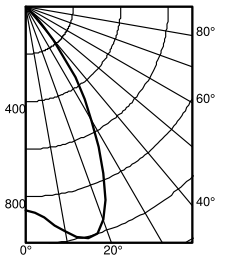
the lighting practice

Catalog Information: EVO4-35/10-AR-MD-LSS-MOVLT-GZ10

Date: 09/30/2022
Fixture Type:

A17

EV04 35/10 MWD LS INPUT WATTS: 8.8W, DELIVERED LUMENS: 1001.7LM, LPW = 113.8, 1.08 S/MH, TEST NO. LTL27786P131



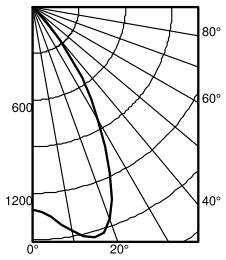
	Ave	Lumens
0	856	
5	888	87
15	1010	280
25	775	350
35	363	225
45	61	56
55	2	2
65	1	1
75	0	0
85	0	0
90	0	

Zone	Lumens	% Lamp
0° - 30°	717.4	71.6
0° - 40°	942.0	94.0
0° - 60°	1000.8	99.9
0° - 90°	1001.7	100.0
90° - 180°	0.0	0.0
0° - 180°	1001.7	*100.0
*Efficiency		

pf / pc / pw	80% 50%	80% 30%	80% 10%	70% 50%	70% 30%	70% 10%	50% 50%	50% 30%	50% 10%
0	119	119	119	116	116	116	111	111	111
1	111	108	106	109	106	104	105	103	101
2	103	99	96	101	98	95	98	95	93
3	96	91	87	95	90	87	92	88	85
4	90	84	80	89	84	80	87	82	79
5	84	78	74	83	78	74	81	77	73
6	79	73	69	78	72	68	76	72	68
7	74	68	64	73	68	64	72	67	63
8	70	64	59	69	63	59	68	63	59
9	66	60	56	65	59	56	64	59	55
10	62	56	52	61	56	52	61	56	52

Mounting Height	Inital FC Center Beam	50% beam - 56.7° Diameter	50% beam - 56.7° FC	10% beam - 79.7° Diameter	10% beam - 79.7° FC
8.0	28.3	5.9	14.1	9.2	2.8
10.0	15.2	8.1	7.6	12.5	1.5
12.0	9.5	10.3	4.7	15.9	0.9
14.0	6.5	12.4	3.2	19.2	0.6
16.0	4.7	14.6	2.3	22.5	0.5

EV04 35/15 MWD LSS INPUT WATTS: 13.7W, DELIVERED LUMENS: 1527.3LM, LPW = 111.4, 1.08 S/MH, TEST NO. LTL27786P137



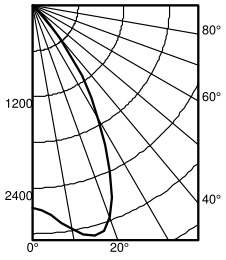
	Ave	Lumens
0	1305	
5	1354	133
15	1539	428
25	1181	533
35	553	342
45	93	86
55	2	4
65	1	1
75	0	0
85	0	0
90	0	

Zone	Lumens	% Lamp
0° - 30°	1093.9	71.6
0° - 40°	1436.2	94.0
0° - 60°	1525.8	99.9
0° - 90°	1527.3	100.0
90° - 180°	0.0	0.0
0° - 180°	1527.3	*100.0
*Efficiency		

pf / pc / pw	80% 50%	80% 30%	80% 10%	70% 50%	70% 30%	70% 10%	50% 50%	50% 30%	50% 10%
0	119	119	119	116	116	116	111	111	111
1	111	108	106	109	106	104	105	103	101
2	103	99	96	101	98	95	98	95	93
3	96	91	87	95	90	87	92	88	85
4	90	84	80	89	84	80	87	82	79
5	84	78	74	83	78	74	81	77	73
6	79	73	69	78	72	68	76	72	68
7	74	68	64	73	68	64	72	67	63
8	70	64	59	69	63	59	68	63	59
9	66	60	56	65	59	56	64	59	55
10	62	56	52	61	56	52	61	56	52

Mounting Height	Inital FC Center Beam	50% beam - 56.7° Diameter	50% beam - 56.7° FC	10% beam - 79.7° Diameter	10% beam - 79.7° FC
8.0	43.2	5.9	21.6	9.2	4.3
10.0	23.2	8.1	11.6	12.5	2.3
12.0	14.5	10.3	7.2	15.9	1.4
14.0	9.9	12.4	4.9	19.2	1.0
16.0	7.2	14.6	3.6	22.5	0.7

EV04 35/30 MWD LSS INPUT WATTS: 31.2W, DELIVERED LUMENS: 3110.6LM, LPW = 99.6, 1.08 S/MH, TEST NO. LTL27786P155



	Ave	Lumens
0	2659	
5	2758	271
15	3135	871
25	2406	1086
35	1126	697
45	189	175
55	5	7
65	2	2
75	0	1
85	0	0
90	0	

Zone	Lumens	% Lamp
0° - 30°	2227.9	71.6
0° - 40°	2925.0	94.0
0° - 60°	3107.6	99.9
0° - 90°	3110.6	100.0
90° - 180°	0.0	0.0
0° - 180°	3110.6	*100.0
*Efficiency		

pf / pc / pw	80% 50%	80% 30%	80% 10%	70% 50%	70% 30%	70% 10%	50% 50%	50% 30%	50% 10%
0	119	119	119	116	116	116	111	111	111
1	111	108	106	109	106	104	105	103	101
2	103	99	96	101	98	95	98	95	93
3	96	91	87	95	90	87	92	88	85
4	90	84	80	89	84	80	87	82	79
5	84	78	74	83	78	74	81	77	73
6	79	73	69	78	72	68	76	72	68
7	74	68	64	73	68	64	72	67	63
8	70	64	59	69	63	59	68	63	59
9	66	60	56	65	59	56	64	59	55
10	62	56	52	61	56	52	61	56	52

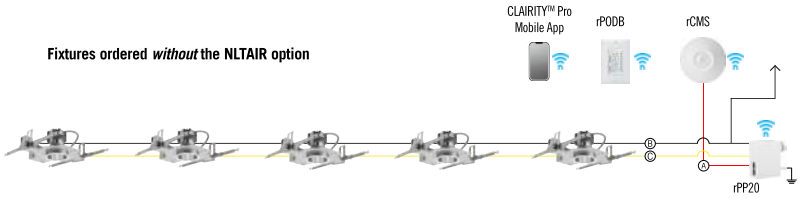
Mounting Height	Inital FC Center Beam	50% beam - 56.7° Diameter	50% beam - 56.7° FC	10% beam - 79.7° Diameter	10% beam - 79.7° FC
8.0	87.9	5.9	43.9	9.2	8.8
10.0	47.3	8.1	23.6	12.5	4.7
12.0	29.5	10.3	14.7	15.9	2.9
14.0	20.1	12.4	10.1	19.2	2.0
16.0	14.6	14.6	7.3	22.5	1.5

NLIGHT AIR

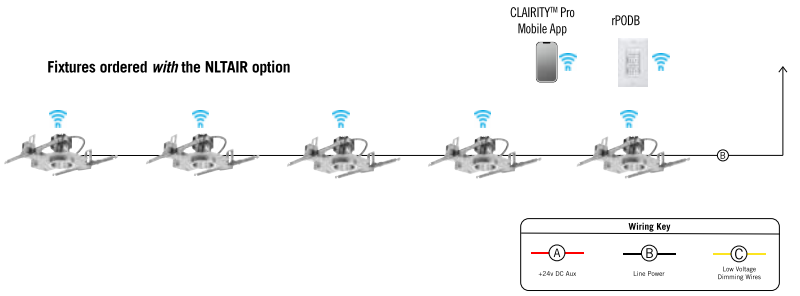
nLight® AIR is the ideal solution for retrofit or new construction spaces where adding communication wiring is cost prohibitive. The integrated nLight AIR rPP20 Power Pack is part of each EVO Luminaire ordered with the NLTAIR option. These individually addressable controls offer the ultimate in flexibility during initial setup and for space repurposing.

Possibilites for nLight® AIR

Fixtures ordered *without* the NLTAIR option



Fixtures ordered *with* the NLTAIR option



nLight® AIR Control Accessories

Order as separate catalog number. Visit nLight AIR.

Wall Switches	Model Number
On/Off single pole	rPODB (color) G2
On/Off two pole	rPODB 2P (color) G2
On/Off & raise/lower single pole	rPODB DX (color) G2
On/Off & raise/lower two pole	rPODB 2P DX (color) G2

nLight® AIR Control Accessories *(cont.)*

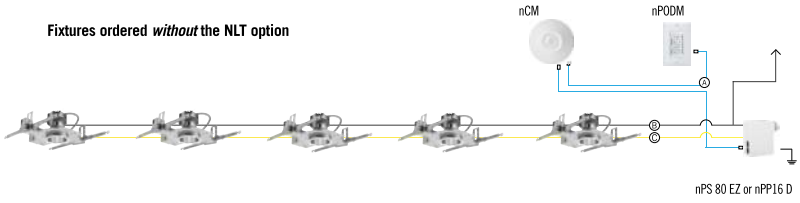
Occupancy Sensors (PIR/dual tech)	Model Number
Small motion 360°, ceiling	rCMS 9 / rCMS PDT 9
Large motion 360°, ceiling	rCMS 10 / rCMS PDT 10

NLIGHT

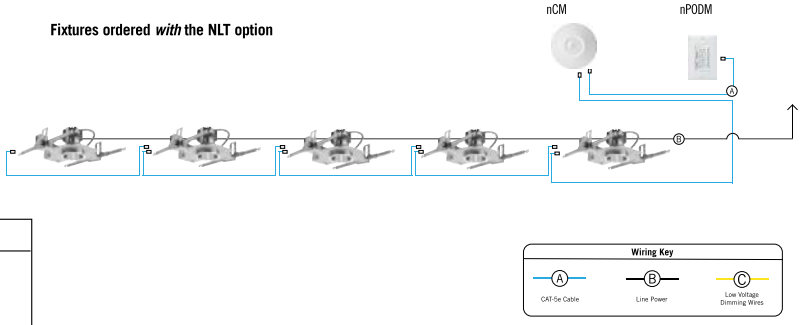
nLight® The nLight® solution is a digital networked lighting control system that provides both energy savings and increased user configurability by cost effectively integrating time-based, daylight-based, sensor-based and manual lighting control schemes.

Possibilites for nLight® wired

Fixtures ordered *without* the NLT option



Fixtures ordered *with* the NLT option



nLight® Wired Control Accessories

Order as separate catalog number. Visit nLight.

Wall Switches	Model Number
On/Off single pole	nPODM (color)
On/Off two pole	nPODM 2P (color)
On/Off & raise/lower single pole	nPOD DX (color)
On/Off & raise/lower two pole	nPODM 2P DX (color)
Graphic touchscreen	nPOD GFX (color)
Photocell Controls	
Dimming	nCM ADCX

nLight® Wired Control Accessories *(cont.)*

Occupancy Sensors (PIR/dual tech)	Model Number
Small motion 360°, ceiling	nCM 9 / nCM PDT 9
Large motion 360°, ceiling	nCM 10 / nCM PDT 10
Wide View	nWV 16 / nWV PDT 16
Wall switch with raise/lower	nWSX LV DX / nWSX PDT LV DX
Cat-5 Cables (plenum rated)	
10', CAT5	CAT5 10FT J1
15', CAT5	CAT5 15FT J1

gotham®

FINELITE

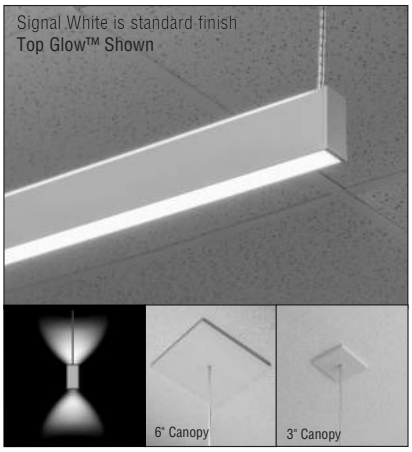
E2 Indirect/Direct (E2-ID) Linear

Date

Project

Type

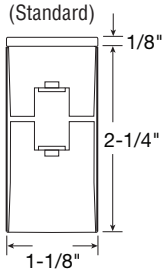
Comments



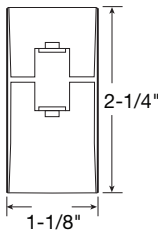
DESCRIPTION

E2 Indirect/Direct (E2-ID) Linear provides excellent light output with a minimalist shape. Based on the Elements platform, E2 uses easy-to-install power supply boxes and power suspension cables that enable independent control of uplight and downlight.
This Product is enrolled in the International Living Future Institute (ILFI) Declare 2.0 Program and is third-party verified with options achieving Declared status.

TOP GLOW (Standard)



FLUSH



DIMENSIONS

Small form with glare-free illumination.

Low Profile T-Bar Power Supply Box (shown)

ELECTRICAL BOX OPTIONS

Mounting options for new and retrofit installations.
See page 2 for more information.

Tailored Lighting
10 working days

- Static white uplight and downlight output options: Standard (**S**), Boosted Standard (**B**), High (**H**), and Very High (**V**)
- Any length greater than 2 feet, in increments down to 1/16" (± 1/32")
- 90-degree mitered corners in a single plane; prescribed configurations
- 80+ or 90+ CRI

ORDERING GUIDE: *Sample Number: E2-ID - L - 4' - H - H - 835 - TG - F - 96LG - 120V - SC - APC - FE - C1 - OBO - RLD*

E2-ID

Finelite **E2** (**ID**-Indirect/Direct) MOD DIRECT ONLY
Luminaire Styles (**L** - Linear)
Lengths (Minimum **2'**, increments accurate to 1/16" (± 1/32"))
~~Uplight Output (**S** - Standard, **B** - Boosted Standard, **H** - High, **V** - Very High)~~
Downlight Output (**S** - Standard, **B** - Boosted Standard, **H** - High, **V** - Very High) MOD 300LM/FT DIRECT
LED CRI/CCT (**830** - 80 CRI min, 3000K **930** - 90 CRI min, 3000K
835 - 80 CRI min, 3500K **935** - 90 CRI min, 3500K
840 - 80 CRI min, 4000K **940** - 90 CRI min, 4000K)
~~Uplight Diffuser Option (**TG** - Top Glow (standard), **F** - Flush)~~
Downlight Diffuser Option (**F** - Flush (standard))
Reflector System (**96LG** - Low Gloss)
Voltage (**120V**, **277V**, **347V**)
Circuiting (**SC** - Single Circuit **DC** - Dual Circuit)
Mounting (**APC** - Adjustable Power Cable (50" Standard))
Endcap (**FE** - Flat Endcap)
Ceiling Type[1] (**C1** - 1" T-Bar, **C2** - 9/16" T-Bar, **C3** - Screw Slot, **C4** - Hard Ceiling[2])
Integrated Sensor[3] (**OBO** - Occupancy Sensor)
Special Options (**RLD** - Declared)

[1] E2-ID does not mount directly in alignment to T-Bar Grid / On-Grid.
[2] C4 is used for sheetrock ceilings. Contact Factory for open ceiling applications.
[3] Sensor is integrated into the canopy above the luminaire. Available for 6" canopy only.

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Finelite, Inc. • 30500 Whipple Road • Union City, CA 94587-1530 • (510) 441-1100 • Fax: (510) 441-1510 • www.finelite.com

Due to continuing product improvements, Finelite reserves the right to change specifications without notice. Please visit www.finelite.com for the most current data.

the lighting practice

Catalog Information: E2-ID (MOD DIRECT ONLY)-L-[LENGTH]-NA-(MOD 300LM/FT DIRECT)-935-NA-F-96LG-[VOLTAGE]-SC-APC-FE-C4
FINISH: RAL 090 80 90

Date: 09/30/2022
Fixture Type:

B1

ELECTRICAL BOX OPTIONS

E2 can be specified with power supply boxes to meet specific application needs. From new to retrofit, T-Bar to drywall, to fully remote, E2 power supply boxes install quickly and easily.

Low Profile T-Bar Power Supply Box with 6" Canopy (P01)

Dimensions - 10-1/8"W x 16-1/8"L x 1-11/16"D

- T-Bar only
- Two drivers maximum per box (illuminates up to 8')
- Includes easy leveling system from below ceiling
- Access drivers from above ceiling for simple maintenance
- (7) ½" feed knockouts available to connect building power
- Optional occupancy sensor located in canopy for a clean aesthetic

Large Capacity Power Supply Box with 6" Canopy (P02)

Dimensions - 10"W x 23"L x 4"D

- T-Bar or Drywall ceiling compatible[1]
- Four drivers maximum per box (illuminates up to 16') or two drivers (illuminates up to 8') and one EM[2] battery pack for egress (illuminates 4' only)
- Includes easy leveling system from below the ceiling
- Access to drivers from below ceiling to reduce maintenance time
- (4) ½" feed knockouts available to connect building power
- Optional Occupancy sensor located in canopy for a clean aesthetic

Retrofit Power Supply Box with 6" Canopy (P03)

Dimensions - 5"W x 14-3/8"L x 8-3/4"D

- T-Bar or Drywall ceiling compatible[1]
- Two drivers maximum per box (illuminates up to 8')
- Includes easy leveling system from below ceiling
- Access to drivers from below ceiling to reduce maintenance time
- (4) ½" feed knockouts available to connect building power
- Optional Occupancy sensor located in canopy for a clean aesthetic

Low Profile T-Bar Power Supply Box with 3" Canopy (P04)

Dimensions - 10-1/8"W x 16-1/8"L x 1-11/16"D

- Small aperture for clean ceiling line.
- T-Bar only
- Two drivers maximum per box (illuminates up to 8')
- Includes easy luminaire leveling system from below ceiling
- Access drivers from above ceiling for simple maintenance.
- (7) ½" feed knockouts available to connect building power.
- Due to size restrictions, P04 does not accommodate integral sensors.

[1] Contact Factory for open ceiling applications.
[2] See Electrical on page 6 for details.

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Catalog Information: E2-ID (MOD DIRECT ONLY)-L-[LENGTH]-NA-(MOD 300LM/FT DIRECT)-935-NA-F-96LG-[VOLTAGE]-SC-APC-FE-C4
FINISH: RAL 090 80 90

Date: 09/30/2022
Fixture Type:

B1

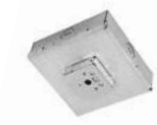
Large Capacity Power Supply Box with 3" Canopy (P05)
Dimensions - 10"W x 23"L x 4"D

- Small aperture for clean ceiling line.
- T-Bar only
- Access to drivers from above ceiling only
- Four drivers maximum per box (illuminates up to 16')
- Includes easy luminaire leveling system from below the ceiling
- (4) ½" feed knockouts available to connect building power
- Due to size restrictions, P05 does not accommodate integral sensors.

Splice Box with 6" Canopy (S01)
Dimensions - 5"W x 5"L x 2-3/8"D

- T-Bar or Drywall ceiling compatible*
- Includes easy leveling system from below ceiling

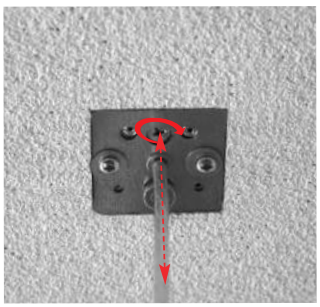
Splice Box with 3" Canopy (S02)
Dimensions - 5"W x 5"L x 2-3/8"D



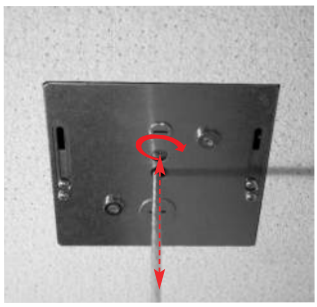
- T-Bar or Drywall ceiling compatible*
- Includes easy leveling system from below ceiling

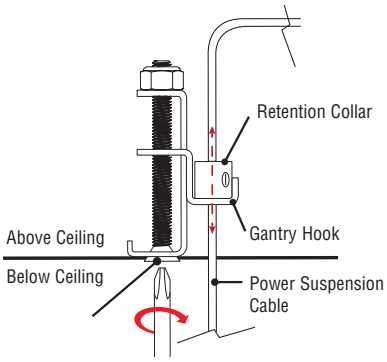
EASY LEVELING SYSTEM ON ALL BOXES
E2-ID includes a patent pending leveling system for simple leveling adjustment for a consistent luminaire sightline.

3" Canopy



6" Canopy





Watch Video

Scan this QR code with your mobile phone or tablet

* Contact Factory for open ceiling applications.

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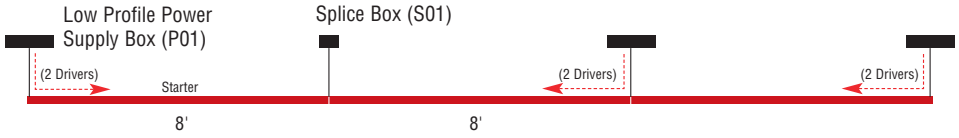
Catalog Information: E2-ID (MOD DIRECT ONLY)-L-[LENGTH]-NA-(MOD 300LM/FT DIRECT)-935-NA-F-96LG-[VOLTAGE]-SC-APC-FE-C4
FINISH: RAL 090 80 90

Date: 09/30/2022
Fixture Type:

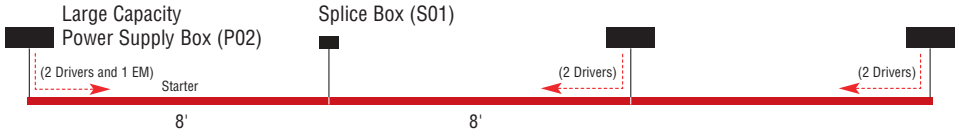
B1

ELECTRICAL BOX SPECIFICATION (For more details, refer to www.finelite.com for the Electrical Box Specification Guide.)

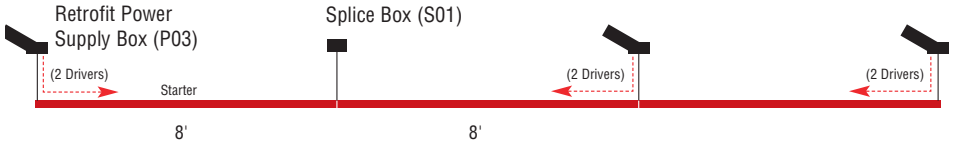
A. 24' run with Low Profile T-Bar Power Supply Boxes (P01). Two drivers in each box. T-Bar ceiling.



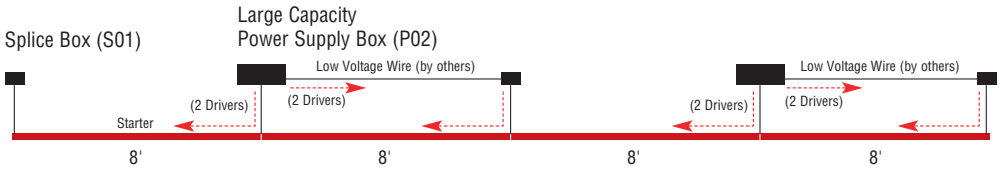
B. 24' run with Large Capacity Power Supply Boxes (P02). Two drivers and one battery backup* in first box. Drywall or T-Bar ceiling.



C. 24' run with Retrofit Power Supply Boxes (P03). Two drivers in each box. Drywall or T-Bar ceiling.



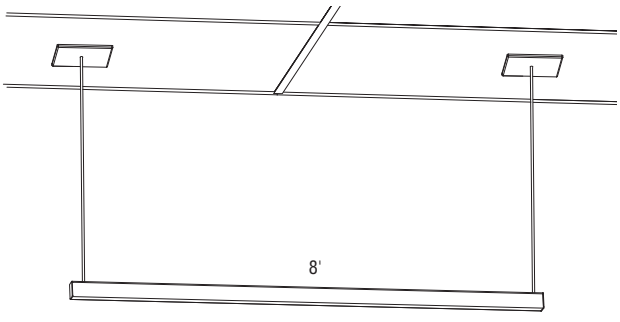
D. 32' run with Large Capacity Power Supply Boxes (P02). Four drivers in each box. Drywall or T-Bar ceiling.



* **Note**: Standard battery backup section is for 4' downlight only.

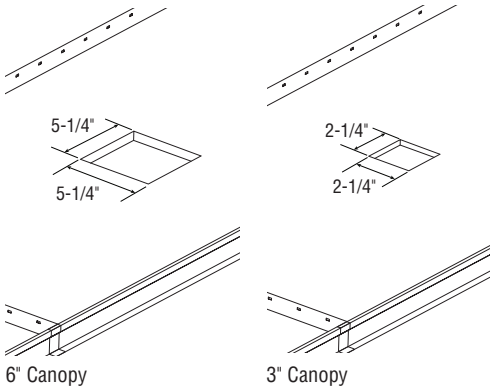
MOUNTING

8-foot maximum section length. Standard off-grid mounting. A single cable suspends and carries power to the luminaire for a consistent and uniform visual aesthetic throughout the installation.



ROUGH-IN

T-Bar or Drywall



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Catalog Information: E2-ID (MOD DIRECT ONLY)-L-[LENGTH]-NA-(MOD 300LM/FT DIRECT)-935-NA-F-96LG-[VOLTAGE]-SC-APC-FE-C4
FINISH: RAL 090 80 90

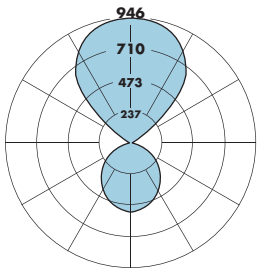
Date: 09/30/2022
Fixture Type:

B1

E2 Indirect/Direct (E2-ID) Linear

PHOTOMETRY - ↑Flush / ↓Flush Diffuser (E2-ID-L-4'-V-V-835-F-F)

Very High Output / Very High Output - 4' Luminaire
Distribution: 61% Up (**V**) / 39% Down (**V**)
Efficacy: 99 lumens per watt
Uplight: 2250 lumens (563 lumens/foot)
Downlight: 1440 lumens (360 lumens/foot)
Total Luminaire Output: 3690 lumens (923 lumens/foot)
37.2 watts (9.3 watts/foot)
CCT: 3500K; CRI: 80
ITL LM79 Report 89277



CANDELA DISTRIBUTION

	0.0	22.5	45	67.5	90	Flux
0	520	520	520	520	520	
5	518	518	518	518	518	49
15	497	494	497	497	497	140
25	457	452	456	455	454	209
35	400	395	398	397	396	248
45	332	328	330	328	327	254
55	257	254	254	253	253	227
65	179	176	175	175	175	174
75	102	100	99	99	100	106
85	29	28	29	29	30	32
90	0	0	0	0	0	
95	20	18	14	11	11	18
105	114	93	70	56	52	82
115	278	236	165	124	113	181
125	471	426	377	265	229	320
135	644	618	579	567	535	449
145	772	759	740	712	708	461
155	862	851	857	845	837	391
165	918	912	916	914	912	258
175	943	942	942	942	942	90
180	946	946	946	946	946	

	↑ Indirect	↓ Direct

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire

	↑S*	↑B*	↑H*	↑V**
↓S*	1511 [↑61% I 39%↓]	1747 [↑66% I 34%↓]	2339 [↑75% I 25%↓]	2839 [↑79% I 21%↓]
↓B*	1662 [↑55% I 45%↓]	1899 [↑61% I 39%↓]	2491 [↑70% I 30%↓]	2991 [↑75% I 25%↓]
↓H*	2041 [↑45% I 55%↓]	2278 [↑51% I 49%↓]	2870 [↑61% I 39%↓]	3370 [↑67% I 33%↓]
↓V*	2361 [↑39% I 61%↓]	2598 [↑45% I 55%↓]	3190 [↑55% I 45%↓]	3690 [↑61% I 39%↓]

Light Output, 3500K, 80 CRI (Lumens Per Foot)

	↑S*	↑B*	↑H*	↑V**
↓S*	378	437	585	710
↓B*	416	475	623	748
↓H*	510	569	718	843
↓V*	590	649	798	923

Power, 3500K, 80 CRI (Watts Per Foot)

	↑S*	↑B*	↑H*	↑V**
↓S*	3.8	4.3	5.5	6.6
↓B*	4.3	4.8	6.0	7.0
↓H*	5.5	6.0	7.2	8.3
↓V*	6.6	7.0	8.3	9.3

Efficacy, 3500K, 80 CRI (Lumens Per Watt)

	↑S*	↑B*	↑H*	↑V**
↓S*	99	101	106	108
↓B*	96	99	104	106
↓H*	93	95	100	102
↓V*	90	92	97	99

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
* Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
** Correlation based on ITL report: 89277

Lumen Adjustment Factors - 80 CRI

3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors - 90 CRI

3000K	0.746
3500K	0.760
4000K	0.789

Apply a lumen adjustment factor to calculate lumens for the desired CCT and CRI.

SAMPLE LUMEN ADJUSTMENT CALCULATION

High Output (**H**) / Standard Output (**S**), 4000K, 90CRI

Lumen Adjustment Factor = 0.789

Total Light Output =
2339 lm x 0.789 = 1845 lm

Total Light Output per Foot =
585 lm/ft x 0.789 = 462 lm/ft

watts/foot = 5.5 W/ft

$$\textit{Efficacy} = \frac{462\ \frac{lm}{ft}}{5.5\ \frac{W}{ft}} = 84\ \text{lm/W}$$

Patent Pending A brand of legrand

the lighting practice

Catalog Information: E2-ID (MOD DIRECT ONLY)-L-[LENGTH]-NA-(MOD 300LM/FT DIRECT)-935-NA-F-96LG-[VOLTAGE]-SC-APC-FE-C4
FINISH: RAL 090 80 90

Date: 09/30/2022
Fixture Type:

B1

SPECIFICATIONS

CONSTRUCTION: Precision cut 6061-T6 extruded aluminum body with diecast aluminum endcaps. Top Glow™ diffuser snaps into place and is easily removed for service.

ENDCAPS: Flat diecast aluminum endcaps add 1/4" to each end of luminaire.

UPLIGHT DIFFUSER: The Top Glow™ diffuser is frost white standard. Coupled with light engine design, the diffuser spreads the light evenly for enhanced ceiling uniformity. Optional: Flush frost white snap-in diffuser.

DOWNLIGHT DIFFUSER: Flush frost white snap-in diffuser standard. Coupled with light engine design, the diffuser spreads the light evenly for enhanced distribution.

LIGHT OUTPUT: Four lumen packages available, Standard (**S**), Boosted Standard (**B**), High (**H**), and Very High (**V**). A separate chart summarizes lumen distribution and wattage.

LIGHT ENGINE: The replaceable light engines are made up of high performance mid-power LEDs and designed to distribute heat properly to maximize the life of the LEDs and the driver.

LUMEN MAINTENANCE: 90% of initial light output (L90) at 100,000+ hours; 70% of initial light output (L70) at 200,000+ hours.

DRIVER: Replaceable 120V/277V and 347V Constant Current Reduction dimming driver standard. Can be wired dimming or non-dimming. 0-10V dimming controls with a range of 10%- 100%. Dimming to 1% available; consult factory. Driver for Low Profile T-Bar Power Supply Box is accessible from above the ceiling. Driver for Large Capacity and Retrofit Power Supply Box are fully accessible from below the ceiling. Power Factor: ≥0.9. Total Harmonic Distortion (THD): <20%. Step-dimming driver (limited programable outputs. Contact F actory). Expected driver lifetime: 100,000 hours.

ELECTRICAL: 120V or 277V prewired. Emergency to generator/inverter wiring, internal generator transfer switch. See Electrical Box Options for more information (page 2). EM battery backup (4' only) will use a BSL722 in hard lid ceiling applications where above ceiling access is not available. Backup batteries deliver 1542 lumens.

Daylight Sensor Occupancy Sensor

INTEGRATED SENSORS: Integrated Occupancy Sensors can be located in the canopy. Sensors are available when using the following power supply boxes: Low Profile T-Bar (**P01**), Large Capacity (**P02**), and Retrofit (**P03**) power supply boxes. Sensors not available with 3" canopy.

MOUNTING: Standard E2-ID Linear mounting is off-grid. Bar Hangers for mounting power supply boxes to joists are ordered separately. Consult Electrical Box Options (Page 2) for maintenance details.

FINISH: Finelite Signal White powder coat finish standard. Optional Adders: 185 RAL colors.

SUPPORT CABLE/FEED: Standard suspension is conductive feed/suspension cable. The adjustable power cable (APC) comes standard in 50" length. 4-conductor cable standard delivering independent up light and downlight control. Field adjustable length. Max support spacing every 8' .

LENGTHS: Any length, 2-foot minimum, in increments down to 1/16" (± 1/32"). 8-foot maximum section length.

WEIGHT: 1.0 lb per foot. 4' E2-ID linear weighs 4 lbs.

LABELS: Luminaire and electrical components are ETL-listed conforming to UL 2108 in the U.S.A. and CAN/CSA C22.2#9.0 in Canada. In accordance with NEC Code 410.130 (G), this luminaire contains an internal driver disconnect. UL 924 and -PoE options available on request, contact factory for more details. Damp Location. Power supply boxes are IC Rated and Chicago Plenum approved. Finelite products use electronic components that are RoHS compliant, and the mechanical components of the luminaire have been verified to not knowingly contain any restricted substances listed per RoHS Directive (EU) 2015/863. Finelite makes the specification process easy when putting healthier products on your projects. Simply add – **RLD** (Declared Label) to your part number.

WARRANTY: 10-year performance-based warranty on all standard components. Optional accessories such as emergency battery packs are covered by their individual manufacturer warranties.

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Catalog Information: E2-ID (MOD DIRECT ONLY)-L-[LENGTH]-NA-(MOD 300LM/FT DIRECT)-935-NA-F-96LG-[VOLTAGE]-SC-APC-FE-C4
FINISH: RAL 090 80 90

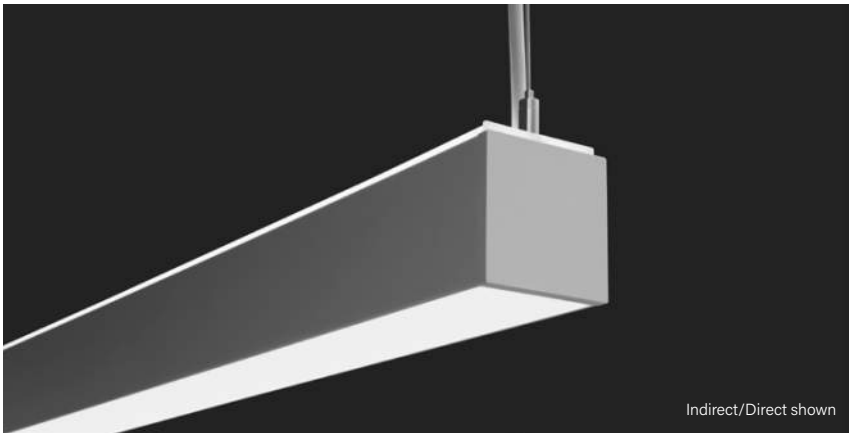
Date: 09/30/2022
Fixture Type:

B1

Submitted by:	
Type:	ect:
Ordering Info:	

FINELITE® Lighting

HPX Product Family



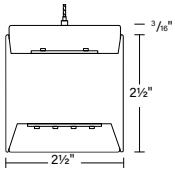
Signal White is standard finish

The High Performance 2.5" Aperture (HPX) is a patented LED linear luminaire with a square micro profile and internal driver design. This line of light luminaire delivers excellent performance, and is equipped with a unique LED configuration for superior illumination. Output can be enhanced with advanced optical options. Available in Pendant and Surface Mount, HPX can be tailored from 2' to 12' sections in 1' increments.

This product is enrolled in the International Living Future Institute (ILFI) Declare 2.0 Program and is third-party verified with options achieving Red List Approved and Declared status.

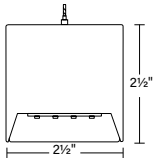
CROSS SECTIONS

Indirect/Direct
Top Glow Diffuser (standard)



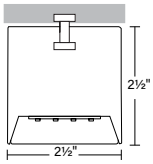
Flush Downlight Diffuser (standard)

Direct



Flush Downlight Diffuser (standard)

Surface Mount



Flush Downlight Diffuser (standard)

LUMEN OUTPUT PACKAGES

- S — Standard
- B — Boosted Standard
- H — High
- V — Very High

PERFORMANCE

Up to **2057** **Lumens** per **Foot**

Up to **125** **Lumens** per **Watt**

Fine TUNE GENERATION 7 Option Available

Declare.

Protected by one or more US Patents: 8915613; 9681516,B2; D702,390

the lighting practice

Catalog Information: HP-X-P-ID-[LENGTH]-S-S-935-WSO-F-[VOLTAGE]-DC-FC-10%-FA100-C4-FE-SW

Date: 09/30/2022
Fixture Type:

B2

Submitted by:

Type: ect:

Ordering Info:

FINELITE® Lighting

Clear Form

HPX Product Family

BODY TYPE

Platform	Series Name	Luminaire Type	Luminaire Distribution	Total Run Length of Configuration
◉ HP - High Performance	◉ X - 2.5" Square	◯ P - Pendant ◯ SM - Surface Mount [7]	◯ D - Direct ◯ ID - Indirect/Direct	_____ Minimum 2' section length. Increments of 1'; 12' maximum section length

OUTPUT and LED TYPE

MECHANICAL/OPTICAL OPTIONS

Uplight Output ID Only	Downlight Output	LED CRI/CCT	Uplight Option ID Only	Downlight Option
◯ S - Standard ◯ B - Boosted Standard ◯ H - High ◯ V - Very High ◯ TL - Tailored: _____ .m/ft *	◯ S - Standard ◯ B - Boosted Standard ◯ H - High ◯ V - Very High ◯ TL - Tailored: _____ .m/ft *	◯ 830 - 80 CRI min, 3000K ◯ 835 - 80 CRI min, 3500K ◯ 840 - 80 CRI min, 4000K ◯ 930 - 90 CRI min, 3000K ◯ 935 - 90 CRI min, 3500K ◯ 940 - 90 CRI min, 4000K ◯ 8TW - 80 CRI min, Tunable White ◯ 9TW - 90 CRI min, Tunable White	◯ TG - Top Glow (Standard) ◯ F - Flush Diffuser ◯ WSO - Widespread Optic ◯ WSOTG - Widespread Optic with Top Glow ◯ ASYTG-L - Asymmetric Left Optic with Top Glow ◯ ASYTG-R - Asymmetric Right Optic with Top Glow	◉ F - Flush

* Specify lm/ft of outputs between Standard (S) and Very High (V). Consult factory for tailored lumen output outside of this range.

ELECTRICAL OPTIONS

Voltage	Circuiting [1]	Driver Selection [2]
◯ 120 - 120 Voltage ◯ 277 - 277 Voltage ◯ 347 - 347 Voltage	◯ SC - Single Circuit* One single circuit in a run ◯ DC - Dual Circuit* Independent control of up and down separately in an I/D style fixture ◯ MC - Multi Circuit* More than one switch leg or zone (not 'DC' indepedent control of up and down separately for an I/D style fixture). Factory shop drawings required *Battery, Night Light, and Emergency to Generator circuits are in addition to the normal luminaire circuit(s)	**0-10V Driver Options** ◯ FC-10% - 0-10V 10% (standard) [3] ◯ FC-1% - 0-10V 1% [3] ◯ OSR-10% - Osram OTi, 0-10V 10% [3] ◯ OSR-1% - Osram OTi, 0-10V 1% [3] ◯ ELD-10V - EldoLED SOLOdrive, 0-10V 0.1% ◯ 10V-TW - Osram OTi, 0-10V 10% *(Tunable White)* [3] **DALI Driver Options** ◯ FC-DALI - DALI 1% ◯ OSR-DALI - Osram Dexal, 1% ◯ ELD-DALI - EldoLED SOLOdrive, DALI 0.1% ◯ DALI-TW - EldoLED Dual Drive Light Shape, 1% *(Tunable White)* **DMX Driver Options** ◯ FIN-DMX - Finelite DMX 1% *(Tunable White - FineTUNE Controls Only)* [4] ◯ DMX - EldoLED POWERdrive, 0.1% ◯ DMX-TW - EldoLED POWERdrive, 0.1% *(Tunable White)* **Lutron Driver Options** ◯ LUT-ES1 - Lutron, Ecosystem 1% ◯ LUT-2W - Lutron, 2-wire (120v only) 1% ◯ LUT-TW - Lutron T-Series, EcoSystem 0.1% *(Tunable White)* See Page 3 for additional driver options and details

MOUNTING OPTIONS

OTHER OPTIONS

Mounting Method	Ceiling Hardware Type	Endcap Style	Finish	Emergency Style (Optional) Clear Selection [1]	Integrated Sensor (Optional) Clear Selection [1]
◯ FA50 - Fully Adjustable 50" ◯ FA100 - Fully Adjustable 100" ◯ FA150 - Fully Adjustable 150" ◯ FA200 - Fully Adjustable 200" ◯ FA250 - Fully Adjustable 250" ◯ FA300 - Fully Adjustable 300" ◯ FM - Flexible Mounting [5]	◯ C1 - 1" T-Bar [6] ◯ C2 - 9/16" T-Bar [6] ◯ C3 - Screw Slot [6] ◯ C4 - Hard Ceiling [6] ◯ C1T - 1" Tegular [6] ◯ C2T - 9/16" Tegular [6] ◯ SMC4 - Surface Mount Hard Ceiling, no grid mount options. (Only available option for HPX-SM)	◉ FE - Flat Endcap	◯ SW - Signal White ◯ FB - Finelite Black ◯ SA - Satin Aluminum ◯ #### - RAL Color Code [7] _____	◯ LGD18W - Legrand 18W Brand Battery Back-up ◯ LGD10W - Legrand 10W Brand Battery Back-up ◯ EM/GEN - Emergency to Generator ◯ NL - Night Light ◯ BSL310LP - Bodine Battery Back up Low Profile [8] ◯ GTD - Generator Transfer Device ◯ ALCR - Automatic Load Control Relay	◯ OBO - Occupancy ◯ OBD - Daylight ◯ W601 - Wattstopper [10] Wireless Sensor ◯ OBE - Enlighted [9]

OTHER OPTIONS

Special Options (Optional) Clear Selection [1]
◯ RLA - Red List Approved ◯ RLD - Declare

[1] Contact factory for switching options
[2] For Indirect/Direct lengths 3' and greater, separate dimming for uplight and downlight available
[3] Add DTO to gain "Dim to Off" functionality (FC-10% - DTO)
[4] B & V outputs only
[5] Direct only
[6] C1,C2,C3 T-bar mounting for Pendant Only.
[7] 20 Business day lead time for color
[8] BSL310LP work with HPX Direct 4ft without sensor only
[9] Enlightened components installed by Finelite; Provided by OTHER
[10] LMFS-601 w/ 0-10V driver(s) and LMFI-111, up to 6 drivers may be connected. LMFS-601 w/ Dali driver, only 1 driver can be connected.

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Catalog Information: HP-X-P-ID-[LENGTH]-S-S-935-WSO-F-[VOLTAGE]-DC-FC-10%-FA100-C4-FE-SW

Date: 09/30/2022

Fixture Type:

B2

HPX Product Family

SUPPLEMENTARY DRIVER PAGE

0-10V Driver Options	
FC-10%	Factory Choice, 0-10V 10% Dimming (Linear)
FC-10%-DTO	Factory Choice, 0-10V 10% Dimming, Dim-to-Off (Linear)
FC-1%	Factory Choice, 0-10V 1% Dimming (Linear)
FC-1%-DTO	Factory Choice, 0-10V 1% Dimming, Dim-to-Off (Linear)
ELD-10V-0%	EldoLED SOLOdrive, 0-10V 0.1% Dimming (Linear)
ELD-10V-1%	EldoLED ECOdrive, 0-10V 1% Dimming (Linear)
OSR-10V-TW	Osram OTi, 0-10V 10% Dimming, *Tunable White* (Linear)
OSR-10V-TWDTO	Osram OTi, 0-10V 10% Dimming, Dim-to-Off, *Tunable White* (Linear)
OSR-10%	Osram OTi, 0-10V 10% Dimming (Linear)
OSR-10%-DTO	Osram OTi, 0-10V 10% Dimming, Dim-to-Off (Linear)
OSR-1%	Osram OTi, 0-10V 1% Dimming (Linear)
OSR-1%-DTO	Osram OTi, 0-10V 1% Dimming, Dim-to-Off (Linear)

DALI Driver Options	
FC-DALI-1%	Factory Choice, DALI 1% Dimming (Logarithmic)
OSR-DALI-1%	Osram Dexal, DALI 1% Dimming (Logarithmic)
ELD-DALI-0%	EldoLED SOLOdrive, DALI 0.1% Dimming (Logarithmic)
ELD-DALI-1%	EldoLED ECOdrive, DALI 1% Dimming (Logarithmic)
ELD-DALI-TW	EldoLED DUALdrive Light Shape, DALI 1% Dimming, *Tunable White* (Logarithmic Dimming, Linear CCT Control)

DMX Driver Options	
FIN-DMX	Finelite, DMX 1% Dimming, *Tunable White* - **FineTUNE Controls Only** (Linear)
ELD-DMX	EldoLED POWERdrive, DMX 0.1% Dimming (8 Bit, 1CH) (Linear)
ELD-DMX-16	EldoLED POWERdrive, DMX 0.1% Dimming (16 Bit, 2CH) (Linear)
ELD-DMX-TW	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (8 Bit, 2CH - CH1 Warm / CH2 Cool) (Linear)
ELD-DMX-TW16	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (16 Bit, 4CH - CH1, 2 Warm / CH3, 4 Cool) (Linear)

Lutron Driver Options	
LUT-ES1	Lutron, Ecosystem 1% Dimming
LUT-2W	Lutron, 2-wire (120v only) 1% Dimming
LUT-TW	Lutron T-Series, EcoSystem 1% Dimming, *Tunable White*

Submitted by:	
Type:	ect:
Ordering Info:	

FINELITE® Lighting

HPX Product Family

SPECIFICATIONS

BODY TYPE

CONSTRUCTION: Precision-cut 6061-T6 extruded aluminum body. Internal joiner system, plug-together wiring, standard.

LENGTHS: Any length, 2' minimum section length. Increments of 1'. 12' maximum section length. For Indirect/Direct, select a minimum body length of 3' or greater when requiring dual circuiting or when uplight and downlight outputs differ.

ARRAY TYPE

LIGHT OUTPUT: Four lumen packages available, Standard (**S**), Boosted Standard (**B**), High (**H**), and Very High (**V**). A separate chart summarizes lumen distribution and wattage. For Tailored Outputs outside of range from Standard (**S**) to Very High (**V**), consult factory. Light engines are replaceable.

MECHANICAL FEATURES

UPLIGHT OPTION [1]: Patented Top Glow Frost White Diffuser, standard. 12' maximum diffuser length. Optical distribution pattern options include Widespread Optic (**WSO**); WSO enables increased luminaire spacing with improved ceiling uniformity, and Asymmetric (**ASYTG-L** / **ASYTG-R**). Asymmetric optic directs light in a specific direction. ASYTG-L distributes light to the left, ASYTG-R distributes light to the right of the luminaire. Consult factory for more tailored lumen outputs.

DOWNLIGHT OPTION: 12' maximum diffuser length. Flush (**F**) frost white snap-in diffuser, standard; 73% transmissive, 99% diffusion. Internal secondary diffusers at corners ensure visually seamless, uniform, continuous illumination. Consult factory for more tailored lumen outputs.

LUMEN MAINTENANCE: 90% of initial light output (L90) at 100,000+ hours; 70% of initial light output (L70) at 200,000+ hours.

ELECTRICAL FEATURES

STATIC WHITE FEED: 18-gauge/5-conductor single-circuit feed, standard. 14-gauge feed used when luminaire current exceeds 5 amps.

TUNABLE WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed. 14-gauge feed used when fixture current exceeds 5 amps. DMX and power feed at same location (standard). DMX feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths.

STATIC WHITE DRIVER: Replaceable 120V, 277V, and 347V Constant Current Reduction dimming driver standard. Can be wired dimming or non-dimming. 0-10V dimming controls with a range of 10% - 100% Dimming to 1% available; Consult factory. Separate dimming for uplight and downlight available. Driver is fully accessible from below the ceiling.
- **Power Factor:** ≥ 0.9
- **Total Harmonic Distortion (THD):** <20%
- **Expected driver lifetime:** 100,000 hours

LUTRON STATIC DRIVER OPTIONS:
- **LUT-ES (LDE1)** - (Hi-lume 1% EcoSystem with Soft-On, Fade-to-Black dimming (LDE1 series))
- **LUT-W2 (LTES2W)** - (Hi-lume 1% 2-wire, 120V forward phase dimming (LTEA series)).

TUNABLE WHITE DRIVER: Replaceable LED driver. Driver is accessible from below the ceiling. 120V/277V.
- **Power factor** ≥0.9
- **Total Harmonic Distortion (THD):** <20%
- **Dimming Range:** 100 - 1%
- **Expected driver lifetime:** 100,000 hours

LUTRON TUNABLE WHITE DRIVER OPTION: LUTDTW 1% T-Series 2-Channel Digital Tunable White (PSQ Series).

MOUNTING TYPE

HANGING HARDWARE:
- **Pendant:** 50" Fully Adjustable (**FA**) plated steel aircraft cable with safety stop hardware standard. Contact factory for additional lengths up to 150". The Flexible Mounting Bracket (**FM**) [2] adjusts the suspension points to accomodate existing architecture. Suspension points adjust up to 2' in from the end of 8' to 12' fixture lengths and up to 1' in on shorter lengths.
- **Surface Mount:** Ceiling types: Drywall or concrete surfaces (walls or ceilings): 1/4"-20 stud and nut (provided by others).

OTHER FEATURES

ENDCAPS: Flat diecast aluminum endcaps add 1/4" to each end of luminaire.

EMERGENCY STYLE: Optional emergency to generator/inverter wiring, internal generator transfer switch, nightlight wiring, step-dimming driver, backup battery.

Backup Battery

	Factory Choice	Bodine BSL310LP
HPX-P-D		
Min. Housing Length	8'*	4'
EM Lumen Output	2024	1202
EM Section Illuminated	2'	2' or 4'
HPX-SM-D		
Min. Housing Length	8'*	4'*
EM Lumen Output	2024	1202
EM Section Illuminated	2'	2' or 4'
HPX-P-ID		
Min. Housing Length	12'	8'
EM Lumen Output	2024	1202
EM Section Illuminated	2'	2' or 4'

* Minimum fixture housing length for battery pack approved without sensor

[1] Indirect/Direct (ID) only
[2] Direct only

Continued Page 4

HPX Product Family

SPECIFICATIONS

TUNABLE WHITE ELECTRICAL OPTIONS:
- **TW Driver Options 0-10V:** EM/GEN, GTD, or Battery Back-up
- **FineTune DMX:** EM/GEN or Battery Back-up
- **DMX:** Battery Back-up
- **DALI:** EM/GEN, GTD, or Battery Back-up
- **LUTRON:** EM/GEN, GTD, or Battery Back-up

INTEGRATED SENSORS: Integrated PIR (Passive Infrared) Occupancy (**OBO**) or Daylight Sensors (**OBD**) available with Flush and Bottom Glow downlight diffusers. PIR sensors not recommended for stairwell applications. Refer to Occupancy Sensor & Daylight Sensor tech sheet and the Embedded Intelligence landing page for more information and additional sensor options.

FINISHES: Finelite Signal White (**SW**) powder coat standard. Finelite Black (RAL 9005) with semi gloss fine texture (**FB**) [3] and satin Aluminum (**SA**) [3] are available. Optional Adders: 185 RAL colors. [3]

LABELS: Luminaire and electrical components are ETL-listed conforming to UL 1598 in the U.S.A. and CAN/CSA C22.2 No. 250.0 in Canada. In accordance with NEC Code 410.130 (G), this luminaire contains an internal driver disconnect. UL 924 and UL 2108 - PoE options available on request, contact factory for more details. These fixtures are rated for Damp Location. Finelite products use electronic components that are RoHS compliant, and the mechanical components of the luminaire have been verified to not knowingly contain any restricted substances listed per RoHS Directive 2015/863. HPX can be used to comply with 2016 Title 24, Part 6 (JA8); high efficacy LED light source requirements. Finelite makes the specification process easy when putting healthier products on your projects. Simply add – **RLA** (Red List Approved) or – **RLD** (Declared Label) to your part number.

WEIGHT: 2.3 lb/ft.

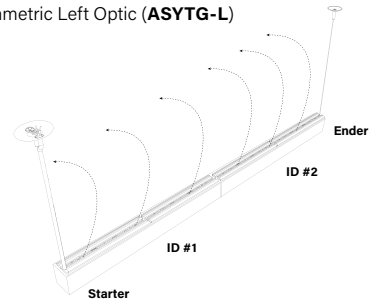
WARRANTY: 10-year performance-based warranty on all standard components. Optional accessories such as emergency battery packs are covered by their individual manufacturer warranties.

[3] 20 Business day lead time for color

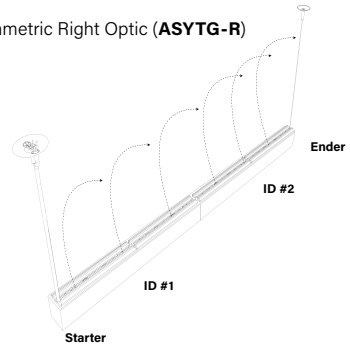
ASYMMETRIC OPTIC OPTIONS

Use this tool to understand how to specify Asymmetric for your project. The diagrams below show a linear run from power feed to ender. Specify, ASYTG-L distributes light to the left or ASYTG-R distributes light to the right.

Asymmetric Left Optic (**ASYTG-L**)



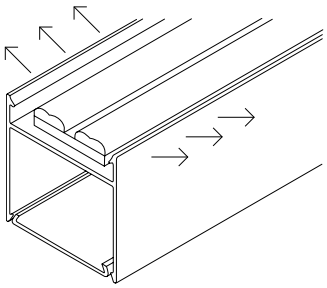
Asymmetric Right Optic (**ASYTG-R**)



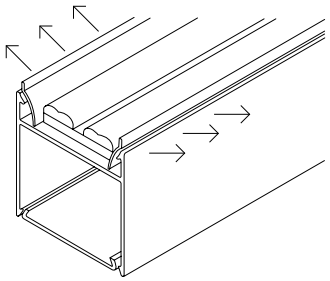
WIDESPREAD OPTIC OPTIONS

Wide Spread Optic (**WSO**) delivers a batwing distribution for improved performance.

Widespread Optic (**WSO**)



Widespread Optic Top Glow (**WSOTG**)



FINELITE® Lighting

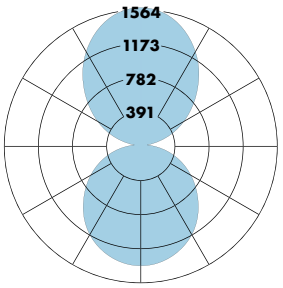
HPX Product Family

Indirect/Direct with Top Glow Photometry

4' Luminaire 3500K

HPX-P-ID-V-V-835-TG-F
Uplight: Top Glow / **Downlight:** Flush

Distribution: 50% Up (**V**) / 50% Down (**V**)
Efficacy: 119 lm/W
Uplight: 4073 lumens (1018 lumens/ft)
Downlight: 4111 lumens (1028 lumens/ft)
Total luminaire output: 8184 lumens
68.9 watts
Peak Candela Value: 1564 @ 180°
CRI: 80 / CCT: 3500K
ITL LM79 Report 92550



CANDLEPOWER SUMMARY

	0.0	22.5	45.0	67.5	90.0	Flux
0	1378	1378	1378	1378	1378	
5	1371	1372	1372	1372	1372	130
15	1327	1318	1326	1327	1323	374
25	1234	1221	1232	1233	1230	566
35	1097	1087	1096	1095	1092	684
45	923	919	927	931	929	714
55	727	722	734	740	743	655
65	509	510	526	536	541	518
75	287	297	316	332	337	333
85	86	102	125	145	152	137
90	2	23	51	74	82	
95	69	85	108	130	137	119
105	237	249	270	291	298	286
115	441	445	468	483	489	462
125	672	667	684	695	702	612
135	912	903	916	922	926	706
145	1147	1129	1142	1141	1141	712
155	1347	1328	1337	1332	1329	614
165	1485	1474	1478	1476	1470	416
175	1554	1554	1554	1554	1554	147
180	1564	1564	1564	1564	1564	

Total Light Output, 3500K, 80 CRI (Lumens)- 4' Luminaure				
	↑S[1]	↑B[1]	↑H[1]	↑V[2]
↓S[1]	3350 [↑50% | 50%↓]	3783 [↑56% | 44%↓]	4865 [↑66% | 34%↓]	5778 [↑71% | 29%↓]
↓B[1]	3779 [↑45% | 55%↓]	4212 [↑50% | 50%↓]	5293 [↑60% | 40%↓]	6207 [↑66% | 34%↓]
↓H[1]	4851 [↑35% | 65%↓]	5283 [↑40% | 60%↓]	6365 [↑50% | 50%↓]	7279 [↑56% | 44%↓]
↓V[1]	5756 [↑29% | 71%↓]	6189 [↑34% | 66%↓]	7270 [↑44% | 56%↓]	8184 [↑50% | 50%↓]

Light Output, 3500K, 80 CRI (Lumens Per Foot)				
	↑S[1]	↑B[1]	↑H[1]	↑V[2]
↓S[1]	838	946	1216	1445
↓B[1]	945	1053	1323	1552
↓H[1]	1213	1321	1591	1820
↓V[1]	1439	1547	1818	2046

Power, 3500K, 80 CRI (Watts Per Foot)				
	↑S[1]	↑B[1]	↑H[1]	↑V[2]
↓S[1]	6.7	7.7	10.0	12.0
↓B[1]	7.7	8.6	10.9	12.9
↓H[1]	10.0	10.9	13.2	15.2
↓V[1]	12.0	12.9	15.2	17.2

Efficacy, 3500K, 80 CRI (Lumens Per Watt)				
	↑S[1]	↑B[1]	↑H[1]	↑V[2]
↓S[1]	124	124	122	121
↓B[1]	123	123	122	120
↓H[1]	122	121	120	120
↓V[1]	120	120	119	119

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 92550

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**) / Standard Output (**S**), 4000K, 90 CRI

Lumen Adjustment Factor: 0.789

Total Light Output: 4865 lm x 0.789 = 3839 lm

Total Light Output per Foot: 1216 lm x 0.789 = 959 lm

watts/foot: 10.0 W/ft.

Efficacy = $\frac{959 \ \frac{\text{lm}}{\text{ft.}}}{10.0 \ \frac{\text{W}}{\text{ft.}}}$ = 96 lm/W

FINELITE® Lighting

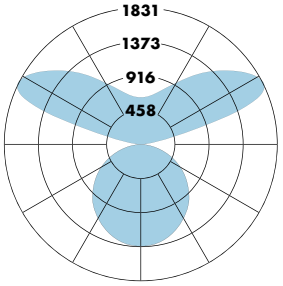
HPX Product Family

Indirect/Direct with Widespread Optic Photometry

4' Luminaire 3500K

HPX-P-ID-V-V-835-WSO-F
Uplight: Widespread Optic / **Downlight:** Flush

Distribution: 51% Up (**V**) / 49% Down (**V**)
Efficacy: 119 lm/W
Uplight: 4223 lumens (1056 lumens/ft)
Downlight: 4005 lumens (1001 lumens/ft)
Total luminaire output: 8228 lumens
69.0 watts
Peak Candela Value: 1375 @ 0°
CRI: 80 / CCT: 3500K
ITL LM79 Report 92549



CANDLEPOWER SUMMARY

	0.0	22.5	45.0	67.5	90.0	Flux
0	1375	1375	1375	1375	1375	
5	1367	1368	1368	1368	1369	130
15	1322	1316	1322	1323	1320	373
25	1230	1218	1227	1228	1225	565
35	1094	1084	1092	1091	1087	681
45	922	915	922	918	915	708
55	723	718	723	719	716	643
65	507	504	507	505	505	500
75	286	286	290	291	291	306
85	85	86	90	92	91	99
90	0	0	0	0	0	
95	37	83	214	99	78	141
105	145	218	811	923	651	625
115	259	334	763	1652	1820	926
125	364	438	777	1423	1681	820
135	436	502	775	1197	1390	656
145	503	552	735	981	1097	483
155	561	589	689	801	851	324
165	605	616	653	690	703	186
175	627	629	633	636	638	61
180	630	630	630	630	630	x

Total Light Output, 3500K, 80 CRI (Lumens)- 4' Luminaure				
	↑S¹	↑B¹	↑H¹	↑V²
↓S¹	3368 [↑51% | 49%↓]	3813 [↑57% | 43%↓]	4924 [↑67% | 33%↓]	5862 [↑72% | 28%↓]
↓B¹	3790 [↑46% | 54%↓]	4234 [↑51% | 49%↓]	5346 [↑61% | 39%↓]	6284 [↑67% | 33%↓]
↓H¹	4844 [↑36% | 64%↓]	5288 [↑41% | 59%↓]	6400 [↑51% | 49%↓]	7338 [↑58% | 42%↓]
↓V¹	5734 [↑30% | 70%↓]	6179 [↑35% | 65%↓]	7290 [↑45% | 55%↓]	8228 [↑51% | 49%↓]

Light Output, 3500K, 80 CRI (Lumens Per Foot)				
	↑S¹	↑B¹	↑H¹	↑V²
↓S¹	842	953	1231	1466
↓B¹	947	1059	1336	1571
↓H¹	1211	1322	1600	1835
↓V¹	1433	1545	1822	2057

Power, 3500K, 80 CRI (Watts Per Foot)				
	↑S¹	↑B¹	↑H¹	↑V²
↓S¹	6.8	7.7	10.0	12.0
↓B¹	7.7	8.6	10.9	12.9
↓H¹	10.0	10.9	13.2	15.2
↓V¹	12.0	12.9	15.2	17.3

Efficacy, 3500K, 80 CRI (Lumens Per Watt)				
	↑S¹	↑B¹	↑H¹	↑V²
↓S¹	125	124	123	122
↓B¹	124	123	123	122
↓H¹	121	121	121	120
↓V¹	119	120	120	119

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
¹ Based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
² Based on ITL report: 92549

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**) / Standard Output (**S**), 4000K, 90 CRI

Lumen Adjustment Factor: 0.789

Total Light Output: 4924 lm x 0.789 = 3885 lm

Total Light Output per Foot: 1231 lm x 0.789 = 971 lm

watts/foot: 10.0 W/ft.

Efficacy = $\frac{971 \ \frac{\text{lm}}{\text{ft.}}}{10.0 \ \frac{\text{W}}{\text{ft.}}}$ = 97 lm/W

the lighting practice

Catalog Information: HP-X-P-ID-[LENGTH]-S-S-935-WSO-F-[VOLTAGE]-DC-FC-10%-FA100-C4-FE-SW

Date: 09/30/2022
Fixture Type:

B2

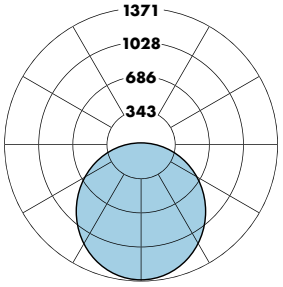
HPX Product Family

Direct & Surface Mount Photometry

4' Luminaire 3500k

HPX-P-D-V-835-F

Efficacy: 120 lm/W
Total luminaire output: 4011 lumens (1003 lumens/ft)
33.5 watts (8.4 watts/ft)
Peak Candela Value: 1371 @ 0°
CRI: 80 / CCT: 3500K
ITL LM79 Report 92552



CANDLEPOWER SUMMARY

	0.0	22.5	45.0	67.5	90.0	Flux
0	1371	1371	1371	1371	1371	
5	1365	1364	1364	1364	1364	130
15	1321	1312	1318	1320	1317	372
25	1228	1215	1225	1225	1223	564
35	1092	1081	1092	1090	1087	681
45	920	915	921	919	915	709
55	723	721	723	722	719	645
65	507	507	509	509	507	503
75	290	288	292	293	294	308
85	88	89	91	94	94	101
90	0	0	0	0	0	

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaure			
S[1]	**B[1]**	**H[1]**	**V[2]**
1642	2064	3120	4011

Light Output, 3500K, 80 CRI (Lumens Per Foot)			
S[1]	**B[1]**	**H[1]**	**V[2]**
410	516	780	1003

Power, 3500K, CRI (Watts Per Foot)			
S[1]	**B[1]**	**H[1]**	**V[2]**
3.3	4.2	6.4	8.4

Efficacy, 3500K, 80 CRI (Lumens Per Watt)			
S[1]	**B[1]**	**H[1]**	**V[2]**
125	124	121	120

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**), 4000K, 90 CRI

Lumen Adjustment Factor: 0.789

Total Light Output: 3120 lm x 0.789 = 2462 lm

Total Light Output per Foot: 780 lm x 0.789 = 615 lm

watts/foot: 6.4 W/ft.

Efficacy = $\frac{615 \ \frac{\text{lm}}{\text{ft.}}}{6.4 \ \frac{\text{W}}{\text{ft.}}}$ = 96 lm/W

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 92552

FINELITE® Lighting

0-10V Tunable White

Finelite's award-winning, contractor friendly Tunable White luminaires are available at low cost, with powerful and simple 0-10V tuning and intensity controls.

TUNABLE WHITE FEATURES

- CCT range: 2700K - 6500K
- Dimming Range: 100% to 10%
- CRI Options: 80 CRI or 90 CRI

PHOTOMETRY

Apply a power adjustment factor to calculate wattage usage

POWER	CONVERSION FACTOR
	1.1X

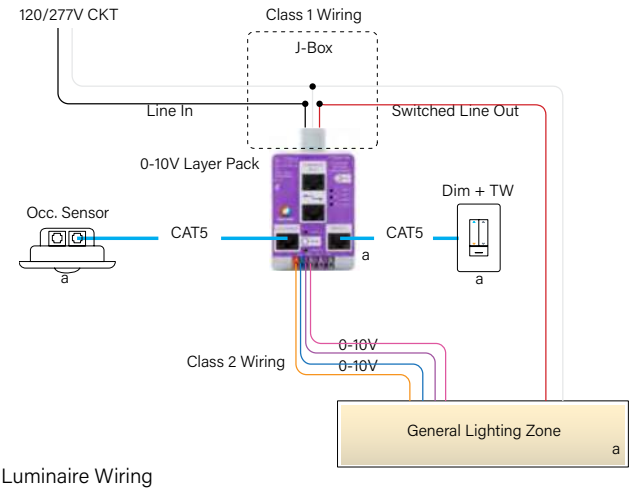
(Example: a 50 watt luminaire in static white would draw 55 watts using 0-10V Tunable White)

LUMINAIRE FAMILY MODIFICATIONS/RESTRICTIONS

	Section Lengths									
Direct	2'	3'	4'	5'	6'	7'	8'	9'	10'	11'	12'
Output S,B,H,V Single Circuit	Rows can be comprised of 2'-12' sections.										
Integral Battery Backup (BSL310LP)							✓		✓		✓
Indirect/Direct											
Output S,B Single Circuit	✓		✓		✓		✓		✓		✓
Integral Battery Backup (BSL310LP)							✓		✓		✓
Output H,V Single Circuit			✓				✓				✓
Integral Battery Not Available	Remote Battery backup solution available. Contact Factory.										
Output S,B,H,V Dual Circuit			✓				✓				✓
Integral Battery Not Available	Remote Battery backup solution available. Contact Factory.										

EN/GEN sections available for all body lengths

WIRING DIAGRAM - DIMMABLE TO 10%

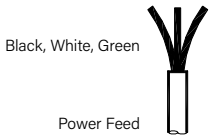


Luminaire Wiring

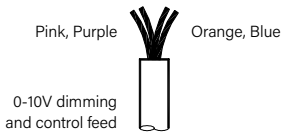
- **Purple** (+) / **Pink** (-) control wires are for intensity control
- **Orange** (+) / **Blue** (-) control wires are for Tunable White control

Note:
Load or Dim to Off options available.

DUAL FEED DETAIL



WIRING LEGEND		
Black	Hot	Line Voltage
White	Neutral	Line Voltage
Green	Ground	



WIRING LEGEND		
Pink	Dimming	0-10V DC
Purple	Dimming	0-10V DC
Orange	TW	0-10V DC
Blue	TW	0-10V DC

Tunable White LUMINAIRES

the lighting practice

Catalog Information: HP-X-P-ID-[LENGTH]-S-S-935-WSO-F-[VOLTAGE]-DC-FC-10%-FA100-C4-FE-SW

Date: 09/30/2022
Fixture Type:

B2

gotham® | INCITO™

Multiple Layers of Light

Luminaire Type:

Catalog Number:

Buy American

High Center Beam Pendant Cord Cylinder 4"

OVERVIEW

Feature Set

- Eleven optimized distribution patterns allow designers to achieve tailored objectives
- Bounding Ray™ optical design
- 45° cutoff to source and source image
- Fully serviceable lensed LED light engine
- Fixtures are damp location standard; wet location option (WL)
- ENERGY STAR® Certified product
- Have the cleanest of installations with a 0.29" diameter color coordinated cord. Multi-conductor ultra-pliable cord with embedded aircraft cable ensures no chance of kinks, crooked mounting, or need to tether power cord to suspension cable (patent pending).
- Multiple recessed or surface j-box mounting configurations available with cords
- 20 standard colors in textured and gloss finish; custom or RAL colors also available

Distribution

Superior Perfomance

Nominal Lumens	500	700	1000	1200	1500	2000	2500	3000	3500	4000	4500	5000
Delivered	703	807	1062	1326	1545	1977	2419	2920	3548	3982	4419	4848
Wattage	6.7	7.5	9.8	12.2	15.1	21.5	26.5	34.1	33.8	39.5	46.2	53.2
Efficacy	104	108	108	108	102	92	91	86	105	101	96	91

COMPLEMENTARY PRODUCTS

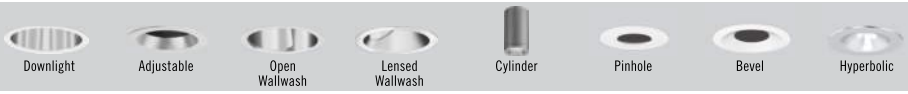
Coordinated Apertures | Multiple Layers of Light

General Illumination Layer | EVO

High Center Beam Layer | Incito

EVO + Incito — Multiple Layers of Light

Core



Healthcare

Special Applications

the lighting practice

Catalog Information: ICO4CC-35/07-AR-LSS-25D-MVOLT-GZ10-JBXCC-CCAN-[CORD LENGTH]

Date: 09/30/2022

Fixture Type:

B17

ORDERING INFORMATION

A+ Capable options indicated by this color background.

Luminaire Type:

Catalog Number:

EXAMPLE: ICO4CC 35/15 AR LSS 35D MVOLT EZ1 JBXCC CCAN C120 DWHG

Series		Color Temperature		Lumens		Reflector Color		Reflector Finish		Beam		Voltage	
ICO4CC	Incito 4in Pendant Cord Round Cylinder Open Downlight	27/	2700 K	05	500 lumens	AR	Clear	LSS	Semi-specular	10D[2]	10° beam angle	MVOLT	120V - 277V
		30/	3000 K	07	750 lumens	PR	Pewter	LD	Matte diffuse	15D	15° beam angle	120	120V
		35/	3500 K	10	1000 lumens	WTR	Wheat	LS	Specular	20D	20° beam angle	277	277V
		40/	4000 K	15	1500 lumens	GR	Gold			25D	25° beam angle	347[3]	347V
		50/	5000 K	20	2000 lumens	WR[1]	White painted			30D	30° beam angle		
				25	2500 lumens	BR[1]	Black			35D	35° beam angle		
				30	3000 lumens	WRAMF[1]	White Anti-microbial			40D	40° beam angle		
				35	3500 lumens					45D	45° beam angle		
				40	4000 lumens	BZR[1]	Dark Bronze painted			50D	50° beam angle		
				45	4500 lumens					60D	60° beam angle		
				50	5000 lumens					65D	65° beam angle		

Driver[4]		Mounting		Canopy Type		Cord Length[10,16]	
GZ10	0-10V driver dims to 10%	JBX	Integral driver, Recessed or Surface J-box	CCAN	5° Cord canopy with "hang straight" swivel	C120	10' Mounting Cord
GZ1	0-10V driver dims to 1%	JBXCC	Integral driver, Surface J-box with Conduit Covers	CCAN45[9]	45° Cord canopy with "hang straight" swivel	C180	15' Mounting Cord
EZ10	eldoLED 0-10V ECOdrive. Linear dimming to 10% min.	SGB[8]	Surface gear box (for driver at ceiling), Recessed or surface J-box (not wall or surface ceiling)			C240	20' Mounting Cord
EZ1	eldoLED 0-10V ECOdrive. Linear dimming to 1% min.	SGBCC[8]	Surface gear box (for driver at ceiling), surface J-box with Conduit Covers (not wall or surface ceiling)				
EZB	eldoLED 0-10V SOLOdrive. Logarithmic dimming to <1%.	RGH	Recessed Gear Housing				
EDAB[5]	eldoLED SOLOdrive DALI. Logarithmic dimming to <1%.						
EDXB[5,6,7]	eldoLED POWERdrive DMX with RDM (remote device management). Square Law dimming to <1%. Min: 1000LM; Max: 4000LM						
ECOS2[5]	Lutron® Hi-Lume® 2-wire forward-phase driver. 120V Only. Minimum dimming level 1%. Min: 1000LM; Max: 2000LM.						
ECOD[5]	Lutron® EcoSystem® digital Hi-Lume 1% soft-on, fade to black. Max: 4000LM.						
ELV[5]	Electronic line voltage/Forward phase/Triac dimming. 120V only.						

Control Interface[11]		Options		Architectural Colors - Powder Paint[15]			
(blank)	No controls	SF	Single fuse. Specify 120V or 277V.	DWHAMF	Gloss White with Anti-microbial finish	DDBT	Textured Dark Bronze
NLT	nLight® dimming pack. Specify 120V or 277V	90CRI	High CRI (90+)	DDB	Gloss Dark Bronze	DBLB	Textured Black
NLTER[12]	nLight® dimming pack for fixtures on emergency circuit. Specify 120V or 277V	N80	nLight Lumen Compensation	DBL	Matte Black	DWHG	Textured White
NLTAIR2	nLight® AIR dimming pack. Specify 120V or 277V	HAO[13]	High Ambient Option (40°C)	DWH	Gloss White	DBNH	Textured Bronze
NLTAIRER2[12]	nLight® AIR dimming pack for fixtures on emergency circuit. Specify 120V or 277V	WL[14]	Wet Location	DMB	Matte Medium Bronze	DNAT	Textured Natural Aluminum
		E10WCPR	Emergency battery pack, 10W Constant Power, CA Title 20 compliant with remote test switch (requires RGH)	DNA	Gloss Natural Aluminum	DSST	Textured Sandstone
		CP[17]	Chicago Plenum. Specify 120V or 277V (requires RGH)	DSS	Gloss Sandstone	DSPD	Textured Dark Grey
		GTD	IOTA Generator Transfer Device. Specify 120V or 277V (requires RGH)	DGC	Gloss Charcoal Grey	DSPE	Textured Green
				DTG	Gloss Tennis Green	DSPH	Textured Light Red
				DBR	Gloss Bright Red		
				DSB	Gloss Steel Blue		

ACCESSORIES — order as separate catalog numbers (shipped separately)

GCOLORS KIT	Architectural colors chip kit, consisting of powder-coat and plated finishes
OPTC4 XXD	Additional optics for field installation. Replace "XX" with beam angle.
CYLJBOXADPT 4SQ2OCT __	4in Square J-box to 4in Octagonal J-box adaptor. Replace __ with Architectural Color or PRM for primed ready for field painting

GOTHAM ARCHITECTURAL DOWNLIGHTING | 1400 Lester Road Conyers, GA 30012 | P 800-705-SERV (7378) | gothamlighting.com

ORDERING INFORMATION

ORDERING NOTES

1. Not Available with Finishes.
2. Only available 1500lm and below.
3. Factory supplied step down transformer must be remote mounted. Access required to location of remote mounted device.
4. Refer to Tech 240 for compatible dimmers.
5. Not Available with Control Interfaces.
6. Requires SGB or SGBCC mounting option.
7. Includes terminator resistor.
8. Only available with DMX driver (EDXB).
9. Not available with SGB or SGBCC: those mountings require a flat ceiling.
10. Cord can be cut in field to achieve non-uniform lengths (i.e. for a field cut 8' length, order 10' cord). Cord length is nominal: actual length is about 2" shorter.
11. Factory installed with RGH option otherwise field installed. Access required to location of remote mounted device.
12. ER for use as UL924 Emergency Operation via power sense lead. Will require an emergency hot feed and normal hot feed. EM for use as UL924 Emergency Operation via power interrupt detection.
13. Only available up to 2500 lumens; not available with wet location.
14. Not available with JBXCC, SGB, or SGBCC. Max: 2500LM.
15. For details on RAL and Custom colors please see Architectural colors.
16. Cord color is determined by cylinder color: DWHG, DWH, and DWHAMF will have white cord; DBL and DBLB will have black cord; all others will have gray cord.
17. CP not available with NLTAIR2, NLTAIRER2 or E10WCPR options.

GOTHAM ARCHITECTURAL DOWNLIGHTING | 1400 Lester Road Conyers, GA 30012 | P 800-705-SERV (7378) | gothamlighting.com

SPECIFICATIONS

Optical Assembly

Fully serviceable and upgradeable lensed LED light engine suitable for field maintenance or service from below the ceiling.

Optical design is a Bounding Ray™ design with 45° cutoff to source and source image. Top down flash characteristic for superior glare control.

Electrical

The luminaire shall operate from a 50 or 60 Hz ±3 Hz AC line over a voltage ranging from 120 VAC to 277 VAC. Support 347V via remote-mounted stepdown transformer. The fluctuations of line voltage shall have no visible effect on the luminous output.

The luminaire shall have a power factor of 90% or greater at all standard operating voltages and full luminaire output.

Sound Rated A+. Driver shall be >80% efficient at full load across all input voltages.

Input wires shall be 18AWG, 300V minimum solid copper.

Controls

Luminaire shall be equipped with interface for nLight wired or nLight AIR networks with integral power supply as per specification.

Emergency

Luminaires supplied with a battery pack comply with NFPA 101 (Life Safety code) and deliver constant light output throughout the 90 minutes of code required emergency operation period when there is a normal AC power loss.

Luminaires equipped with a generator transfer device work in conjunction with an auxiliary generator or a central inverter system to power fixtures for safe egress lighting.

Dimming

The luminaire shall be capable of continuous dimming without perceivable stroboscopic flicker as measured by flicker index (ANSI/IES RP-16-10) over a range of 100 – 10%, 100 – 1.0% or 100 – 0.1% of rated lumen output with a smooth shut off function to step to 0%.

eldoLED LED drivers shall conform to IEEE P1789 standards. Alternatively, manufacturers must demonstrate conformance with product literature and testing which demonstrates this performance. Systems that do not meet IEEE P1789 will not be considered.

Driver is inaudible in 24dB environment, and stable when input voltage conditions fluctuate over what is typically experienced in a commercial environment.

Construction

Heaving-gauge aluminum construction. Extruded cylinder body with flangeless reflector allows flow-through passive thermal management. Canopy matches cylinder in finish and diameter.

Pendant cord mount for installation to 4" recessed or surface octagonal junction box with integral driver.

Recessed gear box available for driver above ceiling, nLight, battery pack, CP, and GTD options.

Surface gear box available for driver at ceiling installation.

Optional field configurable conduit covers available. Conduit covers match cylinder in finish and diameter.

Listings

Fixtures are CSA Certified to meet US and Canadian Standards: All fixtures manufactured in strict accordance with the appropriate and current requirements of the "Standards for Safety" to UL, damp location standard; wet location covered ceiling optional (WL).

Luminaire configurations are Energy Star certified through testing in EPA–recognized laboratories, with the results reviewed by an independent, accredited certification organization. Visit www.energystar.gov for specific configurations listed.

Photometrics

LEDs tested to LM-80 standards. Measured by IESNA Standard LM-79-08 in an accredited lab. Lumen output shall not decrease by more than 30% over the minimum operational life of 60,000 hours.

Color appearance from luminaire to luminaire of the same type and in all configurations, shall be consistent both initially and at 6,000 hours and operate within a tolerance of <2.5 MacAdam ellipse as defined by the center of the quadrangles defined in ANSI C78.377-2015.

Buy American

This product is assembled in the USA and meets the Buy America(n) government procurement requirements under FAR, DFARS and DOT.
Please refer to www.acuitybrands.com/buy-american for additional information.

Warranty

5-year limited warranty. Complete warranty terms located at: www.acuitybrands.com/support/warranty/terms-and-conditions

Note:

Actual performance may differ as a result of end user environment and application.
All values are design or typical values, measured under laboratory conditions at 25 °C.

A+ Capable Luminaire

This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® control networks when ordered with drivers marked by a shaded background*
- This luminaire is part of an A+ Certified solution for nLight® control networks, providing advanced control functionality at the luminaire level, when selection includes driver and control options marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.

*See ordering tree for details

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Tables of Use

ICO - eldoLED Driver Default Dimming Curve			
Nomenclature	Min Dimming	Driver Dim Curve	Control Dim Curve
EZ10	10%	Linear	Linear/Logarithmic
EZ1	1%	Linear	Linear/Logarithmic
EZB	<1%	Logarithmic	Linear
EDAB	<1%	Logarithmic*	Linear
EDXB	<1%	Square	Linear

*Changable thorugh DALI controller

Lumen Output Multiplier		
CRI	CCT	Multplier
80	2700K	0.916
	3000K	0.948
	3500K	1
	4000K	1.032
	5000K	1.1
90	2700K	0.748
	3000K	0.8
	3500K	0.838
	4000K	0.845
	5000K	0.945

Reflector Finish Multiplier	
Reflector Finish	Multiplier
LS - Specular	1
LSS - Semi Specular	0.956
WR - White	0.87
LD - Matte Diffuse	0.85
BR - Black	0.73
BZR - Bronze	0.73

Driver		Control Provided (note: 347V/UVOLT versions provided with 347 option selected)			
Nomenclature	Description	NLT	NLTER	NLTAIR2	NLTAIRER2
GZ10	0-10V driver dims to 10%	nPP16 D EFP	nPP16 D ER EFP	RPP20 D 24V G2	RPP20 D 24V ER G2
GZ1	0-10V driver dims to 1%	nPP16 D EFP	nPP16 D ER EFP	RPP20 D 24V G2	RPP20 D 24V ER G2
EZ10	eldoLED 0-10V ECOdrive	nPS 80 EZ	nPS 80 EZ ER	RPP20 D 24V G2	RPP20 D 24V ER G2
EZ1	eldoLED 0-10V ECOdrive	nPS 80 EZ	nPS 80 EZ ER	RPP20 D 24V G2	RPP20 D 24V ER G2
EZB	eldoLED 0-10V SOLOdrive	nPS 80 EZ	nPS 80 EZ ER	RPP20 D 24V G2	RPP20 D 24V ER G2

J-box Compatibility Matrix		Cylinder Configurations					
		JBX	SGB	SGBCC	SGB w/EDXB Driver	SGBCC w/EDXB Driver	JBXCC
Recommended J-box (by others)	4" Octagonal 4x4x1.5 deep"	✓	✓	✓	✓	✓	✓
	4" Octagonal 4x4x2.125 deep	✓	✓	×	✓	×	×
	4" Square 4x4x1.5 deep	✓ *with adaptor plate accessory	✓ *with adaptor plate accessory	×	✓ *with adaptor plate accessory	×	×

Standard Architectural Color Options for Cylinder Bodies

NOTE: These colors were carefully reproduced to give as true a depiction as possible of finished product color. Some colors, however, may vary slightly from actual appearance due to display/printing variations and limitations. Please always contact a Gotham representative for an accurate paint chip sample.

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the lighting practice

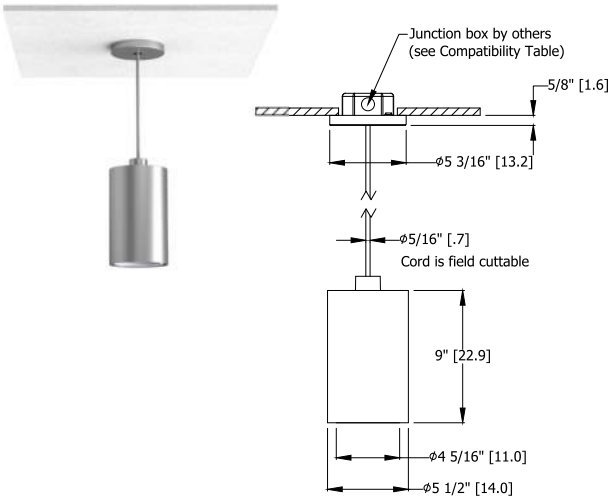
Catalog Information: ICO4CC-35/07-AR-LSS-25D-MVOLT-GZ10-JBXCC-CCAN-[CORD LENGTH]

Date: 09/30/2022
Fixture Type:

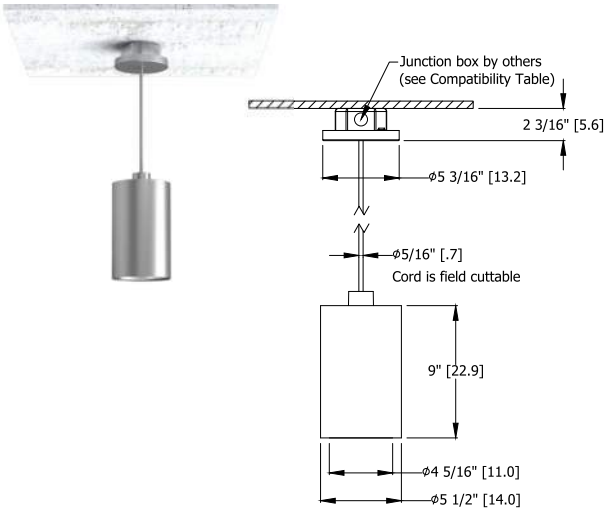
B17

DIMENSIONAL DATA

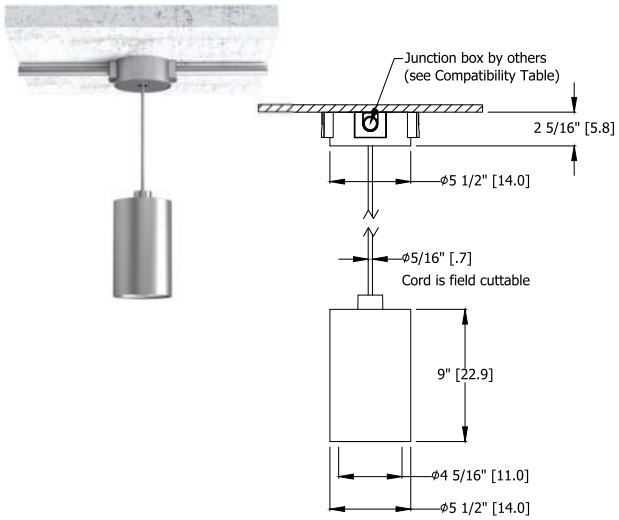
JBX Recessed J-Box



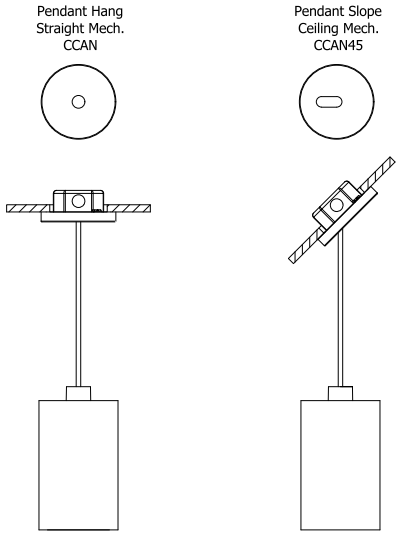
JBX Surface J-Box



JBXCC Surface J-Box with Conduit Covers



Canopy Covers for Flat or Sloped Ceilings



*Dimensions in inches [centimeters]

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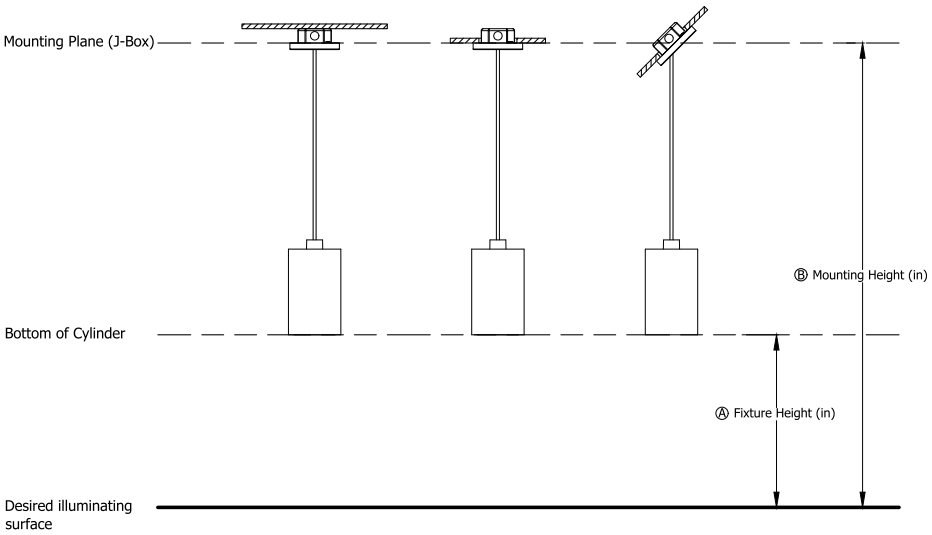
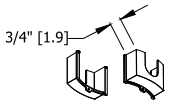
DIMENSIONAL DATA

Stem Cutting Formulas for JBX



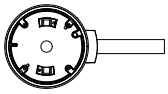
Cord Length=Ⓑ-Ⓐ- 4"

Conduit Feed Examples and Keys

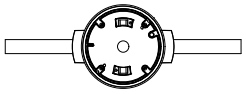


Conduit Key
(4) provided with each,
for use with 1/2" or 3/4" conduit

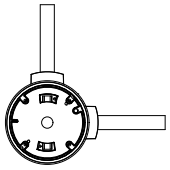
Blank Key
(4) provided with each



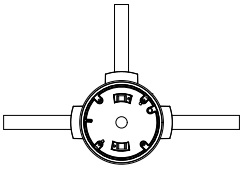
Single Conduit Feed



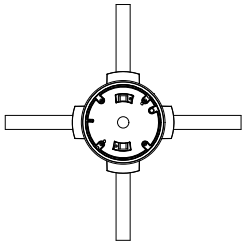
Double 180° conduit



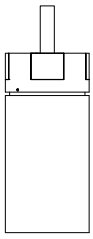
Double 90°conduit



Triple 0°, 90° & 180° conduit



Quad 0°, 90°, 180°, & 270° conduit



Top conduit feed

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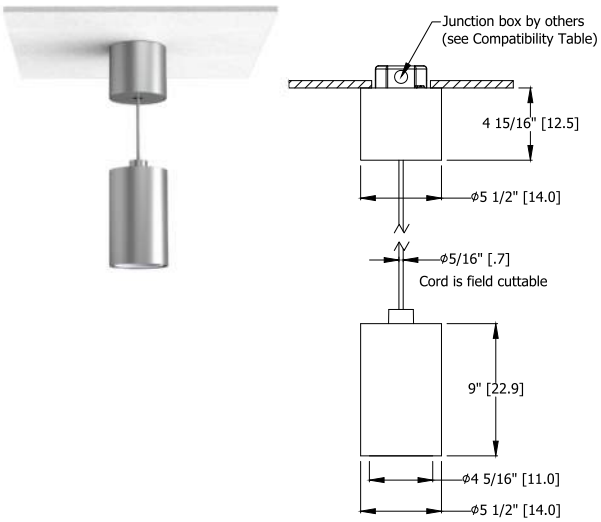
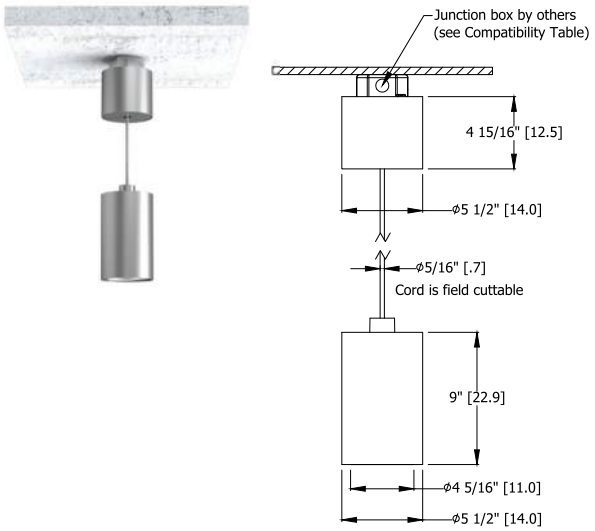
DIMENSIONAL DATA

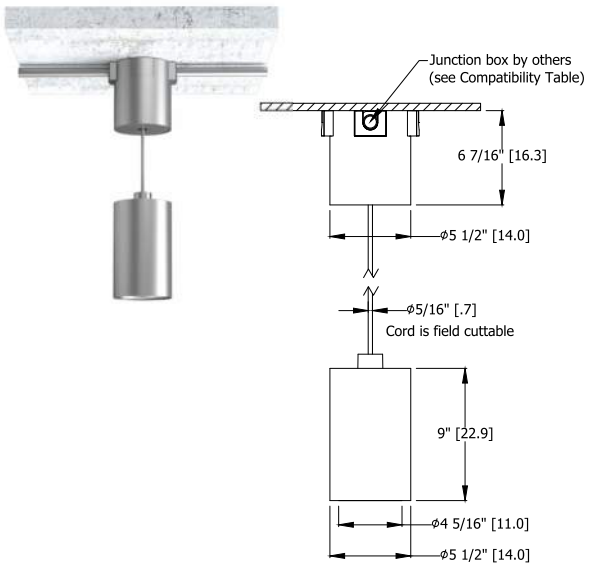
SGB Surface Gear Box for EDXB_Recessed J-Box



JBX Surface J-Box



SGBCC Surface Gear Box for EDXB with Conduit Covers



*Dimensions in inches [centimeters]

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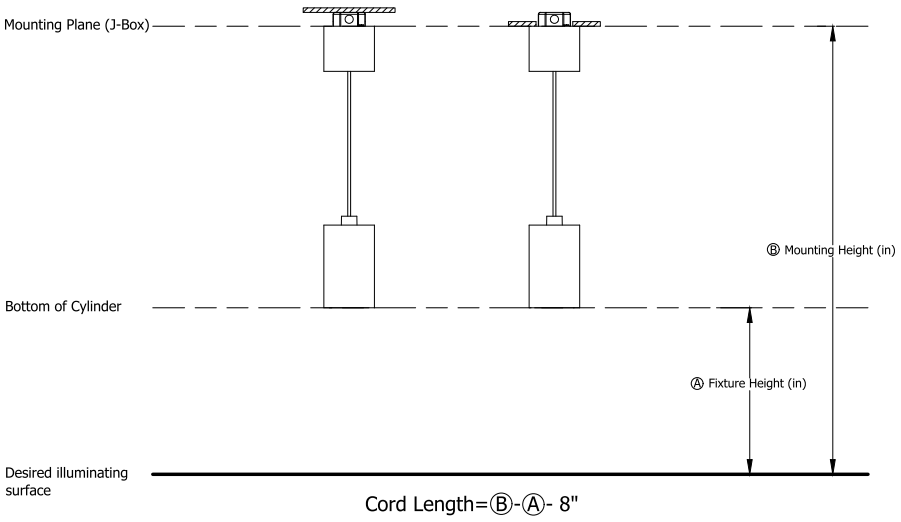
Catalog Information: ICO4CC-35/07-AR-LSS-25D-MVOLT-GZ10-JBXCC-CCAN-[CORD LENGTH]

Date: 09/30/2022
Fixture Type:

B17

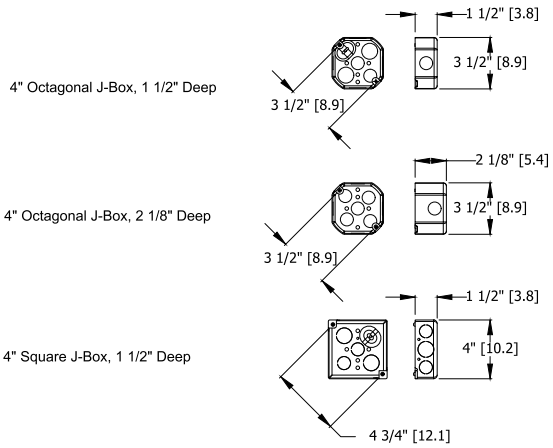
DIMENSIONAL DATA

Cutting Formulas for SGB



Cord Length=Ⓑ-Ⓐ- 8"

Junction Box Dimensions (by others)



*Dimensions in inches [centimeters]

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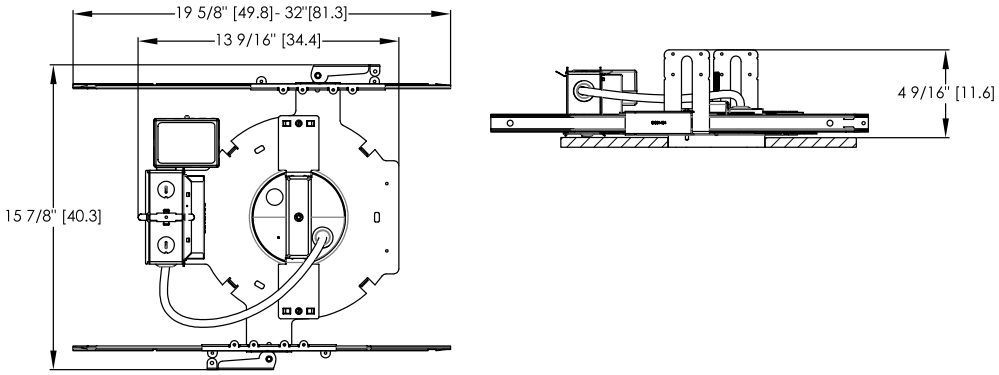
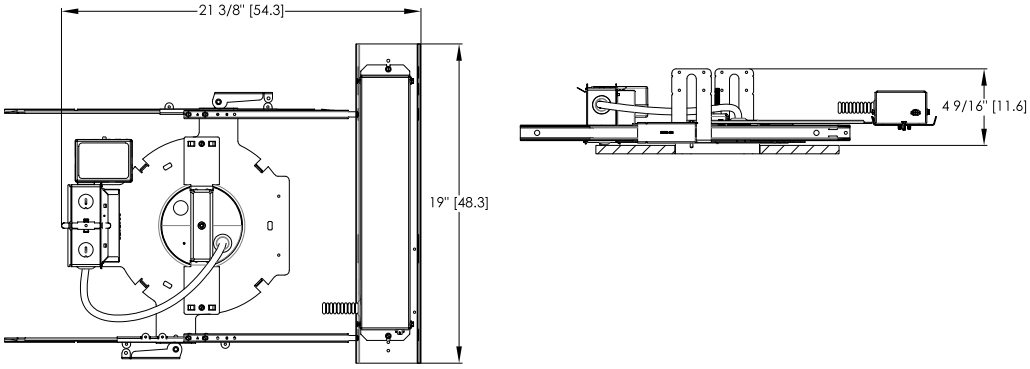
DIMENSIONAL DATA

RGH Standard



Ceiling thickness range: 1/2"[1.3] to 3"[7.6]
Ceiling cutout: 5 1/16"[12.9]

RGH with Battery Backup (E10WCPR) Standard



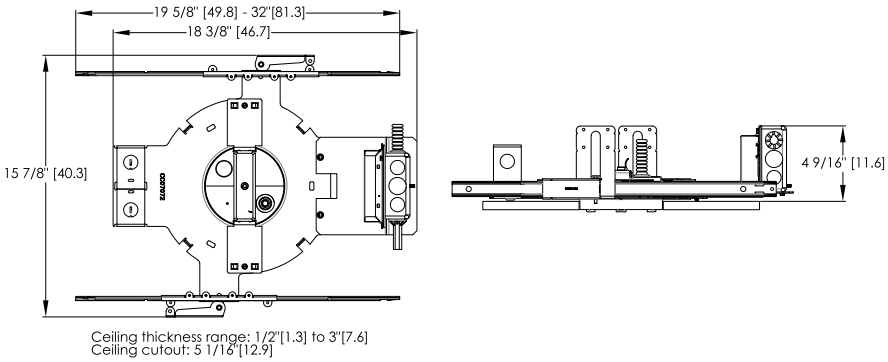
With Emergency Battery or GTD option

Minimum plenum height for emergency batteries in non-accessible ceilings: 12 1/2"[31.8]
Ceiling thickness range: 1/2"[1.3] to 3"[7.6]
Ceiling cutout: 5 1/16"[12.9]

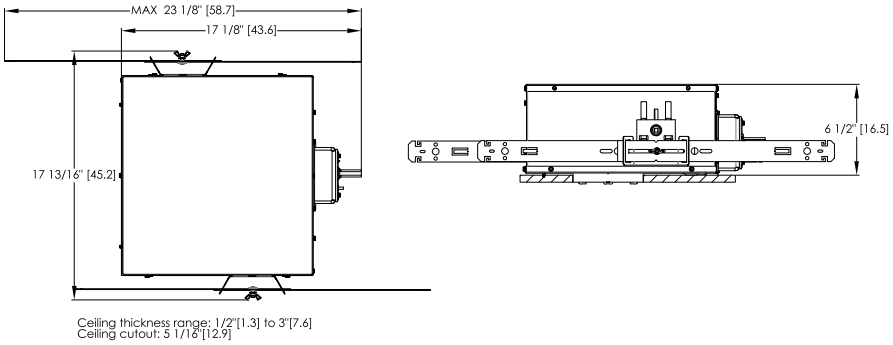
*Dimensions in inches [centimeters]

DIMENSIONAL DATA

RGH CP Standard



RGH with Chicago Plenum (CP) for use with nLight Enclosed



*Dimensions in inches [centimeters]

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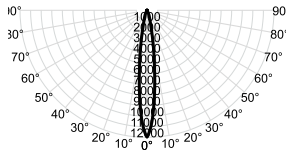
Photometry

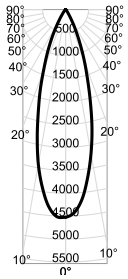
CONSULT WWW.GOTHAMLIGHTING.COM FOR ADDITIONAL PHOTOMETRY.

ICO4CC 35/15 AR LSS 15D Input Watts: 15.1, Delivered Lumens: 1504, LPW: 99.6, S/MH: 0.24, Test No: ISF 192654P4364



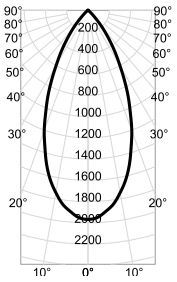
CP Summary		Zonal Lumen Summary			Coefficients of Utilization										Cone of Light			Luminance (cd/sq.m)	
					pf		80%			20%			50%		Mounting Height	Initial FC Center Beam	Beam Diameter		
	0°	Zone	Lumens	% Fixture	pc					70%									Average Luminance
0°	11,964	0° - 30°	1,449	96%	pw	50%	30%	10%	50%	30%	10%	50%	30%	10%					
5°	8,038	0° - 40°	1,479	98%	0	122	122	122	119	119	119	114	114	114	6.0	332.3	1.5	0°	1,505,657
15°	1,254	0° - 60°	1,501	100%	1	116	115	113	114	113	111	110	109	108	8.0	186.9	2.0	45°	3,408
25°	280	0° - 90°	1,503	100%	2	112	109	107	110	107	105	107	105	103	10.0	119.6	2.4	55°	1,106
35°	41	90° - 180°	1	0%	3	108	104	102	106	103	101	104	101	99	12.0	83.1	2.9	65°	300
45°	19	0° - 180°	1,504	100%	4	104	100	98	103	100	97	101	98	96	14.0	61.0	3.4	75°	0
55°	5				5	101	97	94	100	97	94	98	95	93				85°	0
65°	1				6	98	94	92	97	94	91	96	93	91	Beam Angle: 13.9°				
75°	0				7	96	92	89	95	91	89	94	91	89	Field Angle: 30.8°				
85°	0				8	93	90	87	93	89	87	92	89	87					
90°	0				9	91	88	85	91	87	85	90	87	85					
					10	89	86	83	89	86	83	88	85	83					

ICO4CC 35/15 AR LSS 30D Input Watts: 15.1, Delivered Lumens: 1411, LPW: 93.4, S/MH: 0.47, Test No: ISF 192657P4364



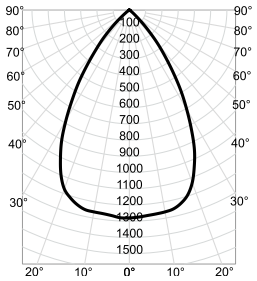
CP Summary		Zonal Lumen Summary			Coefficients of Utilization										Cone of Light			Luminance (cd/sq.m)	
					pf		80%			20%			50%		Mounting Height	Initial FC Center Beam	Beam Diameter		
	0°	Zone	Lumens	% Fixture	pc					70%									Average Luminance
0°	4,525	0° - 30°	1,295	92%	pw	50%	30%	10%	50%	30%	10%	50%	30%	10%					
5°	4,140	0° - 40°	1,376	97%	0	119	119	119	116	116	116	111	111	111	6.0	125.7	3.1	0°	569,489
15°	2,088	0° - 60°	1,407	100%	1	112	110	108	110	108	107	106	105	103	8.0	70.7	4.2	45°	4,664
25°	590	0° - 90°	1,410	100%	2	106	103	100	105	102	99	102	99	97	10.0	45.3	5.2	55°	1,327
35°	95	90° - 180°	1	0%	3	101	97	94	100	96	93	97	94	92	12.0	31.4	6.3	65°	300
45°	26	0° - 180°	1,411	100%	4	97	92	89	96	92	88	94	90	87	14.0	23.1	7.3	75°	0
55°	6				5	92	88	85	92	87	84	90	86	84				85°	0
65°	1				6	89	84	81	88	84	81	87	83	80	Beam Angle: 29.3°				
75°	0				7	85	81	77	85	80	77	84	80	77	Field Angle: 58.8°				
85°	0				8	82	77	74	82	77	74	81	77	74					
90°	0				9	79	75	72	79	74	71	78	74	71					
					10	76	72	69	76	72	69	75	71	69					

ICO4CC 35/15 AR LSS 45D Input Watts: 15.1, Delivered Lumens: 1437, LPW: 95.2, S/MH: 0.73, Test No: ISF 192660P4364



CP Summary		Zonal Lumen Summary			Coefficients of Utilization										Cone of Light			Luminance (cd/sq.m)	
					pf		80%			20%			50%		Mounting Height	Initial FC Center Beam	Beam Diameter		
	0°	Zone	Lumens	% Fixture	pc					70%									Average Luminance
0°	1,968	0° - 30°	1,060	74%	pw	50%	30%	10%	50%	30%	10%	50%	30%	10%					
5°	1,901	0° - 40°	1,329	92%	0	120	120	120	117	117	117	112	112	112	6.0	54.7	5.2	0°	247,708
15°	1,504	0° - 60°	1,432	100%	1	111	109	107	109	107	105	105	104	102	8.0	30.8	6.9	45°	13,812
25°	894	0° - 90°	1,437	100%	2	104	100	97	102	99	96	99	96	94	10.0	19.7	8.7	55°	2,211
35°	378	90° - 180°	1	0%	3	97	92	89	96	91	88	93	90	86	12.0	13.7	10.4	65°	900
45°	78	0° - 180°	1,437	100%	4	91	86	82	90	85	81	88	84	80	14.0	10.0	12.1	75°	490
55°	10				5	86	80	76	85	79	75	83	78	75				85°	0
65°	3				6	81	75	71	80	74	70	78	74	70	Beam Angle: 46.9°				
75°	1				7	76	70	66	75	70	66	74	69	66	Field Angle: 80.5°				
85°	0				8	72	66	62	71	66	62	70	65	62					
90°	0				9	68	62	59	68	62	58	67	62	58					
					10	65	59	55	64	59	55	63	58	55					

ICO4CC 35/15 AR LSS 65D Input Watts: 15.1, Delivered Lumens: 1382, LPW: 91.5, S/MH: 0.98, Test No: ISF 192663P4364



CP Summary		Zonal Lumen Summary			Coefficients of Utilization										Cone of Light			Luminance (cd/sq.m)	
					pf		80%			20%			50%		Mounting Height	Initial FC Center Beam	Beam Diameter		
	0°	Zone	Lumens	% Fixture	pc					70%									Average Luminance
0°	1,280	0° - 30°	913	66%	pw	50%	30%	10%	50%	30%	10%	50%	30%	10%					
5°	1,270	0° - 40°	1,238	90%	0	119	119	119	116	116	116	111	111	111	6.0	35.6	7.5	0°	161,080
15°	1,231	0° - 60°	1,376	100%	1	110	108	106	108	106	104	104	102	101	8.0	20.0	10.0	45°	20,269
25°	946	0° - 90°	1,382	100%	2	102	98	95	101	97	94	97	94	92	10.0	12.8	12.5	55°	2,654
35°	471	90° - 180°	1	0%	3	95	90	86	94	89	85	91	87	84	12.0	8.9	15.0	65°	900
45°	114	0° - 180°	1,382	100%	4	88	83	78	87	82	78	85	81	77	14.0	6.5	17.5	75°	490
55°	12				5	82	76	72	82	76	72	80	75	71				85°	0
65°	3				6	77	71	66	76	70	66	75	70	66	Beam Angle: 64.1°				
75°	1				7	72	66	61	71	66	61	70	65	61	Field Angle: 96.1°				
85°	0				8	68	61	57	67	61	57	66	61	57					
90°	0				9	64	57	53	63	57	53	62	57	53					
					10	60	54	50	59	54	50	59	53	50					

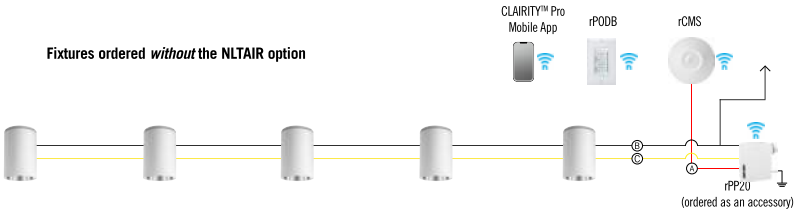
GOTHAM ARCHITECTURAL DOWNLIGHTING | 1400 Lester Road Conyers, GA 30012 | P 800-705-SERV (7378) | gothamlighting.com

NLIGHT AIR

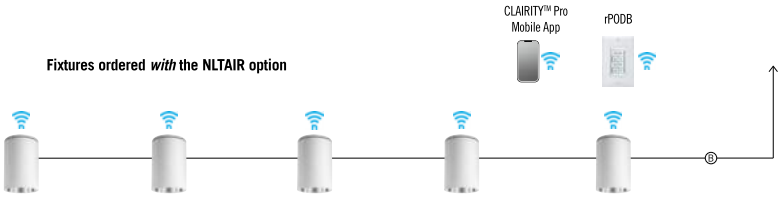
Possibilites for nLight® AIR

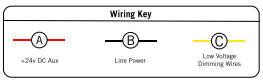
nLight® AIR is the ideal solution for retrofit or new construction spaces where adding communication wiring is cost prohibitive. The integrated nLight AIR rPP20 Power Pack is part of each EVO Luminaire ordered with the NLTAIR option. These individually addressable controls offer the ultimate in flexibility during initial setup and for space repurposing.

Fixtures ordered *without* the NLTAIR option



Fixtures ordered *with* the NLTAIR option





nLight® AIR Control Accessories
Order as separate catalog number. Visit nLight AIR.

Wall Switches	Model Number
On/Off single pole	rPODB (color) G2
On/Off two pole	rPODB 2P (color) G2
On/Off & raise/lower single pole	rPODB DX (color) G2
On/Off & raise/lower two pole	rPODB 2P DX (color) G2

nLight® AIR Control Accessories *(cont.)*

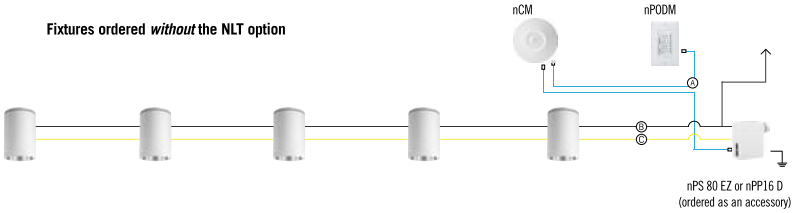
Occupancy Sensors (PIR/dual tech)	Model Number
Small motion 360°, ceiling	rCMS 9 / rCMS PDT 9
Large motion 360°, ceiling	rCMS 10 / rCMS PDT 10

NLIGHT

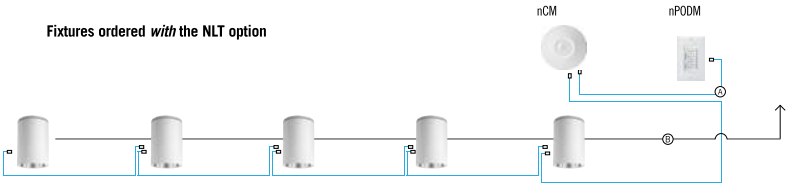
Possibilites for nLight® wired

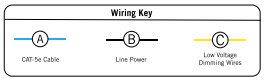
nLight® Wired The nLight® solution is a digital networked lighting control system that provides both energy savings and increased user configurability by cost effectively integrating time-based, daylight-based, sensor-based and manual lighting control schemes.

Fixtures ordered *without* the NLT option



Fixtures ordered *with* the NLT option





nLight® Wired Control Accessories
Order as separate catalog number. Visit nLight.

Wall Switches	Model Number
On/Off single pole	nPODM (XX)
On/Off two pole	nPODM 2P (XX)
On/Off & raise/lower single pole	nPOD DX (XX)
On/Off & raise/lower two pole	nPODM 2P DX (XX)
Graphic touchscreen	nPOD GFX (XX)
Photocell Controls	
Dimming	nCM ADCX

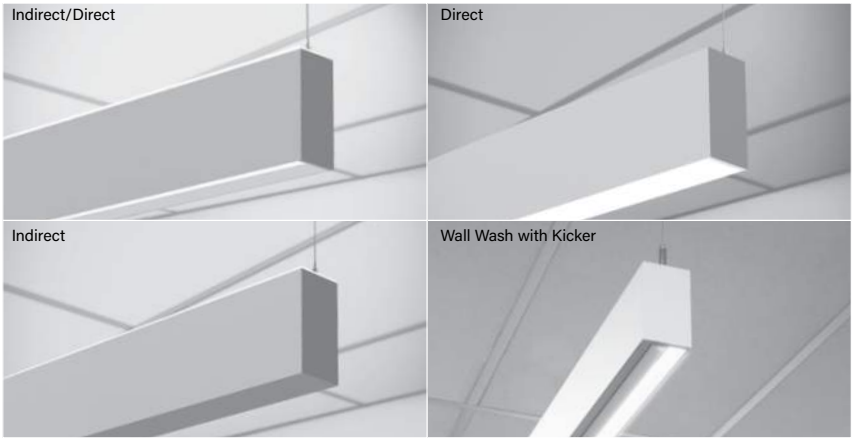
nLight® Wired Control Accessories *(cont.)*

Occupancy Sensors (PIR/dual tech)	Model Number
Small motion 360°, ceiling	nCM 9 / nCM PDT 9
Large motion 360°, ceiling	nCM 10 / nCM PDT 10
Wide View	nWV 16 / nWV PDT 16
Wall switch with raise/lower	nWSX LV DX / nWSX PDT LV DX
Cat-5 Cables (plenum rated)	
10', CAT5	CAT5 10FT J1
15', CAT5	CAT5 15FT J1

gotham®

Submitted by:	
Type:	ject:
Ordering Info:	

High Performance 2" Aperture (HP-2) Pendant



Signal White is standard finish

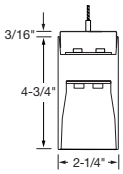
Note: see page 6 for all aesthetic options

High Performance 2" Aperture is a patented, linear LED luminaire family. HP-2 delivers excellent performance using an advanced optical design and mid-power LEDs. Achieving 90% of initial light output at 100,000+ hours and backed by a 10-year performance-based warranty on all standard components.

This product is enrolled in the International Living Future Institute (ILFI) Declare 2.0 Program and is third-party verified with options achieving **Red List Approved** and **Declared** status.

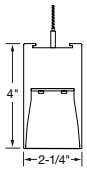
CROSS SECTIONS

Indirect/Direct
Top Glow Diffuser (standard)



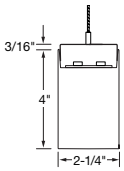
Flush Downlight Diffuser (standard)

Direct

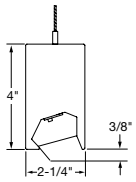


Flush Downlight Diffuser (standard)

Indirect
Top Glow Diffuser (standard)

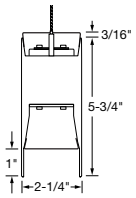


Wall Wash Direct



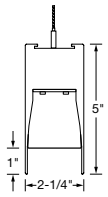
Kicker (standard)

Regressed Indirect/Direct
Top Glow Diffuser (standard)



Flat Diffuser with 1" Regressed (standard)

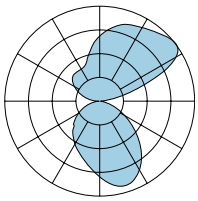
Regressed Direct



Flat Diffuser with 1" Regressed (standard)

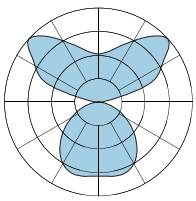
OPTIC OPTIONS

Asymmetric & Asymmetric Top Glow (**ASY / ASY-TG**)



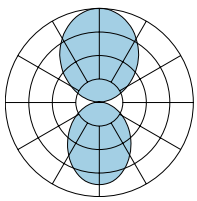
Downlight Asymmetric Optic (**DAO**)

Widespread & Widespread Top Glow (**WSO / WSO-TG**)



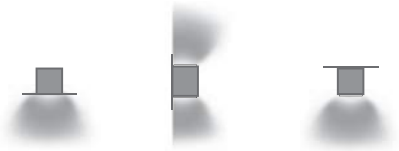
Downlight Spread Optic (**DSO**)

Standard Uplight Flush Optic (**F**)



Standard Downlight Flush Optic (**F**)

ALSO AVAILABLE IN



Recessed (**R**)

Wall Mount (**WM**)

Surface Mount (**SM**)

Also available in Indigo-Clean. See Indigo-Clean Tech Sheet

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Catalog Information: HP-2-P-I-[LENGTH]-B-NA-940-WSO-NA-98LG-[VOLTAGE]-SC-FC-10%-FA100-C4-FE-SA

Date: 09/30/2022

Fixture Type:

C1

Submitted by:

Type: ect:

Ordering Info:

FINELITE Lighting

Home | Order | Specs | Options | Photometry | Wall Setback | Tunable White

Clear Form

High Performance 2" Aperture (HP-2) Pendant

BODY TYPE

Platform	Series Name	Luminaire Type	Luminaire Distribution	Total Length of Run
◉ HP - High Performance	◉ 2	◯ P - Pendant ◯ P RG - Pendant Regressed [1] (Wall Wash not available)	◯ D - Direct ◯ WW-D - Wall Wash Direct ◯ ID - Indirect/Direct ◯ I - Indirect	_____ Minimum 2' section length. Increments accurate to 1/16" (±1/32"), standard. 12' maximum section length.

OUTPUT and LED TYPE

Uplight Output ID & I Only (Flush)	Downlight Output ID & D Only (Flush)
◯ S - Standard (393 lm/ft) ◯ B - Boosted (494 lm/ft) ◯ H - High (747 lm/ft) ◯ V - Very High (961 lm/ft) ◯ TL - Tailored:_____ lm/ft*	◯ S - Standard (322 lm/ft) ◯ B - Boosted (405 lm/ft) ◯ H - High (612 lm/ft) ◯ V - Very High (786 lm/ft) ◯ TL - Tailored: _____ lm/ft*

Lumen provide are for Flush lens only, see pg. 17 for WW lumens
* Specify lm/ft of outputs between Standard (S) and Very High (V). Consult factory for tailored lumen output outside of this range.

OUTPUT and LED TYPE

LED CRI/CCT
◯ 830 - 80 CRI, 3000K
◯ 835 - 80 CRI, 3500K
◯ 840 - 80 CRI, 4000K
◯ 930 - 90 CRI, 3000K
◯ 935 - 90 CRI, 3500K
◯ 940 - 90 CRI, 4000K
◯ 8TW - 80 CRI, Tunable White
◯ 9TW - 90 CRI, Tunable White

MECHANICAL/OPTICAL OPTIONS

Uplight	Downlight	Reflector System
◯ TG - Top Glow (standard) ◯ F - Flush ◯ WSO - Widespread Optic ◯ WSOTG - Widespread Optic with Top Glow ◯ ASY-L - Asymmetric Left Optic ◯ ASY-R - Asymmetric Right Optic ◯ ASYTG-L - Asymmetric Left Optic with Top Glow ◯ ASYTG-R - Asymmetric Right Optic with Top Glow	◯ F - Flush (standard) [2] ◯ BG - Bottom Glow [2] ◯ DL - 1" Drop Down Lens [2] ◯ RG-D - Flat Diffuser with 1" Regress [2, 3] ◯ RG WCB - White Cross Blade Baffle [2, 3] ◯ RG-LHE - Hollowed Ellipse Louver [2, 3] ◯ RG-LHC - Hex Louver [2, 3] ◯ DSO - Downlight Spread Optic [2, 4] ◯ DAO-L - Downlight Asymmetric Optic Left [2, 4] ◯ DAO-R - Downlight Asymmetric Optic Right [2, 4] ◯ K - Kicker for Wall Wash only (standard) [5] ◯ FO - Fully Open for Wall Wash only	◯ 96LG - 96 Low Gloss White ◯ SW - Signal White for Wall Wash only

ELECTRICAL OPTIONS

Voltage
◯ 120 - 120 Voltage
◯ 277 - 277 Voltage
◯ 347 - 347 Voltage

ELECTRICAL OPTIONS

Circuiting [6]
◯ SC - Single Circuit* One single circuit in a run
◯ DC - Dual Circuit* [7] Independent control of up and down separately in an I/D style fixture
◯ MC - Multi-Circuit* More than one switch leg or zone. Factory shop drawings required

* Battery, Night Light, and Emergency to Generator circuits are in addition to the normal luminaire circuit(s)

Driver Selection
0-10V Driver Options
◯ FC-10% - 0-10V 10% [8] (standard)
◯ FC-1% - 0-10V 1% [8]
◯ OSR-10% - Osram OTi, 0-10V 10% [8]
◯ OSR-1% - Osram OTi, 0-10V 1% [8]
◯ ELD-10V-0% - EldoLED SOLOdrive, 0-10V 0.1%
◯ OSR-10V-TW - Osram OTi, 0-10V 10% *(Tunable White)* [8]
DALI Driver Options
◯ FC-DALI-1% - DALI 1%
◯ OSR-DALI-1% - Osram Dexal, 1%
◯ ELD-DALI-0% - EldoLED SOLOdrive, 0.1%
◯ ELD-DALI-TW - EldoLED DUALdrive LightShape, 0.1% *(Tunable White)*
DMX Driver Options
◯ FIN-DMX - Finelite DMX 1% *(Tunable White - FineTune Controls Only)* [9]
◯ ELD-DMX - EldoLED POWERdrive, 0.1%
◯ ELD-DMX-TW - EldoLED POWERdrive, 0.1% *(Tunable White)*
Lutron Driver Options
◯ LUT-ES1 - Lutron, Ecosystem 1%
◯ LUT-2W - Lutron, 2-wire (120V only) 1%
◯ LUT-TW - Lutron T-Series, EcoSystem 0.1% *(Tunable White)*

See Page 3 for additional driver options and details

MOUNTING OPTIONS

Mounting Method
◯ FA50 - Fully Adjustable 50" (standard)
◯ FA100 - Fully Adjustable 100"
◯ FA150 - Fully Adjustable 50"
◯ FA200 - Fully Adjustable 200"
◯ FA250 - Fully Adjustable 250"
◯ FA300 - Fully Adjustable 300"
◯ FM - Flexible Mounting [10]

MOUNTING OPTIONS

Ceiling Hardware Type
◯ C1 - 1" T-Bar
◯ C2 - 9/16" T-Bar
◯ C3 - Screw Slot
◯ C4 - Hard Ceiling
◯ C1T - 1" Tegular
◯ C2T - 9/16" Tegular

OTHER OPTIONS

Endcap Style	Finish	Emergency Style (Optional) Clear Selection	Integrated Sensor (Optional) Clear Selection	Special Options (Optional) Clear Selection
◯ FE - Flat Endcap (standard) ◯ DE - 1" Drop Endcap [11] ◯ OE - Open Endcap [12]	◯ SW - Signal White (standard) ◯ FB - Finelite Black ◯ SA - Satin Aluminum ◯ #### - RAL Color Code [13] _____	◯ LGD18W - Legrand 18W Brand Battery Back-up ◯ LGD10W - Legrand 10W Brand Battery Back-up ◯ EM/GEN - Emergency to Generator ◯ NL - Night Light ◯ BSL310LP - Bodine Battery Back up Low Profile ◯ GTD - Generator Transfer Device ◯ ALCR - Automatic Load Control Relay	◯ OBO - Occupancy [2] ◯ OBD - Daylight [2] ◯ W601 - Wattstopper [14] Wireless Sensor ◯ OBE - Enlighted [2, 15] ◯ REE - Remote Enlighted [16]	◯ CP - Chicago Plenum [17] ◯ RLA - Red List Approved ◯ RLD - Declared

[1] Not available with Indirect
[2] Not available with Wall Wash
[3] D & ID Regressed only
[4] Not available with Regressed or Curves
[5] Kicker standard in Signal White. Customer Custom color kickers have a surcharge
[6] Contact factory for switching options
[7] Indirect/Direct only
[8] Add DTO to gain "Dim to Off" functionality (FC-10% - DTO)
[9] B & V outputs only
[10] Direct only
[11] 1" Drop Down Lens downlight only
[12] Available with Hollowed Ellipse Louver (**LHE**) only
[13] 20 business days lead time for color
[14] LMFS-601 w/ 0-10V driver(s) and LMFI-111, up to 6 drivers may be connected. LMFS-601 w/ Dali driver, only 1 driver can be connected.
[15] Enlighted components installed by Finelite, provided by others
[16] Enlighted for Wall Wash fixtures. Enlighted Control Unit & Sensor Cable installed for Remote mounting sensor
[17] Only available with C1, C2, and C3 mounting hardware with Finelite Gridbox

Protected by one or more US Patents: 8915613; D702,391; D702,390; D700,732

the lighting practice

Catalog Information: HP-2-P-I-[LENGTH]-B-NA-940-WSO-NA-98LG-[VOLTAGE]-SC-FC-10%-FA100-C4-FE-SA

Date: 09/30/2022

Fixture Type:

C1

High Performance 2" Aperture (HP-2) Pendant

SUPPLEMENTARY DRIVER PAGE

0-10V Driver Options	
FC-10%	Factory Choice, 0-10V 10% Dimming (Linear)
FC-10%-DTO	Factory Choice, 0-10V 10% Dimming, Dim-to-Off (Linear)
FC-1%	Factory Choice, 0-10V 1% Dimming (Linear)
FC-1%-DTO	Factory Choice, 0-10V 1% Dimming, Dim-to-Off (Linear)
ELD-10V-0%	EldoLED SOLOdrive, 0-10V 0.1% Dimming (Linear)
ELD-10V-1%	EldoLED ECOdrive, 0-10V 1% Dimming (Linear)
OSR-10V-TW	Osram OTi, 0-10V 10% Dimming, *Tunable White* (Linear)
OSR-10V-TW-DTO	Osram OTi, 0-10V 10% Dimming, Dim-to-Off, *Tunable White* (Linear)
OSR-10%	Osram OTi, 0-10V 10% Dimming (Linear)
OSR-10%-DTO	Osram OTi, 0-10V 10% Dimming, Dim-to-Off (Linear)
OSR-1%	Osram OTi, 0-10V 1% Dimming (Linear)
OSR-1%-DTO	Osram OTi, 0-10V 1% Dimming, Dim-to-Off (Linear)

DALI Driver Options	
FC-DALI-1%	Factory Choice, DALI 1% Dimming (Logarithmic)
OSR-DALI-1%	Osram Dexal, DALI 1% Dimming (Logarithmic)
ELD-DALI-0%	EldoLED SOLOdrive, DALI 0.1% Dimming (Logarithmic)
ELD-DALI-1%	EldoLED ECOdrive, DALI 1% Dimming (Logarithmic)
ELD-DALI-TW	EldoLED DUALdrive Light Shape, DALI 0.1% Dimming, *Tunable White* (Logarithmic Dimming, Linear CCT Control)

DMX Driver Options	
FIN-DMX	Finelite, DMX 1% Dimming, *Tunable White* - **FineTUNE Controls Only** (Linear)
ELD-DMX	EldoLED POWERdrive, DMX 0.1% Dimming (8 Bit, 1CH) (Linear)
ELD-DMX-16	EldoLED POWERdrive, DMX 0.1% Dimming (16 Bit, 2CH) (Linear)
ELD-DMX-TW	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (8 Bit, 2CH - CH1 Warm / CH2 Cool) (Linear)
ELD-DMX-TW16	EldoLED POWERdrive, DMX 0.1% Dimming, *Tunable White* (16 Bit, 4CH - CH1, 2 Warm / CH3, 4 Cool) (Linear)

Lutron Driver Options	
LUT-ES1	Lutron, Ecosystem 1% Dimming
LUT-2W	Lutron, 2-wire (120V only) 1% Dimming
LUT-TW	Lutron T-Series, EcoSystem 0.1% Dimming, *Tunable White*

FINELITE Lighting

High Performance 2" Aperture (HP-2) Pendant

SPECIFICATIONS

BODY TYPE

CONSTRUCTION: Precision-cut 6061-T6 extruded aluminum body. Internal joiner system and plug-together wiring are standard.

LENGTHS: Any length, 2' minimum, in increments down to 1/16th" (±1/32"). 12' maximum section length. Hollowed Ellipse Louver (LHE), Hex Louver (LHC), and White Cross Blade Baffle (**WCB**) are available in 1' increments.

MITERED CORNERS [1]: Illuminated corners of greater than 60° and less than 180° in a single plane, available with Flush Diffuser, Bottom Glow Diffuser, Regressed Diffuser, or White Cross Blade Baffle [3]. Corners not available with Wall Wash (**WW**), Hollowed Ellipse Louver (**LHE**), Hex Louver (**LHC**) or 1" Drop Down Lens. Contact factory for Double miters using the White Cross Blade Baffle. Consult factory for tailored lighting options.

OUTPUT AND LED TYPE

LIGHT OUTPUT: Four lumen packages available, Standard (**S**), Boosted Standard (**B**), High (**H**), and Very High (**V**). For lengths 3' and greater, the uplight and downlight can be specified with different lumen packages and dual controls. For Tailored Outputs outside of range from Standard (**S**) to Very High (**V**), consult factory. Light engines are replaceable.

MECHANICAL/OPTICAL OPTIONS

UPLIGHT OPTION [4]: Patented Top Glow frost white diffuser standard. 12' maximum diffuser length. 73% transmissive, 99% diffusion. Internal secondary diffusers at corners ensure visually seamless, uniform, continuous illumination options include: Flush frost white snap-in diffuser, 73% transmissive, 99% diffusion; Widespread Optic (**WSO**) and Widespread Optic with Top Glow (WSOTG); WSO enables increased luminaire spacing with improved ceiling uniformity. Asymmetric optic directs light in a specific direction. **ASY-L** distributes light to the left, **ASY-R** distributed light to the right of the luminaire. Consult factory for more tailored lumen outputs.

DOWNLIGHT OPTION [5]: 12' maximum diffuser length. Flush frost white snap-in diffuser standard, 73% transmissive, 99% diffusion. Internal secondary diffusers at corners ensure visually seamless, uniform, continuous illumination. Available with Flush (**F**), Bottom Glow (**BG**), 1" Drop Down Lens (**DL**), White Cross Blade Baffle (**WCB**) [7], Hollowed Ellipse Louver (**LHE**) [7], Hex Louver (**LHC**) [7], Downlight Spread Optic (**DSO**) [6], Downlight Asymmetric Optic (**DAO**) [6], and Regressed downlight diffusers (**RG**) [7]. 1" Drop Down Lens made of highly efficient acrylic. Available with a solid endcap or an endcap with a diffuse filler to continue the luminous aesthetic. Downlight Spread & Downlight Asymmetric Optics are extruded lenses with a subtle ribbed appearance providing a batwing or asymmetric distribution for improved optical performance. Consult factory for more tailored lumen outputs.

LUMEN MAINTENANCE: 90% of initial light output (L90) at 100,000+ hours; 70% of initial light output (L70) at 200,000+ hours.

REFLECTORS: Die-formed 20-gauge cold-rolled steel reflectors finished in 96LG High Reflectance white powder coat paint. The standard Semi-Specular Aluminum (**SSA**) Kicker (**K**) reflector delivers light high on the vertical surface. The Kicker reflector can be easily removed for open distribution (**FO**).

ELECTRICAL OPTIONS

STATIC WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed controlling uplight and downlight together (power and dimming). Specify dual feeds for independent control of uplight and downlight. 14-gauge feed used when luminaire current exceeds 5 amps.

TUNABLE WHITE FEED: Standard with one 18-gauge/5-conductor single-circuit feed. 14-gauge feed used when fixture current exceeds 5 amps. DMX and power feed at same location (standard). DMX feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths.

STATIC WHITE DRIVER: Replaceable 120V, 277V, and 347V constant current reduction dimming driver standard. Can be wired dimming or non-dimming. 0-10V dimming controls with a range of 100%-10% standard. Dimming to 1% available. Separate dimming for uplight and downlight available. Driver is fully accessible from below the ceiling.
- **Power Factor:** ≥ 0.9
- **Total Harmonic Distortion (THD):** <20%
- **ExpectedDdriver Lifetime:** 100,000 hours

LUTRON STATIC DRIVER OPTIONS:
- **LUT-ES1 (LDE1)** - (Hi-lume 1% EcoSystem with Soft-On, Fade-to-Black dimming (LDE1 series))
- **LUT-2W (LTEA2W)** - (Hi-lume 1% 2-wire, 120V forward phase dimming (LTEA series)).

TUNABLE WHITE DRIVER: Replaceable LED driver. Driver is accessible from below the ceiling. 120V, 277V, and 347V.
- **Power factor:** ≥0.90
- **Total Harmonic Distortion (THD):** <20%
- **Dimming Range:** 100%-10%
- **Expected Driver Lifetime.:** 100,000 hours
- **FineTune DMX:** 1%

LUTRON TUNABLE WHITE DRIVER OPTION: LUT-TW (0.1% T-Series 2-Channel Digital Tunable White (PSQ Series)).

[1] Not available with Wall Wash
[2] Indirect/Direct and Direct only
[3] White Cross Blade (WCB) baffles not available with custom angles. Available in 90 degrees only
[4] Pendant Indirect/Direct, Pendant Regressed Indirect/Direct, and Pendant Indirect only
[5] Pendant Indirect/Direct, Pendant Regressed Indirect/Direct, Pendant Direct, and Pendant Regressed Direct only
[6] Not available with Regressed or Curves
[7] Pendant Regressed Indirect/Direct & Pendant Regressed Direct only

Continued

High Performance 2" Aperture (HP-2) Pendant

SPECIFICATIONS

MOUNTING OPTIONS

HANGING HARDWARE: 50" Fully Adjustable (**FA**) plated steel aircraft cable with safety stop hardware standard. The Flexible Mounting Bracket (FM) adjusts the suspension points to accommodate existing architecture. Suspension points adjust up to 2' in from the end of 8' or 12' fixture lengths and up to 1' in on shorter lengths. Consult factory for tailored lighting options.

TUNABLE WHITE DMX HANGING HARDWARE: For grid ceiling applications the dual GridBox™ mounting is supplied (standard). For hard ceiling applications the ceiling mounting box is supplied (standard). DMX feeds cannot be cut or spliced. DMX feeds should be ordered based on fixed lengths. Available DMX pendant feed lengths are 5' (standard), 12', and 30'.

TUNABLE WHITE DMX INTERCONNECTION CABLES: Luminaires are pre-wired with plug-and-play interconnection cables to support easy plug-together joining of fixture runs. If a non-FineTune DMX system is specified, a DMX to RJ45 adapter is provided.

OTHER OPTIONS

ENDCAPS: Flat diecast aluminum endcaps (**FE**) add 1/4" to each end of luminaire. 1" Drop Down Lens Endcap (**DE**)[7] includes diffuse element to continue luminance of drop lens. Open Endcap (**OE**) is for use with the Hollowed Ellipse Louver (**LHE**); following the curve of the louver.

EMERGENCY STYLE: Optional emergency to generator/inverter wiring, internal generator transfer switch, nightlight wiring, step-dimming driver, backup battery.

Backup Battery

	Legrand 18W	Legrand 10W/ Bodine BSL310LP
HP2-P-D		
Min. Housing Length	8'*	4'**
EM Lumen Output	1608	956
EM Section Illuminated	2'	2' or 4'
HP2-P-WW-D		
Min. Housing Length	8'*	4'*
EM Lumen Output	1500	891
EM Section Illuminated	4'	4'

* Minimum fixture housing length for battery pack approved without sensor
** Exception: 5' not available, 6'+ okay

Bodine GTD and Legrand ALCR Min. Length

Configuration	Min Length
Generator	D-4'; ID-6'
Generator + OCC	D-6'; ID-8'
Daylight	D-4'; ID-6'
Generator + Daylight	D-6'; ID-8'

Backup Battery

	Legrand 18W	Legrand 10W/ Bodine BSL310LP
HP2-P-ID		
Min. Housing Length	12'	8'
EM Lumen Output	1854	956
EM Section Illuminated	2'	2' or 4'
HP2-P-I		
Min. Housing Length	8'*	4'*
EM Lumen Output	1874	956
EM Section Illuminated	2'	2' or 4'

* Minimum fixture housing length for battery pack approved without sensor

TUNABLE WHITE ELECTRICAL OPTIONS[8]:
- **TW Driver Options 0-10V:** EM/GEN, GTD or Battery Back up
- **FineTune DMX:** EM/GEN or Battery Back up
- **DMX:** Battery Back up
- **DALI:** EM/GEN, GTD or Battery Back up
- **LUTRON:** EM/GEN, GTD or Battery Back up

INTEGRATED SENSORS: Integrated PIR (Passive Infrared) Occupancy (**OBO**) or Daylight Sensors (**OBD**) available with Flush and Bottom Glow downlight diffusers. PIR sensors not recommended for stairwell applications. Refer to Occupancy Sensor & Daylight Sensor tech sheet and the Embedded Intelligence landing page for more information and additional sensor options.

FINISHES: Finelite Signal White (**SW**) powder coat, Finelite Black (**RAL 900**5) with semi gloss fine texture (**FB**), and Satin Aluminum (**SA**) are standard. Optional Adder: 185 RAL colors[9] are available.

LABELS: Luminaire and electrical components are ETL-listed conforming to UL 1598 in the U.S.A. and CAN/CSA C22.2 No. 250.0 in Canada. In accordance with NEC Code 410.130 (G), this luminaire contains an internal driver disconnect. UL 924 and UL 2108 - PoE options available on request. These fixtures are rated for Damp Location. Chicago Plenum options available for C1, C2, or C3 suspension using our GridBox. HP-2 can be used to comply with 2016 Title 24, Part 6 (JA8); high efficacy LED light source requirements. Finelite products use electronic components that are RoHS compliant, and the mechanical components of the luminaire have been verified to not knowingly contain any restricted substances listed per RoHS Directive 2015/863. Consult factory for tailored lighting options. Finelite makes the specification process easy when putting healthier products on your projects. Simply add – RLA (Red List Approved) or – RLD (Declared Label) to your part number.

WEIGHT[10]: ID - 2.9 lb/ft; D - 2.3 lb/ft; I - 2.3 lb/ft; WW - 2.9 lb/ft

WARRANTY: 10-year performance-based warranty on all standard components. Optional accessories such as emergency battery packs are covered by their individual manufacturer warranties.

[8] Consult Finelite for Generator Transfer Device and Battery Back up fit
[9] 20 business days lead time for color
[10] Excludes Battery Back up and Generator Transfer Device weight

High Performance 2" Aperture (HP-2) Pendant

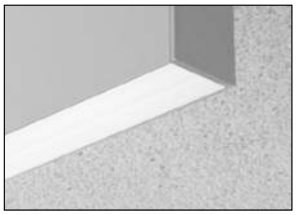
AESTHETIC OPTIONS

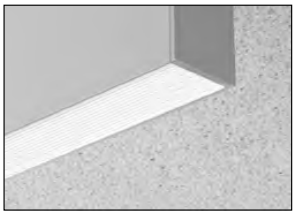

Flush Diffuser (**F**)

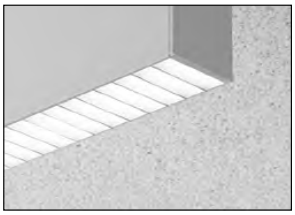

Bottom Glow Diffuser (**BG**)

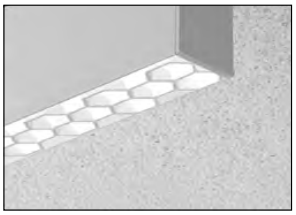

1" Drop Down Lens (**DL**)

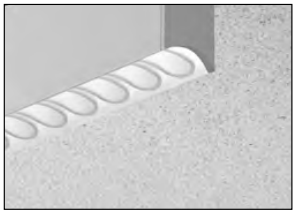

Flat Diffuser with 1" Regressed (**RG-D**)

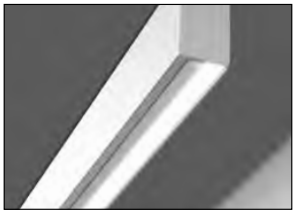

Downlight Asymmetric Optic (**DAO**) [1]
Externally flush


Downlight Spread Optic (**DSO**) [1]
Externally flush


White Cross Blade Baffle [1] (**RG-WCB**)


Hex Louver [2] (**RG-LHC**)


Hollowed Ellipse Louver [2] (**RG-LHE**)


Kicker (**K**) - Wall Wash only

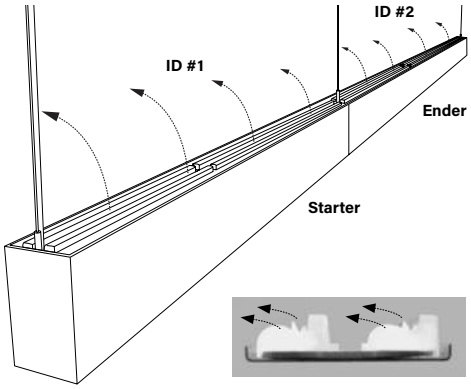
[1] With a subtle ribbed appearance providing specialized distribution
[2] Regressed only. Not available with Wall Wash

High Performance 2" Aperture (HP-2) Pendant

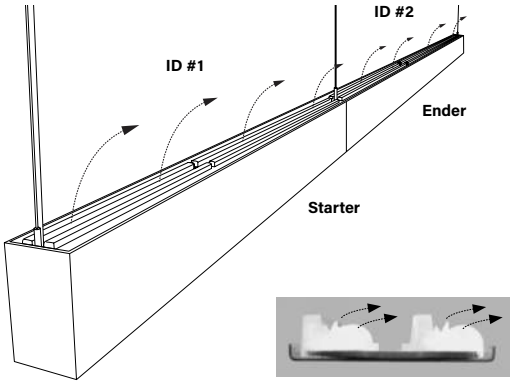
ASYMMETRIC OPTIONS

Use this tool to understand how to specify Asymmetric for your project. The diagrams below show a linear run from power feed to ender. Specify ASY-L distributes light to the left or ASY-R distributes light to the right.

Asymmetric Left Optic (ASY-L)



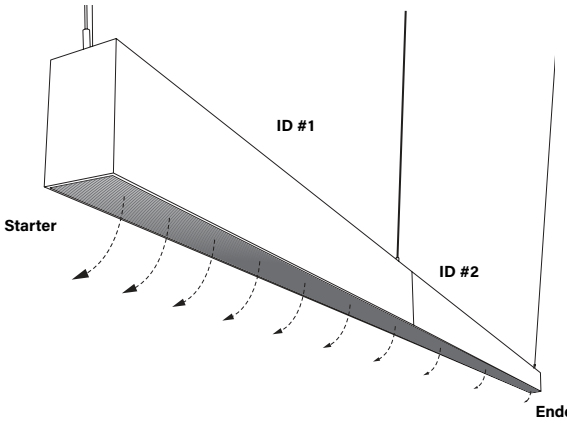
Asymmetric Right Optic (ASY-R)



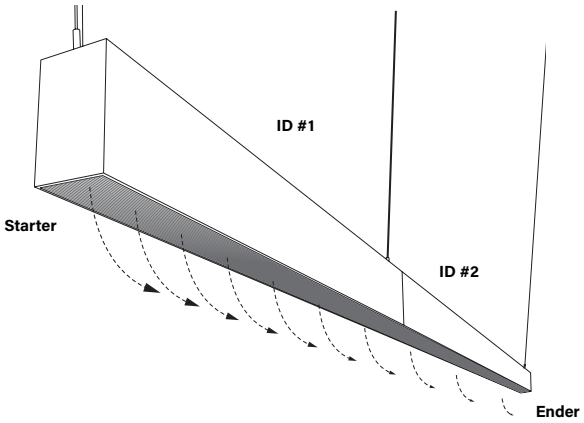
DOWNLIGHT ASYMMETRIC OPTIONS

Use this tool to understand how to specify Downlight Asymmetric for your project. The diagrams below show a linear run from power feed to ender. Specify DAO-L distributes light to the left or DAO-R distributes light to the right.

Downlight Asymmetric Optic Left (DAO-L)



Downlight Asymmetric Optic Right (DAO-R)



PREINSTALLED LABEL

For DAO, Preinstalled label on diffuser shows direction of light. Remove after installation.

Submitted by:	
Type:	ect:
Ordering Info:	

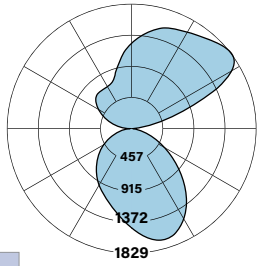
FINELITE® Lighting

High Performance 2" Aperture (HP-2) Pendant

Indirect/Direct Photometry - 4' Luminaire 3500K

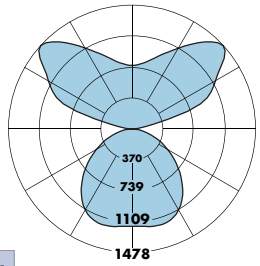
HP2-P-ID-4'-V-V-835-ASY-R-DAO-R
Uplight: Asymmetric Right Optic
Downlight: Downlight Asymmetric Optic - Right

Distribution: 53% Up (**V**) / 47% Down (**V**)
Efficacy: 112 lm/W
Uplight: 4301 lumens (1075 lumens/foot)
Downlight: 3742 lumens (936 lumens/foot)
Total luminaire output: 8043 lumens (2011 lm/ft)
72 watts (18 W/ft)
Peak Candela Value: 1829 @ 127.5°
CRI: 80 / CCT: 3500K
ITL LM79 Report REP-051921-01



HP2-P-ID-4'-V-V-835-WSO-DSO
Uplight: Widespread Optic
Downlight: Downlight Spread Optic

Distribution: 55% Up (**V**) / 45% Down (**V**)
Efficacy: 101 lm/W
Uplight: 4018 lumens (1105 lumens/foot)
Downlight: 3273 lumens (818 lumens/foot)
Total luminaire output: 7291 lumens (1823 lm/ft)
72 watts (18 W/ft)
Peak Candela Value: 1457 @ 135°
CRI: 80 / CCT: 3500K
ITL LM79 Report 89456 and 94139



Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	3292 [↑53% I 47%↓]	3745 [↑59% I 41%↓]	4877 [↑69% I 31%↓]	5833 [↑74% I 26%↓]
↓B [1]	3686 [↑48% I 52%↓]	4139 [↑53% I 47%↓]	5271 [↑63% I 36%↓]	6227 [↑69% I 31%↓]
↓H [1]	4671 [↑38% I 62%↓]	5124 [↑43% I 57%↓]	6256 [↑54% I 46%↓]	7211 [↑60% I 40%↓]
↓V [2]	5503 [↑32% I 68%↓]	5955 [↑37% I 63%↓]	7087 [↑47% I 53%↓]	8043 [↑53% I 47%↓]

Light Output, 3500K, 80 CRI (Lumens Per Foot)

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	823	936	1219	1458
↓B [1]	922	1035	1318	1557
↓H [1]	1168	1281	1564	1803
↓V [2]	1376	1489	1772	2011

Power, 3500K (Watts Per Foot)

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	7.0	8.0	10.4	12.5
↓B [1]	8.0	9.0	11.4	13.5
↓H [1]	10.4	11.4	13.8	15.9
↓V [2]	12.5	13.5	15.9	18.0

Efficacy, 3500K, 80 CRI (Lumens Per Watt)

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	117	117	117	116
↓B [1]	115	116	116	116
↓H [1]	112	113	113	113
↓V [2]	110	111	111	112

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL reports: 89456, 94139

Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	2985 [↑55% I 45%↓]	3408 [↑60% I 40%↓]	4465 [↑70% I 30%↓]	5358 [↑75% I 25%↓]
↓B [1]	3329 [↑49% I 51%↓]	3752 [↑55% I 45%↓]	4809 [↑65% I 35%↓]	5702 [↑70% I 30%↓]
↓H [1]	4191 [↑39% I 61%↓]	4614 [↑45% I 55%↓]	5671 [↑55% I 45%↓]	6564 [↑61% I 39%↓]
↓V [2]	4918 [↑33% I 67%↓]	5341 [↑38% I 62%↓]	6398 [↑49% I 51%↓]	7291 [↑55% I 45%↓]

Light Output, 3500K, 80 CRI (Lumens Per Foot)

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	746	852	1116	1340
↓B [1]	832	938	1202	1426
↓H [1]	1048	1154	1418	1641
↓V [2]	1230	1335	1600	1823

Power, 3500K (Watts Per Foot)

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	7.1	8.0	10.5	12.6
↓B [1]	8.0	9.0	11.4	13.5
↓H [1]	10.4	11.4	13.8	15.9
↓V [2]	12.5	13.4	15.9	18.0

Efficacy, 3500K, 80 CRI (Lumens Per Watt)

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	106	107	107	107
↓B [1]	104	105	105	105
↓H [1]	101	102	103	103
↓V [2]	99	99	101	101

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL reports: 89456, 94139

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**) / Standard Output (**S**), 4000K, 90 CRI
Lumen Adjustment Factor: 0.789
Total Light Output: 4465 lm x 0.789 = 3523 lm
Total Light Output per Foot: 1116 lm/ft x 0.789 = 881 lm/ft.
watts/foot: 10.5 W/ft.

$$\textbf{Efficacy} = \frac{881\ \frac{\text{lm}}{\text{ft.}}}{10.5\ \frac{\text{W}}{\text{ft.}}} = 84\ \text{lm/W}$$

Submitted by:	
Type:	ect:
Ordering Info:	

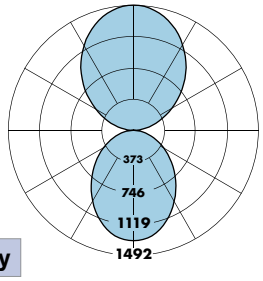
FINELITE® Lighting

High Performance 2" Aperture (HP-2) Pendant

Indirect/Direct Photometry - 4' Luminaire 3500K

HP2-P-ID-V-V-835-F-F
Uplight: Flush Diffuser / **Downlight:** Flush Diffuser

Distribution: 55% Up (**V**) / 45% Down (**V**)
Efficacy: 95 lm/W
Uplight: 3813 lumens (953 lumens/foot)
Downlight: 3175 lumens (794 lumens/foot)
Total luminaire output: 6988 lumens (1747 lm/ft)
73.8 watts (18.5 W/ft)
Peak Candela Value: 1492 @ 180°
CRI: 80 / CCT: 3500K
ITL LM79 Report 85132



Complete LM79 LED Photometry etry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	2861 (↑55% I 45%↓)	3262 (↑60% I 40%↓)	4265 (↑70% I 30%↓)	5113 (↑75% I 25%↓)
↓B [1]	3195 (↑49% I 51%↓)	3596 (↑55% I 45%↓)	4600 (↑65% I 35%↓)	5447 (↑70% I 30%↓)
↓H [1]	4030 (↑39% I 61%↓)	4432 (↑44% I 56%↓)	5435 (↑55% I 45%↓)	6282 (↑61% I 39%↓)
↓V [2]	4736 (↑33% I 67%↓)	5137 (↑38% I 62%↓)	6141 (↑48% I 52%↓)	6988 (↑55% I 45%↓)

Light Output, 3500K, 80 CRI (Lumens Per Foot)

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	715	815	1066	1278
↓B [1]	799	899	1150	1362
↓H [1]	1008	1108	1359	1571
↓V [2]	1184	1284	1535	1747

Power, 3500K (Watts Per Foot)

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	7.2	8.2	10.7	12.8
↓B [1]	8.2	9.2	11.7	13.8
↓H [1]	10.7	11.7	14.2	16.3
↓V [2]	12.8	13.8	16.3	18.5

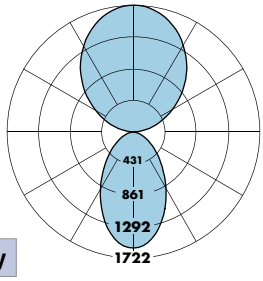
Efficacy, 3500K, 80 CRI (Lumens Per Watt)

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	99	99	100	100
↓B [1]	97	98	99	99
↓H [1]	94	95	96	96
↓V [2]	92	93	94	95

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 89132

HP2-P RG-ID-V-V-835-F
Uplight: Flush Diffuser / **Downlight:** Regressed Diffuser

Distribution: 59% Up (**V**) / 41% Down (**V**)
Efficacy: 99 lm/W
Uplight: 4304 lumens (1076 lumens/foot)
Downlight: 2928 lumens (732 lumens/foot)
Total luminaire output: 7232 lumens (1808 lm/ft)
73.2 watts (18.3 W/ft)
Peak Candela Value: 1722 @ 180°
CRI: 80 / CCT: 3500K
ITL LM79 Report 90352



Complete LM79 LED Photometry etry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	2960 (↑60% I 40%↓)	3414 (↑65% I 35%↓)	4546 (↑74% I 26%↓)	5503 (↑78% I 22%↓)
↓B [1]	3269 (↑54% I 46%↓)	3722 (↑60% I 40%↓)	4854 (↑69% I 31%↓)	5811 (↑74% I 26%↓)
↓H [1]	4039 (↑44% I 56%↓)	4492 (↑49% I 51%↓)	5625 (↑60% I 40%↓)	6581 (↑65% I 35%↓)
↓V [2]	4690 (↑38% I 62%↓)	5143 (↑43% I 57%↓)	6276 (↑53% I 47%↓)	7232 (↑59% I 41%↓)

Light Output, 3500K, 80 CRI (Lumens Per Foot)

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	740	853	1137	1376
↓B [1]	817	930	1214	1453
↓H [1]	1123	1406	1645	1645
↓V [2]	1172	1286	1569	1808

Power, 3500K (Watts Per Foot)

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	7.2	8.1	10.6	12.7
↓B [1]	8.1	9.1	11.6	13.7
↓H [1]	10.6	11.6	14.0	16.2
↓V [2]	12.7	13.7	16.2	18.3

Efficacy, 3500K, 80 CRI (Lumens Per Watt)

	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	103	105	107	108
↓B [1]	100	102	105	106
↓H [1]	95	97	100	102
↓V [2]	92	94	97	99

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 90352

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**) / Standard Output (**S**), 4000K, 90 CRI
Lumen Adjustment Factor: 0.789
Total Light Output: 4265 lm x 0.789 = 3365 lm
Total Light Output per Foot: 1066 lm/ft x 0.789 = 841 lm/ft.
watts/foot: 10.7 W/ft.

$$\textbf{Efficacy} = \frac{841\ \frac{\text{lm}}{\text{ft.}}}{10.57\ \frac{\text{W}}{\text{ft.}}} = 78.6\ \text{lm/W}$$

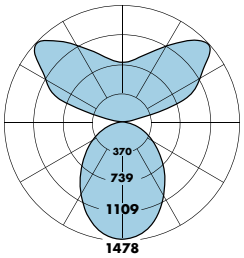
Submitted by:	
Type:	ect:
Ordering Info:	

High Performance 2" Aperture (HP-2) Pendant

Indirect/Direct Photometry - 4' Luminaire 3500K

HP2-P-ID-V-V-835-WSO-F
Uplight: Widespread Optic / **Downlight:** Fluse Diffuser

Distribution: 55% Up (**V**) / 45% Down (**V**)
Efficacy: 101 lm/W
Uplight: 4018 lumens (1005 lumens/foot)
Downlight: 3312 lumens (828 lumens/foot)
Total luminaire output: 7330 lumens (1833 lm/ft)
74.5 watts (18.6 W/ft)
Peak Candela Value: 1461 @ 0°
CRI: 80 / CCT: 3500K
ITL LM79 Report 89456



Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire				
	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	3001 (↑55% I 45%↓)	3424 (↑60% I 40%↓)	4481 (↑70% I 30%↓)	5374 (↑75% I 25%↓)
↓B [1]	3349 (↑49% I 51%↓)	3772 (↑55% I 45%↓)	4830 (↑65% I 35%↓)	5722 (↑70% I 30%↓)
↓H [1]	4221 (↑39% I 61%↓)	4644 (↑44% I 56%↓)	5701 (↑55% I 45%↓)	6594 (↑61% I 39%↓)
↓V [2]	4957 (↑33% I 67%↓)	5380 (↑38% I 62%↓)	6437 (↑48% I 52%↓)	7330 (↑55% I 45%↓)

Light Output, 3500K, 80 CRI (Lumens Per Foot)				
	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	750	856	1120	1343
↓B [1]	837	943	1207	1431
↓H [1]	1055	1161	1425	1649
↓V [2]	1239	1345	1609	1833

Power, 3500K (Watts Per Foot)				
	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	7.1	8.1	10.5	12.6
↓B [1]	8.1	9.0	11.5	13.6
↓H [1]	10.5	11.5	13.9	16.0
↓V [2]	12.6	13.6	16.0	18.1

Efficacy, 3500K, 80 CRI (Lumens Per Watt)				
	↑S [1]	↑B [1]	↑H [1]	↑V [2]
↓S [1]	106	106	107	107
↓B [1]	104	105	105	105
↓H [1]	100	101	102	103
↓V [2]	98	99	100	101

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 89456

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**) / Standard Output (**S**), 4000K, 90 CRI
Lumen Adjustment Factor: 0.789
Total Light Output: 4481 lm x 0.789 = 3536 lm
Total Light Output per Foot: 1120 lm/ft x 0.789 = 884 lm/ft.
watts/foot: 10.5 W/ft.

$$\textbf{Efficacy} = \frac{884\ \frac{\text{lm}}{\text{ft.}}}{10.5\ \frac{\text{W}}{\text{ft.}}} = 84\ \text{lm/W}$$

the lighting practice

Catalog Information: HP-2-P-I-[LENGTH]-B-NA-940-WSO-NA-98LG-[VOLTAGE]-SC-FC-10%-FA100-C4-FE-SA

Date: 09/30/2022
Fixture Type:

C1

Submitted by:	
Type:	ect:
Ordering Info:	

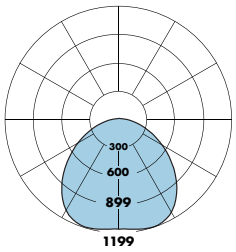
FINELITE® Lighting

High Performance 2" Aperture (HP-2) Pendant

Direct Photometry - 4' Luminaire 3500K

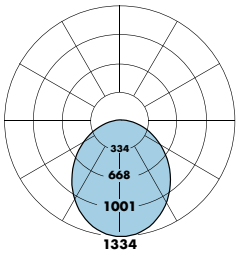
HP2-P-D-4'-V-835-DSO
Downlight: Downlight Spread Optic

Efficacy: 92 lm/W
Total luminaire output: 3273 lumens (818 lm/ft)
35.7 watts (8.9 W/ft)
Peak Candela Value: 1199 @ 17.5°
CRI: 80 / CCT: 3500K
ITL LM79 Report 94139



HP2-P-D-V-835-F
Downlight: Flush Diffuser

Efficacy: 87 lm/W
Total luminaire output: 3215 lumens (804 lm/ft)
36.9 watts (9.2 W/ft)
Peak Candela Value: 1334 @ 0°
CRI: 80 / CCT: 3500K
ITL LM79 Report 85136



Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire			
S [1]	B [1]	H [1]	V [2]
1340	1684	2546	3273

Light Output, 3500K, 80 CRI (Lumens Per Foot)			
S [1]	B [1]	H [1]	V [2]
335	421	636	818

Power, 3500K (Watts Per Foot)			
S [1]	B [1]	H [1]	V [2]
3.5	4.4	6.8	8.9

Efficacy, 3500K, 80 CRI (Lumens Per Watt)			
S [1]	B [1]	H [1]	V [2]
96	95	93	92

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 94139

Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire			
S [1]	B [1]	H [1]	V [2]
1316	1655	2501	3215

Light Output, 3500K, 80 CRI (Lumens Per Foot)			
S [1]	B [1]	H [1]	V [2]
329	414	625	804

Power, 3500K (Watts Per Foot)			
S [1]	B [1]	H [1]	V [2]
3.6	4.6	7.1	9.2

Efficacy, 3500K, 80 CRI (Lumens Per Watt)			
S [1]	B [1]	H [1]	V [2]
91	90	88	87

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 85136

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**) / Standard Output (**S**), 4000K, 90 CRI
Lumen Adjustment Factor: 0.789
Total Light Output: 2546 lm x 0.789 = 2009 lm
Total Light Output per Foot: 636 lm/ft x 0.789 = 502 lm/ft.
watts/foot: 6.8 W/ft.

$$\textbf{Efficacy} = \frac{502\ \frac{\text{lm}}{\text{ft.}}}{6.8\ \frac{\text{W}}{\text{ft.}}} = 74\ \text{lm/W}$$

the lighting practice

Catalog Information: HP-2-P-I-[LENGTH]-B-NA-940-WSO-NA-98LG-[VOLTAGE]-SC-FC-10%-FA100-C4-FE-SA

Date: 09/30/2022
Fixture Type:

C1

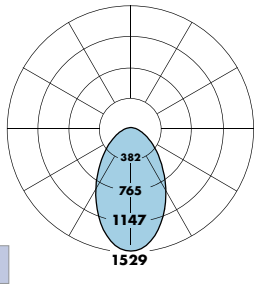
FINELITE® Lighting

High Performance 2" Aperture (HP-2) Pendant

Direct Photometry - 4' Luminaire 3500K

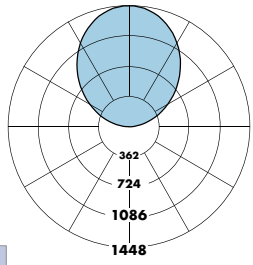
HP2-P RG-D-V-835-RG
Downlight: Regressed Diffuser

Efficacy: 79 lm/W
Total luminaire output: 2887 lumens (722 lm/ft)
36.7 watts (9.2 W/ft)
Peak Candela Value: 1529 @ 0°
CRI: 80 / CCT: 3500K
ITL LM79 Report 90350



HP2-P-I-V-835-F
Uplight: Flush Diffuser

Efficacy: 102 lm/W
Total luminaire output: 3749 lumens (937 lm/ft)
36.7 watts (9.2 W/ft)
Peak Candela Value: 1448 @ 180°
CRI: 80 / CCT: 3500K
ITL LM79 Report 85134



Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire			
S [1]	B [1]	H [1]	V [2]
1182	1486	2245	2887

Light Output, 3500K, 80 CRI (Lumens Per Foot)			
S [1]	B [1]	H [1]	V [2]
295	371	561	722

Power, 3500K (Watts Per Foot)			
S [1]	B [1]	H [1]	V [2]
3.6	4.6	7.0	9.2

Efficacy, 3500K, 80 CRI (Lumens Per Watt)			
S [1]	B [1]	H [1]	V [2]
82	81	80	79

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 90350

Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire			
S [1]	B [1]	H [1]	V [2]
1535	1929	2916	3749

Light Output, 3500K, 80 CRI (Lumens Per Foot)			
S [1]	B [1]	H [1]	V [2]
384	482	729	937

Power, 3500K (Watts Per Foot)			
S [1]	B [1]	H [1]	V [2]
3.6	4.6	7.0	9.2

Efficacy, 3500K, 80 CRI (Lumens Per Watt)			
S [1]	B [1]	H [1]	V [2]
107	106	104	102

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 85134

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**) / Standard Output (**S**), 4000K, 90 CRI
Lumen Adjustment Factor: 0.789
Total Light Output: 2245 lm x 0.789 = 1771 lm
Total Light Output per Foot: 561 lm/ft x 0.789 = 443 lm/ft.
watts/foot: 7.0 W/ft.

$$\textbf{Efficacy} = \frac{443\ \frac{\text{lm}}{\text{ft.}}}{7.0\ \frac{\text{W}}{\text{ft.}}} = 63\ \text{lm/W}$$

the lighting practice

Catalog Information: HP-2-P-I-[LENGTH]-B-NA-940-WSO-NA-98LG-[VOLTAGE]-SC-FC-10%-FA100-C4-FE-SA

Date: 09/30/2022
Fixture Type:

C1

Submitted by:

Type: ect:

Ordering Info:

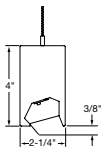
FINELITE Lighting

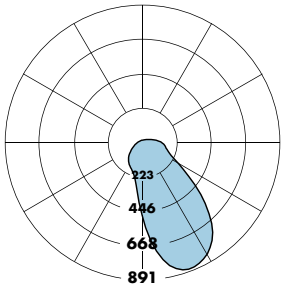
High Performance 2" Aperture (HP-2) Pendant

Wall Wash Direct Photometry - 4' Luminaire 3500K

HP2-P-WW-D-K-V-835
Downlight: With Kicker

Efficacy: 77 lm/W
Total luminaire output: 1500 lumens (375 lm/ft)
19.6 watts (4.9 W/ft)
Peak Candela Value: 882 @ 25°
CRI: 80 / CCT: 3500K
ITL LM79 Report 85137





CANDELA DISTRIBUTION

FLUX	0.0	22.5	45.0	67.5	90.0	
0	485	485	485	485	485	
5	652	606	483	378	342	47
15	863	790	470	251	219	145
25	882	829	442	201	184	231
35	795	764	397	168	152	282
45	581	629	333	133	105	277
55	326	436	251	86	62	217
65	196	250	167	43	24	144
75	158	145	88	7	0	87
85	124	97	24	0	0	50
90	93	68	0	0	0	

Complete LM79 LED Photometry

Total Light Output, 3500K, 80 CRI (Lumens) - 4' Luminaire			
S [1]	**B** [1]	**H** [1]	**V** [2]
614	772	1167	1500

Light Output, 3500K, 80 CRI (Lumens Per Foot)			
S [1]	**B** [1]	**H** [1]	**V** [2]
154	193	292	375

Power, 3500K (Watts Per Foot)			
S [1]	**B** [1]	**H** [1]	**V** [2]
2.0	2.5	3.8	4.9

Efficacy, 3500K, 80 CRI (Lumens Per Watt)			
S [1]	**B** [1]	**H** [1]	**V** [2]
76	77	77	77

Sample Lumen Adjustment Calculation

Lumen Adjustment Factors 80 CRI	
3000K	0.985
3500K	1.000
4000K	1.032

Lumen Adjustment Factors 90 CRI	
3000K	0.746
3500K	0.760
4000K	0.789

High Output (**H**), 4000K, 90 CRI

Lumen Adjustment Factor: 0.789

Total Light Output: 1167 lm x 0.789 = 921 lm

Total Light Output per Foot: 292 lm/ft x 0.789 = 230 lm/ft.

watts/foot: 3.8 W/ft.

Efficacy = $\frac{230 \frac{\text{lm}}{\text{ft.}}}{3.8 \frac{\text{W}}{\text{ft.}}}$ = 60.5 lm/W

S - Standard Output, B - Boosted Standard Output, H - High Output, V - Very High Output
[1] Family Correlation based on 4' luminaire 3500K Very High Output (**V**) test - 120V.
[2] Based on ITL report: 85137

the lighting practice

Catalog Information: HP-2-P-I-[LENGTH]-B-NA-940-WSO-NA-98LG-[VOLTAGE]-SC-FC-10%-FA100-C4-FE-SA

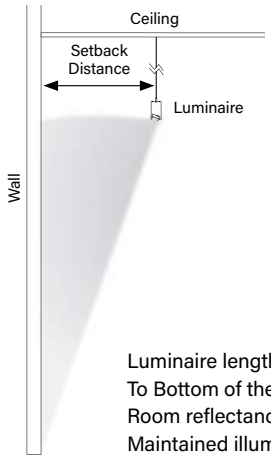
Date: 09/30/2022
Fixture Type:

C1

High Performance 2" Aperture (HP-2) Pendant

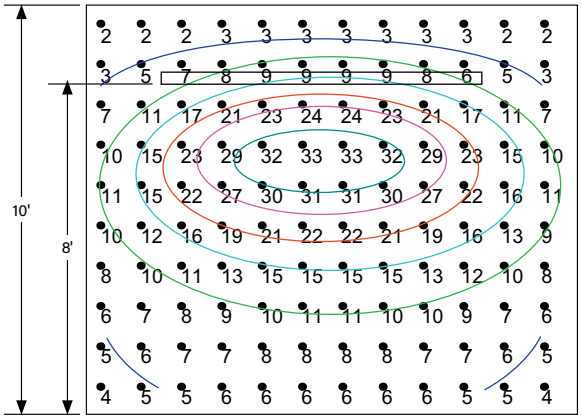
Wall Wash Direct - Setback Info and Application Data

HP2-WW-D-K-4'-V-835
Downlight: With Kicker
Total luminaire output: 1206 lumens (302 lm/ft)
19.6 watts (4.9 W/ft)
CRI: 80 / CCT: 3500K



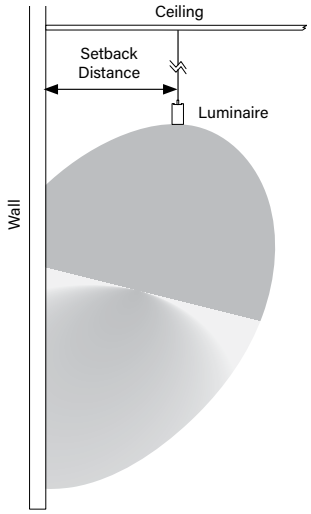
Luminaire length: 8'
To Bottom of the luminaire: 8'-0"
Room reflectances: 80-50-20
Maintained illuminance levels: LLF 0.86"

Setback Distance - 2'

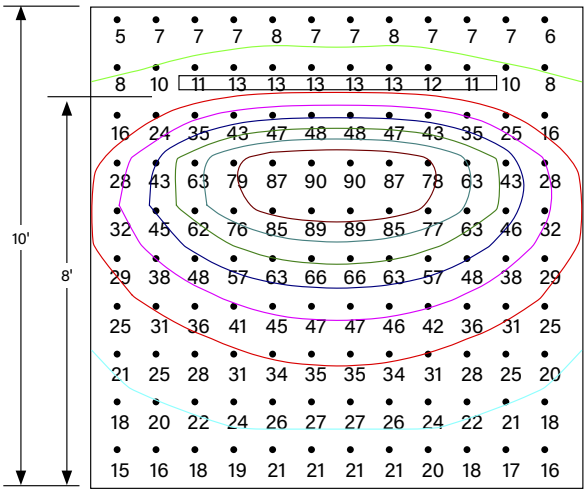


Downlight Asymmetric Optic - Setback Info and Application Data

HP2-P-D-4ft-V-835-DAO
Downlight: DAO
Total luminaire output: 3742 lumens (936 lm/ft)
35.6 watts (8.9 W/ft)
CRI: 80 / CCT: 3500K



Setback Distance - 2'



0-10V Tunable White

Finelite's award-winning, contractor friendly Tunable White luminaires are available at low cost, with powerful and simple 0-10V tuning and intensity controls.

TUNABLE WHITE FEATURES

- CCT range: 2700K - 6500K
- Dimming Range: 100% to 10%
- CRI Options: 80 CRI or 90 CRI

PHOTOMETRY

Apply a power adjustment factor to calculate wattage usage

POWER	CONVERSION FACTOR
	1.1X

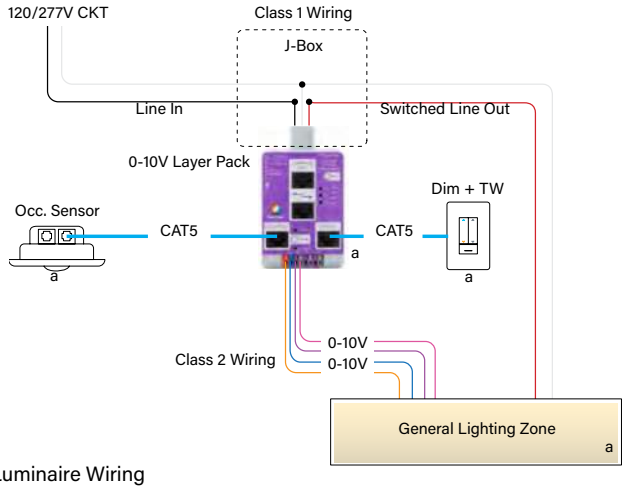
(Example: a 50 watt luminaire in static white would draw 55 watts using 0-10V Tunable White)

LUMINAIRE FAMILY MODIFICATIONS/RESTRICTIONS

	Section Lengths										
Direct	2'	3'	4'	5'	6'	7'	8'	9'	10'	11'	12'
Output S,B,H,V Single Circuit	Rows can be comprised of 2'-12' sections. Tailored lengths available.										
Integral Battery Backup (BSL310LP)							✓		✓		✓
Indirect/Direct											
Output S,B Single Circuit	✓		✓		✓		✓		✓		✓
Integral Battery Backup (BSL310LP)							✓		✓		✓
Output H,V Single Circuit			✓				✓				✓
Integral Battery Not Available	Remote Battery backup solution available. Consult factory for tailored lighting options.										
Output S,B,H,V Dual Circuit			✓				✓				✓
Integral Battery Not Available	Remote Battery backup solution available. Consult factory for tailored lighting options.										

EN/GEN sections available for all body lengths

WIRING DIAGRAM - DIMMABLE TO 10%

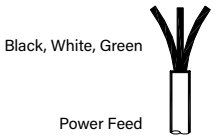


Luminaire Wiring

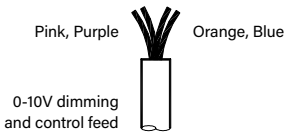
- **Purple** (+) / **Pink** (-) control wires are for intensity control
- **Orange** (+) / **Blue** (-) control wires are for Tunable White control

Note:
Load or Dim to Off options available.

DUAL FEED DETAIL



WIRING LEGEND		
Black	Hot	Line Voltage
White	Neutral	Line Voltage
Green	Ground	



WIRING LEGEND		
Pink	Dimming	0-10V DC
Purple	Dimming	0-10V DC
Orange	TW	0-10V DC
Blue	TW	0-10V DC

Catalog Information: HP-2-P-I-[LENGTH]-B-NA-940-WSO-NA-98LG-[VOLTAGE]-SC-FC-10%-FA100-C4-FE-SA

Date: 09/30/2022
Fixture Type:

C1

UNILUME LED SLIMLINE

TECH LIGHTING

PRODUCT FEATURES

- A low-profile solution designed at less than 1" height and 3" wide for task lighting great for residential and commercial spaces.
- Available in four sizes (7", 13", 19", 31") and two finishes (black and white).
- 90 CRI. Choose from 3 color temperatures: 2700K, 3000K, 3500K.
- Standard On/Off switch.
- Link up to 70 units together with a connector (not included).
- Protected by a 5-year warranty. Please visit the "About Us" page on techlighting.com for more for warranty details.

7" WHITE
(SHOWN OFF)

LAMPING

With four convenient lengths, the ability to power up to 70 linked units from a single outlet, a standard on/off switch, a reliable integrated driver, and color temperature/CRI options; Unilume LED Slimline is perfect for residential or commercial use.

13" BLACK
(SHOWN ON)

ACCESSORIES

JUMPER CONNECTORS

Can be used to link one undercabinet housing to another or to a splice box. The maximum wattage for a single run is 600 watts. Use female to female connector to create longer lengths or contact us for custom lengths. Nominal length.

700UCJC	LENGTH*		COLOR	
	01	1"	B	BLACK
	03	3"	W	WHITE
	06	6"		
	12	12"		
	24	24"		

*FOR CUSTOM LENGTHS, CONTACT OUR FACTORY

SPLICE BOX

Required for hardware applications. Conduit is fed into the back and Jumper Connector ports on each side can feed power to Unilume LED Slimline runs in two directions. The 1" Jumper Connector can be used to place the Splice Box next to the undercabinet housing. Longer Jumper Connectors can be used to place the Splice Box in a more convenient or remote location. Includes 3/8" conduit connector.

700UCSB	FINISH	
	B	BLACK
	W	WHITE

FEMALE TO FEMALE CONNECTOR

Joins two jumper connectors together.

700UCFFC	COLOR	
	B	BLACK
	W	WHITE

PLUG-IN WALL FEED

Can be used to plug one undercabinet housing directly into an outlet.

700UCPL	LENGTH*		COLOR	
	24	24"	B	BLACK
	72	72"	W	WHITE

*FOR CUSTOM LENGTHS, CONTACT OUR FACTORY

ORDERING INFORMATION

700UCF	LENGTH		CRI		CCT		FINISH		LAMP TYPE	
	07	7.2"	9	90 CRI	2	2700K	B	BLACK	-LED	LED
	13	13.2"			3	3000K	W	WHITE		
	19	19.2"			5	3500K				
	31	31.3"								

700UCF _____ _____ _____ _____ _____

JOB NAME _____

NOTES _____

_____

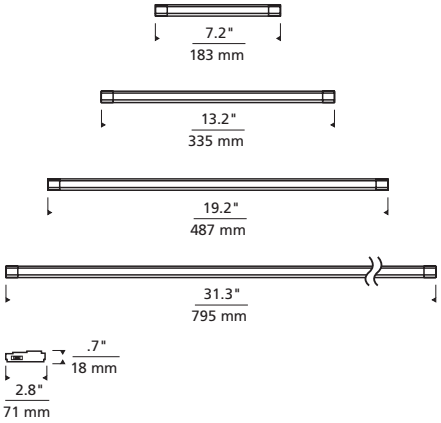
7400 Linder Avenue, Skokie, IL 60077
T 847.410.4400 | F 847.410.4500 | techlighting.com

UNILUME LED SLIMLINE

TECH LIGHTING

DIMENSIONS

	7"	13"	19"	31"
HEIGHT	.7"	.7"	.7"	.7"
WIDTH	2.8"	2.8"	2.8"	2.8"
LENGTH	7.2"	13.2"	19.2"	31.3"
NET WEIGHT	1	2	3	4.5



LAMPING SPECIFICATIONS

	7"	13"	19"	31"
INTEGRATED LED	Yes	Yes	Yes	Yes
DELIVERED LUMENS	240	527	693	1224
WATTS	4W	8.5W	10.5W	18W
EFFICACY	60 lms/W	62 lms/W	66 lms/W	68 lms/W
MAX WATTAGE	4W	8.5W	10.5W	18W
INPUT VOLTAGE	120V			
DIMMING TYPE*	ELV (down to 15%)			
CCT	2700K, 3000K or 3500K			
CRI	90			
LED LIFETIME	50,000 hours to 70%			
FIELD SERVICEABLE LED	No			
LAMP BASE	Integrated LED			
LAMP INCLUDED?	Yes			
WARRANTY**	5 years			

*Dimming information available at www.techlighting.com/Downloads#dimming
**Visit techlighting.com for specific warranty limitations and details.

SPECIFICATIONS

HARDWARE MATERIAL	Aluminum
SHADE MATERIAL	Glass
DAMP LISTED	Yes
MOUNTING DETAILS	
GENERAL LISTING	ETL
INCLUDES	

T20/T24 INFORMATION

	INTEGRATED LED	REPLACEMENT LED LAMP	NO LAMP*
This product can be used to comply with California Building Energy Efficiency Standards 2016 **Title 24** Part 6.	Yes		
This product meets California Appliance Efficiency Standards 2016 **Title 20** and may be shipped to and sold in California.	Yes		

*If a light fixture or component does not include a lamp or light source, it is the responsibility of the customer to select a lamp that meets the T24 and T20 requirements.

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FLEXALIGHTING
TOP QUALITY ITALIAN LED LIGHTING

JOEL 6

Adjustable downlights

40mm IP65 made in Italy

design Roberto Mantovani

The Joel range combines extremely small dimensions with luminous fluxes suited to general lighting. The embedded optics ensures high visual comfort. Thanks to the IP65 grade, it can be used in wet areas.

La gamma Joel combina dimensioni estremamente ridotte a flussi luminosi tali da prestarsi ad illuminazioni generali. L'ottica arretrata garantisce un elevato comfort visivo. Grazie al grado IP65 può essere impiegato in zone umide.

La gamme Joel combine des dimensions extrêmement réduites avec des flux lumineux adaptés à l'éclairage général. L'optique encastrée assure un confort visuel élevé. Grâce à son indice IP65, il peut être utilisé dans les zones humides.

Die Joel-Reihe kombiniert extrem kleine Abmessungen mit Lichtströmen, die für die Allgemeinbeleuchtung geeignet sind. Die versenkte Optik sorgt für hohen Sehkomfort. Dank der Schutzart IP65 kann es in Nassbereichen eingesetzt werden.

La gama Joel combina dimensiones extremadamente pequeñas con flujos luminosos adecuados para iluminaciones generales. La óptica empotrada garantiza un gran confort visual. Gracias a su grado de protección IP65, puede utilizarse en zonas húmedas.

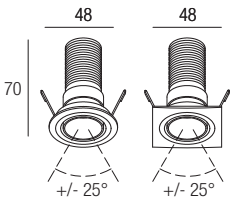
Supply current
350-500 mA (V_t 8,7V)

Power
3-6 W

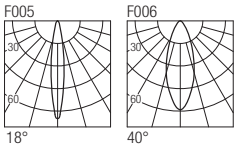
Series wiring

CRI
85

Dimensions



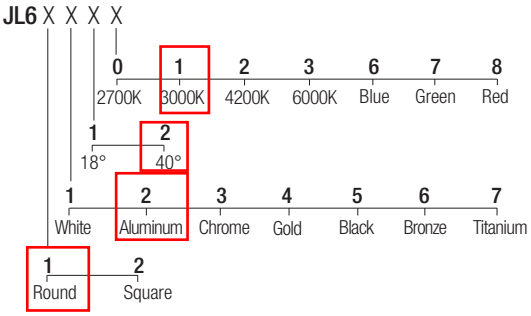
Photometric diagrams



CCT/CRI/Flux

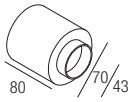
	350mA	500mA
2700K	267lm	384lm
3000K	279lm	400lm
4200K	309lm	462lm
6000K	342lm	495lm

Code construction



Optionals

CS1005
Recessing box



LJL601
Low luminance louver

SJL601
Milky screen

Note: the filter and the screen must be ordered together with the lighting fixture

AL7022
24VDC/500mA constant current converter

Drivers

350 mA

on/off	dimmable
AL1034 (1..3) 30mm IP20	**AL4000** (1..4) 72mm IP20 PUSH 0/1..10V
AL1035 (1..3) 40mm IP20	**AL4051** (1..4) 72mm IP20 DALI
AL1037 (1..5) 55mm IP20 S.P.	**AL4053** (1..4) 56mm IP20 PUSH IGBT-TRIAC
AL9011 (1..4) 44mm IP67	**AL8035** (2..4) IP67 DALI

500 mA

on/off	dimmable
AL1074 (1..2) 30mm IP20	**AL4010** (1..4) 72mm IP20 PUSH 0/1..10V
AL1077 (1..2) 40mm IP20	**AL4151** (1..4) 72mm IP20 DALI
AL1084 (1..3) 55mm IP20 S.P.	**AL4153** (1..4) 56mm IP20 PUSH IGBT-TRIAC
AL9051 (1..3) 44mm IP67	**AL8050** (2..4) IP67 DALI

09/30/2022

FLEXALIGHTING Srl via Lisbona 21, 50065 Pontassieve (FI) Italy t. +39.055.8323021 f. +39.055.8324866 info@flexalighting.it

iQ

iQ Track Luminaire

JOB NAME		CATALOG NUMBER	
NOTES		TYPE	

ELECTRICAL DATA

LED Light Engine	System Wattage *	CCT / CRI	Nominal Delivered Lumens **
L0	11W	3000K / 82 CRI	980lm
L1	16W	3000K / 82 CRI	1300 lm

*System Wattage includes driver and LED module consumption

**Delivered lumens output will vary depending on, lumen packages, CCT/CRI and optic selection. See IES files for exact values.

FEATURES

- High performance LED with 2 SDCM binning
- Spot optic with 14,500 CBCP
- Choice of multiple CCT/CRI options

LED LIGHT ENGINE

- Color consistency of 2 MacAdam Elipses
- 82 or 92 CRI in 2700, 3000, 3500 & 4000K
- 50,000 hours L70 (rated life at 70% output)

OPTICS

- 12° spot, 24° narrow flood, 36° flood, and 50° wide flood
- Field changeable optics

ELECTRICAL SYSTEM

- 120/277V 50/60Hz input
- Class 2 power supply
- Over voltage/current and short circuit protection
- Auto Recovery

DIMMING

- Forward/ Reverse phase dimming
- Phase dimming in 120V only
- 0-10V dimming available with Pulse Control Track

TRACK COMPATIBILITY

Track luminaire is designed for use with the following track systems:

- Single Circuit / Single Neutral 120V
- Two Circuit / Single Neutral 120V (No Dimming)
- Pro-Series Two Circuit / Two Neutral 120V
- Pro-Series Two Circuit / Two Neutral 277V
- Pulse Control Track 0-10V Dimming 120V
- J-Type Single /Two Circuit 120V
- L-Type Single / Two Circuit 120V

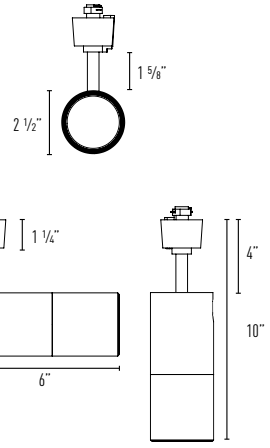
ACCESSORIES

- Accessories include: Hex louver, prismatic spread lens, linear spread lens, and solite lens.
- Luminaire will accommodate (1) accessory. Holder required.

LISTING/WARRANTY

- ETL Listed to US and Canadian standards for damp locations
- 5-Year Intense LED Limited Warranty

iQ



Horizontal Adjustability: 358°
Vertical Adjustability: 180°

Example: IQL130W-NF

Luminaire	Wattage	CCT / CRI	Driver	Finish	Beam Spread	Adapter
IQ	-L0 (11 Watts)	27 (2700K/82 CRI)	blank (Non-Dimming)	W (White)	-SP (12° Spot)	blank (Intense Single / Two Circuit 120V)
	-L1 (16 Watts)	279 (2700K/92 CRI)	-DIM[1,2] (Phase Dimming)	B (Black)	-NF (24° Narrow Flood)	-PS (Pro-Series 120V)
		30 (3000K/82 CRI)	-D101[3] (0-10V Dimming)	SV (Silver)	-FL (36° Flood)	-PS-27[1] (Pro-Series 277V)
		309 (3000K/92 CRI)			-WF (50° Wide Flood)	-CT[2] (Pulse Control Track 120V)
		35 (3500K/82 CRI)				-J (J-Type Adapter 120V)
		359 (3500K/92 CRI)				-L (L-Type Adapter 120V)
		40 (4000K/82 CRI)				
		409 (4000K/92 CRI)				

Accessories:

- LH56 (Accessory Holder)
- PFLMB-56 (Hex Louver)
- PFL56-1 (Prismatic Spread Lens)
- PFL56-2 (Linear Spread Lens)
- PFL56-4 (Solite Lens)

Field Changeable Optic:

- IP-B047SP (12° Spot)
- IP-B047NF (24° Narrow Flood)
- IP-B047FL (36° Flood)
- IP-B047WF (50° Wide Flood)

Notes:
1. Phase dimming available in 120V only.
2. Phase dimming not available with Pulse Control Track
3. 0-10V dimming requires Pulse Control Track

TRACK SYSTEM LJM-8428:21 P-5

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iQ

iQ Track Luminaire

JOB NAME		CATALOG NUMBER	
NOTES		TYPE	

IQL130

Report #:
ILL-20170505-01
ILL-20170505-02
ILL-20170505-03
ILL-20170505-04

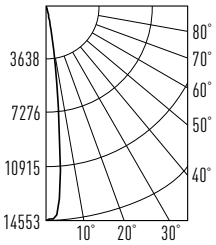
CCT / CRI Multipliers:

2700K / 82 CRI	(x 0.94)
2700K / 92 CRI	(x 0.75)
3000K / 82 CRI	(x 1.00)
3000K / 92 CRI	(x 0.81)
3500K / 82 CRI	(x 1.00)
3500K / 92 CRI	(x 0.87)
4100K / 82 CRI	(x 1.00)
4100K / 92 CRI	(x 0.87)

LED Engine Multiplier:

IQ-L0	(x 0.75)
IQ-L1	(x 1.00)

12° Spot (-SP)

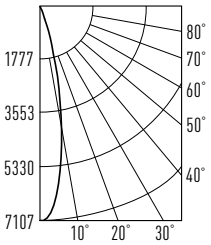


Watts: 16
Lumens: 1115
LPW: 70
CCT: 3000K

Candelas at Nadir

Degree	Candela
0°	14553
5°	9019
15°	883
25°	155
35°	69
45°	25

24° Narrow Flood (-NF)

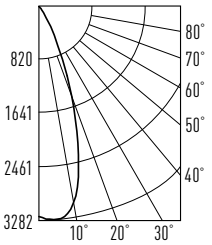


Watts: 16
Lumens: 1277
LPW: 80
CCT: 3000K

Candelas at Nadir

Degree	Candela
0°	7107
5°	6270
15°	1986
25°	266
35°	38
45°	11

36° Flood (-FL)

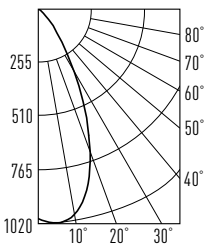


Watts: 16
Lumens: 1311
LPW: 82
CCT: 3000K

Candelas at Nadir

Degree	Candela
0°	3282
5°	3310
15°	2191
25°	739
35°	158
45°	17

50° Flood (-WF)



Watts: 16
Lumens: 1020
LPW: 64
CCT: 3000K

Candelas at Nadir

Degree	Candela
0°	981
5°	1008
15°	1021
25°	712
35°	325
45°	91

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Catalog Information: IQ-L1-35-D101-SV-WF-PFLMB-56

Date: 09/30/2022
Fixture Type:

H1A

Pulse Control 0-10V Dimming (120V) Track

ICT4 / ICT8 / ICT12

JOB NAME		CATALOG NUMBER	
NOTES		TYPE	

DESCRIPTION

Pulse Control Track provides a specification grade track platform for mounting high quality fixtures. The heavy duty extruded aluminum profile is ideal for demanding applications where numerous and/or heavy fixtures are needed. This phase track gives you your standard 120V connection for 3 circuit/ 1 neutral. Maximum control and reduced energy costs make Pulse Track an excellent choice.

Pulse Control Track is engineered to be durable, dependable, and simple-to-install lighting solution. The track's extruded aluminum construction and continuously crimped conductor ensure mechanical strength and electrical reliability. The integral suspension rail and predrilled mounting holes of the track simplify installations.

FEATURES

- High quality, Low profile, easy and flexible installation
- For use with specified Intense track luminaires
- Dimming feature available, see track luminaire for compatibility

ELECTRICAL

- Voltage: 120V 60Hz
- Amperage: 20A Max. / 2400W each.
- Dimming: dimming must be specified by track luminaire

CONSTRUCTION

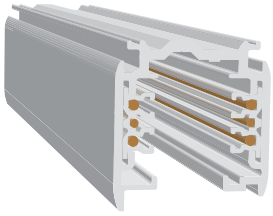
- Architectural grade extruded aluminum
- Polarity ridge is located on face of track to indicate position of track adapters
- Available in white, black or silver
- Field cuttable to desired lengths

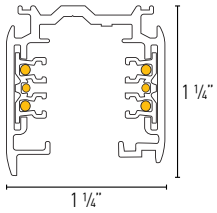
MOUNTING OPTIONS

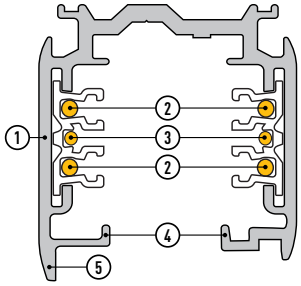
Track can be surface or mounted to T-bar grid

LISTING/WARRANTY

- NRTL Listed to UL 1574 / CSA C22.2 No. 9.0-96
- One (1) Year Limited Warranty







1. Quality Construction

- ISO 9001
- Rigid aluminum profile
- High quality powder coat finish
- Curved Track Available

2. Oversized Conductors

- For higher operating safety and reduced overload potential
- 3 Circuit Control Allows energy savings: Certain lights can be dimmed or shut off while others illuminate products
- Enhanced merchandising: Attention can be focused on select products

3. 0-10V Conductors

- Used for 0-10V connection

4. Separate Mechanical Suspension Points

- Superior weight bearing capacity
- Integrity of electrical contacts is maintained, preventing arcing and extending the life of fixtures and lamps

5. Raised Ridge

- This track is polarized and therefore direction sensitive, so care must be taken when selecting the connecting pieces
- The raised ridge on one side of the track ensures proper polarity connection

Part Number (Example: ICT4W)

Track Length		Finish	
☐ **ICT4**	(4-Foot Track)	☐ **W**	(White)
☐ **ICT8**	(8-Foot Track)	☐ **B**	(Black)
☐ **ICT12**	(12-Foot Track)	☐ **SV**	(Silver)

SPECIFICATION SHEET I/M-065:18 P-1

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Catalog Information: ICT TRACK SYSTEM - SV

Date: 09/30/2022

Fixture Type:

T1

Pulse Control 0-10V Dimming (120V) Track

Accessories & Mounting Options

JOB NAME		CATALOG NUMBER	
NOTES		TYPE	

Live End Feed Connector
Power feed added to end of track run.
Adds 3 ¼" to the start of a run.

Part Number		Finish	
☐ **ICT301**	(Live End Feed)	☐ **W**	(White)
☐ **ICT301R**	(Reversed Polarity Live End Feed)	☐ **B**	(Black)
		☐ **SV**	(Silver)

Straight Feed Connector
To connect two track sections end-to-end. Can be used as a power feed.

Part Number		Finish	
ICT303	(Straight Feed)	☐ **W**	(White)
		☐ **B**	(Black)
		☐ **SV**	(Silver)

"L" Connector
To connect two track sections in a 90° "L" shape. Can be used as a power feed.

Part Number		Finish	
☐ **ICT306A**	(Inside Polarity)	☐ **W**	(White)
☐ **ICT306B**	(Outside Polarity)	☐ **B**	(Black)
		☐ **SV**	(Silver)

"T" Connector
To connect three track sections in a "T" shape. Can be used as a power feed.

Part Number		Finish	
☐ **ICT304A**	(Inside Left Polarity)	☐ **W**	(White)
☐ **ICT304B**	(Outside Left Polarity)	☐ **B**	(Black)
☐ **ICT305A**	(Inside Right Polarity)	☐ **SV**	(Silver)
☐ **ICT305B**	(Outside Right Polarity)		

"X" Connector
To connect four track sections in a "X" shape. Can be used as a power feed.

Part Number		Finish	
ICT307	("X" Connector)	☐ **W**	(White)
		☐ **B**	(Black)
		☐ **SV**	(Silver)

Linear Coupler Connector
To join two track sections end-to-end.
Adds no length to track run.

Part Number		Finish	
ICT308	(Linear Coupler)	☐ **W**	(White)
		☐ **B**	(Black)
		☐ **SV**	(Silver)

Dead End
Mounts to the end of track section.

Part Number		Finish	
ICT313	(Dead End)	☐ **W**	(White)
		☐ **B**	(Black)
		☐ **SV**	(Silver)

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Catalog Information: ICT TRACK SYSTEM - SV

Date: 09/30/2022
Fixture Type:

T1

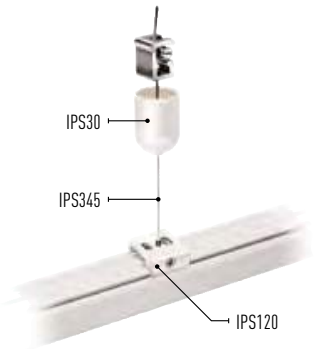
Pulse Control 0-10V Dimming (120V) Track

Accessories & Mounting Options

JOB NAME		CATALOG NUMBER	
NOTES		TYPE	

CABLE MOUNT

Must order ceiling cups, suspension cable and mounting brackets separately.



Ceiling Cup
For cable or threaded rod

- ☐ **IPS30W** (White)
- ☐ **IPS30B** (Black)

Suspension Cable

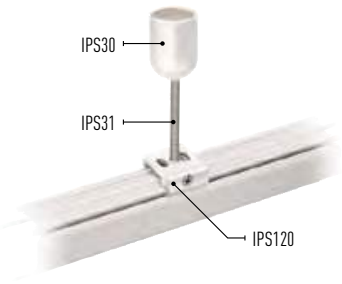
- ☐ **IPS345** (5' Cable)
- ☐ **IPS349** (9' Cable)

Mounting Bracket

- ☐ **IPS120W** (White)
- ☐ **IPS120B** (Black)

THREADED ROD MOUNT

Must order ceiling cups, suspension cable and mounting brackets separately.



Ceiling Cup
For cable or threaded rod

- ☐ **IPS30W** (White)
- ☐ **IPS30B** (Black)

Threaded Rod
Diameter: 1/4" / Length: 6'

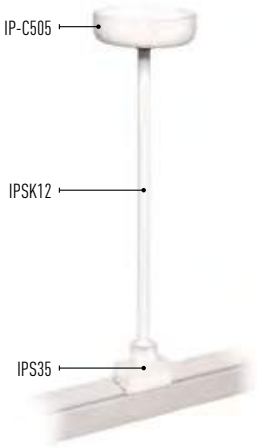
- ☐ **IPS31** 6' Threaded Rod

Mounting Bracket

- ☐ **IPS120W** (White)
- ☐ **IPS120B** (Black)

STEM MOUNT

Must order canopies, stems and stem suspension points separately.



Stem
Stem Diameter: 3/8"

Length		Finish	
☐ **IPSK12**	(12" Stem)	☐ **W**	(White)
☐ **IPSK18**	(18" Stem)	☐ **B**	(Black)
☐ **IPSK24**	(24" Stem)		
☐ **IPSK48**	(48" Stem)		

Canopy
Diameter: 5" / Height: 1 1/2"

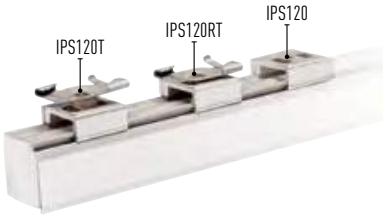
- ☐ **IP-C505-B** (White)
- ☐ **IP-C505-W** (Black)

Stem Suspension Point
Includes bracket and cover. Stem not included.

- ☐ **IPS35B** (White)
- ☐ **IPS35W** (Black)

T-BAR MOUNT

Must order T-Bar clamps and mounting brackets separately.



T-Bar Ceiling Clamp

- ☐ **IPS120TW** (White)
- ☐ **IPS120TB** (Black)

Recessed T-Bar Ceiling Clamp

- ☐ **IPS120RTW** (White)
- ☐ **IPS120RTB** (Black)

Mounting Bracket

- ☐ **IPS120W** (White)
- ☐ **IPS120B** (Black)

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SECTION 265219

EXIT LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exit signs.

B. Related Work:

1. Section 017419 – Construction and Demolition Waste Management Disposal.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 ACTION SUBMITTALS

A. Product Data: For universal exit sign.

1. Include data on features, accessories, and finishes.
2. Include physical description of the unit and dimensions.

B. Product Schedule:

1. For exit signs. Use same designations indicated on Drawings.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.5 APPROVALS/WARRANTY

A. Approvals/Warranty: Life safety NFPA 101, NEC/OSHA. LED Illuminator warranted for 25 years,

PART 2 - PRODUCTS

2.1 EXIT SIGNS

A. General Requirements for Exit Signs: for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Universal Mount LED Die Cast Aluminum Exit Signs:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Lithonia

b. Mcphilban

c. Atlite

2. A fully universal LED Edgelit Exit Sign with a brushed die cast aluminum housing and trim plate. A tapered injection molded acrylic panel hangs from the trim plate. The acrylic panel utilizes an invisible hinge and removable arrows that allow the installer to choose all combinations of surface or recessed mounting including arrow configurations in the field.

3. Operating at nominal voltage of 277 V AC, 60 Hz.

C. LED Illuminator:

1. The LED Illuminator shall consist of 10 bright LEDs at nearly 180 degree emitting angle allowing for even illumination. The LEDs shall be wired in sets of two, insuring that in the unlikely event of a single LED failure, the sign will continue to be illuminated.

D. Electronics:

1. Power consumption: 1.9 watts.

E. Housing:

1. Housing shall be constructed of die cast aluminum with a brushed finish standard. The housing shall include adjustable mounting bars to allow for a flush fit to the ceiling.

2. The housing shall be shipped with mounting bars installed for recessed mounting. Removal of the mounting bar assembly shall configure the housing for surface mounting.

3. The housing shall be shipped with a standard 6” stem for surface, pendant mounting.

4. 3/4” conduit knockouts shall be included in the top and side of the housing.

F. Trim Panel Assembly

1. Trim assembly shall be constructed of die cast aluminum with a brushed finish standard.

2. Trim assembly shall be configurable in the field for recessed ceiling or wall installation, as well as surface mounting.

3. Trim assembly shall attach to the housing using captive, recessed concealed screws to ensure a tight, flush fit to the ceiling.

4. Panel assembly shall be constructed of injection molded acrylic, tapered for a slim appearance.

5. Panel assembly shall consist of 2 halves allowing the installer to choose single or double faced installation in the field.

6. Panel halves shall be held together with an invisible hinge, allowing panel configuration to be changed easily in the field.

7. All panels shall have removable arrows applied in the factory allowing arrows to be removed in the field to achieve all arrow combinations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for conditions affecting performance of signs.

B. Examine roughing-in for sign to verify actual locations of sign and electrical connections before sign installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where signs will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Install signs level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Supports:

1. Provide support for sign without causing deflection of ceiling or wall.

D. Wall-Mounted Sign Support:

1. Do not attach signs directly to gypsum board.

E. Suspended Sign Support:

1. Stem-Mounted, Single-Unit Signs: Support with approved outlet box and accessories that hold stem and provide damping of sign oscillations. Support outlet box vertically to building structure using approved devices.
2. Do not use ceiling grid as support for pendant signs. Connect support wires or rods to building structure.

F. Ceiling Grid Mounted Signs:

1. Secure to any required outlet box.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Sign will be considered defective if it does not pass operation tests and inspections.

3.5 ADJUSTING

A. Adjustments: Within 12 months of date of Substantial Completion, provide on-site visit to do the following:

1. Inspect all signs. Replace signs that are defective.

a. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

END OF SECTION 265219

SECTION 265219

EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exit signs.

B. Related Work:

1. Section 017419 – Construction and Demolition Waste Management Disposal.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 ACTION SUBMITTALS

A. Product Data: For universal exit sign.

1. Include data on features, accessories, and finishes.
2. Include physical description of the unit and dimensions.

B. Product Schedule:

1. For exit signs. Use same designations indicated on Drawings.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.5 APPROVALS/WARRANTY

A. Approvals/Warranty: Life safety NFPA 101, NEC/OSHA. LED Illuminator warranted for 25 years,

PART 2 - PRODUCTS

2.1 EXIT SIGNS

A. General Requirements for Exit Signs: for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Universal Mount LED Die Cast Aluminum Exit Signs:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Lithonia

b. Mcphilban

c. Atlite

2. A fully universal LED Edgelit Exit Sign with a brushed die cast aluminum housing and trim plate. A tapered injection molded acrylic panel hangs from the trim plate. The acrylic panel utilizes an invisible hinge and removable arrows that allow the installer to choose all combinations of surface or recessed mounting including arrow configurations in the field.

3. Operating at nominal voltage of 120 V AC, 60 Hz.

C. LED Illuminator:

1. The LED Illuminator shall consist of 10 bright LEDs at nearly 180 degree emitting angle allowing for even illumination. The LEDs shall be wired in sets of two, insuring that in the unlikely event of a single LED failure, the sign will continue to be illuminated.

D. Electronics:

1. Power consumption: 1.9 watts.

E. Housing:

1. Housing shall be constructed of die cast aluminum with a brushed finish standard. The housing shall include adjustable mounting bars to allow for a flush fit to the ceiling.

2. The housing shall be shipped with mounting bars installed for recessed mounting. Removal of the mounting bar assembly shall configure the housing for surface mounting.

3. The housing shall be shipped with a standard 6” stem for surface, pendant mounting.

4. 3/4” conduit knockouts shall be included in the top and side of the housing.

F. Trim Panel Assembly

1. Trim assembly shall be constructed of die cast aluminum with a brushed finish standard.

2. Trim assembly shall be configurable in the field for recessed ceiling or wall installation, as well as surface mounting.

3. Trim assembly shall attach to the housing using captive, recessed concealed screws to ensure a tight, flush fit to the ceiling.

4. Panel assembly shall be constructed of injection molded acrylic, tapered for a slim appearance.

5. Panel assembly shall consist of 2 halves allowing the installer to choose single or double faced installation in the field.

6. Panel halves shall be held together with an invisible hinge, allowing panel configuration to be changed easily in the field.

7. All panels shall have removable arrows applied in the factory allowing arrows to be removed in the field to achieve all arrow combinations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for conditions affecting performance of signs.

B. Examine roughing-in for sign to verify actual locations of sign and electrical connections before sign installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where signs will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Install signs level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Supports:

1. Provide support for sign without causing deflection of ceiling or wall.

D. Wall-Mounted Sign Support:

1. Do not attach signs directly to gypsum board.

E. Suspended Sign Support:

1. Stem-Mounted, Single-Unit Signs: Support with approved outlet box and accessories that hold stem and provide damping of sign oscillations. Support outlet box vertically to building structure using approved devices.
2. Do not use ceiling grid as support for pendant signs. Connect support wires or rods to building structure.

F. Ceiling Grid Mounted Signs:

1. Secure to any required outlet box.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Sign will be considered defective if it does not pass operation tests and inspections.

3.5 ADJUSTING

A. Adjustments: Within 12 months of date of Substantial Completion, provide on-site visit to do the following:

1. Inspect all signs. Replace signs that are defective.

a. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

END OF SECTION 265219

SECTION 27 41 16

INTEGRATED AUDIOVISUAL SYSTEMS

PART 1 - GENERAL

1.1 SYSTEM DESCRIPTION

A. It is the intent of these specifications to provide a complete working audio visual system ready for the Owner's use. System acceptance shall be judged on the successful adherence to the installation instructions of this Specification.

B. Any item not specifically shown on the drawings or called for in the specifications, but normally required to conform to the intent, are to be considered as part of the Work.

C. Any given item type of equipment or material shall be the product of one manufacturer throughout the facility. Multiple manufacturers of any one item will not be permitted, unless specifically noted otherwise.

D. These specifications are equipment and performance specifications and are considered to be one all-encompassing package with the drawings. Actual installation shall be as engineered by the Contractor with prior approval by the Design Professional.

E. Provide audio visual devices and equipment with performance levels and capacities as noted herein.

1.2 SCOPE OF WORK

A. General: Provide audio visual systems design, engineering, and installation within all phases and spaces of the Renovations to Relocate Admissions for Rehabilitation of Administration project at SUNY Purchase College (SUCF #291036.01). Systems are to include all devices, equipment, installation, programming and commissioning in accordance with requirements of the contract documents and drawings.
   1. The Work detailed within the Contract Documents has been specified to meet certain requirements for performance, appearance, and costs. It shall be the responsibility of the Contractor to implement the guidelines and requirements contained in the Contract Documents and translate them into a complete design package containing all elements necessary for a complete, operational, and functionally integrated Audio Visual System(s).
   2. Provide all work as detailed in the Contract Documents as a turnkey installation including all material, labor, engineering, warranties, taxes, freight, and permits. Only items and requirements specifically stated to be provided by others shall not be a requirement for this Section of the Work.

B. Work Included:
   1. Base AV Work
      a. Low-Voltage cabling and Audiovisual Equipment installation for the following spaces:
         1) Orientation #003

C. Work Specified Elsewhere
   1. Installation of raceway, pull-boxes, floor penetrations, plywood backboards and floor-boxes (provided under electrical Work). Coordination is required within the design to verify the appropriate raceways are in place.
   2. Cutting, patching and painting of walls, unless damaged performing the work described herein.

D. Coordinated Work
   1. Coordinate with related trades to schedule the Work and ensure a complete installation in accordance with the schedule outlined by the Owner.
   2. Installation of support structure. Coordination is required within design to verify size and overall dimensions required.

E. Design Intent
   1. The design intent of the system may require equipment not listed in the attached spreadsheet, but are indicated elsewhere in the contract documents, in either the drawings or the written specification or is required for normal or intended operation of the system. It is the sole responsibility of the Contractor to reconcile the contract documents with the equipment and labor required for this project. In all cases, the most stringent requirements of the contract documents shall be followed.
   2. The Contractor shall research, design and engineer a complete working and turnkey solution. That solution is to be provided with all components of that solution identified inclusive of Manufacturer, Model Number, Quantities (either provided in these documents herein or required for the Contractor proposed solution), itemized costs, associated cut sheets as well as a systems diagram equal to the level of detail of other fully designed systems within this specification.
      a. In this situation, the Contractor is required to submit 3 references of similar size and complexity within the last 3 years in support of the components identified to include Contact Name, Address, Phone Number and detailed description of the system and application.
      b. No claims for additional equipment required will be allowed if the sole reason for such claims is that the equipment was not listed in the attached spreadsheet. It is the sole responsibility of the Contractor to verify the completeness of the proposed solution.

1.3 RELATED DOCUMENTS

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

B. Refer to the following Sections for specifications related to the Work:
   1. Section 26 05 00 – Common Work Results for Electrical
   2. Section 27 05 26 – Grounding and Bonding for Communications Systems

C. Refer to the following Sections for specifications for the Data Network:
   1. Section 27 21 00 – Data Communications
   2. Section 27 21 12 – Data Communications Network Security Appliances
   3. Section 27 21 26 – Data Communications Network Management
   4. Section 27 21 29 – Data Communications Switches

D. Refer to the following standards for performance verification related to the Work:
   1. AVIXA 10-201X, AV Systems Performance Verification

1.4 DOCUMENT ORDER OF PRECEDENCE

A. While it is the Contractor's responsibility to verify the completeness and accuracy of their proposed turnkey solution the following shall serve as general guidance for the order of precedence of any conflicting information.
   1. Specifications (including equipment schedules), TA-700 series drawings
   2. TA Infrastructure Package (TA-000, TA-100 series and TA-600 series)

1.5 RELATED WORK

A. The CM's General Conditions shall be considered part of this Specification. Unless this Section contains statements, which are more definitive or more restrictive than those contained in the Contractor's General Conditions, this Specification shall not be interpreted as waiving or overruling any requirements expressed in the General Conditions.

B. Contractor shall coordinate with CM on raceway/junction box locations for audio visual equipment and routing of audio, video, control, and power cables/raceway from equipment, terminal and pull boxes to system equipment racks. Including but not limited to attending coordination meetings, weekly project meetings, and participating in coordination DWG process.

C. Related Work: Equipment and materials provided and installed by others, unless otherwise shown in this Section or the Drawings, shall include but are not limited to:
   1. Section 26 05 00 – Common Work Results for Electrical
   2. Section 26 05 26 – Grounding and Bonding for Electrical Systems
   3. Section 26 05 29 – Hangers and Supports for Electrical Systems
   4. Section 26 05 33 – Raceway and Boxes for Electrical Systems
   5. Section 26 05 36 – Cable Trays for Electrical Systems
   6. Section 26 09 23 – Lighting Control Devices
   7. Section 26 09 43 – Network Lighting Controls

1.6 DEFINITIONS

A. The following shall serve as general identifiers as specified herein.
   1. Architect – Kliment Halsband Architects (KHA)
   2. Consultant – Shen Milsom & Wilke LLC (SMW).
   3. Contractor – The Contractor is the firm submitting a proposal to furnish and install the Work as defined within this Specification.
   4. Project – The Project is the Audiovisual Systems installation for SUNY Purchase College.
   5. Work – The term "Work" means all construction and services specified within this document. The Work includes all related labor, materials, equipment, and services provided, or to be provided, by the Contractor to fulfill the proposal's obligations.
   6. Drawings – The term "Drawings" means all Audio Visual Systems, Architectural, Electrical Drawings and associated sketches, details, riser diagrams, relative to this project.

B. As used in the Drawings and Specifications for the Work, certain non-technical words and phrases shall be understood to have specific meanings as follows, regardless of indications to the contrary in the General Conditions or other documents governing the Work.
   1. "Furnish" – Purchase and deliver to the project site complete with every necessary appurtenance and support, all as part of the Audio Visual Systems Work. Purchasing shall include payment of all sales taxes and other surcharges as may be required to assure that purchased items are free of all liens, claims, or encumbrances.
   2. "Install" – Unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project, all as part of the Work.
   3. "New" – Manufactured within the past year and never before used.
   4. "Provide" – Furnish and Install.

C. Regardless of their usage in codes or other industry standards, certain words or phrases as used in the Drawings or Specifications for the Work, shall be understood to have the specific meanings as ascribed to them in the following list:
   1. "Circuit" – Any specific run of circuitry
   2. "Circuitry" – Any Work which consists of wires, cables, raceways, and/or specialty wiring method assemblies complete with associated junction boxes, pull boxes, outlet boxes, joints, couplings, splices, and connections except where limited to a lesser meaning by specific description.
   3. "Concealed" (as applied to circuitry) – Covered completely by building materials, except for penetrations (by boxes and fittings) to a level flush with the surface as necessitated by functional or specified accessibility requirements.
   4. "Exposed" (as applied to circuitry) – Not covered in any way by building materials.
   5. "Normal Work Conditions" – Locations within building confines that are not damp, wet, or hazardous and that are not used for air handling.
   6. "Patch Panel" – A System of terminal blocks, patch cords, and backboards that facilitate administration of cross-connecting cables.
   7. "Raceway" – Any pipe, duct, extended enclosure, or conduit (as specified for a particular System) which is used to contain wires and which is of such nature as to require that the wires be installed by a "pulling in" procedure.

8. "Riser" – Shall refer to the portion of the installation that transmits between building floors (or between Audio Visual Systems rooms), also referred to as "Backbone Cabling".
9. "AV System(s)" – Audio Visual System(s), includes all components contained herein that work in conjunction to create and completely integrated and fully functioning system as described within the Drawings and Specifications
10. "Audio Visual Systems Wiring" – see "Circuitry"
11. "Audio Visual Systems Work" – See "Scope of Work"
12. "Standard" (as applied to wiring devices) – Not of a separately designated individual type.
13. "Subject to Mechanical Damage" – Exposed within 2,200 mm of the floor in mechanical rooms, manufacturing spaces, vehicular spaces, or other spaces where heavy items are moved around or rigged as a common practice or as required for replacement purposes.
14. "System" – See "AV Systems"
15. "Wiring" – see "Circuitry"

D. Where the word "conduit" is used without specific reference to type, it shall be understood to mean "raceway".

E. Reference to "U.L. (Materials Construction) Standards" shall mean the "Standards for Safety" published by Underwriters Laboratories, Inc.

1.7 REFERENCES

A. The Audio Visual Systems shall be installed in accordance with the latest applicable revisions pertaining to all applicable national, state, and local codes and standards including, but not limited to the following:
   1. Local Governing Authorities Having Jurisdiction
   2. Any portion of the audiovisual work not subject to the requirements of an electrical code published by a specific authority having jurisdiction over such work shall be governed by the National Electrical Code and any and all applicable sections of the National Fire code, as published by the National Fire Protection Association.
   3. Installation procedures, methods and conditions shall be in compliance with the latest requirements of the Federal Occupational Safety and Health Administration (OSHA), the Americans with Disabilities Act (ADA) and the Architectural Barriers Act (ABA).
   4. The Contractor is responsible for all costs incurred to meet these codes and conditions.
   5. Additional codes and requirements pertaining to the work:
      a. NFPA-72 National Fire Alarm and Signaling Code
      b. Current National (NEC) and Local Electric Codes
      c. IEC 60268-16 Third Edition 2003-05 Objective rating of speech intelligibility
      d. ANSI/AVIXA
         1) 10:2013 Audiovisual Systems Performance Verification
         2) 1M:2009 Audio Coverage Uniformity Standard in Enclosed Listener Areas
         3) 2M:2010 Standard Guide for Audiovisual Systems Design and Coordination
         4) 3M:2011 Projected Image System Contrast Ratio

5) X3T9.5 FDDI
6) X3T9.5 CDDI

e. Sustainable Technology Environments Program
f. Underwriters Laboratories, Inc. (UL)
g. Society of Motion Picture and Television Engineers (SMPTE)
h. Building Industry Consulting Service International (BICSI) Telecommunications Distribution Methods Manual - latest edition.
i. ANSI/TIA/EIA-568-B - Commercial Building Telecommunications Cabling Standard
j. ANSI/TIA/EIA-569 - Commercial Building Standards for Telecommunications Pathways and Spaces
k. ANSI/TIA/EIA-606-A. Administration Standard for Commercial Telecommunications Infrastructure
l. TIA-607-A, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
m. EIA RS-232 Serial Communications Electrical Interface
n. EIA RS-310-C Racks, Panels and Associated Equipment
o. FCC Part 15
p. FCC Part 68
q. IEEE 802.3
r. IEEE 802.5
s. Article 770 Optical Fiber Cables
t. Article 800 Communications Circuits
u. NFPA 70 National Electrical Code
v. NFPA 75 Protection of Electronic Computer / Data Processing Equipment
w. United States Green Building Council (USGBC): Leadership in Energy & Environmental Design(LEED®): Green Building Rating System for New Construction & Major Renovations (NC) Version 3.0 (2009) www.usgbc.org.

1.8 CONTRACTOR'S GENERAL CONDITIONS

A. The Contractor represents that they are familiar with, and have expertise in the Work of this nature and scope. The Contractor further agrees that they shall provide all Work as may be required to make a complete job of that which may not be fully defined in the Contract Documents.

B. The Contractor shall comply with all of the regulations, including all security and safety regulations of national, city, local and other government agencies having jurisdiction concerning the work of the Contractor. The Contractor shall give all notices and comply with all laws, ordinances, codes, rules, and regulations bearing on the conduct of the Work. If the Contractor performs any work, which is contrary to such laws, ordinances, codes, rules and regulations, they shall make all changes for compliance and bear all associated costs.

C. The Contractor shall be responsible to provide and maintain a storage facility. If this storage facility is required to be on-site it shall be the Contractor's responsibility to coordinate the size and spatial requirements with the Owner and CM. The Contractor shall assume full responsibility for the storage facility and all contents, unless otherwise indicated by the Owner.

D. The Contractor shall provide all protection necessary to safeguard their work from damage by their operations and the operations of others. Unless the Contractor proves to the Owner's satisfaction that the Work has been damaged by others, the Contractor shall promptly repair, adjust, and clean all defective installations and bear all associated costs.

E. All of the Contractor's work shall be tested and inspected by all authorities having jurisdiction and in accordance with all Specifications. The Contractor shall coordinate and cooperate fully and shall provide at no additional cost to the Owner, manpower, blueprints, facilities, scaffolds, etc. to reasonably assist the inspectors.

F. The project documentation is, in general, diagrammatic and/or developed to communicate design intent. The Contractor shall coordinate the installation of all devices and/or equipment with the Owner and CM prior to installation based on the existing field conditions.

G. The Contractor shall examine the site and the Contract Documents and review with the Owner and CM the designated areas of access, delivery, and storage for the Contractor's use. The Contractor agrees that such areas are satisfactory and sufficient for their needs in the completion of their work and in conformance with the terms of this Contract.

H. The Owner reserves the right to furnish any materials necessary for the Project.

I. All permits required for any part of the Contractor's work shall be procured and paid for by the Contractor. The Contractor shall determine all permits required and transmit this information to the CM.

J. The Owner shall provide to the Contractor AutoCAD backgrounds for all required floor plans for the facility. All pre-fabrication and record drawings required for the Project and as stated herein, shall be completed within the latest version of AutoCAD.

K. The Contractor, upon receiving notice from Owner that the Contractor has furnished inferior, improper or unsound work or materials (including equipment), or work or materials at variance with that which is specified, will, within 24 hours, proceed to remove such work or materials and make good all other work or materials damaged thereby, and, at the option of the Owner, the Contractor shall immediately replace such work or materials with work or materials as specified. The removal, replacement, and repair shall be performed at such times and with manpower sufficient, in the judgment of the Owner, so as to avoid disturbance to occupants, or other ongoing work for the Project.

1. If the Contractor does not remove such unsound Work within a reasonable time, the Owner may remove it and may store the material at the expense of the Contractor. If the Contractor does not pay the expenses of such removal within ten (10) days' time thereafter, the Owner may, upon written notice, sell such materials at auction or at private sale and shall account for the net proceeds thereof, after deducting all the costs and expenses that should have been borne by the Contractor and all expenses of the sale.
2. The Owner shall have the authority at all times, until final completion and acceptance of the Work, to inspect and reject work and materials which in its judgment are not in conformity with the Drawings and Details, Room Data Sheets and Specifications, and

its decision in regard to character and value of Work shall be final and conclusive on both contracting parties. If the Owner permits said Work or materials to remain, the Owner shall be allowed the difference in value or shall at its election have the right to have said Work or materials repaired or replaced, as well as the damage caused thereby, at the expense of the Contractor, at any time within one (1) year after the completion of the entire project, or within such longer period as may be covered by any guaranty; and neither payments made to the Contractor, nor any other acts of the Owner, shall be construed as evidence of acceptance, waiver, or estoppels.

3. Any expense incurred by the Owner in connection with the foregoing, shall be borne by the Contractor, and the Owner may withhold money due to the Contractor or recover money already paid to the Contractor, to the extent of such expense.

L. It shall be understood that the Room Data Sheets, Specifications and Drawings are complementary. Where there are conflicts within the documents, the overall design intent shall govern.

M. To the extent that they govern the Work, the contract documents, Specifications and Drawings also govern change order Work, if any.

N. The Drawings for the Work utilize symbols and schematic diagrams that have no dimensional significance. The Work shall be installed to fulfill the diagrammatic intent expressed on the Drawings, field layouts, and shop drawings of all trades.

O. Certain details appear on the Drawings for the Work that are specified with regard to the dimensioning and positioning of the Work. These are intended only for general information purposes. They do not obviate field coordination for individual items of the indicated Work.

P. Information as to general construction and architectural general construction and architectural features and finishes shall be derived from the structural and architectural drawings and specifications, and may require ongoing coordination with the Architect and CM.

Q. Ratings of devices, materials, and equipment specified without reference to specific performance criteria shall be understood to be nominal or nameplate ratings established by means of industry standard procedures.

R. It is the intent of the Drawings and Specifications to provide complete operating Audio Visual Systems. All Work necessary to provide such a System shall be performed. Any discrepancies shall be brought to the Consultant's attention.

S. The Work called for under this Contract shall be coordinated with the Work of other trades and Owner functions as to not delay the overall progress of the construction project. The Contractor is responsible for all coordination of the Work with other trades.

T. Include in the Work all necessary supervision and issuing of all coordination information to any other trades who are supplying work to accommodate the Audio Visual Systems installation.

U. For items of equipment which are to be installed but not purchased as part of the Work, the Work shall include:

1. Coordination of delivery
2. Mounting in rack, mounting hardware and AV connection(s) as specified
3. Upon receipt, the Contractor is responsible for confirmation and validation for conformance with performance criteria of all equipment provided by others.

V. Items which are to be installed, but not purchased as part of the Work shall be carefully examined upon delivery to the project. Claims that any of these items have been received in such condition that their installation will require procedures beyond the reasonable scope of the Work will be considered only if presented in writing within one (1) week of the date of delivery to the project of the items in question. The Work includes all procedures necessary to put in satisfactory operation all items for which no claims have been submitted as outlined above.

1.9 PROJECT MANAGEMENT

A. The Contractor shall provide a Project Manager to oversee and coordinate all activities on the Project

B. Project Manager's Duties and Responsibilities:
   1. The Contractor shall provide to the Owner, as a part of the prefabrication submittal, the name of the Project Manager that will provide all duties and responsibilities as specified herein, during the term of the project.
   2. The Project Manager shall maintain the ability of making all managerial decisions on behalf of the Contractor on a day-to-day basis, and shall retain the authority of accepting notices of deduction, inspection reports, payment schedules and any other project related correspondence on behalf of the owner.
   3. The Project Manager shall schedule and attend project management meetings, during which time all System related issues are discussed, scheduled, confirmed, and/or resolved.
   4. The Project Manager shall be available during normal business hours (0800 hours to 1700 hours) within two (2) hours by telephone during the term of the project.
      a. After normal business hours, the Project Manager shall be available within four (4) hours by telephone during the term of the project.
      b. In the event that the Project Manager is not available within the allotted time frame, the Contractor may designate another employee to temporarily act as the Project Manager in all correspondence with the Owner.
      c. The Contractor shall ensure that any individual temporarily assuming the duties of the Project Manager is at equal or higher level in the Contractor's managerial chain of command.
   5. Upon notification by the Owner, of any project related installation issue, or issue that may contradict the Specifications as stated herein, the Project Manager shall respond to such issue, verbally and/or in writing within an eight (8) hour period
      a. Responses to such issues as stated above shall include a clear understanding of the issue, along with a tentative plan of action, reflecting milestones and/or deadlines to resolve the issue.

b. Where appropriate, based on the overall importance of the project issue, the Project Manager shall follow-up their initial response with a written response to the issue within 24 hours of identification of the issue.

6. As the System installation progresses, the Project Manager shall be capable of discussing any/or all of the above mentioned items at the request of the Owner, and shall address each item, as it relates to the current status of the Work.

1.10 SUBMITTALS

A. Furnish submittals in accordance with general requirements specified in Division 1, and CM/General Contractor's submittal procedures

1. All submissions are to be processed via the CM/General Contractor and then forwarded to the A/E team for tracking and response purposes

B. SCHEDULE SUBMITTAL

1. On a PER ROOM BASIS and prior to the initiation of the Work, the Project Manager shall submit a schedule reflecting key milestones of the Work, including but not limited to the following:
   a. Contract award
   b. Kick-off meeting
   c. Prefabrication submittal
   d. Ordering, delivery, and installation
   e. Shop Fabrication
   f. Shop Acceptance Testing
   g. Equipment delivery to Site
   h. Project management schedule
   i. Payment schedule
   j. Site Installation Schedule inclusive of Hardware and Software
   k. Systems training
   l. Delivery of As-Built documentation
   m. Delivery of Operations & Maintenance Manuals
   n. Final System test
   o. Acceptance of System
2. The Project Manager shall coordinate the schedule with overall project milestone dates as set by owner and CM. The Project Manager shall update the schedule on a weekly basis to reflect the status of each key milestone as the Work progresses.

C. Prefabrication Submittals

1. Submit pre-fabrication submittals in accordance with the Owner's construction schedule.
2. Pre-fabrication submittals shall consist of product data, shop drawings, samples, furniture modifications, and a detailed completion schedule. Partial submittals will not be accepted without prior written approval from the Architect.
3. Pre-fabrication submittals shall be furnished in electronic formats as defined by the General Conditions under Part 1 of the Project Specifications.

4. No portion of the Work shall commence nor shall any equipment be procured until the Architect has approved the pre-fabrication submittals in writing.
5. A letter of transmittal identifying the name of the Project, Contractor's name, date submitted for review, shall accompany pre-fabrication submittals and a list of items transmitted.

D. Product data required as part of the pre-fabrication submittal shall include the following:
1. Submit manufacturer's product data sheets for all materials and equipment proposed for use on the project sorted by room and indexed.
2. Submit manufacturer's product data sheets for all fire stopping materials proposed for use on the project.
3. Equipment schedules listing all System components, manufacturer, model number and the quantity of each
4. General functional descriptions for each System
5. Manufacturer's data specification sheets for all System components, including any warranty information.
    a. Mark each product data sheet to show applicable choices and options (sheets containing more than one device or component model number shall be clearly marked to delineate items included in the Work)
    b. Manufacturer's Data: For each manufactured device submit manufacturers' specifications and print photograph of the proposed device. Include engineering descriptions, principle of operation, application, and proposed model, style or size clearly indicated.
6. A complete list of cable and wiring types, sizes, manufacturer, and model number
7. A complete list of finishes and sample graphics, including custom art work and custom graphics (if applicable)
8. List of parts inventory to provide manufacturer recommended service and maintenance of the Work

E. Shop Drawings shall include the following:
1. Detailed plan views and elevations of AV Control and/or Head-end rooms (in addition to relevant telecommunications rooms) showing raceway, sleeves, cable tray, cable paths, equipment racks, equipment cabinets, termination blocks, power receptacles and grounding bus bars.
2. Drawings to show evidence of coordination with other trades.
3. Cable run sheets denoting cable type, signal type, termination type, cable number designation, start point and end point.
4. Cable termination schedules showing cable transmission and device location. Provide schedules in printed and electronic format.
5. Floor plan drawings indicating device locations with device legends
6. System riser diagram with all devices, wire runs, and wire designations
7. Schematic block diagrams for each System showing all equipment, interconnects, data flow, etc.
8. Wiring diagrams for each subsystem defining the interconnection of all inputs and outputs for all equipment.
9. Fabrication shop drawings for all custom equipment (if applicable)

10. Plans and elevations of the Audiovisual equipment racks and/or custom furniture (including consoles, desks, and lecterns) quantifying all equipment to be mounted therein for review and approval by Owner.
11. The Contractor shall submit samples of any equipment components upon request of the Owner.
12. Samples submitted shall be the latest version of equipment.
13. It is the responsibility of the Contractor to confirm all dimensions, quantities, and the coordination of materials and products supplied by the Contractor with other trades. Approval of shop drawings containing errors does not relieve the Contractor from making corrections at their expense.

F. Record Documentation shall include all information required in the Pre-fabrication Submittals but revised to reflect "as installed" conditions.
   1. General Description and Requirements
      a. Submit Record Documentation in accordance with the CM's construction schedule.
      b. Record Documentation shall consist of Record Drawings and Operation and Maintenance Manuals.
      c. Provide a letter of transmittal with Record Documentation identifying the name of the Project, Contractor's name, date submitted for review, and a list of items transmitted.
      d. Prior to the final acceptance of the Work, submit two draft sets of the Record Drawings portion of Record Documentation to the Architect. The draft copy shall be used during the final acceptance testing by the Architect.
      e. Update all record documentation to reflect changes or modifications made during final acceptance testing as required and submit three blue/black lines and one reproducible set.
      f. Provide cable test results for all cables installed under this Work, tested and documented as described herein.
      g. Provide Owner with Operation and Maintenance Manuals including wiring diagrams, parts lists, shop drawings and manufacturers' information on all equipment and cables provided by the Contractor. Manuals shall be provided in a high quality, 3-ring binder and completely indexed.
      h. Provide Owner with all systems programming on electronic media. All programming and source code is to be considered as a work for hire and will be the property of the Owner upon completion of the project.
   2. Record Drawings
      a. Produce all Record "as-built" Drawings using the latest version of AutoCAD. Record drawings shall, at a minimum, include the following:
         1) Floor plan drawings indicating device locations, with device legends indicating manufacturers and model numbers for each device
         2) Floor plan drawings indicating wire routing, wire routing shall be delineated in straight line runs and be tagged with cable identification and terminal strip numbers to coincide with the installation
         3) Mounting details for all equipment and hardware
         4) Functional block diagrams for each subsystem
         5) Wiring details showing rack elevations, equipment wiring and terminations, and inter-rack wiring.

6) Wiring diagrams for all custom circuitry including interfaces to various control output controlled devices, lighting control interfaces, projection screens, operable window treatments, motorized doors/partitions, etc.
7) Wiring diagrams for each System, wiring diagrams shall be identical to those laminated and located within the door of the equipment room where the subject equipment racks are located.
8) Typical point-to-point wiring diagrams for each piece of equipment and groups of equipment within the System
9) Layout details for each riser location, including Audiovisual panels, power supplies, junction boxes, conduit, and any other Audiovisual related equipment.

3. Operation and Maintenance Manuals
   a. Operation and Maintenance Manuals shall apply to all Audio Visual related devices, equipment and software modules.
   b. Operation and Maintenance Manuals shall be formatted as follows:
      1) Electronic PDF binder
      2) Provide a table of contents and tabulated sheets for each manual.
      3) Any hardware manual demonstrating more than one model number of device on any one page shall be clearly marked as to delineate which model has been implemented in the Work.
   c. Operation and Maintenance Manuals shall include, at a minimum, electronic copies of the following:
      1) Operational description of each subsystem
      2) Detailed programming descriptions for each subsystem
      3) Explanations of subsystem interrelationships
      4) Electrical schematics for each piece of equipment specified.
      5) Power-up and power-down procedures for each subsystem
      6) Description of all diagnostic procedures
      7) A menu tree for each subsystem
      8) Setup procedures for each component of the subsystems
      9) A list of manufacturers, their local representatives, and subContractors that have performed Work on the Project
      10) Installation and service manuals for each piece of equipment
      11) Maintenance schedules for all installed components
   d. Operation and Maintenance Manuals shall include a separate section for each software program incorporated into the Project. The software section shall include, at a minimum, electronic copies of the following information:
      1) Definitions of all software related terms and functions
      2) Description of required sequences
      3) Directory of all disk files
      4) Description of all communications protocols, including data formats, command characters, and a sample of each type of data transfer
      5) Instructions for manufacturer supplied report generation.
      6) Instructions for custom report generation
      7) Database format and data entry requirements

G. Procedure for Resubmitting
   1. Make corrections or changes in O & M and/or Record Drawings as required by the Architect and resubmit when the Architect's stamp requires re-submittal.
   2. Clearly identify changes made other than those specifically requested by the Architect when resubmitting Record Drawings. Changes shall be clouded or similarly highlighted as coordinated with the Architect. Only changes that have been specifically requested by the Architect or have been clouded by the Contractor will be reviewed on resubmittals.
   3. Any drawing sheets added to the resubmittal shall be clearly identified and clouded, and shall not change the sheet numbering scheme for previously issued Record Drawings.
   4. The Contractor shall be responsible for any delays caused by the re-submittal process.
   5. Re-submittal Review Fees
      a. If the Architect rejects the Contractor's Record Submittal (Rejected, Revise, and Resubmit) more than two times, the Architect will be compensated for all subsequent reviews, whether partial or comprehensive. The amount of such compensation will be incorporated by Change Order and withheld from the Contractor's Application for Payment.

H. Status Reports
   1. After the award of contract, the Contractor is responsible for providing weekly status reports outlining his progress on the project. These reports should include information on the work completed during the week, the work to be completed during the upcoming week and any potential scheduling issues. The following should be included in this Status Report:
   2. Expected date of project submittals, including equipment cut sheets, shop drawings, control system interface designs, etc.
   3. Anticipated completion date and percentage complete of in-house rack fabrication and testing, prior to shipping to the job-site.
   4. Anticipated completion date and percentage complete of control system programming, prior to shipping to the job-site.
   5. Schedule and percentage complete of on-site wiring and supervision.
   6. Schedule and percentage complete of on-site installation.
   7. Schedule for owner training.
   8. Schedule for systems checkout and turnover to the Owner.

1.11 QUALITY ASSURANCE

A. Installer Training Process: – Contractor's labor force shall have certified installers who attended training programs of the proposed system preparing them to perform the work.

B. The Installer for this Project is to be certified by all manufacturers of the installed equipment that the Contractor proposes.

C. Registered and Certified supervisors- Contractor must have all supervisory personnel certified for the type of work they are overseeing (installation and design) from AVIXA International (CTS-I/D)

D. Registered and Certified Network Engineers – Contractor must have a Senior Network Engineer assigned to the project as a Key Personnel with the following certifications:
   1. Cisco CCIE
   2. Cisco CCNA

E. Quality assurances for audio visual systems includes a multi-step program consisting of pre-qualification procedure for manufacturers and installation specialists; products phase; installation; operating instruction and training; and the submission of maintenance and operating manuals.

F. The Contractor shall have local in-house engineering and project management capabilities consistent with the requirements of the Work.

G. The Contractor certifies they are qualified in all areas pertaining to, directly or indirectly, the Work. In the event the Contractor becomes unable to complete the Work in accordance with the Contract Documents, or the satisfaction of the Owner, it shall be the responsibility of the Contractor to retain the services of applicable manufacturers' representatives to expeditiously complete the Work in accordance with the Owner's construction schedule with no additional cost to the Owner.

H. The Contractor shall provide factory-certified technicians to install, commission, and maintain the Work. All installing personnel shall be licensed as required by local and/or state jurisdictions.

I. The Contractor shall ensure compliance with, and have a thorough understanding of, all local codes and contract conditions pertaining to this Project.

J. The Contractor shall maintain an inventory of spare parts and other items critical to System operation and as necessary to meet the emergency service requirements of this Project.

K. Product Standards
   1. All equipment and materials for contained herein shall be the products of recognized manufacturers and shall be new.
   2. New equipment and materials shall:
      a. Be Underwriters Laboratories, Inc. (U.L.) listed and approved where specifically called for; or where normally subject to such U.L. labeling and/or listing services.
      b. Be without blemish or defect.
      c. Be products that meet with the acceptance of the agency inspecting the Audio Visual Systems work.
      d. Any product not specified in the Specification must be submitted to the Owner and Consultant for review and approval prior to deployment.
   3. It is the intent of these specifications that wherever a manufacturer of a product is specified, and the terms "other approved" or "approved equal" are used, the substituted item must conform in all respects to the specified item. Consideration will

not be given to claims that the substituted item meets the performance requirements with lesser construction. Performance as delineated in schedules and in the specifications shall be interpreted as minimum performance.

4. The approval of shop drawings, or other information submitted in accordance with the requirements hereinbefore specified, does not ensure that the Audiovisual Consultant, Architect, or the Owner attests to the dimensional accuracy, dimensional suitability of the material, or mechanical performance of equipment. Approval of shop drawings does not invalidate the Drawings and Specifications.

1.12 USER TRAINING

A. The Contractor shall provide on-the-job training by a suitably qualified instructor, to personnel designated by the Owner, to instruct them in the operation and maintenance of the systems. In the event the Contractor does not have qualified instructors on staff for certain sophisticated equipment, the Contractor will provide a manufacturer's representative for such instruction to the owner at no additional cost. All training shall take place after the systems are operational and accepted.

1. There shall be a minimum of (12) hours of end-user training. Specific durations and completion dates of these trainings are at the sole discretion of the Owner.
2. The Contractor shall provide all required training materials, inclusive of all subContractor training requirements, to the Owner (30) days prior to any scheduled training.
3. The Contractor shall provide the Owner with a consolidated training manual inclusive of all subContractor trainings no later than (90) days after successful completion of all trainings.
4. The Owner is to retain 10% of contract fee until completion and delivery of all training deliverables.

1.13 PUBLICATION

A. No information relative to the project or work, whether covered in this specification or otherwise may be released for publication.

1.14 INFORMATION TO BE SUBMITTED

A. Contractor Qualifications

1. Contractor shall document a minimum of fifteen (15) years' experience in the fabrication, assembly, and installation of Systems of similar technology (note that the project as defined within this document is more than a videowall and processor, therefore references are to be inclusive of the various audio, video and control technologies), complexity and size as the project specified herein. The documentation submitted shall include 3 verifiable references of projects within the last 3 years. Specific information to be provided shall be:
    a. Technical overview and description of the project. Please identify any specific challenges or project hi-lights.

1) Display Manufacturer
2) Processor Manufacturer
3) Audio Distribution
4) Control System

b. Location
c. Owner (inclusive of contact information)
d. Construction Manager (inclusive of contact information)
e. Audiovisual Consultant (inclusive of contact information)
f. Date of Project initiation
g. Date of Project Completion
h. Contract Value (Contractors Value)
i. Is there a Service Contract in place? Duration?
j. Current relationship with owner/users

B. Equipment Costs

1. Detailed lists of all equipment to be supplied shall be submitted. Each piece of equipment shall be individually priced. An itemized listing is provided in Appendix A, Audiovisual Bill of Materials attached to this specification. Copies of these lists shall be used, with the appropriate price information added.
2. In the event that the equipment list spreadsheet is made available electronically, Shen Milsom & Wilke, LLC. is not responsible for any formulas that may be resident in the spreadsheet. The results of any calculations in the spreadsheet are the sole responsibility of the Contractor.
3. Equipment costs shall reflect all required modifications and accessories. All substitutions for specified equipment shall be listed and individually priced on a separate page.
4. Itemized equipment pricing submitted shall also represent unit pricing for components should additions to systems requirements change.
5. Equipment totals from each equipment list shall be entered in the Master Recapitulation of Costs form.
6. Non-Equipment Costs. Non-equipment costs shall be furnished separately on the Master Recapitulation of Costs form. These non-equipment costs shall be detailed for each of the following categories:
7. Engineering: Including all required designs, drawings, run sheets, instruction manuals, etc.
8. Pre-installation: Including all fabrication, modification, assembly, rack wiring, etc., performed on the Contractor's premises.
9. Installation: Including all on-site installation and wiring, coordination and supervision, testing, checkout, Owner training, etc. performed on the Owner's premises.
10. General and Administrative: Including all G&A expenses, shipping, insurance, and guarantees.
11. Taxes (if any are applicable).

1.15 PROJECT TEAM KEY PERSONNEL

A. Resumes of key personnel. Resumes must reflect skills relating to audio, video, teleconferencing (audio and video), networked audio, networked video, videowalls, videowall processors, control centers, mission critical facilities integrated control systems, programming, project management, etc. Resumes must be submitted for those individuals who will actually be assigned to this project and must include all training background information and certificates. Upon award of contract, those personnel assigned to the project may NOT be changed without the written approval of the Owner and Consultant. Resumes for the following Key Personnel must be submitted:
   1. Project Manager
   2. Senior AV Engineer
   3. Senior Network Engineer
   4. Lead Field Technician

B. Key Personnel workload during the duration of the entire project shall be identified.

1.16 ADMINISTRATIVE/STAFFING:

A. Describe your companies administrative organizational structure, including:
   1. Number of years in business.
   2. Core business
   3. Staff/headcount
      a. Locations of all staffed and operational offices complete with the number of technical support personnel in each office and geographic area of coverage.
      b. Identify area of servicing expertise by staff member inclusive of all relevant manufacturer training and certifications.
      c. Identify the nearest service facility to this installation site and describe how you approach field service requests. Consider a requirement for an emergency 4 hour on-site response time as well as normal field service requests.

B. Sub-Contracting/Teaming
   1. The Contractor must state if they intend to utilize a subContractor in a *systems servicing support role* and provide said subContractor's name and address and technical qualifications as noted above. The subContractor shall comply with all the same rules, regulations, laws and codes, licenses, etc. as required by the Contractor and as specified herein. The Owner reserves the right to approve or disapprove any subContractor proposed by Contractor.
   2. If the Contractor proposes to subcontract any portion of the *system installation work*, any such subContractors shall be clearly identified and their responsibilities and qualifications detailed. Any and all work performed by a subContractor shall be considered fully as part of the primary Contractor's contract and responsibility.
   3. For each proposed subContractor, at least three client references, with contact names and phone numbers, for comparable projects accomplished by those subContractors.
   4. If it is the intent of the Contractor to "team" with one or more additional Contractors, then this must be clearly stated and so identified. The Contractor shall be considered

as the "prime" with respect to these circumstances, and will assume and accept full responsibility for the performance of all members of the "team," including themselves and all other subContractors engaged in the performance of the contract.

5. Work specified herein shall be the responsibility of a single Contractor with a minimum of fifteen (15) years' experience in the fabrication, assembly, and installation of Systems of similar complexity as specified herein. The Systems are defined as combination of audio, video, AV control, systems programming (of AV devices) and network interface which are to encompass all system types as specified in this document The documentation shall include the names, locations, points of contact and DETAILED descriptions for at least three (3) installations of the type and complexity specified herein.
6. The Contractor warrants that both they and their subContractors are licensed as required by the authorities having jurisdiction and as required by local ordinances.

C. User Serviceability & Service Training
   1. Define and identify specifically what equipment and equipment components can be field repaired/replaced by the users and at what level of manufacturer provided training is required.
   2. The Contractor should provide a list of recommend spares and quantities, providing part numbers and unit costs as appropriate for all critical components and Sub-Systems

Work Included:

3. Prime Contractor
   a. This includes the furnishing and installing of all systems required for the successful implementation of the systems as described throughout this document and not identified as being provided by others or by one of the required subContractors.
   b. Project management of all required subContractors to satisfy the successful implementation of all systems.
   c. Coordination and delivery of a complete and integrated as-builts, operation and maintenance manuals, and Owner training including all professional produced materials and training videos.
   d. Upon project completion all Programming Code is to be provided to the User.
   e. Certification Requirements:
      1) AVIXA Certified Audiovisual Solutions Provider
         a) Emerald or Diamond
      2) Manufacturer specific certification for all proposed systems including but not limited to
         a) Audio Systems
            (1) Biamp Tesira
            (2) DANTE
            (3) SynAudCon
            (4) Or equivalent of proposed alternates.
         b) Video Systems
            (1) Epson
            (2) Crestron
         c) Control Systems
            (1) Crestron Master Programmer GOLD or better

(2) Or equivalent of proposed alternate

1.17 EXCEPTIONS AND PROPOSED MODIFICATIONS

A. Within the Specification, certain manufacturers have been listed with specific intent.

B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

C. Should the Contractor wish to propose recommendations that will enhance the performance of the audiovisual system(s), or reduce costs without loss of performance, such comments shall be made in the proposal. All suggestions that are of value to the Owner shall be taken into consideration and evaluated. All such proposals shall be made as "alternate(s)", with the appropriate cost modifications clearly shown separate and apart from the costs of the system "as specified."

D. Any and all exceptions to specifications, related drawings, general conditions and terms & conditions must be made with the AV systems proposal. In the absence of exceptions, these specifications and related drawings shall be binding in letter and intent upon the Contractor. It is further required, and the Owner shall expressly rely on the fact, that the Contractor has examined all designs and specifications in detail and is prepared to accept full responsibility for the performance of the complete system installation as designed and specified. It is further required, and the Owner shall expressly rely on the fact, that the Contractor has reviewed and accepted current site conditions.

PART 2 - PRODUCTS

2.1 DETAILED SPECIFICATIONS

A. ORIENTATION ROOM #003

The Orientation Room will be where presentations to new and prospective students will be conducted. The main display will be a large roll-down projection screen on the front wall. An ultra-short throw projector will show images for the presentation from a laptop PC or a mini OFE desktop PC from the Lectern. Wireless connection to the display will also be available for laptop PCs and BYOD devices. Program speakers on each side of the projection screen will play back the program audio from the presentation. A gooseneck microphone at the Lectern and wireless microphone system will be used for voice reinforcement. A touch panel at the Lectern will be available for audiovisual system control.

1. System Interconnection & Functional Description
   a. The functional interconnections of the audio, video and control systems shall be as detailed on drawing #TA-700

b. The Contractor shall provide all interconnection cable, connectors, terminal strips, wireways, flexible conduit, etc., to facilitate the audiovisual systems as detailed within these specifications and drawings.
c. The conduit and power systems are detailed in the Electrical Engineer's drawings.

2. Display and Video
   a. Provide and integrate an projector, presentation switchers, interfaces and cabling as detailed on the drawings and as described in this specification.
   b. Provide, install and integrate a Presentation Switcher to allow laptop PC signals from the Lectern to pass to the projection system. Provide, install and integrate all required transmitter/receiver devices (at the displays and walls) to operate in tandem with the switcher.
      1) Presentation Switcher

         Basis-of-Design Product: Subject to compliance with requirements, provide a Presentation Switcher Crestron DMPS3-4K-100-C or a comparable product by one of the following:
         a) Extron
         b) AVProEdge
         c) Or Approved Equal

   c. One (1) 104"Wx58"H tab-tensioned projection screen will be provided and installed by others.
   d. Provide and install one (1) 1920x1080p data video projector, complete with ultra-short throw lens, and all necessary wall mounting hardware for display of high and standard definition video and PC images.
      1) Projector

         Basis-of-Design Product: Subject to compliance with requirements, provide a ultra-short throw projector Epson BrightLink 1485I or a comparable product by one of the following:
         a) NEC
         b) Panasonic
         c) Or Approved Equal

   e. Video source devices from the Lectern:
      1) Laptop PC (OFE) images.
      2) Wireless Video Gateway interface to connect laptop PCs, tablets, smart phones and other devices via wireless to the projector.

         Basis-of-Design Product: Subject to compliance with requirements, provide a Wireless Video Gateway Interface Mersive Solstice POD or a comparable product by one of the following:
         a) Crestron
         b) Barco
         c) Or Approved Equal

3) Mini-Desktop PC (OFE) with HDMI output.

3. Audio
   a. Provide and integrate amplifiers, speakers, audio digital signal processing, and cabling as described in this specification.
   b. Provide an audio digital signal processing system for audio matrix routing and distribution, signal processing, and equalization.
      1) Audio DSP

         Basis-of-Design Product: Subject to compliance with requirements, provide an audio digital signal processing system Biamp TesiraFORTÉ AVB VT4 or a comparable product by one of the following:

         a) QSC
         b) Symetrix
         c) Or approved equal

   c. Provide and install program speakers for playback of program audio. The speakers will be pole mounted from the ceiling.
      1) Program Speaker

         Basis-of-Design Product: Subject to compliance with requirements, provide a Program Speaker Biamp Desono EX-S8 or a comparable product by one of the following:
         a) JBL
         b) Tannoy
         c) Or Approved Equal

   d. Furnish and install a gooseneck microphone and shock mount to be mounted on the Custom Lectern for use with the voice reinforcement system.
      1) Gooesneck Microphone/Shock Mount

         Basis-of-Design Product: Subject to compliance with requirements, provide a Gooseneck Microphone Shure MX418/C and Shock Mount Shure A400SM or comparable products by one of the following:
         a) Sennheiser
         b) Clock Audio
         c) Or Approved Equal

   e. Provide an IR-based assistive listening system, complete with IR emitter, headsets/receivers, charging units, and storage cases. The IR emitter shall be mounted on the front wall.
      1) Assistive Listening System

         Basis-of-Design Product: Subject to compliance with requirements, provide an IR-Based Assistive Listening System from Listen Technologies or a comparable product by one of the following:
         a) Williams AV

b) Contacta
c) Or Approved Equal

f. Provide a wireless microphone system complete with bodypack transmitter. Lavalier microphone, batteries, and receiver for use with the voice reinforcement system.
   1) Wireless Microphone System

      Basis-of-Design Product: Subject to compliance with requirements, provide a Digital Wireless Microphone System Shure ULX-D or comparable products by one of the following:
      a) Sennheiser
      b) Audio Technica
      c) Or Approved Equal

4. Control
   a. Provide, program and install a touch panel located at the Lectern. This panel will be the primary means of user control for the Orientation Room audiovisual system.
   b. Establish control system functionality for the following devices and capabilities for the audiovisual system:
      1) Audiovisual System Power on/off
      2) Ultra-short throw video projector
      3) Projection Screen up/down/stop
      4) Audiovisual Source Selection
      5) Program Volume up/down/mute
      6) Speech Volume up/down/mute
      7) Lighting Scene Preset selection.
   c. Provide remote control of systems with an integrated network-based master controller that provides ports for IR/serial, RS-232/422/485, Ethernet, relay closures, as indicated on the drawings and in this specification. The master controller will be built-in to the Presentation Switcher.
   d. Provide control of all equipment as indicated within this specification and as indicated on drawings.
   e. Provide all loose cables, connectors, etc. required to complete a full working system.
   f. When a choice of control protocols is available for a piece of equipment, the most secure and flexible one shall be used; i.e. RS-232 control, where available, shall be used in place of either infrared or relay control.
   g. Where the power state of a piece of equipment is indeterminate, power sensors shall be provided to indicate the devices power state to prevent misalignment of system and equipment power cycles.

5. User Interface
   a. Provide audiovisual system control from a wall mounted 10” LCD touch panel.
      1) Control Touch Panel - Wired 10"

Basis-of-Design Product: Subject to compliance with requirements, provide a 10" Control Touch Panel Crestron TSW-1070 or a comparable product by one of the following:

a) Extron
b) AVEO Systems
c) Or approved equal.

b. Provide control touch panel layout and operations that are consistent from room to room and/or station to station.
c. Provide feedback that indicates the current equipment and/or system status where possible.

6. Miscellaneous
   a. Provide a Custom Lectern (Middle Atlantic Quote #). This Lectern will have a built-in 12RU audiovisual equipment rack to house all the equipment for the audiovisual system.
   b. Provide a USB wireless keyboard and mouse for use with the OFE Desktop PC.
   c. Provide and install all hardware, cabling, connectors, faceplates, terminators, adapters, wall boxes, etc. required to ensure installation of a fully functional audiovisual system as depicted in the AV Systems drawings.

7. Equipment Layout
   a. The equipment in this area shall be as detailed on drawings.
   b. Provide blank and vent panels as required. There are not to be any open areas on the front of the racks.
   c. All equipment shall be installed with rack ears/mounts or custom rack-mounts/face-plates, using security screws. There shall not be any shelf-mounted components in the audiovisual rack.

8. Owner Furnished Equipment
   a. All room furniture will be furnished by the Owner (Unless otherwise noted in this specification).
   b. All Laptop PCs.
   c. All Desktop PCs

9. Related Work Specified Elsewhere
   The following systems and equipment are not provided under this contract. The Contractor is to coordinate as necessary to insure compatibility.
   a. Installation of all raised floor boxes and/or poke thru devices (excluding any plates and connectors to be provided by the Contractor.
   b. Telephone and telecommunications jacks and special telecom outlets not related directly to AV, (LAN/WAN, ISDN, POTS, etc.).

2.2 AUDIOVISUAL EQUIPMENT LISTS

A. See the attached, detailed equipment lists for the audiovisual systems. The Contractor is responsible for supplying all equipment necessary to provide complete and working systems, whether or not the equipment is specifically enumerated herein.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine the areas to receive the work and the conditions under which the Work would be performed. Contractor shall remedy conditions detrimental to the proper and timely completion of the Work. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General
   1. Installation shall include the delivery to the installation site, unloading, setting in place, fastening to walls, floors, ceilings, counters, or other structures where required, pulling and interconnecting wiring of the system components, equipment alignment and adjustment, programming and configuration and all other work whether or not expressly required herein which is necessary to result in complete and fully operational systems.
   2. Prior to ordering equipment, the Contractor shall coordinate the frequencies of all wireless devices to prevent unwanted interaction between devices and rooms. This includes, but is not limited to, wireless microphones, assisted listening system devices, wireless control panels, etc.
   3. All accessories, including rack mounting hardware, power supplies, etc., shall be obtained from the original equipment manufacturer. Unless otherwise noted or specified, third party accessories shall not be used.
   4. If, in the opinion of the Contractor, an installation practice is desired or required, which is contrary to these specifications or drawings, a written request for modification shall be made to the Design Team. Modifications shall not commence without written approval from the Design Team
   5. During the installation, and up to the date of final acceptance, the Contractor shall be under obligation to protect his finished and unfinished work against damage and loss. In the event of such damage or loss, the damage shall be replaced or repaired at no cost to the Owner.

B. Physical Installation
   1. All equipment shall be firmly secured in place unless requirements of portability dictate otherwise.

2. All equipment shall have an engraved plaque permanently affixed, denoting its function.
3. Fastenings and supports shall be adequate to support their loads with a safety factor of at least three. All boxes, equipment, etc., shall be secured plumb and square.
4. In the installation of equipment and cable, consideration shall be given not only to operational efficiency, but also to overall aesthetic factors.
5. Trim and Escutcheon Components
   a. To insure a proper finished appearance, the Contractor shall furnish and install trim/escutcheon components at all conditions where A/V components pass through the finished ceilings. This would include but not be limited to video projector supports, television monitor/receiver supports and any other component which is not specifically supplied with integral flanges/trim components; i.e. speaker mounts, assistance listening devices, etc.
   b. The visible component of any trim should be minimal in size, preferably no wider than 1/2". All trim components at the ceiling plane shall be finished to match the approved ceiling finish. The audiovisual Contractor should obtain a sample from the General Contractor, including any custom color information, or standard color numbers.
   c. All visible components and finish options shall be submitted to the Design Team for review and approval prior to fabrication.

C. Cable Installation
1. All wire bundles are to be neat and combed free of cable crossovers.
2. All cables, regardless of length, shall be marked with a permanent, self-laminating wrap-around number or letter cable marker at both ends, similar to the Panduit "Pan-Code" system. Labels must be computer-generated for legibility. Wire labels done by hand in the field must be replaced with computer generated labels. There shall be no unmarked cables at any place in the system. Marking codes used on cables shall correspond to codes shown on drawings and or run sheets. All labeling must be reviewed and approved by Owner prior to installation as part of the shop drawing process.
   a. Cable labels shall be affixed to cables at a uniform distance at both ends.
3. All cables shall be grouped according to the signals being carried. In order to reduce signal contamination, separate groups shall be formed for the following cable families:
   a. Power cables
   b. Control cables
   c. Video cables
   d. Audio cables carrying signals less than – 20 dBm
   e. Audio cables carrying signals between – 20 dBm and +20 dBm
   f. Audio cables carrying signals above +20 dBm
4. As a general practice, all power cables, control cables, and high level cables shall be run on the left side of an equipment rack as viewed from the rear. All other cables shall be run on the right side of an equipment rack, as viewed from the rear.
5. Cables ties shall be placed at appropriate intervals of no greater than six inches for vertical bundles, two inches for horizontal bundles.
6. All vertical cable bundles shall be attached to the rack frame.

7. All cables shall be continuous lengths without splices. All system wire, after being cut and stripped, shall have the wire strands twisted back to their original lay and be terminated by approved soldered or mechanical means. Except where noted otherwise in the specifications, NO BARE WIRE TERMINATIONS WILL BE ACCEPTED. Heat-shrink tubing shall be used to insulate the ground or drain wire. Unused wires at the end of a cable shall remain unstripped and shall be laid back and held in place with wire ties.
8. All solder connections shall be made with rosin-core solder using temperature-controlled solder stations. Care shall be taken to avoid cold or cracked solder joints. Any connections that do not appear to be clean and shiny, or which show signs of cracking, shall be resoldered by the Contractor before final acceptance of the system.
9. Mechanical connections using insulated, crimp-type connectors shall be bonded to the connector by soldering the wire to the metal part of the connector.
10. Connections made with screw actuated pressure type terminal strips shall be made by stripping approximately 1/4 inch of insulation from the stranded conductor. Then the un-tinned wire shall be inserted into the terminal and the screw tightened using a secure fitting precision screwdriver.
11. Terminal blocks, boards, strips or connectors shall be furnished for all cables which interface with racks, cabinets, consoles, or equipment modules. No audio cables shall run directly to the audio patch panel jacks. Each audio patch panel shall be furnished with an audio terminal block, and all audio cables to and from the audio patch panel shall terminate on this block.
12. All wire markers shall face a common direction.
13. All cables shall have proper connector housing.
14. Cables shall not protrude from the back of racks.
15. All cable entry shall be through the tops of racks or through entrance holes in the base of the rack. No cable shall enter racks through front, rear or side panel openings.

16. Unless otherwise called for in these specifications and drawings, the following cables, or their approved equals, shall be used in these systems:

Type	Manufacturer	Non-Plenum	Plenum
RF-CATV (Horizontal-RG6)	Belden	1189A	1189P
RF-DBS/DSS (Horizontal-RG6)	Belden	1829A	1829P
RF-CATV (Vertical-RG11)	Belden	1617A/7731	1153A
RF-50 Ohm (Horizontal RG-8)	Times Microwave	Microwave	LMR400
Video (Baseband & SDI)	Belden	1505A	1506A
S-Video	Belden	1807A	7700A
Control (4 conductor shielded)	Belden	1502R	1502P
Control (12 conductor shielded)	Belden	9556	6309FE
Audio	Belden	9451/1266A	9451P
Audio (8 Ohm program speakers)	Belden	8473	1861A
Audio (70 Volt Speaker)	Belden	8461	1863A
Video, RGB (RG6)	Belden	7721A	None
Video, RGB (RG59)	Belden	7796A	1826A
Multi-Channel Audio	Belden	8774	88778
Digital Audio (110 Ohm)	Belden	1800B	1801B
4-Fiber Riser Cable Tight-Buffered 50 µm multimode (OM3)	Corning Cable Systems		004T88-31180-29
Category 6e	Berk-Tek		LANmark-1000 Enhanced Category 6 UTP
Category 6	Berk-Tek		LANmark-6 CAT 6 UTP Plenum
Category 5e	Berk-Tek		LANmark-350 Prem. Cat 5e

D. Note: These cable types are cited to illustrate the type and quality of cable required. Unless otherwise noted, cables from other manufacturers, i.e. Canare, CommScope, Extron, Gepco, Liberty, etc. will be considered if data sheets indicating equivalency are submitted to Consultant for approval prior to installation.

1. It is the responsibility of the Audiovisual Contractor to verify, furnish and install the correct CATV cable type and connectors, as per the local CATV provider.
2. Unless otherwise noted, all video and computer video cables are to be terminated using seventy-five ohm (75 Ohm) connectors, with a captive center pin.
3. Cables running in plenum areas without conduit shall be plenum rated cable, and match the specified cable above. It is the responsibility of the Contractor to inspect the electrical drawings, and verify in what spaces plenum cable shall be used. No claims for additional monies, based on the use of plenum cable, will be allowed.
4. All cables that can be terminated in the field (except video and pulse cables, which must be cut to an electrical length) shall be cut to the length dictated by the run. No splices shall be permitted in any pull boxes without prior permission of the Consultant. For

equipment mounted on casters, in drawers or on slides, the interconnecting cables shall be provided with a service loop of appropriate length.

5. No cable shall be installed with a bend radius less than that recommended by the cable manufacturer.
6. Where cables are installed in architectural niches, ensure that the cables are black, unless otherwise directed, to reduce visibility from the audience.
7. Where cables are visible, the cables will be sheathed in a color wrap that has been submitted for approval by the Design Team.

E. CABLE SEPARATION

1. Typical cable separation for runs greater than 24'. Site conditions and separation requirements shall be verified with the Owner and CM/GC.
   a. Microphone Level – 12" from all other circuits.
   b. Line Level and Control – 12" from any circuit with signal of 20dB or greater than Line Level and Control cables.
   c. Speaker level circuits – 12" from other circuits.
   d. Video and Data – 12" from any circuit with signal of 20dB or greater than Video and Data.
   e. AC Power Circuits – 12" from all other circuits.

F. CABLE SUPPORT

1. Supporting method in accordance with Section 26 05 00
2. Individual runs throughout building – Support cable at 600mm on center and 100mm at any change in direction. Support from building structure. Cables on top of ceiling tiles will be rejected. Cable supported by ceiling grid support wires will be rejected.
3. Cable Bundles – Where multiple cable combine support at 300mm on center and 100mm at any change in direction. Support from building structure. Cables on top of ceiling tiles will be rejected. Cable supported by ceiling grid support wires will be rejected.

G. RACK CABLING

1. Neatly train and lace cables.
2. Route Cables from components to lacing bars installed on rear rack rail.
3. Provide services loops for each cable.
4. Cable separation of cables for runs within Equipment rack.
   a. Microphone Level – 2" from all other circuits.
   b. Line Level and Control – 2" from any circuit with signal of 20dB or greater than Line Level and Control cables.
   c. Speaker level circuits – 2" from other circuits.
   d. Video and Data – 2" from any circuit with signal of 20dB or greater than Video and Data.
   e. AC Power Circuits – shall be installed on opposite side of rack from low voltage cables.

H. APPROVED WIRE TERMINATION MEANS

1. Solder Connections – For connectors utilizing Solder Cups

2. Terminal strip Connectors – For termination of blunt cut cables, cable to be tinned prior to termination
3. Multi Pin connectors – Utilize connector manufacturers crimper
4. Crimp Cap Terminations – For Loudspeaker circuits at individual devices. Distribution cable termination to utilize terminal strip connectors.
5. There shall be no field terminations of STP cable.

I. CONNECTION PLATE RECEPTACLES (unless otherwise specified)

1. All connection plate receptacles must be labeled properly according to Owner approved labeling scheme.
2. Audio (microphone or line level) – XLR type.
3. Audio (loudspeaker level) – Neutrik Speakon®.
4. Intercom – XLR or ¼ inch diameter tip/ring/sleeve type, or as required by the intercom system. Jack shall be insulated from panel type.
5. Video – BNC type.
6. VGA – DB-15HD jack, isolated from panel type, with hex nuts
7. DVI (Inclusive of DVI-A, DVI-I and DVI-D signal types) – DVI-I type connector unless otherwise specified.
8. HDMI – HDMI with locking nut.
9. USB – USB Type A
10. Category 5/6 – RJ45 Type
11. RF – "F" type. Receptacles shall be insulated from panel type.
12. Note: All connectors on wall plates, or in other exposed locations, are to be recessed.

J. PATCH PANELS

1. Patch Panel Assignments
   a. All patch panels shall be wired so that signal "sources" (outputs from) appear on the upper row of a row pair; and all "loads" (inputs to) appear on the lower row of a row pair.
2. Patch Panel Designation Strips
   a. All audio and video patch panel designation strips shall utilize alphanumeric identifications and descriptive information. The jack position in each horizontal row shall be numbered sequentially from left to right. The horizontal jack rows shall be lettered sequentially from top to bottom. The alphanumeric identification of each jack shall be included on the functional block drawings, as well as on reproductions of these drawings, which shall be mounted in an appropriate location near the patch bays.

K. MOUNTING HEIGHTS

1. Coordinate locations of the following with mounting heights as indicated on Architectural, Electrical and Audiovisual drawings.
   a. Technical wall plates
   b. AV input/output connections
   c. Flat panel display panel connections
   d. Annotation panel connections
   e. Networked Digital Clocks
   f. PTZ cameras

g. Wall mounted speaker boxes
h. Control panels
i. Pull boxes
j. Other devices as required

L. GROUNDING PROCEDURES

1. In order to minimize problems resulting from improper grounding, and to achieve maximum signal-to-noise ratios, the following grounding practices shall be adhered to in order to maintain the integrity of the grounding system:

a. Because of the great number of possible variations in grounding systems, it shall be the responsibility of the Contractor to follow good engineering practice, as outlined below, and to deviate from these practices only when necessary to minimize crosstalk, ground loops, ground-induced noise, and to maximize signal-to-noise ratios in the audio, video, and control systems.

b. System Power Ground: A single primary "system ground" shall be established for the system in each particular area. All grounding conductors in that area shall connect to this primary system ground.

1) Secondary system grounding conductors shall be provided between all racks and audiovisual system equipment local to the area. Each of these grounding conductors shall have a maximum of 0.1 Ohms total resistance.

2) Under no conditions shall the AC neutral conductor, either in the power panel or in a receptacle outlet, be used as a system ground, except as specifically defined by NFPA 70 for bonding.

3) Ungrounded equipment with either an inline transformer or a 2-prong plug, shall be bonded to the rack bus bar using #12awg cable.

c. Audio Cable Shields

1) All audio cable shields shall be grounded at one point only. There are no exceptions. For inter and intra-rack wiring, this requires that the shield be connected at one end only. For ungrounded portable equipment, such as microphones, the shield shall be connected at both ends but grounded at only one end.

d. Video Receptacles

1) All video receptacles that are provided and installed by the Contractor shall be insulated from the mounting panel, outlet box, or wireway. Unless otherwise detailed herein, this shall be accomplished by using insulated-from-panel type receptacles.

e. Audio Receptacles

1) All audio receptacles that are provided and installed by the Contractor shall be insulated from the mounting panel, outlet box, or wireway. Unless otherwise detailed herein, this shall be accomplished by using insulated-from-panel type receptacles.

f. General

1) Because of the great number of possible variations in grounding systems, it shall be the responsibility of the Contractor to follow good engineering practice, as outlined above, and to deviate from these practices only when

necessary to minimize crosstalk and to maximize signal-to-noise ratios in the audio, video, and control systems.

3.3 PERFORMANCE STANDARDS

A. Unless restricted by the published specifications of a particular piece of equipment, or unless otherwise required under the Detailed Specifications, the following performance standards shall be met by each system. The signal paths for the above Performance Standards shall be as follows: From all source inputs to all signal destinations. See Contractor System Checkout Section III-T for testing procedures.

1. Analog Audio
   a. Frequency Response Within plus or minus 0.5dB, 20 Hz to 20,000 Hz
2. Signal to Noise Ratio greater than 90dB (including crosstalk and hum at all input/output levels)
3. Total Harmonic Distortion 0.05% maximum from 20 Hz to 20,000 Hz.
   a. Input Levels

1)	Microphone (Nominal)	-50dbu
2)	Overload (Minimum gain)	-5dbu
3)	Maximum Gain -	26dbu
4)	Line (Nominal)	+4dbu
5)	Overload (Minimum gain)	+24dbu
6)	Maximum Gain	+9dbu
7)	Input Common Mode Rejection	>100db

   b. Output Levels

1)	Line (Nominal)	+4dbu
2)	Maximum	+24dbu
3)	Output Impedance	< 0.5 Ohms
4)	Load Impedance	>150 Ohms

4. Analog Video (signal)
   a. Frequency Response
      1) Within plus or minus 0.5dB, DC to 4.2 MHz
   b. Signal to Noise Ratio
      1) 55 dB minimum (peak to RMS) unweighted, DC to 4.2 MHz
   c. Crosstalk
      1) 45 dB minimum
      2) Unweighted DC to 4.2 MHz
   d. Line and Field Tilt:
      1) 2% maximum
   e. Differential Gain:
      1) 3% maximum
   f. Differential Gain:
      1) 2 degrees maximum

5. SDI – Per SMPTE 259M
6. HD SDI – Per SMPTE 292M
7. HD SDI (Dual Link) – Per SMPTE 424M
8. 3G SDI – Per SMPTE 424M
9. HDMI – Per HDMI Ver. 1.3b
10. DVI – Per DVI Ver. 1.0
11. Analog NTSC Video
12. COMPOSITE VIDEO SIGNAL
    a. Signal 1V P-P 75 Ω(3.58, 4.43MHz) NTSC, PAL, or SECAM as appropriate
13. S-VIDEO SIGNAL
    a. Signal Y: 1.0V p-p, 75 ΩC: 0.286V p-p, 75Ω(3.58, 4.43MHz) NTSC, PAL, or SECAM as appropriate
14. COMPONENT VIDEO (Beta Component)
    a. Signal Y: 1.0V p-p, 75 ΩPB/CB: 07V p-p, 75ΩPR/CR: 0.7V p-p, 75 Ω
15. RF Broadband
    a. The RF Broadband system shall meet or exceed the published standards of the following organizations:
       1) FCC Part 15 Rules and Regulations: Radio Frequency Devices
       2) FCC Part 76 Rules and Regulations: Cable Television Service
       3) NCTA-02 Recommended Practices for Measurements on Cable Television Systems.
    b. Visual Carrier Level +7 +/- 3dBMv for each tap at channel WW(433.25 MHz)
    c. Visual Carrier Level +5 +/- 3dBMv for each tap at channel 2(55.25 MHz)
    d. Visual Carrier to Noise Ratio 42 dB minimum on any channel (4MHz bandwidth)
    e. Maximum Loss from common 45 dB or less point to any tap at channel WW(433.25 MHz)
    f. Maximum Loss from common 37 dB or less point to any tap at channel 2(55.25 MHz)
16. Audio Video Bridging (AVB)
    a. IEEE 802.1AS: Timing and Synchronization for Time-Sensitive Applications
    b. IEEE 802.1Qat: Stream Reservation Protocol (SRP)
    c. IEEE 802.1Qav: Forwarding and Queuing for Time-Sensitive Streams
    d. IEEE 802.1BA: Audio Video Bridging Systems
17. Dante Audio
    a. Protocol not subject to performance-based substitution.

B. Audiovisual System, Control System and User Interface Programming
   1. Control system user interfaces pages and programming shall be designed for this project exclusively. While there are a great number of design approaches to designing the user interface, the following guidelines shall be adhered to:
      a. The use of custom system programming from prior projects and/or ‘modules’ provided by a given manufacturer or programmer may or may not meet the functional intent of the systems and work described herein. It is the responsibility of the Contractor to meet the functional intent of the systems in this specification,

including any and all necessary modification of program code or creation of custom modules as required.

b. The operation(s) of all system(s) are to match the functional intent already implemented at the owner's facilities as applicable.

c. All panels are to have the time and date as icons, in the same position on every page.

d. All panels are to have a title, indicating the piece of equipment and/or functionality being controlled.

e. Final programming shall include capability to remotely control all functions of the audiovisual system. Only functions required for normal use shall appear on top level pages while underlying "Tech Pages" shall provide access to full manufacturer's remote control functionality.

f. Devices similar in nature shall be programmed to operate with a common format.

g. No individual component shall be programmed to function atypically.

h. Whenever the same button appears on more than one page, it will be in the same position on each page.

i. Where feasible, multi-level access to controls should be implemented. See paragraph "e", above.

j. During performance testing, all equipment shall be operated under standard conditions as recommended by the manufacturer.

k. Please see Detailed Specifications for further information on specific control system programming requirements.

C. Performance Test Signal Paths

1. The signal paths for the above Performance Standards shall be as follows:

a. Audio:

1) From all inputs through all mixers, switchers, etc., to all signal destinations.

b. Video:

1) From all sources of the above signal paths. This shall not exempt the Contractor from the responsibility of checking all paths and outlets for appropriate compliance with the Performance Standards, see section below for detailed requirements.

D. Optical

1. All optical projection systems shall meet the following performance standards:
2. The total averaged light output from a projector, in lumens, shall be within plus-or-minus 15% of that specified by the projector manufacturer.
3. The "corner" location shall be defined as the four points determined by intersecting lines drawn 5% of the distance in from the focused edges of the image.
4. The light meter used for the above measurements shall be a properly calibrated foot-candle (or lux) meter and shall be cosine-corrected.
5. Projectors, lenses, and mirrors shall be solidly mounted and braced, so that there will be no observable movement in the image induced by motor vibration or other mechanical operations.

3.4 Contractor SYSTEM CHECKOUT

A. Before Commissioning Tests are scheduled, the Contractor shall perform his own system checkout based upon an approved testing procedure for the systems. The Contractor shall furnish all required test equipment and shall perform all work necessary to determine and/or modify performance of the system to meet the requirements of this specification. The Contractor shall submit a testing plan (refer to Section III-J.-1.-n) for approval by the individual or firm representing the Owner during the Audiovisual Installation. At a minimum, the following sub-components of the Audiovisual System shall be tested and verified:

1. Cable and Connectors
   a. All cables and connectors shall be tested and verified to comply with the manufacturer's specifications and design intent
   b. Cable test results shall be submitted in advance of the Commissioning for review by the Owner's Representative
2. Devices
   a. All devices shall meet the functionality as specified by manufacturer.
   b. If any device is found to deviate from the manufacturer's functionality it shall be replaced by the Audiovisual Systems Contractor at no cost to the Owner.
   c. All devices shall be updated with the most recent firmware available from the manufacturer. All devices of the same manufacturer and model shall operate on the same version of firmware. All device firmware shall be documented and provided to the Consultant prior to Systems' Acceptance Testing.
3. Signal Types
   a. The Audiovisual System shall be tested to comply with all video and audio standards as specified in the Performance Standards section and described by the design intent.
4. System Function
   a. The cables and connectors, devices, and signal types shall meet the functional requirements as specified by the design intent.
   b. Acceptable testing procedures may include but is not limited to that which is described in the detailed specifications such as (streaming, push-to-talk, annotation, etc.)
5. Document that all matrix switching crosspoints have been tested and verified.
6. Provide documentation that all Dante Flows and audio signal lines have been tested and verified.
7. Test all audio and video systems for compliance with the Performance Standards, using the example procedure outlined in appendix A:
   a. Test Equipment: The following test equipment (or submit equivalent for approval) shall be used to test the systems on site.
      1) Audio check:
         a) Time based measurement system, Goldline TEF20 or SIA Smaartlive with laptop PC, calibrated omnidirectional mic, and appropriate interface
         b) Audio test set, Audio Precision ATS-1DD
         c) Media representative of all types found in the subject system
         d) Audio cables as required to connect test equipment to the system

e) Set of terminations, adapters etc.

2) Video checks:

a) Video, Component, RGBS, RGBHV and Digital video signal generator, Extron VTG 400 DVI
b) Digital Video test generator with EDID and HDCP components, PureLink HDG-8000 PRO
c) Media and portable hardware (i.e laptop) representative of all types found in the subject system including but not limited to Blu-ray ™ players and discs (provide discs with and without HDCP encrypted content), mobile PC/Tablets.
d) RGB cable, Extron BNC-5-6'HR
e) Video cable
f) Set of terminations, 'T' pieces etc.

3) Gain Setting

a) Adjust all systems (end to end within a system) for maximum signal-to-noise ratio. No hiss should be audible through any loudspeaker at the completion of gain structure setting, and all audio gain stages should clip simultaneously.

8. Signal Paths

a. Video/Audio

1) Connect the output of the video signal generator to a floor box/table/rack connector and select the "Full Field Color Bar" signal. Connect the combined waveform monitor/vectorscope to a final output point, e.g. an input to a picture monitor or video projector. Ensure that the test signal is routed to the selected output.
2) Measure and record the signal amplitudes.
3) Repeat item '1' after selecting the "Multiburst, 50 IRE" test signal.
4) Measure and record the signal amplitudes.
5) Repeat item '1' after selecting the "Modulated 5-step" test signal.
6) Measure and record the signal differential phase and gain.
7) Repeat item #'s '1' through '6' for other video signal paths.
8) Repeat item '1' after selecting the Window test signal.
9) Measure and record the signal line and field tilt.
10) Repeat item '1' after connecting the Black Burst signal from a rear mounted connector.
11) Measure and record the signal/noise ratio.
12) Connect the output of the audio test set to a floor box/table/rack program audio connector and connect the input of the audio test set to a final output point, e.g. an input to a program speaker power amplifier. Ensure that the test signal is routed to the selected output, that the volume control is set to 100% and that the equalizers are bypassed.
13) Measure and record the signal/noise ratio, total harmonic distortion and frequency response.
14) Repeat items '12' and '13' for other audio signal paths.

15) Connect the output of the audio test set to a floor box/table/rack speech audio connector and connect the input of the audio test set to a final output point, e.g. an input to a speech speaker power amplifier. Ensure that the test signal is routed to the selected output, that the volume control is set to 100% and that the equalizer is bypassed.
16) Measure and record the signal/noise ratio, total harmonic distortion and frequency response.
17) Repeat items '15' and '16' for other audio signal paths.
18) DVI: Connect the DVI output of the signal generator to a floorbox/table/rack connector and select the SMPTE & PLUGE signal at the various computer scan rates as follows:

    a) 640 x 480 31.5 kHz H, 60 Hz V
    b) 640 x 480 37.5 kHz H, 75 Hz V
    c) 800 x 600 38 kHz H, 60 Hz V
    d) 832 x 624 49.7 kHz H, 75 Hz V
    e) 1024 x 768 48 kHz H, 60 Hz V
    f) 1280 x 768 48 kHz H, 60 Hz V
    g) 1366 x 768 47.8 kHz H, 60 Hz V
    h) 1280 x 1024 64 kHz H, 60 Hz V
    i) 1400 x 1050 63.9 kHz H, 60 Hz V
    j) HD 720p 45 kHz H, 60 Hz V
    k) HD 1080i 33.75 kHz H, 30/60 Hz V
    l) HD 1080p 33.75 kHz H, 30/60 Hz V

19) Check that the image is correctly displayed on the picture monitor(s) and/or by the video projector.
20) Repeat item '2' using Crosshatch signal, checkerboard signal and H Pattern signal.
21) Repeat item '2' for other DVI connection locations.
22) Connect the output of the audio signal generator to a floorbox/table/rack 'Left' and 'Right' connectors and select the 1 kHz tone. Check that the signal is emitted from the left and right program speakers.
23) Repeat item 'v' for other audio connection location.
24) Note: Whenever possible, include computer sources provided by the Owner, at the desired resolution, in your testing.
25) Note: The term "RGB" is used generically. The system will be tested with the sync format dictated by functional requirements, including, but not limited to, sync-on-green, composite sync and separate horizontal and vertical sync. Whenever possible, include computer sources provided by the Owner, at the desired resolution, in your testing.

b. At the conclusion of the tests, return all equipment settings to previously calibrated positions.
c. Provide written records of all test results in spreadsheet form.
d. Check all control functions, from all controlling devices to all controlled devices, for proper operations.

e. Adjust, balance, and align all equipment for optimum quality and to meet the manufacturer's published specifications. Establish and mark normal settings for all level controls, and record these settings in the "System Operation and Maintenance Manual".

f. Check all optical projection images for average light level, light fall-off, and image alignment and size to comply with the Performance Standards and specifications drawings. Check to determine that all projectors, projector bases, carts, tables, and mirrors are rigid and vibration-less in operation.

g. Maintain documentation of all performance tests for reference by the Consultant during the System Acceptance Tests.

3.5 Systems' Acceptance Tests

A. Systems' Acceptance will not be performed until the Contractor's System Checkout has been completed and the test results have been reviewed. The Commissioning Tests will be supervised by the Owner's Representative and shall consist of the following at a minimum:

1. A physical inventory of all equipment on site and will be compared to equipment lists in the contract documents.
2. The operation of all system equipment shall be demonstrated by the Contractor.
3. Review of final As-Build documentation as described in the "Contractors Documentation" section of this specification.
4. Both subjective and objective tests will be required by the Owner's Representative to determine compliance with the specifications. The Contractor shall be responsible for providing test equipment for these tests.
5. All final, "as-built" drawings, run sheets, manuals, and other required documents, as detailed in Part I, shall be on hand. Two complete sets of these documents shall be delivered to the Owner at this time. (One complete set shall have been delivered to the Consultant prior to the scheduling of Acceptance Tests).

B. In the event further adjustment is required, or defective equipment must be repaired or replaced, tests may be suspended or continued at the option of the Owner's Representative.

C. Any charge for additional time incurred by the Owner's Representative required to over-see the system tests, due to improper system installation or previous failed systems, shall be the responsibility of, and charged directly to the Contractor

END OF SECTION

SECTION 283111

DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Manual fire-alarm boxes.
2. System smoke detectors.
3. Heat detectors.
4. Notification appliances.
5. Device guards.

B. Related Work:

1. Section 017419 – Construction and Demolition Waste Management Disposal.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 DEFINITIONS

A. EMT: Electrical Metallic Tubing.

B. FACP: Fire Alarm Control Panel.

C. HLI: High Level Interface.

D. NICET: National Institute for Certification in Engineering Technologies.

E. PC: Personal computer.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.

1. Include construction details, material descriptions, dimensions, profiles, and finishes.
2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.

3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Provide program report showing that air-sampling detector pipe layout balances pneumatically within the airflow range of the air-sampling detector.
11. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.

    a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    b. Show field wiring required for HVAC unit shutdown on alarm.
    c. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' control system.
    d. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' smoke-evacuation system.
    e. Locate detectors according to manufacturer's written recommendations.
    f. Show air-sampling detector pipe routing.

12. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
13. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

C. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:

    a. Trained and certified by manufacturer in fire-alarm system design.
    b. NICET-certified, fire-alarm technician; Level IV minimum.
    c. Licensed or certified by authorities having jurisdiction.

D. Delegated-Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Drawings showing the location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the device.
2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
3. Indicate audible appliances required to produce square wave signal per NFPA 72.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control reports.

1.6 Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction:

a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
d. Riser diagram.
e. Device addresses.
f. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:

1) Equipment tested.
2) Frequency of testing of installed components.
3) Frequency of inspection of installed components.
4) Requirements and recommendations related to results of maintenance.
5) Manufacturer's user training manuals.

g. Manufacturer's required maintenance related to system warranty requirements.
h. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

1.8 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. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
2. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
3. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
4. Keys and Tools: One extra set for access to locked or tamperproofed components.

5. Audible and Visual Notification Appliances: One of each type installed.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician.

C. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL (nationally recognized testing laboratory).

D. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

E. NFPA Certification: Obtain certification according to NFPA 72 in the form of a placard by an FM Global-approved alarm company.

1.10 PROJECT CONDITIONS

A. Perform a full test of the existing system prior to starting work. Document any equipment or components not functioning as designed.

B. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:

1. Notify Construction Manager no fewer than 7 days in advance of proposed interruption of fire-alarm service.
2. Do not proceed with interruption of fire-alarm service without Construction Manager's written permission.

C. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.11 SEQUENCING AND SCHEDULING

A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service, and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.

B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

1.12 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.

1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
2. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Source Limitations for Fire-Alarm System and Components: Components shall be compatible with, and operate as an extension of, existing system. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.

B. Noncoded, UL-certified addressable system, with multiplexed signal transmission and voice/strobe evacuation.

C. Automatic sensitivity control of certain smoke detectors.

D. All components provided shall be listed for use with the selected system.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

1. Manual stations.
2. Heat detectors.
3. Flame detectors.
4. Smoke detectors.
5. Duct smoke detectors.
6. Air-sampling smoke-detection system (VESDA).
7. Carbon monoxide detectors.
8. Combustible gas detectors.
9. Automatic sprinkler system water flow.
10. Preaction system.
11. Fire-extinguishing system operation.
12. Fire standpipe system.
13. Dry system pressure flow switch.
14. Fire pump running.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances, including voice evacuation notices.
2. Identify alarm and specific initiating device at fire-alarm control unit, connected network control panels, off-premises network control panels, and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Unlock electric door locks in designated egress paths.
5. Release fire and smoke doors held open by magnetic door holders.
6. Activate voice/alarm communication system.
7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.

8. Activate smoke-control system (smoke management) at firefighters' smoke-control system panel.
9. Activate stairwell and elevator-shaft pressurization systems.
10. Close smoke dampers in air ducts of designated air-conditioning duct systems.
11. Activate preaction system.
12. Recall elevators to primary or alternate recall floors.
13. Activate elevator power shunt trip.
14. Activate emergency lighting control.
15. Activate emergency shutoffs for gas and fuel supplies.
16. Record events in the system memory.
17. Record events by the system printer.
18. Indicate device in alarm on the graphic annunciator.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. High- or low-air-pressure switch of a dry-pipe or preaction sprinkler system.
3. Alert and Action signals of air-sampling detector system.
4. Elevator shunt-trip supervision.
5. Fire pump running.
6. Fire-pump loss of power.
7. Fire-pump power phase reversal.
8. Independent fire-detection and -suppression systems.
9. User disabling of zones or individual devices.
10. Loss of communication with any panel on the network.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal ac voltage at fire-alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.
10. Voice signal amplifier failure.
11. Hose cabinet door open.

E. System Supervisory Signal Actions:

1. Initiate notification appliances.
2. Identify specific device initiating the event at fire-alarm control unit, connected network control panels, off-premises network control panels, and remote annunciators.
3. Record the event on system printer.
4. After a time delay of 200 seconds transmit a trouble or supervisory signal to the remote alarm receiving station.
5. Transmit system status to building management system.
6. Display system status on graphic annunciator.

2.3 FIRE-ALARM CONTROL UNIT(Existing)

A. Manufacturer: EDWARDS, MODEL: EST-3

2.4 MANUAL FIRE-ALARM BOXES

A. Approved manufacturer: EDWARDS, MODEL: EST-3

B. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Single-action mechanism, breaking-glass or plastic-rod type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Double-action mechanism requiring two actions to initiate an alarm, breaking-glass or plastic-rod type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
3. Station Reset: Key- or wrench-operated switch.
4. Indoor Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
5. Weatherproof Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.5 SYSTEM SMOKE DETECTORS

A. Approved manufacturer: EDWARDS, MODEL: EST-3

B. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be four-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.

    a. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for 15 or 20 deg F per minute.
    b. Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F.
    c. Multiple levels of detection sensitivity for each sensor.

d. Sensitivity levels based on time of day.

C. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

a. Primary status.
b. Device type.
c. Present average value.
d. Present sensitivity selected.
e. Sensor range (normal, dirty, etc.).

2.6 HEAT DETECTORS

A. Approved manufacturer: EDWARDS, MODEL: EST-3

B. General Requirements for Heat Detectors: Comply with UL 521.

1. Temperature sensors shall test for and communicate the sensitivity range of the device.

C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F (88 deg C).

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status normal, alarm, or trouble to fire-alarm control unit.

2.7 NOTIFICATION APPLIANCES

A. Approved manufacturer: EDWARDS, MODEL: EST-3

B. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

C. Speaker: 23 VDC to 30 VDC, 9mA with power taps ¼, ½, 1 and 2W, Frequency Response 400 to 4000 Hz (S/O), 200 to 10000 Hz (H/F); General Signaling 125 to 12 kHz. Comply with UL 1480 Reverberant Chamber Test. Speaker shall produce a sound-pressure level of 90 dBA, measured 10 feet from the speaker, using the coded signal prescribed in UL test protocol.

D. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- high letters on the lens.

1. Rated Light Output:

a. 15/30/75/110 cd, selectable in the field.

2. Mounting: Wall mounted unless otherwise indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, red.

E. Exit Marking Audible Notification Appliance:

1. Exit marking audible notification appliances shall meet the audibility requirements in NFPA 72.
2. Provide exit marking audible notification appliances at the entrance to all building exits.
3. Provide exit marking audible notification appliances at the entrance to areas of refuge with audible signals distinct from those used for building exit marking.

2.8 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.

1. Factory fabricated and furnished by device manufacturer.
2. Finish: Paint of color to match the protected device.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.

1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

1. Devices placed in service before all other trades have completed cleanup shall be replaced.

2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

B. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.

1. Connect new equipment to existing control panel in existing part of the building.
2. Connect new equipment to existing monitoring equipment at the supervising station.
3. Expand, modify, and supplement existing [control] [monitoring] equipment as necessary to extend existing [control] [monitoring] functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.

C. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.

D. Manual Fire-Alarm Boxes:

1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.
2. Mount manual fire-alarm box on a background of a contrasting color.
3. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.

E. Smoke- or Heat-Detector Spacing:

1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet .
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A [or Annex B]in NFPA 72.
5. HVAC: Locate detectors not closer than 36 inches from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.

F. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

G. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

H. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.

3.3 PATHWAYS

A. Pathways above recessed ceilings and in nonaccessible locations may be routed exposed.

1. Exposed pathways located less than 96 inches above the floor shall be installed in EMT.

B. Pathways shall be installed in EMT.

C. Exposed EMT shall be painted red enamel.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.5 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by Architect.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

D. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Visual Inspection: Conduct visual inspection prior to testing.

    a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
    b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 283111