

PROJECT MANUAL

for

Canton Township Public Safety

PUBLIC SAFETY BUILDING INTERIOR RENOVATIONS

**1150 S. Canton Center Road
Canton, MI 48188**



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PARTNERS PROJECT # 21-130

MARCH 9, 2022 / BIDDING -CONSTRUCTION

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PROJECT IDENTIFICATION

PROJECT: CANTON TOWNSHIP PUBLIC SAFETY -
PUBLIC SAFETY BUILDING INTERIOR RENOVATIONS
1150 S. Canton Center Road
Canton, MI 48188

OWNER: CHARTER TOWNSHIP OF CANTON
1150 S. Canton Center Road
Canton, MI 48188

ARCHITECT: PARTNERS IN ARCHITECTURE, PLC
65 Market Street
Mount Clemens, MI 48043
(586) 469.3600

PARTNERS PROJECT NUMBER: 21-130

BID DUE DATE: **MARCH 31, 2022 @ 3:00 PM**

BID LOCATION: Clerk's Office
Charter Township of Canton
1150 S. Canton Center Road
Canton, MI 48188

END OF SECTION

ADVERTISEMENT FOR BIDS

Charter Township of Canton PUBLIC SAFETY BUILDING INTERIOR RENOVATIONS

The Charter Township of Canton will receive single prime sealed bids for the PUBLIC SAFETY BUILDING INTERIOR RENOVATIONS PROJECT. SEALED BIDS MUST BE DELIVERED TO THE:

Canton – Clerk's Office
CHARTER TOWNSHIP OF CANTON
1150 S. Canton Center Road
Canton, MI 48188

ON OR BEFORE 3:00 PM, THURSDAY, MARCH 31, 2022

Bids shall be submitted in a sealed envelope labeled and marked:

“CANTON TOWNSHIP – PUBLIC SAFETY BUILDING INTERIOR RENOVATIONS”

Bids received after 3:00PM of the date they are due will not be accepted or will be marked late, and retained unopened.
Submit one (1) original, one (1) copy of bid proposal.

Bids received will be publicly opened and read aloud immediately following bid due time.

There will be a Pre-Bid Meeting, for all contractors wishing to submit a bid on **MONDAY, MARCH 14, 2022, at 1:00PM.** Pre-Bid Meeting will be held at the Canton Township Public Safety Building, located at 1150 S. Canton Center Road, Canton, MI 48188. All contractors are encouraged to attend.

This project includes: Interior renovations on the first and second floors of the existing Public Safety Building including: selective demolition, reconfiguration of space, new ceilings, lighting, finishes and mechanical systems replacement. The project will need to be completed in phases to allow continuous operation – contractor to closely coordinate with the public safety department.

Make proposals on the bid form supplied in the project manual. No oral or telegraphic proposals or modifications will be considered. Submit with each bid, a certified check or acceptable bid bond payable to the Charter Township of Canton, in an amount equal to five percent (5%) of the total bid.

Bids may not be withdrawn for a period of sixty (60) days after the scheduled time of opening bids, without the consent of the Owner. The Township reserves the right to reject any or all bids received and to waive any formalities in regard thereto. In addition, the Township reserves the right to evaluate bids on any basis determined by the Township to be in the best interest of the Township and to consider alternate bids if the low bidder(s) does not comply with the project requirements or are otherwise determined to be unqualified.

All contractors working onsite will be required to submit to a background check prior to obtaining unescorted work access in the Canton Police Department. This background check may include up to a state and federal fingerprint check. The Canton Police Department will determine, based upon state and federal guidelines, whether access will be granted.

Bid documents will be available to prospective bidders on or about March 9, 2022. Bid documents can be electronically downloaded from PARTNERS in Architecture, PLC. Contact Judy Houlihan @ jhoulihan@partnersinarch.com to request a link to download the bid documents.

Questions should be directed to PARTNERS in Architecture, PLC, preferably in writing and via email. Forward questions to: jhoulihan@partnersinarch.com. Last day for questions is March 22, 2022.

PARTNERS in Architecture, PLC
65 Market Street
Mount Clemens, MI 48043
(586) 469-3600

SECTION 096933 – LOW PROFILE FIXED HEIGHT ACCESS FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Access-flooring panels.
 - 2. Understructure.
 - 3. Floor panel coverings.
- B. Related Requirements:
 - 1. Section 260526 "Grounding and Bonding for Electrical Systems" for connection to ground of access-flooring understructure.

1.3 COORDINATION

- A. Coordinate location of mechanical and electrical work in underfloor cavity to prevent interference with access-flooring pedestals.
- B. Mark pedestal locations on subfloor using a grid to enable mechanical and electrical work to proceed without interfering with access-flooring pedestals.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review connection with mechanical and electrical systems.
 - 2. Review requirements related to sealing the plenum.
 - 3. Review procedures for keeping underfloor space clean.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include layout of access-flooring system and relationship to adjoining Work based on field-verified dimensions.

1. Details and sections with descriptive notes indicating materials, finishes, fasteners, typical and special edge conditions, accessories, and understructures.

C. Samples:

1. Floor Covering: Full-size units for each color and texture specified.
2. Exposed Metal Accessories: Approximately 10 inches (250 mm) in length.
3. One complete full-size floor panel, pedestal, and understructure unit for each type of access-flooring system required.

D. Samples for Initial Selection: For each type of product and exposed finish.

E. Samples for Verification: For the following products:

1. Floor Covering: Full-size units.
2. Exposed Metal Accessories: Approximately 10 inches (250 mm) in length.
3. One complete full-size floor panel, pedestal, and understructure unit for each type of access-flooring system required.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of access-flooring system.
- C. Product Test Reports: For each type of flooring material and exposed finish, for tests performed by a qualified testing agency.
- D. Seismic Design Calculations: For seismic design of access-flooring systems including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Preconstruction Test Reports: For preconstruction adhesive field test.

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. Flooring Panels: 2% of total quantity required.
 2. Pedestals: 2% of total quantity required.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Mockups: Build mockups to verify selections made under Sample submittals to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Build mockup of typical access-flooring assembly as shown on Drawings. Size to be an area no fewer than five floor panels in length by five floor panels in width.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install access flooring until spaces are enclosed, subfloor has been sealed, ambient temperature is between 50 and 90 deg F (10 and 32 deg C), and relative humidity is not less than 20 and not more than 70 percent.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Calculations shall be performed using a current seismic program and submitted to a local structural engineer licensed in the state where the project is located. The structural engineer shall sign and seal these calculations confirming that these calculations meet all local and state codes for seismic pedestal assemblies. A signed copy of these calculations must be given to the architect and local building department as required.
- B. Structural Performance: Provide access-flooring systems capable of complying with the following performance requirements according to testing procedures in CISCA's "Recommended Test Procedures for Access Floors":
 1. Concentrated Loads: 1250 lbf with the following deflection and permanent set:
 - a. Top-Surface Deflection: 0.10 inch.
 - b. Permanent Set: 0.010 inch.
 2. Ultimate Loads: 1800 lbf.
 3. Rolling Loads: With local or overall deformation not to exceed 0.040 inch (1.02 mm).
 - a. CISCA Wheel 1: 10 passes at 1200 lbf.
 - b. CISCA Wheel 2: 10,000 passes at 800 lbf.
 4. Pedestal Axial Load Test: 5000 lbf.
 5. Pedestal Overturning Moment Test: 1000 lbf x inches.
 6. Uniform Load Test: 600 lbf/sq. ft. with a maximum top-surface deflection not to exceed 0.040 inch (1.02 mm) and a permanent set not to exceed 0.010 inch (0.25 mm).
 7. Drop Impact Load Test: 150 lb.

C. Fire Performance:

1. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 50 or less.
2. Combustion Characteristics: ASTM E 136.

2.2 MANUFACTURERS

- A. Source Limitations: Obtain access-flooring system from single source from single manufacturer.

2.3 FLOOR PANELS

- A. Floor Panels, General: Provide modular panels interchangeable with other field panels without disturbing adjacent panels or understructure.
1. Size: Nominal 24 by 24 inches.
 2. Height: 8" (152 mm) nominal height.
 3. Attachment to Understructure: By gravity.
- B. Cementitious-Core Steel Panels: Fabricated from cold-rolled steel sheet, with the die-cut flat top sheet and die-formed and stiffened bottom pan welded together, and with metal surfaces protected against corrosion by manufacturer's standard factory-applied finish. Fully grout internal spaces of completed units with manufacturer's standard cementitious fill.
1. Access floor system shall be as manufactured by Tate Access Floors, Inc. and shall consist of the ConCore 1250 access floor panel supported by a bolted stringer understructure system or approved equal by Haworth, Inc (TecCrete 1250).
- C. Exposed-Concrete-Surface Panels: Fabricated with bottom pan that is die formed from metallic-coated steel sheet and filled with lightweight concrete that is reinforced and bonded to pan by shear ties. Surface is to be prepped for carpet tile as scheduled.

2.4 UNDERSTRUCTURE

- A. Pedestals: Assembly consisting of base, column with provisions for height adjustment, and head (cap); made of steel.
1. Provide pedestals designed for use in seismic applications.
 2. Base: Square or circular base with not less than 16 sq. in. of bearing area.
 3. Column: Of height required to bring finished floor to elevations indicated. Weld to base plate.
 4. Provide vibration-proof leveling mechanism for making and holding fine adjustments in height over a range of not less than 2 inches and for locking at a selected height, so deliberate action is required to change height setting and prevent vibratory displacement.
 5. Head: Designed to support the panel system indicated.

- a. Provide sound-deadening pads or gaskets at contact points between heads and panels.
- b. Bolted Assemblies: Provide head with four holes aligned with holes in floor panels for bolting of panels to pedestals.

2.5 FLOOR PANEL COVERINGS

- A. FloorScore Compliance: Floor panel coverings shall comply with requirements of FloorScore Standard.
- B. Carpet Tile: Static Dissipative Carpet Tile as located on drawings and type indicated in Material Finish/Color Schedule – Section 000200.

2.6 FABRICATION

- A. Fabrication Tolerances:
 - 1. Size: Plus or minus 0.020 inch of required size.
 - 2. Squareness: Plus or minus 0.015 inch between diagonal measurements across top of panel.
 - 3. Flatness: Plus or minus 0.035 inch, measured on a diagonal on top of panel.
- B. Panel Markings: Clearly and permanently mark floor panels on their underside with panel type and concentrated-load rating.
- C. Cutouts: Fabricate cutouts in floor panels for cable penetrations and service outlets. Provide reinforcement or additional support, if needed, to make panels with cutouts comply with structural performance requirements.
 - 1. Number, Size, Shape, and Location: As indicated on drawings and mechanical and electrical specifications.
 - 2. Grommets: Where indicated, fit cutouts with manufacturer's standard grommets; or, if size of cutouts exceeds maximum grommet size available, trim edge of cutouts with manufacturer's standard plastic molding with tapered top flange. Furnish removable covers for grommets.
 - 3. Provide foam-rubber pads for sealing annular space formed in cutouts by cables.

2.7 ACCESSORIES

- A. Adhesives: Manufacturer's standard adhesive for bonding pedestal bases to subfloor.
- B. Service Outlets: Standard UL-listed and -labeled assemblies, for recessed mounting flush with top of floor panels; for power, communication, and signal services; and complying with the following requirements:
 - 1. Cover and Box Type: As provided by electrical contractor.
 - 2. Location: In center of panel quadrant unless otherwise indicated.
 - 3. Receptacles and Wiring: Electrical receptacles and wiring for service outlets are specified elsewhere.
- C. Occupant Adjustable Diffusers: To be provided by mechanical contractor. Coordinate sizes and reinforcing as required.

- D. Plenum-Wall Brush Grommets: Self-sealing cable brush grommet with usable area required for passage of low voltage cabling through plenum walls – coordinate exact quantity and locations with Owner's low voltage contractor. Plenum-wall brush grommets not required at wall with fire ratings as conduit is to be provided. Frame of aluminum with passageway consists of intermediate layer of flexible EPDM rubber and interwoven nylon filaments. Provide units with plastic cable tray for support of cables and protection of wallboard.
- E. Closures: Where underfloor cavity is not enclosed by abutting walls or other construction, provide metal-closure plates with manufacturer's standard finish.
- F. Panel Lifting Device: Panel manufacturer's standard portable lifting device for each type of panel required for each computer room.
- G. Perimeter Support: Provide manufacturer's standard method for supporting panel edge and forming transition between access flooring and adjoining floor coverings at same level as access flooring.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer and manufacturer's representative present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Verify that substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, foreign deposits, and debris that might interfere with attachment of pedestals.
 - 2. Verify that concrete floor sealer and finish have been applied and cured.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Lay out floor panel installation to keep the number of cut panels at floor perimeter to a minimum. Avoid using panels cut to less than 6 inches (152 mm).
- B. Locate each pedestal, complete any necessary subfloor preparation, and vacuum subfloor to remove dust, dirt, and construction debris before beginning installation.

3.3 INSTALLATION

- A. Install access-flooring system and accessories under supervision of access-flooring manufacturer's authorized representative to produce a rigid, firm installation that complies with performance requirements and is free of instability, rocking, rattles, and squeaks.
- B. Adhesive Attachment of Pedestals: Set pedestals in adhesive, according to access-flooring manufacturer's written instructions, to provide full bearing of pedestal base on subfloor.

- C. Adjust pedestals to permit top of installed panels to be set flat, level, and to proper height.
- D. Install flooring panels securely in place, properly seated with panel edges flush. Do not force panels into place.
- E. Scribe perimeter panels to provide a close fit with adjoining construction with no voids greater than 1/8 inch (3 mm) where panels abut vertical surfaces.
- F. Cut and trim access flooring and perform other dirt-or-debris-producing activities at a remote location or as required to prevent contamination of subfloor under already-installed access flooring.
- G. Grounded Flooring Access Panel Systems: Ground flooring system as recommended by manufacturer and as needed to comply with performance requirements for electrical resistance of floor coverings.
 - 1. Panel-to-Understructure Resistance: Not more than 10 ohms as measured without floor coverings.
- H. Underfloor Dividers: Scribe and install underfloor-cavity dividers to closely fit against subfloor surfaces, and seal with mastic.
- I. Closures: Scribe closures to closely fit against subfloor and adjacent finished-floor surfaces. Set in mastic and seal to maintain plenum effect within underfloor cavity.
- J. Clean dust, dirt, and construction debris caused by floor installation, and vacuum subfloor area as installation of floor panels proceeds.
- K. Seal underfloor air cavities at construction seams, penetrations, and perimeter to control air leakage, according to manufacturer's written instructions.
- L. Install access flooring without change in elevation between adjacent panels and within the following tolerances:
 - 1. Plus or minus 1/8 inch (3 mm) from a level plane over entire access-flooring area. Coordinate with contractor to insure level and consistent transition from adjacent floor systems.

3.4 PROTECTION

- A. Prohibit traffic on access flooring for 24 hours and removal of floor panels for 72 hours after installation to allow pedestal adhesive to set.
- B. After completing installation, vacuum access flooring and cover with continuous sheets of reinforced paper or plastic. Maintain protective covering until time of Substantial Completion.
- C. Replace access-flooring panels that are stained, scratched, or otherwise damaged or that do not comply with specified requirements.

END OF SECTION 096900

Canton Police Department

BACKGROUND AUTHORIZATION REQUEST FOR CONTRACTORS, VENDORS and NON-Criminal Justice Employees who have access to Criminal Justice Information Systems and/or facilities

Individuals who have direct or indirect access to the Criminal Justice Information Systems (LEIN) shall submit to a background check prior to having unescorted access. This background check will include a state and federal fingerprint check. The Canton Police Department will determine, based upon state and federal guidelines, whether access will be granted.

By signing this authorization, the applicant grants permission to the Canton Police Department and any other public or private entity to conduct a background check for the express purpose of determining whether the applicant is eligible to access Criminal Justice Information Systems. The background search will include, but is not limited to, arrests, criminal charges, criminal convictions, and information regarding criminal justice contacts.

I affirm that I have read and fully understand the above paragraphs and I consent to the aforementioned background check.

Signature _____

Date _____

Requested By		Date	
Candidate for		Position	
Agency	<input type="checkbox"/> Temporary Employee	<input type="checkbox"/> Permanent Employee	<input type="checkbox"/> Contractor
Name of Candidate – Last	First	Middle	
Address		Apartment Number	
City		State	Zip Code
Social Security Number		Date of Birth	
Driver License Number		Sex <input type="checkbox"/> Male	<input type="checkbox"/> Female
Race <input type="checkbox"/> White	<input type="checkbox"/> Black (African American)	<input type="checkbox"/> American Indian/Alaskan Native	
<input type="checkbox"/> Hispanic	<input type="checkbox"/> Asian/Pacific Islander	<input type="checkbox"/> Other	

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AUTHORITY: 1935 PA 59
COMPLIANCE: VOLUNTARY

MATERIAL FINISH / COLOR SCHEDULE

PARTNERS 21-130
MATERIAL SCHEDULE
000200-1

Spec Section	Item	Description	Product Specified	Finish / Color	Location <i>(refer to drawings for exact locations)</i>
081416 FLUSH WOOD DOORS					
	WD-1	Pre-finished Wood Door	Masonite, Aspiro Series, Marshfield, Algoma	Wood: Red Oak Stain: Clear	
	WD-2	Pre-finished Wood Door	TSS Bullet Resistant Wood Door	Wood: Red Oak Stain: Clear	
093000 TILING					
	PT-1	Porcelain Tile	Crossville, Color Blox 2.0, 24" x 24" Floor Tile	Color / Finish: Slinky	Lobby Field Tile
	PT-2	Porcelain Tile	Crossville, Color Blox 2.0, 24" x 24" Floor Tile	Color / Finish: Tree House	Lobby Border Tile
	PT-3	Porcelain Tile	Crossville, Color Blox 2.0, 6" x 12" Cove Base	Color / Finish: Tree House	Lobby Cove Base
	PT-4	Porcelain Tile	Crossville, Color Blox 2.0, 3" x 3" Mosaic Floor Tile	Color / Finish: Slinky	Restroom Shower Floor Tile
	PT-5	Porcelain Tile	Crossville, Color Blox 2.0, 6" x 6" Floor Tile	Color / Finish: Slinky	Restroom Floor Tile
	PT-6	Porcelain Tile	Crossville, Color Blox 2.0, 4" x 12" Wall Tile	Color / Finish: Tree House	Restroom Accent Band
	PT-7	Porcelain Tile	Crossville, Color Blox 2.0, 12" x 24" Wall Tile	Color / Finish: Slinky	Restroom Wall Tile Field
		Grout	TEC	Color: To be selected from manufacturer's standard selections	

MARCH 9, 2022 / BIDDING - CONSTRUCTION

MATERIAL FINISH / COLOR SCHEDULE

PARTNERS 21-130
MATERIAL SCHEDULE
000200-2

Spec Section	Item	Description	Product Specified	Finish / Color	Location <i>(refer to drawings for exact locations)</i>
093000 CERAMIC TILE					
	CT-1	Ceramic Tile	Marazzi, Costa Clara, 3" x 12", Accent Tile	Color / Finish: CC85 Ocean Drive	Lobby Accent Wall
	CT-2	Not Used			
	CT-3	Ceramic Tile	Crossville, Color By Numbers, 4" x 12" Accent Tile	Color / Finish: Tea for Two	Break Room Back Splash
	MT-1	Metal Wall Transition		Color: To be selected from manufacturer's standard selections	
		Grout	TEC	Color: To be selected from manufacturer's standard selections	
		Grout	TEC	Color: To be selected from manufacturer's standard selections	
		Thresholds, Solid Polymer	Corian Solid Surface	Color: Canvas	
095123 ACOUSTICAL TILE CEILINGS					
	ACT-1	Acoustical Ceiling Tile	USG Radar Climplus Performance 2' x 2' x 5/8", SLT Edge, DXT Grid 9/16"	Color: White	
	ACT-2	Linear Wood Ceiling	9 Wood, Wood Grille's Series 1000	Wood: Western Hemlock Finish: Teak Stain	Lobby

MARCH 9, 2022 / BIDDING - CONSTRUCTION

MATERIAL FINISH / COLOR SCHEDULE

PARTNERS 21-130
MATERIAL SCHEDULE
000200-3

Spec Section	Item	Description	Product Specified	Finish / Color	Location <i>(refer to drawings for exact locations)</i>
096513 RESILIENT BASE AND ACCESSORIES					
	RB-1	Resilient Base	Roppe	Color:193 Black Brown	Corridors, Open Office, Private Offices, Breakroom
	RB-2	Resilient Base	Roppe	Color: 139 Deep Navy	Dispatch
	RB-3	Resilient Stair - Treads /Riser/ Landing Mats	Roppe, Rubber 95, Tapered Nose, Hammererd w/ Riser	Color: Fiesta	Stair A
096516 RESILIENT SHEET FLOORING					
	RSF-1	Safety Sheet Flooring	Altro Reliance 25	Color: Fountain D2502	Secure Corridor
096519 RESILIENT TILE FLOORING					
	LVT-1	Luxury Vinyl Tile	Patcraft, Crossover - Loose Lay, 7" x 48"	Color: Heron 00550	Breakroom
096536 STATIC CONTROL RESILIENT FLOORING					
	ESD-1	ESD Rubber Tile Flooring	Static Smart, Northland Series, 24" x 24"	Color: Nome	Dispatch and IT
096813 CARPET TILE					
	ESD-2	ESD Carpet Tile	Static Smart Plus, Level 3, Landmark Series	Color: Niagara	Dispatch,
	CPT-1	Carpet Tile	Mannington, CoDi, Automata, 18" x 36"	Color: Phoneix 83377	Corridors, Open Office, Private Offices
	CPT-2	Carpet Tile	Shaw Contract, All Access, Path Tile,	Color: Black Chocolate 34751	Lobby

MARCH 9, 2022 / BIDDING - CONSTRUCTION

MATERIAL FINISH / COLOR SCHEDULE

PARTNERS 21-130
MATERIAL SCHEDULE
000200-4

Spec Section	Item	Description	Product Specified	Finish / Color	Location <small>(refer to drawings for exact locations)</small>
097200 WALL COVERING					
	WC-1	Vinyl Wall Covering	Koroseal, Axis	Color: Whisper 1922-38	Large Conference Room
097823 PHENOLIC INTERIOR WALL PANELING					
	PWP-1	PWP	PSI, Phenolic Wall Panel, System #312	Color: Banding - Platinum Trim - Anodized	Lobby
098433 ACOUSTICAL WALL PANEL					
	AWP-1	Acoustical Wall Panel	Kinetics Noise Control, KNP-F (flat) thickness: 2 inches	Color: To be selected from manufacturer's standard finishes. Finish: To be selected from manufacturer's standard finishes	Interrogation Room
	AWP-2	Acoustic Fabric Wall Panel	Fabric-Wall	Fabric: Guilford of Main, Anchorage, Quarry Blue Track: 1" Core:FWATF	Dispatch
099123 INTERIOR PAINTING					
	PNT-1	Paint	Sherwin Williams	SW 8917 Shell White	Ceiling
	PNT-2	Paint	Sherwin Williams	SW 7043 Worldly Gray	Field
	PNT-3	Paint	Sherwin Williams	SW 7018 Dovetail	Accent
	PNT-4	Paint	Sherwin Williams	SW 6242 Bracing Blue	Accent
	PNT-5	Paint	Sherwin Williams	SW 6993 Black of Night	Lobby Exposed Ceiling

MARCH 9, 2022 / BIDDING - CONSTRUCTION

MATERIAL FINISH / COLOR SCHEDULE

PARTNERS 21-130
MATERIAL SCHEDULE
000200-5

Spec Section	Item	Description	Product Specified	Finish / Color	Location <i>(refer to drawings for exact locations)</i>
099726 CEMENTITIOUS COATINGS					
	SC-1	Sealed Concrete Stain	Schofield	Color: To be selected from manufacturer's standard selections	Corridors
102113.19 TOILET COMPARTMENTS					
	TP-1	Toilet Room Partitions & Urinal Screens	ASI, Global Partition, Black Core Phenolic	Color: Silver Gray # 3000	
102600 WALL AND DOOR PROTECTION					
	CG-1	Corner Guards	Acrovyn, SSM20AN / SSM25AN	To be selected from manufacturer's standard choices	
	RS-1	Roller Shades - Sunscreen Fabric, Room Darkening Fabric, Fascia	Draper, PW4650, 3%, Sunbloc SB9185	Sheer Color: Granite Sunbloc Color: Linge Fascia: Anodized	
123216 MANUFACTURED CASEWORK					
	PL-1	Plastic Laminate	Formica	Color / Finish: Neutral Twill / Matte 8826-58	Dispatch Cabinets
	PL-2	Plastic Laminate	Formica	Color / Finish: Elemental Concrete / Matte 8830-58	Open Office, Dispatch Countertops
	PL-3	Plastic Laminate	Pionite	Color / Finish: Moonlight Papel AV971-SD / Textured Suede	Restrooms / Lavatory Shield
	PL-4	Plastic Laminate	Pionite	Color / Finish: Love Letters AW300 SD / Textured Suede	Open Office, Break Room, Cabinets
	PL-5	Plastic Laminate	Wilsonart	Color / Finish: Aisan Sun 7951K-18 / Linearity	Lobby

MARCH 9, 2022 / BIDDING - CONSTRUCTION

MATERIAL FINISH / COLOR SCHEDULE

PARTNERS 21-130
MATERIAL SCHEDULE
000200-6

Spec Section	Item	Description	Product Specified	Finish / Color	Location <i>(refer to drawings for exact locations)</i>
123661.16 SOLID SURFACING COUNTERTOPS					
	SS-1	Countertop	Wilsonart, Quartz	Color: Lyra Q2001	Lobby
	SS-2	NOT USED			
	SS-3	Countertop	Countertop	Color: VIA Augusta Q4024	Dispatch, Breakroom, Work Room

MARCH 9, 2022 / BIDDING - CONSTRUCTION



AIA[®] Document A701[™] – 2018

Instructions to Bidders

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

Canton Township Public Safety Building Interior Renovations PIA #130
1150 S. Canton Center Road
Canton, MI 48188

THE OWNER:

(Name, legal status, address, and other information)

Charter Township of Canton
1150 S. Canton Center Road
Canton, Michigan 48188

THE ARCHITECT:

(Name, legal status, address, and other information)

PARTNERS in Architecture, PLC
65 Market Street
Mount Clemens, MI 48043
Telephone Number: 586-469-3600

TABLE OF ARTICLES

1	DEFINITIONS
2	BIDDER'S REPRESENTATIONS
3	BIDDING DOCUMENTS
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6	POST-BID INFORMATION
7	PERFORMANCE BOND AND PAYMENT BOND
8	ENUMERATION OF THE PROPOSED CONTRACT DOCUMENTS

ADDITIONS AND DELETIONS:

The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

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

FEDERAL, STATE, AND LOCAL LAWS MAY IMPOSE REQUIREMENTS ON PUBLIC PROCUREMENT CONTRACTS. CONSULT LOCAL AUTHORITIES OR AN ATTORNEY TO VERIFY REQUIREMENTS APPLICABLE TO THIS PROCUREMENT BEFORE COMPLETING THIS FORM.

It is intended that AIA Document G612[™]–2017, Owner's Instructions to the Architect, Parts A and B will be completed prior to using this document.

ARTICLE 1 DEFINITIONS

§ 1.1 Bidding Documents include the Bidding Requirements and the Proposed Contract Documents. The Bidding Requirements consist of the advertisement or invitation to bid, Instructions to Bidders, supplementary instructions to bidders, the bid form, and any other bidding forms. The Proposed Contract Documents consist of the unexecuted form of Agreement between the Owner and Contractor and that Agreement's Exhibits, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, all Addenda, and all other documents enumerated in Article 8 of these Instructions.

§ 1.2 Definitions set forth in the General Conditions of the Contract for Construction, or in other Proposed Contract Documents apply to the Bidding Documents.

§ 1.3 Addenda are written or graphic instruments issued by the Architect, which, by additions, deletions, clarifications, or corrections, modify or interpret the Bidding Documents.

§ 1.4 A Bid is a complete and properly executed proposal to do the Work for the sums stipulated therein, submitted in accordance with the Bidding Documents.

§ 1.5 The Base Bid is the sum stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents, to which Work may be added or deleted by sums stated in Alternate Bids.

§ 1.6 An Alternate Bid (or Alternate) is an amount stated in the Bid to be added to or deducted from, or that does not change, the Base Bid if the corresponding change in the Work, as described in the Bidding Documents, is accepted.

§ 1.7 A Unit Price is an amount stated in the Bid as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, as described in the Bidding Documents.

§ 1.8 A Bidder is a person or entity who submits a Bid and who meets the requirements set forth in the Bidding Documents.

§ 1.9 A Sub-bidder is a person or entity who submits a bid to a Bidder for materials, equipment, or labor for a portion of the Work.

ARTICLE 2 BIDDER'S REPRESENTATIONS

§ 2.1 By submitting a Bid, the Bidder represents that:

- .1 the Bidder has read and understands the Bidding Documents;
- .2 the Bidder understands how the Bidding Documents relate to other portions of the Project, if any, being bid concurrently or presently under construction;
- .3 the Bid complies with the Bidding Documents;
- .4 the Bidder has visited the site, become familiar with local conditions under which the Work is to be performed, and has correlated the Bidder's observations with the requirements of the Proposed Contract Documents;
- .5 the Bid is based upon the materials, equipment, and systems required by the Bidding Documents without exception; and
- .6 the Bidder has read and understands the provisions for liquidated damages, if any, set forth in the form of Agreement between the Owner and Contractor.

ARTICLE 3 BIDDING DOCUMENTS

§ 3.1 Distribution

§ 3.1.1 Bidders shall obtain complete Bidding Documents, as indicated below, from the issuing office designated in the advertisement or invitation to bid, for the deposit sum, if any, stated therein.

(Indicate how, such as by email, website, host site/platform, paper copy, or other method Bidders shall obtain Bidding Documents.)

§ 3.1.2 Any required deposit shall be refunded to Bidders who submit a bona fide Bid and return the paper Bidding Documents in good condition within ten days after receipt of Bids. The cost to replace missing or damaged paper documents will be deducted from the deposit. A Bidder receiving a Contract award may retain the paper Bidding Documents, and the Bidder's deposit will be refunded.

§ 3.1.3 Bidding Documents will not be issued directly to Sub-bidders unless specifically offered in the advertisement or invitation to bid, or in supplementary instructions to bidders.

§ 3.1.4 Bidders shall use complete Bidding Documents in preparing Bids. Neither the Owner nor Architect assumes responsibility for errors or misinterpretations resulting from the use of incomplete Bidding Documents.

§ 3.1.5 The Bidding Documents will be available for the sole purpose of obtaining Bids on the Work. No license or grant of use is conferred by distribution of the Bidding Documents.

§ 3.2 Modification or Interpretation of Bidding Documents

§ 3.2.1 The Bidder shall carefully study the Bidding Documents, shall examine the site and local conditions, and shall notify the Architect of errors, inconsistencies, or ambiguities discovered and request clarification or interpretation pursuant to Section 3.2.2.

§ 3.2.2 Requests for clarification or interpretation of the Bidding Documents shall be submitted by the Bidder in writing and shall be received by the Architect at least seven days prior to the date for receipt of Bids.
(Indicate how, such as by email, website, host site/platform, paper copy, or other method Bidders shall submit requests for clarification and interpretation.)

§ 3.2.3 Modifications and interpretations of the Bidding Documents shall be made by Addendum. Modifications and interpretations of the Bidding Documents made in any other manner shall not be binding, and Bidders shall not rely upon them.

§ 3.3 Substitutions

§ 3.3.1 The materials, products, and equipment described in the Bidding Documents establish a standard of required function, dimension, appearance, and quality to be met by any proposed substitution.

§ 3.3.2 Substitution Process

§ 3.3.2.1 Written requests for substitutions shall be received by the Architect at least ten days prior to the date for receipt of Bids. Requests shall be submitted in the same manner as that established for submitting clarifications and interpretations in Section 3.2.2.

§ 3.3.2.2 Bidders shall submit substitution requests on a Substitution Request Form if one is provided in the Bidding Documents.

§ 3.3.2.3 If a Substitution Request Form is not provided, requests shall include (1) the name of the material or equipment specified in the Bidding Documents; (2) the reason for the requested substitution; (3) a complete description of the proposed substitution including the name of the material or equipment proposed as the substitute, performance and test data, and relevant drawings; and (4) any other information necessary for an evaluation. The request shall include a statement setting forth changes in other materials, equipment, or other portions of the Work, including changes in the work of other contracts or the impact on any Project Certifications (such as LEED), that will result from incorporation of the proposed substitution.

§ 3.3.3 The burden of proof of the merit of the proposed substitution is upon the proposer. The Architect's decision of approval or disapproval of a proposed substitution shall be final.

§ 3.3.4 If the Architect approves a proposed substitution prior to receipt of Bids, such approval shall be set forth in an Addendum. Approvals made in any other manner shall not be binding, and Bidders shall not rely upon them.

§ 3.3.5 No substitutions will be considered after the Contract award unless specifically provided for in the Contract Documents.

§ 3.4 Addenda

§ 3.4.1 Addenda will be transmitted to Bidders known by the issuing office to have received complete Bidding Documents.

(Indicate how, such as by email, website, host site/platform, paper copy, or other method Addenda will be transmitted.)

§ 3.4.2 Addenda will be available where Bidding Documents are on file.

§ 3.4.3 Addenda will be issued no later than four days prior to the date for receipt of Bids, except an Addendum withdrawing the request for Bids or one which includes postponement of the date for receipt of Bids.

§ 3.4.4 Prior to submitting a Bid, each Bidder shall ascertain that the Bidder has received all Addenda issued, and the Bidder shall acknowledge their receipt in the Bid.

ARTICLE 4 BIDDING PROCEDURES

§ 4.1 Preparation of Bids

§ 4.1.1 Bids shall be submitted on the forms included with or identified in the Bidding Documents.

§ 4.1.2 All blanks on the bid form shall be legibly executed. Paper bid forms shall be executed in a non-erasable medium.

§ 4.1.3 Sums shall be expressed in both words and numbers, unless noted otherwise on the bid form. In case of discrepancy, the amount entered in words shall govern.

§ 4.1.4 Edits to entries made on paper bid forms must be initialed by the signer of the Bid.

§ 4.1.5 All requested Alternates shall be bid. If no change in the Base Bid is required, enter "No Change" or as required by the bid form.

§ 4.1.6 Where two or more Bids for designated portions of the Work have been requested, the Bidder may, without forfeiture of the bid security, state the Bidder's refusal to accept award of less than the combination of Bids stipulated by the Bidder. The Bidder shall neither make additional stipulations on the bid form nor qualify the Bid in any other manner.

§ 4.1.7 Each copy of the Bid shall state the legal name and legal status of the Bidder. As part of the documentation submitted with the Bid, the Bidder shall provide evidence of its legal authority to perform the Work in the jurisdiction where the Project is located. Each copy of the Bid shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid by a corporation shall further name the state of incorporation and have the corporate seal affixed. A Bid submitted by an agent shall have a current power of attorney attached, certifying the agent's authority to bind the Bidder.

§ 4.1.8 A Bidder shall incur all costs associated with the preparation of its Bid.

§ 4.2 Bid Security

§ 4.2.1 Each Bid shall be accompanied by the following bid security:

(Insert the form and amount of bid security.)

§ 4.2.2 The Bidder pledges to enter into a Contract with the Owner on the terms stated in the Bid and shall, if required, furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder. Should the Bidder refuse to enter into such Contract or fail to furnish such bonds if required, the amount of the bid security shall be forfeited to the Owner as liquidated damages, not as a penalty. In the event the Owner fails to comply with Section 6.2, the amount of the bid security shall not be forfeited to the Owner.

§ 4.2.3 If a surety bond is required as bid security, it shall be written on AIA Document A310™, Bid Bond, unless otherwise provided in the Bidding Documents. The attorney-in-fact who executes the bond on behalf of the surety shall affix to the bond a certified and current copy of an acceptable power of attorney. The Bidder shall provide surety bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

§ 4.2.4 The Owner will have the right to retain the bid security of Bidders to whom an award is being considered until (a) the Contract has been executed and bonds, if required, have been furnished; (b) the specified time has elapsed so that Bids may be withdrawn; or (c) all Bids have been rejected. However, if no Contract has been awarded or a Bidder has not been notified of the acceptance of its Bid, a Bidder may, beginning days after the opening of Bids, withdraw its Bid and request the return of its bid security.

§ 4.3 Submission of Bids

§ 4.3.1 A Bidder shall submit its Bid as indicated below:

(Indicate how, such as by website, host site/platform, paper copy, or other method Bidders shall submit their Bid.)

§ 4.3.2 Paper copies of the Bid, the bid security, and any other documents required to be submitted with the Bid shall be enclosed in a sealed opaque envelope. The envelope shall be addressed to the party receiving the Bids and shall be identified with the Project name, the Bidder's name and address, and, if applicable, the designated portion of the Work for which the Bid is submitted. If the Bid is sent by mail, the sealed envelope shall be enclosed in a separate mailing envelope with the notation "SEALED BID ENCLOSED" on the face thereof.

§ 4.3.3 Bids shall be submitted by the date and time and at the place indicated in the invitation to bid. Bids submitted after the date and time for receipt of Bids, or at an incorrect place, will not be accepted.

§ 4.3.4 The Bidder shall assume full responsibility for timely delivery at the location designated for receipt of Bids.

§ 4.3.5 A Bid submitted by any method other than as provided in this Section 4.3 will not be accepted.

§ 4.4 Modification or Withdrawal of Bid

§ 4.4.1 Prior to the date and time designated for receipt of Bids, a Bidder may submit a new Bid to replace a Bid previously submitted, or withdraw its Bid entirely, by notice to the party designated to receive the Bids. Such notice shall be received and duly recorded by the receiving party on or before the date and time set for receipt of Bids. The receiving party shall verify that replaced or withdrawn Bids are removed from the other submitted Bids and not considered. Notice of submission of a replacement Bid or withdrawal of a Bid shall be worded so as not to reveal the amount of the original Bid.

§ 4.4.2 Withdrawn Bids may be resubmitted up to the date and time designated for the receipt of Bids in the same format as that established in Section 4.3, provided they fully conform with these Instructions to Bidders. Bid security shall be in an amount sufficient for the Bid as resubmitted.

§ 4.4.3 After the date and time designated for receipt of Bids, a Bidder who discovers that it made a clerical error in its Bid shall notify the Architect of such error within two days, or pursuant to a timeframe specified by the law of the jurisdiction where the Project is located, requesting withdrawal of its Bid. Upon providing evidence of such error to the reasonable satisfaction of the Architect, the Bid shall be withdrawn and not resubmitted. If a Bid is withdrawn pursuant to this Section 4.4.3, the bid security will be attended to as follows:

(State the terms and conditions, such as Bid rank, for returning or retaining the bid security.)

ARTICLE 5 CONSIDERATION OF BIDS

§ 5.1 Opening of Bids

If stipulated in an advertisement or invitation to bid, or when otherwise required by law, Bids properly identified and received within the specified time limits will be publicly opened and read aloud. A summary of the Bids may be made available to Bidders.

§ 5.2 Rejection of Bids

Unless otherwise prohibited by law, the Owner shall have the right to reject any or all Bids.

§ 5.3 Acceptance of Bid (Award)

§ 5.3.1 It is the intent of the Owner to award a Contract to the lowest responsive and responsible Bidder, provided the Bid has been submitted in accordance with the requirements of the Bidding Documents. Unless otherwise prohibited by law, the Owner shall have the right to waive informalities and irregularities in a Bid received and to accept the Bid which, in the Owner's judgment, is in the Owner's best interests.

§ 5.3.2 Unless otherwise prohibited by law, the Owner shall have the right to accept Alternates in any order or combination, unless otherwise specifically provided in the Bidding Documents, and to determine the lowest responsive and responsible Bidder on the basis of the sum of the Base Bid and Alternates accepted.

ARTICLE 6 POST-BID INFORMATION

§ 6.1 Contractor's Qualification Statement

Bidders to whom award of a Contract is under consideration shall submit to the Architect, upon request and within the timeframe specified by the Architect, a properly executed AIA Document A305™, Contractor's Qualification Statement, unless such a Statement has been previously required and submitted for this Bid.

§ 6.2 Owner's Financial Capability

A Bidder to whom award of a Contract is under consideration may request in writing, fourteen days prior to the expiration of the time for withdrawal of Bids, that the Owner furnish to the Bidder reasonable evidence that financial arrangements have been made to fulfill the Owner's obligations under the Contract. The Owner shall then furnish such reasonable evidence to the Bidder no later than seven days prior to the expiration of the time for withdrawal of Bids. Unless such reasonable evidence is furnished within the allotted time, the Bidder will not be required to execute the Agreement between the Owner and Contractor.

§ 6.3 Submittals

§ 6.3.1 After notification of selection for the award of the Contract, the Bidder shall, as soon as practicable or as stipulated in the Bidding Documents, submit in writing to the Owner through the Architect:

- .1 a designation of the Work to be performed with the Bidder's own forces;
- .2 names of the principal products and systems proposed for the Work and the manufacturers and suppliers of each; and
- .3 names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for the principal portions of the Work.

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

§ 6.3.3 Prior to the execution of the Contract, the Architect will notify the Bidder if either the Owner or Architect, after due investigation, has reasonable objection to a person or entity proposed by the Bidder. If the Owner or Architect has reasonable objection to a proposed person or entity, the Bidder may, at the Bidder's option, withdraw the Bid or submit an acceptable substitute person or entity. The Bidder may also submit any required adjustment in the Base Bid or Alternate Bid to account for the difference in cost occasioned by such substitution. The Owner may accept the adjusted bid price or disqualify the Bidder. In the event of either withdrawal or disqualification, bid security will not be forfeited.

§ 6.3.4 Persons and entities proposed by the Bidder and to whom the Owner and Architect have made no reasonable objection must be used on the Work for which they were proposed and shall not be changed except with the written consent of the Owner and Architect.

ARTICLE 7 PERFORMANCE BOND AND PAYMENT BOND

§ 7.1 Bond Requirements

§ 7.1.1 If stipulated in the Bidding Documents, the Bidder shall furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder.

§ 7.1.2 If the furnishing of such bonds is stipulated in the Bidding Documents, the cost shall be included in the Bid. If the furnishing of such bonds is required after receipt of bids and before execution of the Contract, the cost of such bonds shall be added to the Bid in determining the Contract Sum.

§ 7.1.3 The Bidder shall provide surety bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

§ 7.1.4 Unless otherwise indicated below, the Penal Sum of the Payment and Performance Bonds shall be the amount of the Contract Sum.

(If Payment or Performance Bonds are to be in an amount other than 100% of the Contract Sum, indicate the dollar amount or percentage of the Contract Sum.)

§ 7.2 Time of Delivery and Form of Bonds

§ 7.2.1 The Bidder shall deliver the required bonds to the Owner not later than three days following the date of execution of the Contract. If the Work is to commence sooner in response to a letter of intent, the Bidder shall, prior to commencement of the Work, submit evidence satisfactory to the Owner that such bonds will be furnished and delivered in accordance with this Section 7.2.1.

§ 7.2.2 Unless otherwise provided, the bonds shall be written on AIA Document A312, Performance Bond and Payment Bond.

§ 7.2.3 The bonds shall be dated on or after the date of the Contract.

§ 7.2.4 The Bidder shall require the attorney-in-fact who executes the required bonds on behalf of the surety to affix to the bond a certified and current copy of the power of attorney.

ARTICLE 8 ENUMERATION OF THE PROPOSED CONTRACT DOCUMENTS

§ 8.1 Copies of the proposed Contract Documents have been made available to the Bidder and consist of the following documents:

- .1 AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor, unless otherwise stated below.
(Insert the complete AIA Document number, including year, and Document title.)
- .2 AIA Document A101™–2017, Exhibit A, Insurance and Bonds, unless otherwise stated below.
(Insert the complete AIA Document number, including year, and Document title.)
- .3 AIA Document A201™–2017, General Conditions of the Contract for Construction, unless otherwise stated below.
(Insert the complete AIA Document number, including year, and Document title.)
- .4 AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, dated as indicated below:
(Insert the date of the E203-2013.)
- .5 Drawings

	Number	Title	Date	
.6	Specifications			
	Section	Title	Date	Pages
.7	Addenda:			
	Number	Date	Pages	
.8	Other Exhibits:			
	<i>(Check all boxes that apply and include appropriate information identifying the exhibit where required.)</i>			
	<input type="checkbox"/>	AIA Document E204™–2017, Sustainable Projects Exhibit, dated as indicated below: <i>(Insert the date of the E204-2017.)</i>		
	<input type="checkbox"/>	The Sustainability Plan:		
	Title	Date	Pages	
	<input type="checkbox"/>	Supplementary and other Conditions of the Contract:		
	Document	Title	Date	Pages
.9	Other documents listed below:			
	<i>(List here any additional documents that are intended to form part of the Proposed Contract Documents.)</i>			

Additions and Deletions Report for

AIA® Document A701™ – 2018

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

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PAGE 1

Canton Township Public Safety Building Interior Renovations PIA #130
1150 S. Canton Center Road
Canton, MI 48188

...

Charter Township of Canton
1150 S. Canton Center Road
Canton, Michigan 48188

...

PARTNERS in Architecture, PLC
65 Market Street
Mount Clemens, MI 48043
Telephone Number: 586-469-3600

Certification of Document's Authenticity

AIA® Document D401™ – 2003

I, _____, hereby certify, to the best of my knowledge, information and belief, that I created the attached final document simultaneously with its associated Additions and Deletions Report and this certification at 14:33:13 ET on 03/07/2022 under Order No. 2114290003 from AIA Contract Documents software and that in preparing the attached final document I made no changes to the original text of AIA® Document A701™ – 2018, Instructions to Bidders, as published by the AIA in its software, other than those additions and deletions shown in the associated Additions and Deletions Report.

(Signed)

(Title)

(Dated)

SECTION 002213 - SUPPLEMENTARY INSTRUCTIONS TO BIDDERS

1.1 INSTRUCTIONS TO BIDDERS

- A. Instructions to Bidders for Project consist of the following:
 - 1. AIA Document A701, "Instructions to Bidders," a copy of which is bound in this Project Manual.
 - 2. The following Supplementary Instructions to Bidders modify and add to the requirements of the Instructions to Bidders.

1.2 SUPPLEMENTARY INSTRUCTIONS TO BIDDERS, GENERAL

- A. The following supplements modify AIA Document A701, "Instructions to Bidders." Where a portion of the Instructions to Bidders is modified or deleted by these Supplementary Instructions to Bidders, unaltered portions of the Instructions to Bidders shall remain in effect.

1.3 ARTICLE 1 - DEFINITIONS

- A. No modifications.

1.4 ARTICLE 2 - BIDDER'S REPRESENTATIONS

- A. Add Section 2.1.3.1:
 - 1. 2.1.3.1 - The Bidder has investigated all required fees, permits, and regulatory requirements of authorities having jurisdiction and has properly included in the submitted bid the cost of such fees, permits, and requirements not otherwise indicated as provided by Owner.
- B. Add Section 2.1.7:
 - 1. 2.1.7 - The Bidder is a properly licensed Contractor according to the laws and regulations of The State of Michigan and meets qualifications indicated in the Procurement and Contracting Documents.
- C. Add Section 2.1.8:
 - 1. 2.1.8 - The Bidder has incorporated into the Bid adequate sums for work performed by installers whose qualifications meet those indicated in the Procurement and Contracting Documents.

1.5 ARTICLE 3 - BIDDING DOCUMENTS

- A. Delete Paragraph 3.1.1 in its entirety and substitute the following:
 - 1. 3.1.1 - Bidders shall obtain complete bidding documents from the Architect. Bid documents will be available in electronic (PDF format), from the Architect.

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SUPPLEMENTARY INSTRUCTIONS TO BIDDERS
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- B. Section 3.2.2: Add the following: All questions shall be submitted in writing to the Architect no later than the date specified in the advertisement for bids. If no date is specified, no later than 7 days prior to the bid due date.
- C. Add Section 3.3.6:
 - 1. 3.3.6 - Where the Contractor chooses to use an item approved by request but other than one shown on the details or specified, he shall be responsible for the coordination of any necessary changes in other work, and shall bear the cost of such changes.
- D. 3.4 - Addenda:
 - 1. Delete Paragraph 3.4.1 in its entirety and replace with the following:
 - a. 3.4.1: Addenda will be issued in PDF format and will be posted in the same location (cloud platform) of where the bid documents were obtained from. It is the bidder's responsibility to check for and obtain addenda.
 - 2. Delete Paragraph 3.4.3 and replace with the following:
 - a. 3.4.3 - Addenda may be issued at any time prior to the receipt of bids.
 - 3. Add Section 3.4.4.1:
 - a. 3.4.4.1 - Owner may elect to waive the requirement for acknowledging receipt of 3.4.4 Addenda as follows:
 - 1) 3.4.4.1.1 - Information received as part of the Bid indicates that the Bid, as submitted, reflects modifications to the Procurement and Contracting Documents included in an unacknowledged Addendum.
 - 2) 3.4.4.1.2 - Modifications to the Procurement and Contracting Documents in an unacknowledged Addendum do not, in the opinion of Owner, affect the Contract Sum or Contract Time.

1.6 ARTICLE 4 - BIDDING PROCEDURES

- A. 4.1 - Preparation of Bids:
 - 1. Add Section 4.1.9:
 - a. 4.1.9 - Owner may elect to disqualify a bid due to failure to submit a bid in the form requested, failure to bid requested alternates or unit prices, failure to complete entries in all blanks in the Bid Form, or inclusion by the Bidder of any alternates, conditions, limitations or provisions not called for.
- B. Delete Section 4.2.1 in its entirety and substitute the following:
 - 1. 4.2.1 - No bid will be considered, unless it is accompanied by a certified check, cashier's check or acceptable Bid Bond payable without condition to the Owner, in an amount equal to (5%) of the total bid. The certified check, cashier's check or Bid Bond which must accompany each bid is required as a guarantee that the bidder will enter into a contract with the Owner for the work

described in the proposal and furnish a performance and payment bond and certificates of insurance as specified after notice by the Owner or Architect that contracts have been awarded to them and are ready for execution.

C. Add Section 4.2.4.1:

1. 4.2.4.1 - The Bid Security of the three lowest bidders will be retained until the contract has been awarded and executed, but not longer than (75) days. The Bid Security of other bidders will be returned within a reasonable time after the opening of bids.

D. 4.3.1 – Add the following: The Bidder shall submit their bid as described in the advertisement for bids.

E. Add Section 4.3.6 as follows:

1. 4.3.6: The Bidder shall submit with their bid the following information:
 - a. Items listed and described in Specification Section 003000 – Required Bid submission Materials.

F. 4.4 - Modification or Withdrawal of Bids:

1. Section 4.4.3: Add the following: The bid security may be retained as determined by the Owner.
2. Add Section 4.4.1.1:
 - a. 4.4.1.1 – Bids may not be withdrawn for a period of sixty (60) days from the bid opening date.

G. 4.5 - Break-Out Pricing Bid Supplement:

1. Add Section 4.5:
 - a. 4.5 - Provide detailed cost breakdowns (schedule of values) no later than one business day following Architect's request during the Architect's post bid review phase.

H. 4.6 - Subcontractors, Suppliers, and Manufacturers List Bid Supplement:

1. Add Section 4.6:
 - a. 4.6 - Provide list of major subcontractors, suppliers, and manufacturers furnishing or installing products no later than two business days following Architect's request during the Architect's post bid review phase. Include those subcontractors, suppliers, and manufacturers providing work totaling three percent or more of the Bid amount. Upon award of construction contract, the successful bidder shall not change subcontractors, suppliers, or manufacturers from those submitted to Architect during the post bid review process, without approval of Architect.

1.7 ARTICLE 5 - CONSIDERATION OF BIDS

A. 5.2 - Rejection of Bids:

1. Add Section 5.2.1:

- a. 5.2.1 - Owner reserves the right to reject a bid based on Owner's and Architect's evaluation of qualification information submitted with the bid as well as any other information obtained following the opening of bids. Owner's evaluation of the Bidder's qualifications will include (but not be limited to): status of licensure and record of compliance with licensing requirements, record of quality of completed work, record of Project completion and ability to complete, record of financial management including financial resources available to complete Project and record of timely payment of obligations, record of Project site management including compliance with requirements of authorities having jurisdiction, record of and number of current claims and disputes and the status of their resolution, experience with similar projects, and qualifications of the Bidder's proposed Project staff and proposed subcontractors.

1.8 ARTICLE 6 – POST-BID INFORMATION

A. 6.1 - Contractor's Qualification Statement:

1. Add Section 6.1.1:

- a. 6.1.1 – Contractor's Qualification Statement is to be submitted with bid.

B. 6.3 - Submittals:

1. Add Section 6.3.1.4:

- a. 6.3.1.4 - Submit information requested in Sections 6.3.1.1, 6.3.1.2, and 6.3.1.3 no later than two business days following Architect's request.

2. Add Section 6.3.1.5:

- a. 6.3.1.5 – Post Bid Interviews: Temperature Controls Contractor Bids shall be separately identified. The Owner and Project Design Team shall conduct one hour presentations with prospective TC Contractors that shall be a factor for selecting the TC Contractor for the project. Screen connection for Laptop presentation materials shall be made available to present graphical examples. TC Contractor presentation shall include, but not be limited to the following:
 - i. Company information and short history.
 - ii. Company size and staff organization.
 - iii. Project resume.
 - iv. User Graphical Interface Examples.
 - v. Training philosophy and offerings.
 - vi. Service Options.

1.9 ARTICLE 7 - PERFORMANCE BOND AND PAYMENT BOND

A. 7.1 - Bond Requirements:

1. Add Section 7.1.1.1

- a. 7.1.1.1 - Both a Performance Bond and a Payment Bond will be required, each in an amount equal to 100 percent of the Contract Sum.
- b. 7.1.1.2 – Contractor to provide Maintenance and Guarantee Bond in an amount equal to the Contract Amount for the workmanship and materials for the work identified in the Agreement and said Bond shall cover a two-year period after completion of the project and final written acceptance and issuance of final payment by the Owner.

B. 7.2 - Time of Delivery and Form of Bonds:

1. Delete the first sentence of Section 7.2.1 and insert the following:

- a. The Bidder shall deliver the required bonds to Owner no later than 10 days after the date of Notice of Intent to Award and no later than the date of execution of the Contract, whichever occurs first. Owner may deem the failure of the Bidder to deliver required bonds within the period of time allowed a default.

2. Delete Section 7.2.3 and insert the following:

- a. 7.2.3 - Bonds shall be executed and be in force on the date of the execution of the Contract.

1.10 ARTICLE 8 – ENUMERATION OF THE PROPOSED CONTRACT DOCUMENTS

A. Delete Paragraph 8.1.4.

1.11 ARTICLE 9 - EXECUTION OF THE CONTRACT

A. Add Article 9:

1. 9.1.1 - Subsequent to the Notice of Intent to Award, and within 10 days after the prescribed Form of Agreement is presented to the Awardee for signature, the Awardee shall execute and deliver the Agreement to Owner through Architect in such number of counterparts as Owner may require.
2. 9.1.2 - Owner may deem as a default the failure of the Awardee to execute the Contract and to supply the required bonds when the Agreement is presented for signature within the period of time allowed.
3. 9.1.3 - Unless otherwise indicated in the Procurement and Contracting Documents or the executed Agreement, the date of commencement of the Work shall be the date of the executed Agreement.
4. 9.1.4 - In the event of a default, Owner may declare the amount of the Bid security forfeited and elect to either award the Contract to the next responsible bidder or re-advertise for bids.

END OF SECTION 002213

SECTION 003000 –REQUIRED BID SUBMISSION MATERIALS

PART 1 - GENERAL

1.1 SUMMARY

- A. Following this page is the Bid Form. Bidder must completely fill out the Bid Form and Submit (1) original and (1) copy, by the date and time specified.
- B. Bidder must submit with the bid, "Bid Security" as described in specifications Section 002213.
- C. Bidder must submit a Complete Contractor's Qualification Statement in accordance with Specification Section 003111.

END OF SECTION 003000

BID FORM

BID PROPOSAL FOR: **Canton Township Public Safety – Public Safety Building Interior Renovations**

BID TO: **Clerk's Office
CHARTER TOWNSHIP OF CANTON
1150 S. CANTON CENTER ROAD
CANTON, MI 48188**

BID DUE DATE: **MARCH 31, 2022 @ 3:00PM**

BIDDERS NAME: _____

We have examined the Contract Documents for the proposed project as prepared by PARTNERS in Architecture, PLC.

In accordance therewith, the undersigned proposes to furnish all labor and materials for construction as set forth in the Contract Documents, including the following Addenda, if any (fill in the addenda number, thus confirming receipt):

Addendum Number _____ Addendum Number _____

Addendum Number _____ Addendum Number _____

1. Accompanying the proposal is a bid security for work required to be furnished by the Contract Documents, the same being subject to forfeiture in the event of default by the undersigned.
2. I agree to complete the Project, by the dates listed in Specification Section 011000 – Summary; provided that a notice to proceed is issued within thirty (30) days.
3. I understand that the Owner reserves the right to reject any or all bids, and it is agreed that this bid may not be withdrawn for a period of sixty (60) days from the opening thereof.
5. Attached herewith are the documents requested in the Supplementary Instructions to Bidders, Specification Section 002213, paragraph 4.3.5.

A. BASE BID: (Insert a base bid amount in the blank provided).

_____ Dollars \$
(Write our bid in words)

B. ALLOWANCES: Refer to section 012100 for a complete description

(These amounts are included in the "Base Bid" amount listed on the bid form)

1. Allowance No. 1: Building Permit Procurement \$ _____
(Enter value of allowance noted in Section 012100)

C. UNIT PRICES: Refer to section 012200 for a complete description

1. Unit Price No. 1: Acoustic Lay-in Ceiling Tile \$ _____ per Sq. Ft.
(Enter value of unit price)

D. SCHEDULE: Refer to Specification Section 011000 for schedule requirements.

(Fill in proposed substantial completion date)

E. NON-IRAN LINKED BUSINESSES

By signing below, I certify and agree on behalf of myself and the company submitting this proposal the following: (1) that I am duly authorized to legally bind the company submitting this proposal; and (2) that the company submitting this proposal is not an "Iran linked business," as that term is defined in Section 2(e) of the Iran Economic Sanctions Act, being Michigan Public Act No. 517 of 2012; and (3) that I and the company submitting this proposal will immediately comply with any further certifications or information submissions requested by The Charter Township of Canton.

F. BACKGROUND AUTHORIZATION REQUEST FOR CONTRACTORS, VENDORS and NON-CRIMINAL JUSTICE EMPLOYEES.

By signing this authorization, the applicant grants permission to the Canton Police Department and any other public or private entity to conduct a background check for the express purpose to determine if access to the building can be allowed. The background search will include, but is not limited to, arrests, criminal charges, criminal convictions, and information regarding criminal justice contacts.

G. COMPANY / CONTACT INFORMATION

Company Name: _____

Contact Name: _____

Address: _____

Phone Number: _____ Cell Number: _____

Email: _____

Corporate Officer Name: _____ Title _____

Corporate Officer Signature: _____ Date: _____

Federal ID Number : _____

END OF BID FORM

CONTRACTOR'S QUALIFICATION STATEMENT FOR GENERAL CONTRACTORS

CHARTER TOWNSHIP OF CANTON PUBLIC SAFETY BUILDING INTERIOR RENOVATIONS

INSTRUCTIONS AND PROCEDURES

All Bidders must submit with their bid, a completed AIA A305-2020 Contractor's Qualification Statement and associated Exhibits A - E, as modified below and containing the additional requested information.

- A. GENERAL INFORMATION. The Charter Township of Canton is requesting qualifications from interested General Contractors that are submitting a bid for the Proposed Interior Renovations to the Public Safety Building, located at 1150 S. Canton Center Road, Canton, MI 48188.

The completed Contractor's Qualification Statements will be evaluated by The Charter Township of Canton in conjunction with the submitted bids to determine the lowest responsible bid.

- B. MINIMUM QUALIFICATION CRITERIA. Prospective bidders shall have the following minimum qualifications.

1. The Contractor shall have been in business under the present company name for a minimum of five (5) years and shall not have been declared in default on any construction contract within that time or have any pending judgements.
2. The Contractor shall have completed at least three (3) municipal / institutional projects with each project having a construction value of at least \$1,500,000, within the last ten (10) years.
3. The Contractor shall have demonstrated abilities and documented processes to effectively manage a construction project, maintain a construction schedule and expeditiously close out a project.
4. The Contractor shall be able to provide a 100% payment and performance bond for the project and must be able to provide the specified insurances.

- C. CONTRACTOR'S QUALIFICATION STATEMENT. Contractor shall submit a completed AIA A305-2020 Contractor's Qualification Statement and associated Exhibits as listed below:

- Exhibit A – General Information
- Exhibit B – Financial and Performance Information
- Exhibit C – Project Specific Information
- Exhibits D & E – Contractor's Past Project Experience

1. Provide the information requested in AIA A305-2020, (including exhibits) as well as the additional / modified information requested below:

- a. Exhibit A – Add paragraph A3.6 - Provide a specific project management plan and milestone schedule for this project, be sure to consider phases. Provide enough detail to convey your understanding of the project as well as how you will deliver a successful project.
- b. Exhibit A – Add paragraph A5.1 - Explain why your Company is best suited for this project.

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CONTRACTOR'S QUALIFICATION STATEMENT
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- c. Exhibit C - Revise Paragraph C1.4 to read: Include resumes of specific personnel likely to be assigned to this project for the roles of: principal, project manager, project engineer and construction site superintendent. Provide relevant project experience of each individual as well as their current workloads (commitments for other projects). Provide a detailed description of their role for this project, include indications of time commitment (ie: full time, ½ time, etc.).
- d. Exhibit D – In addition to listing (4) recent / completed projects, include a listing of all construction projects your organization has in process, giving the name of the project, owner, owner's contact name and phone number, architect, architect's contact name and phone number, initial contract amount, change order costs to date, scheduled and anticipated completion dates and percentage of the work being performed with your own forces.

D. EVALUATION

- 1. Process. Firms submitting their bids and Contractor's Qualification Statement will be evaluated by the Charter Township of Canton as well as their Architect. The evaluation will be based on the information provided in the firm's submission, oral interviews, as well as any other information the Township or the Architect obtains. Contractors will not only be evaluated on bid price, but also: contractor's technical understanding of the project, contractor's project management approach to accomplishing the project, contractor's capacity and capability to perform and contractor's past project experience.
- 2. Firms which have submitted incomplete information may be provided an opportunity to correct any deficiencies which is at the sole discretion of the Township. The Township will notify the contractor in writing indicating the specific items which need to be addressed in order to be considered for this project.
- 3. The Township expressly reserves the right to reject any and all bids, including the bid of any contractor that is not reasonably determined to be "responsible" in conjunction with the submitted information, evaluation factors or the Responsibility Criteria outlined below. The Township may consider the following information in determining whether a contractor is a Responsible Contractor. This is not intended to be an all-inclusive or exhaustive list.

E. RESPONSIBILITY CRITERIA

- 1. General information about the contractor's company, its principals, and its history, including state, date of formation and type of legal entity which the contractor utilizes to perform its business.
- 2. Evidence that the contractor and its employee(s) are appropriately licensed and are certified to perform the work that has been bid.
- 3. A confirmation that all subcontractors, employees and other individuals working on the Construction Project will maintain current applicable licenses and certifications with all appropriate licensing agencies including the Michigan Bureau of Construction Codes and Fire Safety, or any successor agency, and as may otherwise be required by law for all licensed occupations and professions.
- 4. Documentation that contractor has implemented a MIOSHA-approved safety/training program for employees used on the proposed job site.
- 5. A detailed description of the warranty statement covering labor and materials, which will be provided by the contractor if it is awarded the contract.

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CONTRACTOR'S QUALIFICATION STATEMENT
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6. A list of any and all litigation or arbitrations involving the contractor within the past five (5) years, including an explanation of the circumstances surrounding the dispute, the remedy sought, and how the dispute was resolved or, if pending, the status of the litigation or arbitration.
7. Evidence of insurance, including certificates of insurance, confirming existence and amount of coverage for liability, property damage, workers compensation, and any other insurances required by the proposed contract documents, if it is awarded the contract.
8. References from individuals or entities that have received in the past ten (10) years, or that are currently receiving, the contractor's services, including information regarding records of performance and job site cooperation.
9. A detailed description of any quality assurance program used by the contractor.
10. Evidence of the existence of a drug and alcohol program which will prevent all of the contractor's employees from entering Township property under the influence of drugs or alcohol for each employee that will be working on the job site.
11. Evidence of the existence of criminal records check procedure for each employee that will be working on the job site.
12. Any other relevant expertise, equipment, or ability of the contractor to perform the Construction Project, or relevant portion thereof.

END OF SECTION 003111

AIA[®] Document A305[™] – 2020

Contractor's Qualification Statement

THE PARTIES SHOULD EXECUTE A SEPARATE CONFIDENTIALITY AGREEMENT IF THEY INTEND FOR ANY OF THE INFORMATION IN THIS A305-2020 TO BE HELD CONFIDENTIAL.

SUBMITTED BY: _____ **SUBMITTED TO:** _____
(Organization name and address.) (Organization name and address.)

TYPE OF WORK TYPICALLY PERFORMED

(Indicate the type of work your organization typically performs, such as general contracting, construction manager as constructor services, HVAC contracting, electrical contracting, plumbing contracting, or other.)

THIS CONTRACTOR'S QUALIFICATION STATEMENT INCLUDES THE FOLLOWING:

(Check all that apply.)

- ☐ Exhibit A – General Information
- ☐ Exhibit B – Financial and Performance Information
- ☐ Exhibit C – Project-Specific Information
- ☐ Exhibit D – Past Project Experience
- ☐ Exhibit E – Past Project Experience (Continued)

CONTRACTOR CERTIFICATION

The undersigned certifies under oath that the information provided in this Contractor's Qualification Statement is true and sufficiently complete so as not to be misleading.

Organization's Authorized Representative
Signature

Date

Printed Name and Title

NOTARY

State of:

County of:

Signed and sworn to before me this ____ day of _____

Notary Signature

My commission expires:

ADDITIONS AND DELETIONS:

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(Signed)

(Title)

(Dated)



AIA[®] Document A305[™] – 2020 Exhibit A

General Information

This Exhibit is part of the Contractor's Qualification Statement, submitted by _____ and dated the _____ day of _____ in the year _____.
(In words, indicate day, month and year.)

§ A.1 ORGANIZATION

§ A.1.1 Name and Location

§ A.1.1.1 Identify the full legal name of your organization.

§ A.1.1.2 List all other names under which your organization currently does business and, for each name, identify jurisdictions in which it is registered to do business under that trade name.

§ A.1.1.3 List all prior names under which your organization has operated and, for each name, indicate the date range and jurisdiction in which it was used.

§ A.1.1.4 Identify the address of your organization's principal place of business and list all office locations out of which your organization conducts business. If your organization has multiple offices, you may attach an exhibit or refer to a website.

§ A.1.2 Legal Status

§ A.1.2.1 Identify the legal status under which your organization does business, such as sole proprietorship, partnership, corporation, limited liability corporation, joint venture, or other.

- .1 If your organization is a corporation, identify the state in which it is incorporated, the date of incorporation, and its four highest-ranking corporate officers and their titles, as applicable.
- .2 If your organization is a partnership, identify its partners and its date of organization.
- .3 If your organization is individually owned, identify its owner and date of organization.

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- .4** If the form of your organization is other than those listed above, describe it and identify its individual leaders:

§ A.1.2.2 Does your organization own, in whole or in part, any other construction-related businesses? If so, identify and describe those businesses and specify percentage of ownership.

§ A.1.3 Other Information

§ A.1.3.1 How many years has your organization been in business?

§ A.1.3.2 How many full-time employees work for your organization?

§ A.1.3.3 List your North American Industry Classification System (NAICS) codes and titles. Specify which is your primary NAICS code.

§ A.1.3.4 Indicate whether your organization is certified as a governmentally recognized special business class, such as a minority business enterprise, woman business enterprise, service disabled veteran owned small business, woman owned small business, small business in a HUBZone, or a small disadvantaged business in the 8(a) Business Development Program. For each, identify the certifying authority and indicate jurisdictions to which such certification applies.

§ A.2 EXPERIENCE

§ A.2.1 Complete Exhibit D to describe up to four projects, either completed or in progress, that are representative of your organization's experience and capabilities.

§ A.2.2 State your organization's total dollar value of work currently under contract.

§ A.2.3 Of the amount stated in Section A.2.2, state the dollar value of work that remains to be completed:

§ A.2.4 State your organization's average annual dollar value of construction work performed during the last five years.

§ A.3 CAPABILITIES

§ A.3.1 List the categories of work that your organization typically self-performs.

§ A.3.2 Identify qualities, accreditations, services, skills, or personnel that you believe differentiate your organization from others.

§ A.3.3 Does your organization provide design collaboration or pre-construction services? If so, describe those services.

§ A.3.4 Does your organization use building information modeling (BIM)? If so, describe how your organization uses BIM and identify BIM software that your organization regularly uses.

§ A.3.5 Does your organization use a project management information system? If so, identify that system.

§ A.4 REFERENCES

§ A.4.1 Identify three client references:

(Insert name, organization, and contact information)

§ A.4.2 Identify three architect references:

(Insert name, organization, and contact information)

§ A.4.3 Identify one bank reference:

(Insert name, organization, and contact information)

§ A.4.4 Identify three subcontractor or other trade references:

(Insert name, organization, and contact information)

Additions and Deletions Report for **AIA[®] Document A305[™] – 2020 Exhibit A**

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AIA[®] Document A305[™] – 2020 Exhibit B

Financial and Performance Information

This Exhibit is part of the Contractor's Qualification Statement, submitted by _____ and dated the _____ day of _____ in the year _____.
(In words, indicate day, month and year.)

§ B.1 FINANCIAL

§ B.1.1 Federal tax identification number:

§ B.1.2 Attach financial statements for the last three years prepared in accordance with Generally Accepted Accounting Principles, including your organization's latest balance sheet and income statement. Also, indicate the name and contact information of the firm that prepared each financial statement.

§ B.1.3 Has your organization, its parent, or a subsidiary, affiliate, or other entity having common ownership or management, been the subject of any bankruptcy proceeding within the last ten years?

§ B.1.4 Identify your organization's preferred credit rating agency and identification information.

(Identify rating agency, such as Dun and Bradstreet or Equifax, and insert your organization's identification number or other method of searching your organization's credit rating with such agency.)

§ B.2 DISPUTES AND DISCIPLINARY ACTIONS

§ B.2.1 Are there any pending or outstanding judgments, arbitration proceedings, bond claims, or lawsuits against your organization, its parent, or a subsidiary, affiliate, or other entity having common ownership or management, or any of the individuals listed in Exhibit A, Section 1.2, in which the amount in dispute is more than \$75,000?

(If the answer is yes, provide an explanation.)

§ B.2.2 In the last five years has your organization, its parent, or a subsidiary, affiliate, or other entity having common ownership or management:

(If the answer to any of the questions below is yes, provide an explanation.)

.1 _____ failed to complete work awarded to it?

.2 _____ been terminated for any reason except for an owners' convenience?

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.3 had any judgments, settlements, or awards pertaining to a construction project in which your organization was responsible for more than \$75,000?

.4 filed any lawsuits or requested arbitration regarding a construction project?

§ B.2.3 In the last five years, has your organization, its parent, or a subsidiary, affiliate, or other entity having common ownership or management; or any of the individuals listed in Exhibit A Section 1.2:

(If the answer to any of the questions below is yes, provide an explanation.)

.1 been convicted of, or indicted for, a business-related crime?

.2 had any business or professional license subjected to disciplinary action?

.3 been penalized or fined by a state or federal environmental agency?

Additions and Deletions Report for **AIA[®] Document A305[™] – 2020 Exhibit B**

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

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There are no differences.



AIA[®] Document A305[™] – 2020 Exhibit C

Project Specific Information

This Exhibit is part of the Contractor's Qualification Statement, submitted by _____ and dated the _____ day of _____ in the year _____.
(In words, indicate day, month and year.)

PROJECT:

(Name and location or address.)

Canton Township Public Safety Building Interior Renovations PIA #130
1150 S. Canton Center Road
Canton, MI 48188

CONTRACTOR'S PROJECT OFFICE:

(Identify the office out of which the contractor proposes to perform the work for the Project.)

TYPE OF WORK SOUGHT

(Indicate the type of work you are seeking for this Project, such as general contracting, construction manager as constructor, design-build, HVAC subcontracting, electrical subcontracting, plumbing subcontracting, etc.)

CONFLICT OF INTEREST

Describe any conflict of interest your organization, its parent, or a subsidiary, affiliate, or other entity having common ownership or management, or any of the individuals listed in Exhibit A Section 1.2, may have regarding this Project.

§ C.1 PERFORMANCE OF THE WORK

§ C.1.1 When was the Contractor's Project Office established?

§ C.1.2 How many full-time field and office staff are respectively employed at the Contractor's Project Office?

§ C.1.3 List the business license and contractor license or registration numbers for the Contractor's Project Office that pertain to the Project.

§ C.1.4 Identify key personnel from your organization who will be meaningfully involved with work on this Project and indicate (1) their position on the Project team, (2) their office location, (3) their expertise and experience, and (4) projects similar to the Project on which they have worked.

ADDITIONS AND DELETIONS:

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§ C.1.5 Identify portions of work that you intend to self-perform on this Project.

§ C.1.6 To the extent known, list the subcontractors you intend to use for major portions of work on the Project.

§ C.2 EXPERIENCE RELATED TO THE PROJECT

§ C.2.1 Complete Exhibit D to describe up to four projects performed by the Contractor's Project Office, either completed or in progress, that are relevant to this Project, such as projects in a similar geographic area or of similar project type. If you have already completed Exhibit D, but want to provide further examples of projects that are relevant to this Project, you may complete Exhibit E.

§ C.2.2 State the total dollar value of work currently under contract at the Contractor's Project Office:

§ C.2.3 Of the amount stated in Section C.2.2, state the dollar value of work that remains to be completed:

§ C.2.4 State the average annual dollar value of construction work performed by the Contractor's Project Office during the last five years.

§ C.2.5 List the total number of projects the Contractor's Project Office has completed in the last five years and state the dollar value of the largest contract the Contractor's Project Office has completed during that time.

§ C.3 SAFETY PROGRAM AND RECORD

§ C.3.1 Does the Contractor's Project Office have a written safety program?

§ C.3.2 List all safety-related citations and penalties the Contractor's Project Office has received in the last three years.

§ C.3.3 Attach the Contractor's Project Office's OSHA 300a Summary of Work-Related Injuries and Illnesses form for the last three years.

§ C.3.4 Attach a copy of your insurance agent's verification letter for your organization's current workers' compensation experience modification rate and rates for the last three years.

§ C.4 INSURANCE

§ C.4.1 Attach current certificates of insurance for your commercial general liability policy, umbrella insurance policy, and professional liability insurance policy, if any. Identify deductibles or self-insured retentions for your commercial general liability policy.

§ C.4.2 If requested, will your organization be able to provide property insurance for the Project written on a builder's risk "all-risks" completed value or equivalent policy form and sufficient to cover the total value of the entire Project on a replacement cost basis?

§ C.4.3 Does your commercial general liability policy contain any exclusions or restrictions of coverage that are prohibited in AIA Document A101-2017, Exhibit A, Insurance A.3.2.2.2? If so, identify.

§ C.5 SURETY

§ C.5.1 If requested, will your organization be able to provide a performance and payment bond for this Project?

§ C.5.2 Surety company name:

§ C.5.3 Surety agent name and contact information:

§ C.5.4 Total bonding capacity:

§ C.5.5 Available bonding capacity as of the date of this qualification statement:

Additions and Deletions Report for

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PAGE 1

Canton Township Public Safety Building Interior Renovations PIA #130
1150 S. Canton Center Road
Canton, MI 48188



AIA[®] Document A305[™] – 2020 Exhibit D

Contractor's Past Project Experience

	1	2	3	4
PROJECT NAME				
PROJECT LOCATION				
PROJECT TYPE				
OWNER				
ARCHITECT				
CONTRACTOR'S PROJECT EXECUTIVE				
KEY PERSONNEL (include titles)				
PROJECT DETAILS	Contract Amount Completion Date % Self-Performed Work	Contract Amount Completion Date % Self-Performed Work	Contract Amount Completion Date % Self-Performed Work	Contract Amount Completion Date % Self-Performed Work
PROJECT DELIVERY METHOD	<input type="checkbox"/> Design-bid-build <input type="checkbox"/> Design-build <input type="checkbox"/> CM constructor <input type="checkbox"/> CM advisor <input type="checkbox"/> Other:	<input type="checkbox"/> Design-bid-build <input type="checkbox"/> Design-build <input type="checkbox"/> CM constructor <input type="checkbox"/> CM advisor <input type="checkbox"/> Other:	<input type="checkbox"/> Design-bid-build <input type="checkbox"/> Design-build <input type="checkbox"/> CM constructor <input type="checkbox"/> CM advisor <input type="checkbox"/> Other:	<input type="checkbox"/> Design-bid-build <input type="checkbox"/> Design-build <input type="checkbox"/> CM constructor <input type="checkbox"/> CM advisor <input type="checkbox"/> Other:
SUSTAINABILITY CERTIFICATIONS				



AIA[®] Document A305™ – 2020 Exhibit E

Contractor's Past Project Experience, Continued

	1	2	3	4
PROJECT NAME				
PROJECT LOCATION				
PROJECT TYPE				
OWNER				
ARCHITECT				
CONTRACTOR'S PROJECT EXECUTIVE				
KEY PERSONNEL (include titles)				
PROJECT DETAILS	Contract Amount Completion Date % Self-Performed Work	Contract Amount Completion Date % Self-Performed Work	Contract Amount Completion Date % Self-Performed Work	Contract Amount Completion Date % Self-Performed Work
PROJECT DELIVERY METHOD	<input type="checkbox"/> Design-bid-build <input type="checkbox"/> Design-build <input type="checkbox"/> CM constructor <input type="checkbox"/> CM advisor <input type="checkbox"/> Other:	<input type="checkbox"/> Design-bid-build <input type="checkbox"/> Design-build <input type="checkbox"/> CM constructor <input type="checkbox"/> CM advisor <input type="checkbox"/> Other:	<input type="checkbox"/> Design-bid-build <input type="checkbox"/> Design-build <input type="checkbox"/> CM constructor <input type="checkbox"/> CM advisor <input type="checkbox"/> Other:	<input type="checkbox"/> Design-bid-build <input type="checkbox"/> Design-build <input type="checkbox"/> CM constructor <input type="checkbox"/> CM advisor <input type="checkbox"/> Other:
SUSTAINABILITY CERTIFICATIONS				

DOCUMENT 004313 - BID SECURITY FORMS

1.1 BID FORM SUPPLEMENT

- A. A completed bid bond form is required to be attached to the Bid Form.
 - 1. A certified check is also an acceptable means of providing the required bid security. Certified check must be payable to "Charter Township of Canton".

1.2 BID BOND FORM

- A. AIA Document A310, "Bid Bond," is the recommended form for a bid bond. A bid bond acceptable to Owner, or other bid security as described in the Instructions to Bidders, is required to be attached to the Bid Form as a supplement.
- B. Copies of AIA standard forms may be obtained from The American Institute of Architects; www.aia.org/contractdocs/purchase/index.htm; email: docspurchases@aia.org; (800) 942-7732.

END OF DOCUMENT 004313

SECTION 004373 - PROPOSED SCHEDULE OF VALUES FORM

1.1 POST BID SUPPLEMENT

- A. A completed Proposed Schedule of Values form is required to be provided, upon request from Architect after bid has been submitted.

1.2 PROPOSED SCHEDULE OF VALUES FORM

- A. Proposed Schedule of Values Form: Provide a breakdown of the bid amount, including alternates, in enough detail to facilitate continued evaluation of bid. Coordinate with the Project Manual table of contents. Provide multiple line items for principal material and subcontract amounts in excess of five percent of the Contract Sum.
 - 1. Upon award of contract, Contractor to identify "labor" and "material" costs for each line item on the schedule of values.
 - 2. Refer to Specification Section 012900 for additional schedule of values requirements.
- B. Arrange schedule of values consistent with format of AIA Document G703.
 - 1. Copies of AIA standard forms may be obtained from the American Institute of Architects; <http://www.aia.org/contractdocs/purchase/index.htm>; docspurchases@aia.org; (800) 942-7732.

END OF SECTION 004373

SECTION 006000 - FORMS

1.1 FORM OF AGREEMENT AND GENERAL CONDITIONS

- A. The following form of Owner/Contractor Agreement and form of the General Conditions shall be used for Project:
 - 1. AIA Document A101, "Standard Form of Agreement between Owner and Contractor, Stipulated Sum."
 - a. The General Conditions for Project are AIA Document A201, "General Conditions of the Contract for Construction."
 - b. The Supplementary General Conditions. Refer to Section 008000 for copy.

1.2 ADMINISTRATIVE FORMS

- A. Administrative Forms: Additional administrative forms are specified in Division 01 General Requirements.
- B. Copies of AIA standard forms may be obtained from the American Institute of Architects; <http://www.aia.org/contractdocs/purchase/index.htm>; docspurchases@aia.org; (800) 942-7732.
- C. Preconstruction Forms:
 - 1. Form of Performance Bond and Labor and Material Bond: AIA Document A312, "Performance Bond and Payment Bond."
 - 2. Form of Certificate of Insurance: AIA Document G715, "Supplemental Attachment for ACORD Certificate of Insurance 25-S."
- D. Information and Modification Forms:
 - 1. Form of Request for Proposal: AIA Document G709, "Work Changes Proposal Request."
 - 2. Change Order Form: AIA Document G701, "Change Order."
 - 3. Form of Architect's Memorandum for Minor Changes in the Work: AIA Document G707, "Architect's Supplemental Instructions."
 - 4. Form of Change Directive: AIA Document G714, "Construction Change Directive."
- E. Payment Forms:
 - 1. Schedule of Values Form: AIA Document G703, "Continuation Sheet."
 - 2. Payment Application: AIA Document G702/703, "Application and Certificate for Payment and Continuation Sheet."
 - 3. Form of Contractor's Affidavit: AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
 - 4. Form of Affidavit of Release of Liens: AIA Document G706A, "Contractor's Affidavit of Payment of Release of Liens."
 - 5. Form of Consent of Surety: AIA Document G707, "Consent of Surety to Final Payment."

END OF SECTION 006000



AIA® Document A201® – 2017

General Conditions of the Contract for Construction

for the following PROJECT:

(Name and location or address)

Canton Township Public Safety Building Interior Renovations PIA #130
1150 S. Canton Center Road
Canton, MI 48188

THE OWNER:

(Name, legal status and address)

Charter Township of Canton
1150 S. Canton Center Road
Canton, Michigan 48188

THE ARCHITECT:

(Name, legal status and address)

PARTNERS in Architecture, PLC
65 Market Street
Mount Clemens, MI 48043

TABLE OF ARTICLES

1	GENERAL PROVISIONS
2	OWNER
3	CONTRACTOR
4	ARCHITECT
5	SUBCONTRACTORS
6	CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS
7	CHANGES IN THE WORK
8	TIME
9	PAYMENTS AND COMPLETION
10	PROTECTION OF PERSONS AND PROPERTY
11	INSURANCE AND BONDS
12	UNCOVERING AND CORRECTION OF WORK
13	MISCELLANEOUS PROVISIONS

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

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

14 TERMINATION OR SUSPENSION OF THE CONTRACT

15 CLAIMS AND DISPUTES



Init.

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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents

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

§ 1.1.2 The Contract

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

§ 1.1.3 The Work

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

§ 1.1.4 The Project

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

§ 1.1.5 The Drawings

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

§ 1.1.6 The Specifications

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

§ 1.1.7 Instruments of Service

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

§ 1.1.8 Initial Decision Maker

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

§ 1.2 Correlation and Intent of the Contract Documents

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

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

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

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

§ 1.3 Capitalization

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

§ 1.4 Interpretation

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

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

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

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

§ 1.6 Notice

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

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

§ 1.7 Digital Data Use and Transmission

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

§ 1.8 Building Information Models Use and Reliance

Any use of, or reliance on, all or a portion of a building information model without agreement to protocols governing the use of, and reliance on, the information contained in the model and without having those protocols set forth in AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document

G202™–2013, Project Building Information Modeling Protocol Form, shall be at the using or relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

ARTICLE 2 OWNER

§ 2.1 General

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

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

§ 2.2 Evidence of the Owner's Financial Arrangements

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

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

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

§ 2.2.4 Where the Owner has designated information furnished under this Section 2.2 as "confidential," the Contractor shall keep the information confidential and shall not disclose it to any other person. However, the Contractor may disclose "confidential" information, after seven (7) days' notice to the Owner, where disclosure is required by law, including a subpoena or other form of compulsory legal process issued by a court or governmental entity, or by court or arbitrator(s) order. The Contractor may also disclose "confidential" information to its employees, consultants, sureties, Subcontractors and their employees, Sub-subcontractors, and others who need to know the content of such information solely and exclusively for the Project and who agree to maintain the confidentiality of such information.

§ 2.3 Information and Services Required of the Owner

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

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

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

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

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

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

§ 2.4 Owner's Right to Stop the Work

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

§ 2.5 Owner's Right to Carry Out the Work

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

ARTICLE 3 CONTRACTOR

§ 3.1 General

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

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

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

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

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

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

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

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

§ 3.3 Supervision and Construction Procedures

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

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

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

§ 3.4 Labor and Materials

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

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

§ 3.4.3 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them.

§ 3.5 Warranty

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

§ 3.5.2 All material, equipment, or other special warranties required by the Contract Documents shall be issued in the name of the Owner, or shall be transferable to the Owner, and shall commence in accordance with Section 9.8.4.

§ 3.6 Taxes

The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

§ 3.7 Permits, Fees, Notices and Compliance with Laws

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

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

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

§ 3.7.4 Concealed or Unknown Conditions

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

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

§ 3.8 Allowances

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

§ 3.8.2 Unless otherwise provided in the Contract Documents,

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

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

§ 3.9 Superintendent

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

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

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

§ 3.10 Contractor's Construction and Submittal Schedules

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

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

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

§ 3.11 Documents and Samples at the Site

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

delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.12 Shop Drawings, Product Data and Samples

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

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

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

§ 3.12.4 Shop Drawings, Product Data, Samples, and similar submittals are not Contract Documents. Their purpose is to demonstrate how the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

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

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

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

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

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

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

§ 3.12.10.1 If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will

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

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

§ 3.13 Use of Site

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

§ 3.14 Cutting and Patching

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

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

§ 3.15 Cleaning Up

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

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

§ 3.16 Access to Work

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

§ 3.17 Royalties, Patents and Copyrights

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

§ 3.18 Indemnification

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

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

ARTICLE 4 ARCHITECT

§ 4.1 General

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

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

§ 4.2 Administration of the Contract

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

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

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

§ 4.2.4 Communications

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

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

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

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

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

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

§ 4.2.10 If the Owner and Architect agree, the Architect will provide one or more Project representatives to assist in carrying out the Architect's responsibilities at the site. The Owner shall notify the Contractor of any change in the duties, responsibilities and limitations of authority of the Project representatives.

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

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

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

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

ARTICLE 5 SUBCONTRACTORS

§ 5.1 Definitions

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

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

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

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

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

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

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

§ 5.3 Subcontractual Relations

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

§ 5.4 Contingent Assignment of Subcontracts

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

- .1 assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor; and
- .2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

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

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

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

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

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

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

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

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

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

§ 6.2 Mutual Responsibility

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

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

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

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

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

§ 6.3 Owner's Right to Clean Up

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

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

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

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

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

§ 7.2 Change Orders

§ 7.2.1 A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor, and Architect stating their agreement upon all of the following:

- .1 The change in the Work;
- .2 The amount of the adjustment, if any, in the Contract Sum; and
- .3 The extent of the adjustment, if any, in the Contract Time.

§ 7.3 Construction Change Directives

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

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

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

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

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

- .1 Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Architect;
- .2 Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;
- .3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;
- .4 Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related to the change; and
- .5 Costs of supervision and field office personnel directly attributable to the change.

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

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

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

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

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

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

§ 7.4 Minor Changes in the Work

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

ARTICLE 8 TIME

§ 8.1 Definitions

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

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

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

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

§ 8.2 Progress and Completion

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, commence the Work prior to the effective date of insurance required to be furnished by the Contractor and Owner.

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

§ 8.3 Delays and Extensions of Time

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by (1) an act or neglect of the Owner or Architect, of an employee of either, or of a Separate Contractor; (2) by changes ordered in the Work; (3) by labor disputes, fire, unusual delay in deliveries, unavoidable casualties, adverse weather conditions documented in accordance with Section 15.1.6.2, or other causes beyond the Contractor's control; (4) by delay authorized by the Owner pending mediation and binding dispute resolution; or (5) by other causes that the Contractor asserts, and the Architect determines, justify delay, then the Contract Time shall be extended for such reasonable time as the Architect may determine.

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

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

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

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

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

§ 9.2 Schedule of Values

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit a schedule of values to the Architect before the first Application for Payment, allocating the entire Contract Sum to the various portions of the Work. The schedule of values shall be prepared in the form, and supported by the data to substantiate its accuracy, required by the Architect. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment. Any changes to the schedule of values shall be submitted to the Architect and supported by such data to substantiate its accuracy as the Architect may require, and unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment.

§ 9.3 Applications for Payment

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

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

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

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

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

§ 9.4 Certificates for Payment

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

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

§ 9.5 Decisions to Withhold Certification

§ 9.5.1 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

- .1 defective Work not remedied;
- .2 third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;
- .3 failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;

- .4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- .5 damage to the Owner or a Separate Contractor;
- .6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
- .7 repeated failure to carry out the Work in accordance with the Contract Documents.

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

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

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

§ 9.6 Progress Payments

§ 9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.

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

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

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

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

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

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

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

§ 9.7 Failure of Payment

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

§ 9.8 Substantial Completion

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

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

§ 9.8.3 Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

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

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in the Certificate. Upon such acceptance, and consent of surety if any, the Owner shall make payment of retainage applying to the Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 9.9 Partial Occupancy or Use

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

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

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

§ 9.10 Final Completion and Final Payment

§ 9.10.1 Upon receipt of the Contractor's notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

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

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

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

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

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

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 Safety Precautions and Programs

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

§ 10.2 Safety of Persons and Property

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

- .1 employees on the Work and other persons who may be affected thereby;
- .2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor; and
- .3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

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

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

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

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

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

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

§ 10.2.8 Injury or Damage to Person or Property

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

§ 10.3 Hazardous Materials and Substances

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

§ 10.3.2 Upon receipt of the Contractor's notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of the material or substance or who are to perform the task of removal or safe containment of the material or substance. The Contractor and the Architect will

promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up.

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

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

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

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

§ 10.4 Emergencies

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

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor's Insurance and Bonds

§ 11.1.1 The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Contractor shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Owner, Architect, and Architect's consultants shall be named as additional insureds under the Contractor's commercial general liability policy or as otherwise described in the Contract Documents.

§ 11.1.2 The Contractor shall provide surety bonds of the types, for such penal sums, and subject to such terms and conditions as required by the Contract Documents. The Contractor shall purchase and maintain the required bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

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

§ 11.1.4 Notice of Cancellation or Expiration of Contractor's Required Insurance. Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by the Contract Documents, the Contractor shall provide notice to the Owner of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act

or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage.

§ 11.2 Owner's Insurance

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

§ 11.2.2 Failure to Purchase Required Property Insurance. If the Owner fails to purchase and maintain the required property insurance, with all of the coverages and in the amounts described in the Agreement or elsewhere in the Contract Documents, the Owner shall inform the Contractor in writing prior to commencement of the Work. Upon receipt of notice from the Owner, the Contractor may delay commencement of the Work and may obtain insurance that will protect the interests of the Contractor, Subcontractors, and Sub-Subcontractors in the Work. When the failure to provide coverage has been cured or resolved, the Contract Sum and Contract Time shall be equitably adjusted. In the event the Owner fails to procure coverage, the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent the loss to the Owner would have been covered by the insurance to have been procured by the Owner. The cost of the insurance shall be charged to the Owner by a Change Order. If the Owner does not provide written notice, and the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain the required insurance, the Owner shall reimburse the Contractor for all reasonable costs and damages attributable thereto.

§ 11.2.3 Notice of Cancellation or Expiration of Owner's Required Property Insurance. Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or expiration of any property insurance required by the Contract Documents, the Owner shall provide notice to the Contractor of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Contractor: (1) the Contractor, upon receipt of notice from the Owner, shall have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the Contractor; (2) the Contract Time and Contract Sum shall be equitably adjusted; and (3) the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent any loss to the Owner would have been covered by the insurance had it not expired or been cancelled. If the Contractor purchases replacement coverage, the cost of the insurance shall be charged to the Owner by an appropriate Change Order. The furnishing of notice by the Owner shall not relieve the Owner of any contractual obligation to provide required insurance.

§ 11.3 Waivers of Subrogation

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

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

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

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

§11.5 Adjustment and Settlement of Insured Loss

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

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

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

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

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

§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

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

§ 12.2.2 After Substantial Completion

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

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

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

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

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

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

§ 12.3 Acceptance of Nonconforming Work

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

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

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

§ 13.2 Successors and Assigns

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

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

§ 13.3 Rights and Remedies

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

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

§ 13.4 Tests and Inspections

§ 13.4.1 Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and

approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

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

§ 13.4.3 If procedures for testing, inspection, or approval under Sections 13.4.1 and 13.4.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Architect's services and expenses, shall be at the Contractor's expense.

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

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

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

§ 13.5 Interest

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

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

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

- .1 Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
- .2 An act of government, such as a declaration of national emergency, that requires all Work to be stopped;
- .3 Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or
- .4 The Owner has failed to furnish to the Contractor reasonable evidence as required by Section 2.2.

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

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

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

§ 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

- .1 repeatedly refuses or fails to supply enough properly skilled workers or proper materials;
- .2 fails to make payment to Subcontractors or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;
- .3 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or
- .4 otherwise is guilty of substantial breach of a provision of the Contract Documents.

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

- .1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
- .2 Accept assignment of subcontracts pursuant to Section 5.4; and
- .3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

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

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

§ 14.3 Suspension by the Owner for Convenience

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

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

- .1 that performance is, was, or would have been, so suspended, delayed, or interrupted, by another cause for which the Contractor is responsible; or
- .2 that an equitable adjustment is made or denied under another provision of the Contract.

§ 14.4 Termination by the Owner for Convenience

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

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

- .1 cease operations as directed by the Owner in the notice;
- .2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and
- .3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

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

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

§ 15.1.1 Definition

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

§ 15.1.2 Time Limits on Claims

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

§ 15.1.3 Notice of Claims

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

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

§ 15.1.4 Continuing Contract Performance

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

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

§ 15.1.5 Claims for Additional Cost

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

§ 15.1.6 Claims for Additional Time

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

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

§ 15.1.7 Waiver of Claims for Consequential Damages

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

- .1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and
- .2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit, except anticipated profit arising directly from the Work.

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

§ 15.2 Initial Decision

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

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

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

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

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

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

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

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

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

§ 15.3 Mediation

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

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

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

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

§ 15.4 Arbitration

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

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

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

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

§ 15.4.4 Consolidation or Joinder

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

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

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

Additions and Deletions Report for

AIA® Document A201® – 2017

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

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PAGE 1

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Canton, MI 48188

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Canton, Michigan 48188

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Mount Clemens, MI 48043

Certification of Document's Authenticity

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I, _____, hereby certify, to the best of my knowledge, information and belief, that I created the attached final document simultaneously with its associated Additions and Deletions Report and this certification at 14:33:03 ET on 03/07/2022 under Order No. 2114290003 from AIA Contract Documents software and that in preparing the attached final document I made no changes to the original text of AIA® Document A201™ – 2017, General Conditions of the Contract for Construction, as published by the AIA in its software, other than those additions and deletions shown in the associated Additions and Deletions Report.

(Signed)

(Title)

(Dated)

SECTION 008000 - SUPPLEMENTARY CONDITIONS

The following supplements modify, change, delete from or add to the "General Conditions of the Contract for Construction", AIA Document A201/2017 Edition. Where any Article of the General Conditions is modified or any Paragraph, Subparagraph or Clause thereof is modified or deleted by these supplements, the unaltered provisions of that Article, Paragraph, Subparagraph or Clause shall remain in effect.

SUPPLEMENTARY CONDITIONS

ARTICLE 16 MODIFICATIONS TO THE GENERAL CONDITIONS

16.1 Modification of ARTICLE 1 GENERAL PROVISIONS

16.1.1 Modification of Paragraph 1.1 BASIC DEFINITIONS

16.1.1.3 Add to Subparagraph 1.1.3:

The definition of 'Work' shall also include labor, materials, equipment and services provided or to be provided by subcontractors, sub-subcontractors, material suppliers or any other entity for whom the Contractor is responsible under or pursuant to the Contract Documents.

16.2 Modification of ARTICLE 2 OWNER

16.2.3 Modification of Paragraph 2.3 INFORMATION AND SERVICES REQUIRED OF THE OWNER

16.2.3.4 Add to Subparagraph 2.3.4:

However, Contractor shall notify Owner of any errors, problems or inaccuracies which it becomes aware of in the course of its use of such surveys.

16.2.5 Modification of Paragraph 2.5 OWNER'S RIGHT TO CARRY OUT THE WORK

16.2.5.1 Add Subparagraph 2.5.1:

2.5.1 The Contractor agrees that the Owner, by mutual agreement with the Contractor, shall have the right to place and install equipment and machinery during the progress of the Work before the completion of the various parts of the Work; and further agrees that such placing and installation of equipment shall not in any way effect the completion of the Work or any portion thereof, nor signify the Owner's acceptance of the Work or any portion thereof. Should the Owner place or install such equipment and machinery with its own forces, then it shall be responsible for any damage to Work of the Contractor caused by the Owner's work or workers. Should the Owner have such placement or installation performed by another contractor, then the Owner shall require said contractor to be responsible for all such damage caused by its work, its workmen, or its subcontractor.

16.3.4 Modification of Paragraph 3.4 LABOR AND MATERIALS

16.3.4 Add Subparagraphs 3.4.4, 3.4.5, 3.4.6 and 3.4.7:

- 3.4.4 Materials shall conform to manufacturer's standards in effect at the date of issuance of the proposed Contract Documents and shall be installed in strict accordance with manufacturer's directions.
- 3.4.5 Where the Contract Documents require the Work, or any part of same, to be above the standards required by applicable laws, ordinances, rules and regulations and other statutory provisions pertaining to the Work, or above the quality of normal construction or trade standards, such Work shall be performed and completed by the Contractor in accordance with the Contract Documents.
- 3.4.6 Immediately after the issuance of a Letter of Intent or the award of the Contract for the Work to the Contractor, and prior to the first Request for Payment, The Contractor shall submit to the Architect a schedule indicating the name of manufacturers of all material and equipment which it and its Subcontractors propose for use in the Work. No material or equipment shall be ordered until acceptance of the manufacturer is received from the Architect.
- 3.4.7 Identifying Markings: Where the manufacturer's name, patent numbers, Underwriter's labels, model numbers or similar identifying marks are required, locate such markings as inconspicuously as possible. In no case will such marks be acceptable as part of basic design.

16.3.5 Modification of Paragraph 3.5 WARRANTY

16.3.5.1 Add Subparagraph 3.5.3:

3.5.3 The Contractor shall:

- .1 Warrant that all materials and workmanship of all of the Work of the Contract will be serviceable, satisfactory, and will perform dependably, without excessive or unusual maintenance or care, the functions for which it was designed and free of defects in materials or workmanship for a period of at least two (2) years, and for such longer periods and special requirements as may be specified for individual types of materials, equipment, or Work, under individual Sections of the Specifications. Such warranty is in addition to and independent of any warranty or guarantee of any Subcontractor, Supplier or Manufacturer.
- .2 Submit the above warranty, and all warranties required by the Contract Documents to be delivered by Subcontractors, executed by the Contractor in written form and deliver all to the Owner as a condition precedent to Final Payment.
- .3 The Contractor shall remedy at the Contractor's expense any failure to conform, or any defect identified in materials or workmanship. In addition, the Contractor shall remedy at the Contractor's expense any damage to the Owner's real or personal property, when the damage is the result of: the Contractor's failure to conform to contract requirements or any defect of equipment, material or workmanship furnished.
- .4 The Contractor shall restore any work damaged in fulfilling the terms and conditions of this clause. The Contractor's warranty period with respect to the work repaired or replaced shall restart from the date of repair or replacement.

- .5 Warranty Process: The overall process that should be followed for handling a warranty item is described as follows:
 - a. Owner or Owner's designated representative shall notify the Contractor in writing, within a reasonable time after the discovery of any failure, defect or damage.
 - b. Within twenty-four (24) hours, Contractor shall acknowledge receipt of notice from Owner and shall respond in writing as to when Contractor or Contractor's representative will be onsite to review warranty item.
 - c. Contractor shall commence any work required hereunder within seven (7) working days after receipt of written notice to do so by the Owner. If The Contractor shall fail or neglect to do so or to complete the fulfillment of its obligations hereunder within fifteen (15) days of receipt of said notice or such longer period as may be authorized by the Owner, the Owner shall have the right to perform all or any part of the Work or employ another person to do all or part of such Work and charge the expense thereof to the Contractor.
- .6 With respect to all warranties, express or implied, from sub-contractors, manufacturers or suppliers for work performed and materials furnished under this contract, the Contractor shall:
 - a. Obtain all warranties for all aspects of the work.
 - b. Require all warranties to be executed, in writing for the benefit of the Owner.
 - c. Enforce all warranties for the benefit of the Owner.
- .7 Warranties shall be assignable and enforceable by all future Owners of the project.

16.3.7 Modification of Paragraph 3.7 PERMITS, FEES AND NOTICES

16.3.7.1.1 – 16.3.7.1.4 Add Subparagraphs 3.7.1.1 – 3.7.1.4:

- 3.7.1.1 The Contractor shall obtain a Certificate of Occupancy as required for partial and complete occupancy by the Owner. The Contractor shall pay all fees necessary to secure said Certificates and shall deliver said Certificate to the Architect or Owner.
- 3.7.1.2 The Contractor shall furnish to the local authorities all necessary bonds or cash deposits required as a pledge and security for the protection or maintenance of any public property or as otherwise stipulated.
- 3.7.1.3 Contractor shall be responsible for all approvals and permits not specifically enumerated as the Owner's responsibility in paragraph 2.3.1 hereof or in the Contract Documents.
- 3.7.1.4 A photocopy of the building permit shall be delivered to the Architect and Owner as soon as it is obtained.

16.3.9 Modification of Paragraph 3.9 SUPERINTENDENT

16.3.9 Add Subparagraphs 3.9.4, 3.9.5 and 3.9.6:

- 3.9.4 The Contractor's Superintendent or his duly authorized representative, shall remain in attendance at the Site and shall be present at all times when work of any kind is being done, including work done at other than normal working hours.
- 3.9.5 The Contractor's Superintendent shall not be removed except for valid cause acceptable to the Architect and the Owner in which case another Superintendent acceptable to them shall be provided.

- 3.9.6 Any employee of the Contractor whom the Architect or Owner considers detrimental to the proper carrying out of the Work is to be removed promptly on the request of the Architect or Owner.

16.3.17 Modification of Paragraph 3.17 ROYALTIES AND PATENTS

16.3.17 Add Subparagraphs 3.17.1 and 3.17.2:

- 3.17.1 Use of Printed Materials: Contractors and suppliers shall agree that the Owner may, without cost, duplicate, publish, use, dispose of, and disclose in any manner and for any periods whatsoever, and have others so do, all Subject Data (whether or not copyrighted) which may be submitted or delivered to the Owner for use in the course of, or under, any Work performed for the Owner, or which may relate to said Work. By "Subject Data" is meant all writings (including, without limitation, instructions manuals, operating manuals, maintenance manuals and specifications), sound recordings, pictorial reproductions, drawings, prints, photographs and graphical representations, and works of a nature similar to any of the foregoing. In the event any such Subject Data shall be covered by copyright, Contractors and suppliers shall agree to grant to the Owner or obtain for the Owner the copyrighted material, a royalty-free, non-exclusive and irrevocable license, including a right to sublicense thereunder.
- 3.17.2 Any provision or provisions of these General Conditions or of the Contract to the contrary notwithstanding, the Owner shall have the right at any time to modify, remove, obliterate, or ignore any marking not authorized by the terms of the Contract on any piece of Subject Data furnished or delivered under the Contract.

16.3.18 Modification of Paragraph 3.18 INDEMNITY

16.3.18.1 Add Subparagraphs 3.18.1.1 – 3.18.1.6

- 3.18.1.1 Hold Harmless. The Contractor agrees to hold harmless the Township against and from any and all liabilities, obligations, damages, penalties, claims, costs, charges, losses, and expenses, including without limitation, fees and expenses of attorneys, expert witnesses and other consultants which may be imposed upon, incurred by, or asserted against the Township by reason of, arising out of, or related to any of the following occurring during the performance of this Contract:
- a. any negligent or tortious act, error, or omission of the Contractor, or any of its personnel, employees, consultants, or subcontractors, agents or any entities associated, affiliated or subsidiary to the Contractor now existing or hereafter created, their agents and employees for whose acts any of them might be liable, including, but not limited to, any and all injury to the personal or damage to the property of, or any loss or expense incurred by an employee of the Township;
 - b. any failure by the Contractor, or any of its agents and employees to perform their obligations either implied (industry standards) or expressed under this Contract;
 - c. any violation of any federal, state or local statute, regulation, ordinance, permit or license by the Contractor, or any of its personnel, employees, consultants, or subcontractors, agents or any entities associated, affiliated or subsidiary to the Contractor now existing or hereafter created.
- 3.18.1.2 Assumption of Risk. The Contractor undertakes and assumes all risk of dangerous conditions, on all places where it will be performing the work, in order to determine whether such places are safe for the performance of the work. Except for acts of gross negligence or intentional

misconduct by the Township or its employees or agents, the Contractor also agrees to waive and release any claim or liability against the Township for personal injury or property damage sustained by it or its agents or employees for personal injury or property damages while performing under the Contract.

3.18.1.3 Defense. In the event any action or proceeding shall be brought against the Township by reason of any claim covered under this Section, the Contractor, upon notice from the Township, shall at its own sole cost and expense, have the duty and the right to resist and defend the same; provided, however, the Township shall also have the right to appoint another attorney to appear in any such litigation as co-counsel, at the Townships expense.

3.18.1.4 Property and Materials. The Contractor agrees that it is the Contractor's responsibility, and not the responsibility of the Township, to safeguard the property and materials that the Contractor or any of the Contractor's agents, subcontractors or employees, use or have in their possession while performing under this Contract. Further, the Contractor agrees to hold the Township harmless for any loss of property and materials used pursuant to the Contractor's performance under this Contract which is in their possession, except if caused by the Townships gross negligence or intentional misconduct.

3.18.1.5 No Limitation. The indemnification obligation under this Section shall not be limited in any way by any limitation on the amount or type of damages, compensation or other employee benefits. In addition, the Contractor agrees to hold the Township harmless from the payment of any deductible on any insurance policy.

3.18.1.6 Survival of Indemnification. The indemnification obligation under this Section shall survive the termination or expiration of this Contract.

16.4 Modification to ARTICLE 4 ARCHITECT

16.4.1 Modification to Paragraph 4.1 GENERAL:

16.4.1.1.1 Add Subparagraph 4.1.1.1:

4.1.1.1 Architect - As used herein and elsewhere in the Contract Documents, the term "Architect" shall mean PARTNERS in Architecture, PLC, 65 Market Street, Suite 200, Mount Clemens, MI 48043, acting individually or through any agents, consultants, or representatives duly authorized to act in its behalf, subject to the provisions of the Owner/Architect Agreement for the Project between Owner and PARTNERS in Architecture, PLC ("Architect").

16.5 Modifications of ARTICLE 5 SUBCONTRACTORS

16.5.2 Modification of Paragraph 5.2 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK

16.5.2.1 Add to Subparagraph 5.2.1:

The list of proposed subcontractors shall be submitted within 24 hours of bid opening by the low bidder(s), which list shall upon acceptance by the Owner be incorporated into the Contract.

16.5.3 Modification to Paragraph 5.3 SUBCONTRACTUAL RELATIONS

16.5.3 Add Subparagraphs 5.3.1:

- 5.3.1 Contractor shall furnish Owner and Architect an electronic copy of each executed subcontract within ten (10) days after it is executed, but not later than forty-five (45) days after execution of the Owner – Contractor Construction Agreement.

16.7 Modifications to ARTICLE 7 CHANGES IN THE WORK

16.7.1 Modification to Paragraph 7.1 GENERAL

16.7.1 Add Subparagraphs 7.1.4, 7.1.5, 7.1.6 and 7.1.7:

- 7.1.4 Proposal Request is a Change Proposal: A document issued by the Architect and signed by the Contractor, containing a price quotation for Changes in the Work as described by a written "Change Description" and supplemented when necessary by revised drawings all attached thereto.

- 7.1.5 Contractor shall make no claims for extra cost on account of delay in completion of the Work caused by any Changes in the Work except as expressly provided in the executed Change Order authorizing said Change.

- 7.1.6 Changes in Contract Sum:
For any adjustments to the Contract Sum based on other than the unit prices method, the Contractor agrees to charge and accept payment for his overhead, bonds, insurance, field supervision, profit and all other general conditions items / related miscellaneous costs at the following percentages of the cost attributable to the change in the Work:

.1 Ten percent (10%) for Work (labor and materials) by the Contractor not involving subcontractors;

.2 Ten percent (10%) for Work (labor and materials) by subcontractors;

.3 When both additions and credits are involved in any change, the allowable markup shall be figured on the basis of the net increase, if any;

- 7.1.7 A detailed breakdown of material (quantity and type) and an hourly breakdown of labor must be submitted with each request for additional compensation.

16.8 Modifications to ARTICLE 8 TIME

16.8.2 Modification to Paragraph 8.2 PROGRESS AND COMPLETION

16.8.2.1 Add to paragraph 8.2.1:

and that Contractor is capable of properly completing the Work within the contract time.

16.9 Modifications to ARTICLE 9 PAYMENTS AND COMPLETION

16.9.2 Modifications to Paragraph 9.2 SCHEDULE OF VALUES

16.9.2 Add to Subparagraph 9.2:

9.2 The schedule of values shall only be used after approval by Architect.

16.9.2.2 Add Subparagraph 9.2.1:

9.2.1 Initial Sworn Statements. Prior to commencement of the Work, the Contractor shall deliver to the Owner, a sworn statement, duly executed and acknowledged and in form satisfactory to the Owner, listing all subcontracts and the amount of each such subcontract, together with a similar sworn statement from each subcontractor and, where appropriate, from sub-subcontractors. This is in addition to the copies of the subcontracts as required in paragraph 5.3.1.

16.9.3 Modification of Paragraph 9.3 APPLICATIONS FOR PAYMENT

16.9.3.4 Add to Subparagraph 9.3.1.3:

9.3.1.3 Each application for payment shall be accompanied by the following, all in form and substance satisfactory to the Owner:

- .1 A duly executed and acknowledged sworn statement showing all subcontractors with whom the Contractor has entered into subcontracts, the amount of each such subcontract, the amount requested for any subcontractor in the requested progress payment and the amount to be paid to the Contractor from such progress payment, together with similar sworn statements from all subcontractors and, where appropriate, from sub-subcontractors; and
- .2 Duly executed Waivers of Mechanic's and Material Liens establishing payment or satisfaction of all such obligations.

16.9.4 Modification to Paragraph 9.4 CERTIFICATES FOR PAYMENT

16.9.4 Add Subparagraph 9.4.3:

9.4.3 If so directed by the Owner or Architect, the Contractor shall, within fifteen (15) days from the date of Owner's remittance, submit partial waivers of lien signed by each Subcontractor designated by the Owner, in a form acceptable to the Owner, for the full amount of the sum included for said Subcontractor, in the Owner's remittance for the previous month. Failure to submit partial waivers of lien shall justify the withholding of future payments by the Owner until said delinquent waivers are received by the Owner.

16.9.4.4 Add Subparagraph 9.4.4:

9.4.4 The Owner agrees to make payments to the Contractor on account of the Contract provided in the Agreement.

- .1 Following Substantial Completion: Following the date of Substantial Completion, the Contractor may request the Architect to inspect the project and deliver to Contractor a list of work necessary to Final Completion. Promptly following certification by the Architect to the Owner that the work on such list has been satisfactorily completed, the Owner will pay to Contractor such additional sum as may be necessary to bring the total payments to Contractor to 98% of the total Contract Sum, adjusted as provided in the Contract Documents.

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16.9.6 Modification to Paragraph 9.6 PROGRESS PAYMENTS

16.9.6.1 Add to Subparagraph 9.6.1:

9.6.1 Payments shall be made at the sole discretion of Owner with the advice and comment from Architect.

16.11 Modification to Article 11 INSURANCE AND BONDS

11.1.1 Add paragraphs 11.1.1.1 – 11.1.1.3:

11.1.1.1 Refer to Canton General Requirements Section 000100 for insurance requirements.

11.1.1.2 The Contractor shall not commence work, nor shall the contractor allow any subcontractor to commence work under this contract until the Contractor and the subcontractor have obtained a policy of insurance meeting the requirements of this section. The Contractor shall maintain at its expense and keep in effect during the term of this contract the following insurance:

11.1.1.3 Insufficiency of Insurer. In the event the Township deems any insurer to be unsatisfactory, upon notification to the Contractor, the Contractor shall furnish forth a substitution of insurer acceptable to the Township and copy of all required certificates of insurance in compliance with the Section. No additional payment shall be deemed due or shall be made by the Township to the contractor because of the required substitution.

16.11.1.2 Add paragraphs 11.1.2.1 – 11.1.2.6:

11.1.2.1 The Contractor shall furnish bonds as described below, covering the faithful performance of the Contract and the payments of all obligations arising thereunder. The Contract will not be signed until the Owner has received the proper bond specified under this Article, issued by a bonding company licensed to do business in the State where construction will take place, and on the current list of Company's Holding Certificates of Authority as acceptable Sureties on Federal Bonds and as acceptable reinsuring companies as published in Circular 570 (Amended) by the Audit Staff Bureau of Accounts, U.S. Treasury Department. All bonds signed by an agent must be accompanied by a certificate copy of the authority to act.

11.1.2.2 Furnish both AIA A312 Performance Bond and AIA A312 Payment Bond in the amount of 100% of the Contract Price.

11.1.2.3 The performance Bond and Payment Bond shall be submitted in the exact form specified in Section 11.1.2.2 above, and with the certificates specified in Section 11.1.2.4, below, and no other modifications addendum whatsoever shall be allowed.

11.1.2.4 Duly executed, notarized and updated Acknowledgements of both the Principal and Surety and the Surety's Power of Attorney must be attached to each of the two required bonds.

11.1.2.5 Bond amounts shall not exceed the single bond limit for the Contractor's Bonding company as set forth in the Federal Register current as of the bid date.

11.1.2.5.1 Upon receipt of Notice to Award, contractor is to submit Bonds to the Architect, prior to signing of the contract.

END OF SECTION 008000

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Bid / project schedule.
4. Work under separate contracts.
5. Future work.
6. Access to site.
7. Work restrictions.
8. Specification and drawing conventions.
9. Miscellaneous provisions.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.2 PROJECT INFORMATION

A. Project Identification: Canton Township Public Safety Building Interior Renovations.

1. Project Location: 1150 S. Canton Center Road, Canton, MI 48188.

B. Owner: Canton Township Public Safety

1. Owner's Representative: Barbara Caruso, Business Operations Coordinator; Canton Public Safety Department; 1150 S. Canton Center Road; Canton MI 48188; (734) 394-5448.

C. Architect: PARTNERS in Architecture, PLC; 65 Market Street, Suite 200, Mount Clemens, MI 48043; (586) 469-3600.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. The following is a brief project overview and is not meant to describe the complete scope of the project.

The work includes interior renovation of the existing Canton Township Public Safety Building affecting an approximate total area of 37,710 sq.ft. over two floors. On the first floor, the scope of the project includes a redesign of the current main entrance lobby and its ancillary spaces, an expansion of the existing dispatch room and associated offices, revisions to the main egress

corridor serving all of the spaces, improvements to the Clerk/Records room and miscellaneous modifications to other nearby spaces. The second-floor scope of work includes a redesign of the existing lobby and ancillary spaces, creation of a social services suite of offices, creation of a temporary dispatch area, expansion / renovation of restroom facilities, redesigned copy room and break room, and miscellaneous modifications to other spaces throughout the floor.

Almost all of the existing acoustic lay in ceilings and some hard ceilings on both floors are to be removed and replaced in order to provide adequate access for new mechanical system replacement and electrical installations as well as architectural changes. Work on the first floor will occur around a moderately sized existing detention area containing eight (8) holding cells and ancillary spaces. Maintenance of security will be a critical factor that must be considered for all areas of this project. Special required security features include the use of ballistic rated glazing and wall panels in the public lobbies. Work to be performed throughout the facility requires all individuals involved in the work to successfully pass a background check and establish eligibility for access.

B. Type of Contract.

1. Project will be constructed under a single prime contract.

1.4 BID / PROJECT SCHEDULE

A. The projected bid / project schedule milestones are as follows:

1. Issue Documents for bid: March 9, 2022.
2. Pre-Bid Meeting: March 14, 2022; 1:00 pm.
3. Last Day to Submit Questions: March 22, 2022.
4. Bids Due: March 31, 2022; 3:00pm.
5. Tentative Contractor Interviews: April 13 & 14, 2022. All bidders shall hold their calendars open on these days for a potential interview. Generally, the lowest three to four bidders will be called in for an interview. Interviews most likely will be held virtually, but could be held in person at the Public Safety Building.
6. Projected Contract Award Date: April 26, 2022.
7. Desired Construction Commencement: May 16, 2022. (or sooner if possible).
8. Achieve Substantial Completion: March 17, 2023 (or sooner if possible).
 - a. Building must be ready for occupancy. All inspections / approvals must be received to allow occupancy.
9. Project Closeout: All project closeout activities shall be completed within thirty (30) days following the substantial completion date, but not later than April 14, 2023.

1.5 WORK UNDER SEPARATE CONTRACTS

- A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under separate contracts.
- B. Concurrent Work: Owner will award separate contract(s) for the following construction operations at Project site. Those operations will be conducted simultaneously with work under this Contract.
 1. Data/Communication system installation and rework.

1.6 FUTURE WORK

- A. The Owner may begin work on a separate project in the Township Hall side of the building. Timing of this future project is not yet known, but may commence prior to substantial completion of this project. Access may be needed through the project area.

1.7 ACCESS TO SITE

- A. General: Contractor shall have full use of building for construction operations during construction period. Contractor's use of building may be limited by certain security restrictions imposed by the Owner and his right to perform work, or to retain other contractors on portions of the Project.
- B. Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is located.
 - 1. Access must be maintained to the facility at all times. This includes any vehicular or pedestrian traffic.
 - 2. Keep roads clear and available to patrons and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.

1.8 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public roads and with other requirements of authorities having jurisdiction. Logistics for best routes to access the site with equipment and materials will be critical.
- B. On-Site Work Hours: Limit work on site to normal business working hours of 7:00 a.m. to 7:30 p.m., Monday through Friday and 8:00 a.m. to 7:30 p.m., Saturday.
 - 1. Alternate Hours: Contractor may make a request to the Owner to allow alternate hours. Although the Contractor may request alternate hours, there are no guarantees that the Owner will be able to approve the request. The above stated hours coincide with township Noise Ordinances.
- C. Existing Utility Interruptions: Do not interrupt utilities serving other portions of the facility occupied by others, unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
 - 1. Notify Owner not less than four days in advance of proposed utility interruptions.
 - 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to adjacent properties with Owner.
 - 1. Notify Owner not less than four days in advance of proposed disruptive operations.
 - 2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Restricted Substances: Use of tobacco products and other controlled substances on Project site is not permitted.

- F. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

1.9 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 - 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
 - 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 - 2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012100 - ALLOWANCES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements governing allowances.
- B. Types of allowances include the following:
 - 1. Lump-sum allowances.

1.2 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection, or purchase and delivery, of each product or system described by an allowance must be completed by the Owner to avoid delaying the Work.
- B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Architect from the designated supplier.

1.3 ACTION SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances in the form specified for Change Orders.

1.4 INFORMATIONAL SUBMITTALS

- A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.
- C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.5 LUMP-SUM ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.

- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.

1.6 ADJUSTMENT OF ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

- A. Allowance No. 1: Lump-Sum Allowance: Building Permit Allowance - Include the sum of \$20,000.00 in the base bid to cover the cost of the Township building permit.
 - 1. This allowance includes an estimated total cost for the building permit.
 - 2. This allowance does not include cost for any sub-trade permits (mechanical, electrical, etc.) Each sub-trade contractor shall include their respective permit costs in their bids to the general contractor.
 - 3. Unused amounts will be credited back to the Owner.

END OF SECTION 012100

SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for unit prices.
- B. Related Requirements:
 - 1. Section 012100 "Allowances" for quantity allowances related to unit costs listed within this section.
 - 2. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.

1.2 DEFINITIONS

- A. Unit price is an amount incorporated in the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.3 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit and other ancillary costs.
- B. Measurement and Payment: See individual Specification Sections and drawings for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor.
- D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

- A. Unit Price No. 1 – Acoustic Lay-in Ceiling Tile

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1. Description: This item shall include the labor, supervision, equipment and material necessary to install additional 2' x 2' lay-in acoustic ceiling tile and grid beyond that which appears on the base bid construction drawings.
2. Unit of Measurement: Square Feet.

END OF SECTION 012200

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

1.3 ACTION SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use CSI Form 13.1A.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
 - b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.

- i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
- 3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
 - a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
 - 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Requested substitution will not adversely affect Contractor's construction schedule.
 - c. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - d. Requested substitution is compatible with other portions of the Work.
 - e. Requested substitution has been coordinated with other portions of the Work.
 - f. Requested substitution provides specified warranty.

- g. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Not allowed.

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

1.2 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

1.3 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - e. Quotation Form: Use CSI Form 13.6D, "Proposal Worksheet Summary," and Form 13.6C, "Proposal Worksheet Detail or forms acceptable to Architect.
- B. Contractor-Initiated Work Change Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
 - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.

2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Work Change Proposal Request Form: Use CSI Form 13.6A, "Change Order Request (Proposal)," with attachments CSI Form 13.6D, "Proposal Worksheet Summary," and Form 13.6C, "Proposal Worksheet Detail." or form acceptable to Architect.

1.4 ADMINISTRATIVE CHANGE ORDERS

- A. Allowance Adjustment: See Section 012100 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.
- B. Unit-Price Adjustment: See Section 012200 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.5 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Changes Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Section 012100 "Allowances" for procedural requirements governing the handling and processing of allowances.
 - 2. Section 012200 "Unit Prices" for administrative requirements governing the use of unit prices.
 - 3. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 4. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.2 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with continuation sheets.
 - b. Submittal schedule.
 - c. Items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 - 2. Arrange schedule of values consistent with format of AIA Document G703.
 - 3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Each line item shall have separate "labor" and

"material" cost amounts. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.

- a. Closeout Costs. Include separate line items under Contractor as well as principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and individual subcontract amounts.
4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
6. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
8. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
9. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.3 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: Submit Application for Payment to Architect by the last day of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.
- C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 2. Include amounts of approved Change Orders and Construction Change Directives issued before last day of construction period covered by application.

- E. **Stored Materials:** Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
1. Provide certificate of insurance (with Owner as Certificate Holder), evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- F. **Transmittal:** Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. **Waivers of Mechanic's Lien:** With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 5. **Waiver Forms:** Submit executed waivers of lien on forms acceptable to Owner.
- H. **Initial Application for Payment:** Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule (preliminary if not final).
 4. Products list (preliminary if not final).
 5. Schedule of unit prices.
 6. Submittal schedule (preliminary if not final).
 7. List of Contractor's staff assignments.
 8. List of Contractor's principal consultants.
 9. Copies of building permits.
 10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.

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11. Initial progress report.
 12. Report of preconstruction conference.
 13. Certificates of insurance and insurance policies.
 14. Performance and payment bonds.
- I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. AIA Document G706-1994, "Contractor's Affidavit of Payment of Debts and Claims."
 5. AIA Document G706A-1994, "Contractor's Affidavit of Release of Liens."
 6. AIA Document G707-1994, "Consent of Surety to Final Payment."
 7. Evidence that claims have been settled.
 8. Final meter readings for utilities and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. Requests for Information (RFIs).
 - 4. Project meetings.
- B. Related Requirements:
 - 1. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.

1.2 DEFINITIONS

- A. RFI: Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.3 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Use CSI Form 1.5A. Include the following information in tabular form:
 - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1.4 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's construction schedule.
 2. Preparation of the schedule of values.
 3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.
 5. Progress meetings.
 6. Preinstallation conferences.
 7. Project closeout activities.
 8. Startup and adjustment of systems.

1.5 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - b. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid.

2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings.
3. Mechanical / Electrical Rooms: Provide coordination drawings for mechanical / electrical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility.

1.6 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
 1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
 1. Project name.
 2. Project number.
 3. Date.
 4. Name of Contractor.
 5. Name of Architect.
 6. RFI number, numbered sequentially.
 7. RFI subject.
 8. Specification Section number and title and related paragraphs, as appropriate.
 9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.
 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
- C. RFI Forms: AIA Document G716 or form acceptable to Architect.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
 1. The following RFIs will be returned without action:

- a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for coordination information already indicated in the Contract Documents.
 - d. Requests for adjustments in the Contract Time or the Contract Sum.
 - e. Requests for interpretation of Architect's actions on submittals.
 - f. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:
1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect.
 4. RFI number including RFIs that were dropped and not submitted.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect's response was received.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 2. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.7 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within five days of the meeting.
- B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.

1. Attendees: Authorized representatives of Owner, Architect and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Critical work sequencing and long-lead items.
 - c. Designation of key personnel and their duties.
 - d. Procedures for processing field decisions and Change Orders.
 - e. Procedures for RFIs.
 - f. Procedures for testing and inspecting.
 - g. Procedures for processing Applications for Payment.
 - h. Distribution of the Contract Documents.
 - i. Submittal procedures.
 - j. Sustainable design requirements.
 - k. Preparation of record documents.
 - l. Use of the premises.
 - m. Work restrictions.
 - n. Working hours.
 - o. Owner's occupancy requirements.
 - p. Responsibility for temporary facilities and controls.
 - q. Procedures for moisture and mold control.
 - r. Procedures for disruptions and shutdowns.
 - s. Parking availability.
 - t. Office, work, and storage areas.
 - u. Equipment deliveries and priorities.
 - v. First aid.
 - w. Security.
 - x. Progress cleaning.
 3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Sustainable design requirements.
 - i. Review of mockups.

- j. Possible conflicts.
 - k. Compatibility problems.
 - l. Time schedules.
 - m. Weather limitations.
 - n. Manufacturer's written instructions.
 - o. Warranty requirements.
 - p. Compatibility of materials.
 - q. Acceptability of substrates.
 - r. Temporary facilities and controls.
 - s. Space and access limitations.
 - t. Regulations of authorities having jurisdiction.
 - u. Testing and inspecting requirements.
 - v. Installation procedures.
 - w. Coordination with other work.
 - x. Required performance results.
 - y. Protection of adjacent work.
 - z. Protection of construction and personnel.
- 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 - 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 - 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Progress Meetings: Conduct progress meetings at weekly intervals.
- 1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.

- 4) Status of sustainable design documentation.
 - 5) Deliveries.
 - 6) Off-site fabrication.
 - 7) Access.
 - 8) Site utilization.
 - 9) Temporary facilities and controls.
 - 10) Progress cleaning.
 - 11) Quality and work standards.
 - 12) Status of correction of deficient items.
 - 13) Field observations.
 - 14) Status of RFIs.
 - 15) Status of proposal requests.
 - 16) Pending changes.
 - 17) Status of Change Orders.
 - 18) Pending claims and disputes.
 - 19) Documentation of information for payment requests.
3. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
- a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
1. Contractor's construction schedule.
 2. Construction schedule updating reports.
 3. Daily construction reports.
 4. Site condition reports.

1.2 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 2. Predecessor Activity: An activity that precedes another activity in the network.
 3. Successor Activity: An activity that follows another activity in the network.
- B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. Float: The measure of leeway in starting and completing an activity.
1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.

1.3 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
1. Working electronic copy of schedule file, where indicated.
 2. PDF electronic file.
- B. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.

- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
 - 1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.
- D. Daily Construction Reports: Submit at bi-weekly intervals.
- E. Site Condition Reports: Submit at time of discovery of differing conditions.

1.4 COORDINATION

- A. Coordinate Contractor's construction schedule with the schedule of values, submittal schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from entities involved.
 - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

1.5 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
 - 1. Use Microsoft Project, Primavera or Meridian Prolog. Other software may also be acceptable upon approval from Architect.
- B. Time Frame: Extend schedule from date established for the Notice of Award to date of final completion.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 - 1. Activity Duration: Define activities so no activity is longer than 30 days, unless specifically allowed by Architect.
 - 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 - a. Structural steel.
 - b. Light fixtures and electrical equipment.
 - c. HVAC equipment and systems.
 - d. Aluminum window / storefront framing, doors and glazing.

- e. Skylights.
 - f. Interior doors and hardware.
 - g. Metal panels, trim and roofing.
 - h. Prefabricated fireplace insert.
 - i. Elevator.
- 3. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
 - 4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
 - 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
 - 6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
- 1. Phasing: Arrange list of activities on schedule by phase.
 - 2. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 - 3. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Uninterruptible services.
 - b. Partial occupancy before Substantial Completion.
 - c. Use of premises restrictions.
 - d. Provisions for future construction.
 - e. Seasonal variations.
 - f. Environmental control.
 - 4. Work Stages: Indicate important stages of construction for each major portion of the Work.
- E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.
- F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
- 1. Unresolved issues.
 - 2. Unanswered Requests for Information.
 - 3. Rejected or unreturned submittals.
 - 4. Notations on returned submittals.
 - 5. Pending modifications affecting the Work and Contract Time.
- G. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate final completion percentage for each activity.
- H. Two (2) Week Look-Ahead Schedule: Generate (2) Week Look-Ahead Schedule for review / distribution at each construction meeting. Update weekly.
- I. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.
- J. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.
 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.6 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's construction schedule within 15 days of date established for the Notice of Award.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

1.7 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
1. List of subcontractors at Project site.
 2. List of separate contractors at Project site.
 3. Approximate count of personnel at Project site.
 4. Equipment at Project site.
 5. Material deliveries.
 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 7. Accidents.
 8. Testing and inspection.

9. Meetings and significant decisions.
10. Unusual events.
11. Stoppages, delays, shortages, and losses.
12. Meter readings and similar recordings.
13. Emergency procedures.
14. Orders and requests of authorities having jurisdiction.
15. Change Orders received and implemented.
16. Construction Change Directives received and implemented.
17. Services connected and disconnected.
18. Equipment or system tests and startups.
19. Partial completions and occupancies.
20. Substantial Completions authorized.

- B. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013200

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

B. Related Requirements:

1. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
2. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
3. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
4. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action.
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.3 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1.4 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Architect.
4. Name of Contractor.

5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.
7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
8. Category and type of submittal.
9. Submittal purpose and description.
10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
11. Drawing number and detail references, as appropriate.
12. Indication of full or partial submittal.
13. Location(s) where product is to be installed, as appropriate.
14. Other necessary identification.
15. Remarks.
16. Signature of transmitter.

B. Options: Identify options requiring selection by Architect.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. Paper Submittals:

1. Place a permanent label or title block on each submittal item for identification; include name of firm or entity that prepared submittal.
2. Provide a space approximately 6 by 8 inches (150 by 200 mm) on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
3. Action Submittals: Submit three paper copies of each submittal unless otherwise indicated. Architect, will return two copies.
4. Informational Submittals: Submit one paper copy of each submittal unless otherwise indicated. Architect will not return copies.
5. Transmittal for Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using Architect's transmittal form, included in Project Manual.

E. PDF Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

1.5 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Email: Prepare submittals as PDF package, and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.
2. Paper: Prepare submittals in paper form, and deliver to Architect.

- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Resubmittal Review: Allow 15 days for review of each resubmittal.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.6 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:

- a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 5. Submit Product Data before Shop Drawings, and before or concurrent with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 2. Paper Sheet Size: Except for templates, patterns, and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm), but no larger than 30 by 42 inches (750 by 1067 mm).
 - a. Three opaque copies of each submittal. Architect will return two copies.
- C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.
 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
 3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics, and identification information for record.
 4. Paper Transmittal: Include paper transmittal including complete submittal information indicated.
 5. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.

- b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
- 6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit two full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect, will return one submittal with options selected.
- 7. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit two sets of Samples. Architect will return one set.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. Certificates:
 - 1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
 - 2. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.
 - d. Product and manufacturers' names.
 - e. Description of product.
 - f. Test procedures and results.
 - g. Limitations of use.

1.7 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.8 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
 1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return it. Architect will indicate, via markup on each submittal, the appropriate action, as follows:
 1. No comments noted
 2. Comments Noted
 3. Revise and send record copies
 4. Resubmit information
 5. Rejected
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements.
- C. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- D. Architect will discard submittals received from sources other than Contractor.
- E. Submittals not required by the Contract Documents will be returned by Architect without action.
- F. Architect will review initial submittal and up to one revision of same submittal. Subsequent reviews of additional re-submittals are considered additional services for the Architect. All additional time spent will be invoiced to the Owner on an hourly basis at the Architect's current billable rates. All additional service fees will be deducted from Contractor's contract amount, via deduct change order.

PARTNERS 21-130
SUBMITTAL PROCEDURES
013300 - 8

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 2. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
 - 3. Specific test and inspection requirements are not specified in this Section.

1.2 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
 - 1. Laboratory Mockups: Full-size physical assemblies constructed at testing facility to verify performance characteristics.
- D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- F. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.

- G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.3 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1.4 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 INFORMATIONAL SUBMITTALS

- A. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
 - 1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
 - 2. Main wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.

- B. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.6 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, and telephone number of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.
 - 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - 12. Name and signature of laboratory inspector.
 - 13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
 - 1. Statement on condition of substrates and their acceptability for installation of product.
 - 2. Statement that products at Project site comply with requirements.
 - 3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 - 4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 - 5. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
 - 1. Statement that equipment complies with requirements.
 - 2. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 - 3. Other required items indicated in individual Specification Sections.

1.7 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- F. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
 - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- G. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
 - 1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.

- c. When testing is complete, remove test specimens, assemblies, and mockups; do not reuse products on Project.
 - 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
- 1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
 - 2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 - 3. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 4. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
 - a. Allow seven days for initial review and each re-review of each mockup.
 - 5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 6. Demolish and remove mockups when directed unless otherwise indicated.

1.8 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
- 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 - 2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
- 1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 - 2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 - 3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 - 4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.

5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Manufacturer's Field Services: Where indicated, engage a manufacturer's representative to observe and inspect the Work. Manufacturer's representative's services include examination of substrates and conditions, verification of materials, inspection of completed portions of the Work, and submittal of written reports.
- D. Retesting / Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- E. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform any duties of Contractor.
- F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.9 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
 - 1. Date test or inspection was conducted.
 - 2. Description of the Work tested or inspected.
 - 3. Date test or inspection results were transmitted to Architect.
 - 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
 - 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.3 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
- B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

1. AABC - Associated Air Balance Council; www.aabc.com.
2. AAMA - American Architectural Manufacturers Association; www.aamanet.org.
3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
7. ABMA - American Boiler Manufacturers Association; www.abma.com.
8. ACI - American Concrete Institute; (Formerly: ACI International); www.abma.com.
9. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.
10. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
11. AF&PA - American Forest & Paper Association; www.afandpa.org.
12. AGA - American Gas Association; www.aga.org.
13. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
14. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
15. AI - Asphalt Institute; www.asphaltinstitute.org.
16. AIA - American Institute of Architects (The); www.aia.org.
17. AISC - American Institute of Steel Construction; www.aisc.org.
18. AISI - American Iron and Steel Institute; www.steel.org.
19. AITC - American Institute of Timber Construction; www.aitc-glulam.org.
20. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
21. ANSI - American National Standards Institute; www.ansi.org.
22. AOSA - Association of Official Seed Analysts, Inc.; www.aosaseed.com.
23. APA - APA - The Engineered Wood Association; www.apawood.org.
24. APA - Architectural Precast Association; www.archprecast.org.
25. API - American Petroleum Institute; www.api.org.
26. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
27. ARI - American Refrigeration Institute; (See AHRI).
28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
29. ASCE - American Society of Civil Engineers; www.asce.org.
30. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
31. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
32. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
33. ASSE - American Society of Safety Engineers (The); www.asse.org.
34. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.

35. ASTM - ASTM International; www.astm.org.
36. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
37. AWEA - American Wind Energy Association; www.awea.org.
38. AWI - Architectural Woodwork Institute; www.awinet.org.
39. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
40. AWPA - American Wood Protection Association; www.awpa.com.
41. AWS - American Welding Society; www.aws.org.
42. AWWA - American Water Works Association; www.awwa.org.
43. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
44. BIA - Brick Industry Association (The); www.gobrick.com.
45. BICSI - BICSI, Inc.; www.bicsi.org.
46. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.org.
47. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
48. BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bissc.org.
49. CDA - Copper Development Association; www.copper.org.
50. CEA - Canadian Electricity Association; www.electricity.ca.
51. CEA - Consumer Electronics Association; www.ce.org.
52. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
53. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
54. CGA - Compressed Gas Association; www.cganet.com.
55. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
56. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
57. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
58. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
59. CPA - Composite Panel Association; www.pbmdf.com.
60. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
61. CRRC - Cool Roof Rating Council; www.coolroofs.org.
62. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
63. CSA - Canadian Standards Association; www.csa.ca.
64. CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
65. CSI - Construction Specifications Institute (The); www.csinet.org.
66. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
67. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
68. CWC - Composite Wood Council; (See CPA).
69. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
70. DHI - Door and Hardware Institute; www.dhi.org.
71. ECA - Electronic Components Association; (See ECIA).
72. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
73. ECIA - Electronic Components Industry Association; www.eciaonline.org.
74. EIA - Electronic Industries Alliance; (See TIA).
75. EIMA - EIFS Industry Members Association; www.eima.com.
76. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
77. ESD - ESD Association; (Electrostatic Discharge Association); www.esda.org.
78. ESTA - Entertainment Services and Technology Association; (See PLASA).
79. EVO - Efficiency Valuation Organization; www.evo-world.org.
80. FCI - Fluid Controls Institute; www.fluidcontrolsintstitute.org.
81. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.

82. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
83. FM Approvals - FM Approvals LLC; www.fmglobal.com.
84. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
85. FRSA - Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.; www.floridarooft.com.
86. FSA - Fluid Sealing Association; www.fluidsealing.com.
87. FSC - Forest Stewardship Council U.S.; www.fscus.org.
88. GA - Gypsum Association; www.gypsum.org.
89. GANA - Glass Association of North America; www.glasswebsite.com.
90. GS - Green Seal; www.greenseal.org.
91. HI - Hydraulic Institute; www.pumps.org.
92. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
93. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
94. HPVA - Hardwood Plywood & Veneer Association; www.hpva.org.
95. HPW - H. P. White Laboratory, Inc.; www.hpwhite.com.
96. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
97. IAS - International Accreditation Service; www.iasonline.org.
98. IAS - International Approval Services; (See CSA).
99. ICBO - International Conference of Building Officials; (See ICC).
100. ICC - International Code Council; www.iccsafe.org.
101. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
102. ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
103. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
104. IEC - International Electrotechnical Commission; www.iec.ch.
105. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
106. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
107. IESNA - Illuminating Engineering Society of North America; (See IES).
108. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
109. IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.
110. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
111. ILI - Indiana Limestone Institute of America, Inc.; www.ili.ai.com.
112. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
113. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
114. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
115. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
116. ISO - International Organization for Standardization; www.iso.org.
117. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
118. ITU - International Telecommunication Union; www.itu.int/home.
119. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
120. LMA - Laminating Materials Association; (See CPA).
121. LPI - Lightning Protection Institute; www.lightning.org.
122. MBMA - Metal Building Manufacturers Association; www.mbma.com.
123. MCA - Metal Construction Association; www.metalconstruction.org.
124. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
125. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
126. MHIA - Material Handling Industry of America; www.mhia.org.

127. MIA - Marble Institute of America; www.marble-institute.com.
128. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
129. MPI - Master Painters Institute; www.paintinfo.com.
130. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
131. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
132. NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.
133. NADCA - National Air Duct Cleaners Association; www.nadca.com.
134. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
135. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
136. NBI - New Buildings Institute; www.newbuildings.org.
137. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
138. NCMA - National Concrete Masonry Association; www.ncma.org.
139. NEBB - National Environmental Balancing Bureau; www.nebb.org.
140. NECA - National Electrical Contractors Association; www.necanet.org.
141. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
142. NEMA - National Electrical Manufacturers Association; www.nema.org.
143. NETA - InterNational Electrical Testing Association; www.netaworld.org.
144. NFHS - National Federation of State High School Associations; www.nfhs.org.
145. NFPA - National Fire Protection Association; www.nfpa.org.
146. NFPA - NFPA International; (See NFPA).
147. NFRC - National Fenestration Rating Council; www.nfrc.org.
148. NHLA - National Hardwood Lumber Association; www.nhla.com.
149. NLGA - National Lumber Grades Authority; www.nlga.org.
150. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
151. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
152. NRCA - National Roofing Contractors Association; www.nrca.net.
153. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
154. NSF - NSF International; www.nsf.org.
155. NSPE - National Society of Professional Engineers; www.nspe.org.
156. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
157. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
158. NWFA - National Wood Flooring Association; www.nwfa.org.
159. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
160. PDI - Plumbing & Drainage Institute; www.pdionline.org.
161. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); www.plasa.org.
162. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
163. RFCI - Resilient Floor Covering Institute; www.rfci.com.
164. RIS - Redwood Inspection Service; www.redwoodinspection.com.
165. SAE - SAE International; www.sae.org.
166. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
167. SDI - Steel Deck Institute; www.sdi.org.
168. SDI - Steel Door Institute; www.steeldoor.org.
169. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
170. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
171. SIA - Security Industry Association; www.siaonline.org.
172. SJI - Steel Joist Institute; www.steeljoist.org.
173. SMA - Screen Manufacturers Association; www.smainfo.org.
174. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.

175. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
176. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
177. SPIB - Southern Pine Inspection Bureau; www.spib.org.
178. SPRI - Single Ply Roofing Industry; www.spri.org.
179. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
180. SSINA - Specialty Steel Industry of North America; www.ssina.com.
181. SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.
182. STI - Steel Tank Institute; www.steeltank.com.
183. SWI - Steel Window Institute; www.steelwindows.com.
184. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
185. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
186. TCNA - Tile Council of North America, Inc.; www.tileusa.com.
187. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
188. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
189. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
190. TMS - The Masonry Society; www.masonrysociety.org.
191. TPI - Truss Plate Institute; www.tpinst.org.
192. TPI - Turfgrass Producers International; www.turfgrassod.org.
193. TRI - Tile Roofing Institute; www.tilerroofing.org.
194. UL - Underwriters Laboratories Inc.; www.ul.com.
195. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
196. USAV - USA Volleyball; www.usavolleyball.org.
197. USGBC - U.S. Green Building Council; www.usgbc.org.
198. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
199. WASTEC - Waste Equipment Technology Association; www.wastec.org.
200. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
201. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
202. WDMA - Window & Door Manufacturers Association; www.wdma.com.
203. WI - Woodwork Institute; www.wicnet.org.
204. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
205. WWPA - Western Wood Products Association; www.wwpa.org.

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

1. DIN - Deutsches Institut für Normung e.V.; www.din.de.
2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
3. ICC - International Code Council; www.iccsafe.org.
4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

1. COE - Army Corps of Engineers; www.usace.army.mil.
2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
4. DOD - Department of Defense; www.quicksearch.dla.mil.
5. DOE - Department of Energy; www.energy.gov.
6. EPA - Environmental Protection Agency; www.epa.gov.

7. FAA - Federal Aviation Administration; www.faa.gov.
 8. FG - Federal Government Publications; www.gpo.gov.
 9. GSA - General Services Administration; www.gsa.gov.
 10. HUD - Department of Housing and Urban Development; www.hud.gov.
 11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
 12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
 13. SD - Department of State; www.state.gov.
 14. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
 15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
 16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
 17. USDJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
 18. USP - U.S. Pharmacopeial Convention; www.usp.org.
 19. USPS - United States Postal Service; www.usps.com.
- E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list.
1. CFR - Code of Federal Regulations; Available from Government Printing Office; www.gpo.gov/fdsys.
 2. DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.quicksearch.dla.mil.
 3. DSCC - Defense Supply Center Columbus; (See FS).
 4. FED-STD - Federal Standard; (See FS).
 5. FS - Federal Specification; Available from DLA Document Services; www.quicksearch.dla.mil.
 - a. Available from Defense Standardization Program; www.dsp.dla.mil.
 - b. Available from General Services Administration; www.gsa.gov.
 - c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org/ccb.
 6. MILSPEC - Military Specification and Standards; (See DOD).
 7. USAB - United States Access Board; www.access-board.gov.
 8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).
- F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.
1. CBHF; State of California; Department of Consumer Affairs; Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; www.bearhfti.ca.gov.
 2. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.calregs.com.
 3. CDHS; California Department of Health Services; (See CDPH).
 4. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cal-iaq.org.
 5. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
 6. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.

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REFERENCES

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7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development;
www.txforestsservice.tamu.edu.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.2 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, testing agencies, and authorities having jurisdiction.

1.3 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.
- C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- D. Moisture-and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold.
- E. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:
 - 1. Locations of dust-control partitions at each phase of work.
 - 2. HVAC system isolation schematic drawing.
 - 3. Location of proposed air-filtration system discharge.
 - 4. Waste-handling procedures.

1.4 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.5 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.8-mm-) thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized-steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts.

2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
 - 1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
 - 2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- (1.2-m-) square tack and marker boards.
 - 3. Drinking water.
 - 4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F (20 to 22 deg C).
 - 5. Lighting fixtures capable of maintaining average illumination of 20 fc (215 lx) at desk height.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
 - 1. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of HVAC system, provide vented, self-contained, fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
 - 3. Permanent HVAC System: If Owner authorizes use of HVAC system for use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Section 017700 "Closeout Procedures".

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
 - 1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.3 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
 - 1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- F. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
- G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- H. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line(s) for each field office.
 - 1. Provide superintendent with cellular telephone for use when away from field office.
- I. Electronic Communication Service: Provide a desktop computer in the primary field office adequate to access project electronic documents and maintain electronic communications.
 - 1. Printer: "All-in-one" unit equipped with printer server, combining color printing, photocopying, scanning, and faxing, or separate units for each of these three functions.
 - 2. Internet Service: Provide wireless or broadband service with access to the internet.

3.4 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
 - 1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
 - 2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Traffic Controls: Comply with requirements of authorities having jurisdiction.
 - 1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 - 2. Maintain access for fire-fighting equipment and access to fire hydrants.

- C. Parking: Limited site area will be available for parking. Contractor responsible to coordinate parking arrangements for construction personnel. Do not negatively impact local neighboring streets with construction parking.
- D. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
 - 1. Identification Signs: Provide Project identification signs as indicated on Drawings.
 - 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.
 - 3. Maintain and touchup signs so they are legible at all times.
- E. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."
- F. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
 - 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and authorities having jurisdiction.
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Tree and Plant Protection: Comply with requirements specified in Section 015639 "Temporary Tree and Plant Protection."
- F. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- G. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals

so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.

- H. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
 - 1. Extent of Fence: As required to enclose entire Project site.
 - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner and Architect.
- I. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.
- J. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.
- L. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire prevention program.
 - 1. Prohibit smoking in construction areas.
 - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
 - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

3.6 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.
 - 1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
 - 2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
 - 3. Indicate methods to be used to avoid trapping water in finished work.

- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
1. Protect porous materials from water damage.
 2. Protect stored and installed material from flowing or standing water.
 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 4. Remove standing water from decks.
 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 2. Keep interior spaces reasonably clean and protected from water damage.
 3. Periodically collect and remove waste containing cellulose or other organic matter.
 4. Discard or replace water-damaged material.
 5. Do not install material that is wet.
 6. Discard and replace stored or installed material that begins to grow mold.
 7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.
- D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective and require replacing.
 - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
 - c. Remove and replace materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.7 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
 3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 012500 "Substitution Procedures" for requests for substitutions.

1.2 DEFINITIONS

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

1.3 ACTION SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

- a. Form of Approval: As specified in Section 013300 "Submittal Procedures."
 - b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

1.4 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

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

1.6 PRODUCT WARRANTIES

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

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
 3. Refer to other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected," Architect will make selection.
 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
- B. Product Selection Procedures:
1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 3. Products:
 - a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

- b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
 - 4. Manufacturers:
 - a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - b. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
 - 5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
- C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
 - 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
 - 1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 - 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - 3. Evidence that proposed product provides specified warranty.

4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Coordination of Owner-installed products.
 - 6. Progress cleaning.
 - 7. Starting and adjusting.
 - 8. Protection of installed construction.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for limits on use of Project site.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
 - 1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence

and location of underground utilities, mechanical and electrical systems and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

- B. General: Engage a land surveyor or professional engineer to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish limits on use of Project site.
 - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 4. Inform installers of lines and levels to which they must comply.
 - 5. Check the location, level and plumb, of every major element as the Work progresses.
 - 6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
 - 1. Once the building is staked by the Contractor, Architect will engage a surveyor to review the Contractor's initial construction staking of the building. Contractor may not use the same surveyor.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

- A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
- B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
- C. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- D. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 1. Make vertical work plumb and make horizontal work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 2. Allow for building movement, including thermal expansion and contraction.
 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
1. Remove liquid spills promptly.
 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements"

3.9 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.
- B. Related Requirements:
 - 1. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 2. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
 - 3. Section 017900 "Demonstration and Training" for requirements for instructing Owner's personnel.

1.2 ACTION SUBMITTALS

- A. Product Data: For cleaning agents.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.3 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest control inspection.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.5 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
 - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.
 - 5. Submit test/adjust/balance records.
 - 6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Advise Owner of pending insurance changeover requirements.
 - 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 - 3. Complete startup and testing of systems and equipment.
 - 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 - 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
 - 6. Advise Owner of changeover in heat and other utilities.
 - 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 - 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 - 9. Complete final cleaning requirements, including touchup painting.
 - 10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for final completion.

1.6 FINAL COMPLETION PROCEDURES

- A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:
1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Submit pest-control final inspection report and warranty.
 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings.
- B. Inspection: Submit a written request for final inspection to determine acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.7 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
1. Organize list of spaces in sequential order, starting with exterior areas.
 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
 3. Submit list of incomplete items in the following format:
 - a. MS Excel electronic file. Architect, will return annotated copy.

1.8 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
 - 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (215-by-280-mm) paper.
 - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
 - 4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
- C. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
 - 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

- a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent.
 - l. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - o. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
 - p. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.
- D. If the Owner or Architect determines that the cleaning is not sufficient, the Owner or Architect will request that the cleaning be redone; or at the Owner's option, the Owner will hire a professional cleaning company to perform the said work, and thus deduct the cost from the Contractor's final Pay Application, via Deduct Change Order.
- 3.2 REPAIR OF THE WORK
- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

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1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

3.3 SCHEDULE

- A. All closeout activities shall be completed within thirty (30) days of the substantial completion date.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
1. Operation and maintenance documentation directory.
 2. Emergency manuals.
 3. Operation manuals for systems, subsystems, and equipment.
 4. Product maintenance manuals.
 5. Systems and equipment maintenance manuals.

1.2 CLOSEOUT SUBMITTALS

- A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
1. Architect will comment on whether content of operations and maintenance submittals are acceptable.
 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operations and maintenance manuals in the following format:
1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
 - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.
 2. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves.
- C. Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information.
- B. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.
 - 3. Manual contents.
- C. Title Page: Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of Project.
 - 3. Name and address of Owner.
 - 4. Date of submittal.
 - 5. Name and contact information for Contractor.
 - 6. Name and contact information for Construction Manager.
 - 7. Name and contact information for Architect.
 - 8. Name and contact information for Commissioning Authority.
 - 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 - 10. Cross-reference to related systems in other operation and maintenance manuals.
- D. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
- E. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- F. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 - 2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- G. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.
2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.2 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for each of the following:
 1. Type of emergency.
 2. Emergency instructions.
 3. Emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
 1. Fire.
 2. Flood.
 3. Gas leak.
 4. Water leak.
 5. Power failure.
 6. Water outage.
 7. System, subsystem, or equipment failure.
 8. Chemical release or spill.
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

2.3 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor is delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.4 PRODUCT MAINTENANCE MANUALS

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 4. Material and chemical composition.
 - 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 - 1. Inspection procedures.
 - 2. Types of cleaning agents to be used and methods of cleaning.
 - 3. List of cleaning agents and methods of cleaning detrimental to product.
 - 4. Schedule for routine cleaning and maintenance.
 - 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

2.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

- C. **Manufacturers' Maintenance Documentation:** Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
 - 1. Standard maintenance instructions and bulletins.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 - 3. Identification and nomenclature of parts and components.
 - 4. List of items recommended to be stocked as spare parts.
- D. **Maintenance Procedures:** Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.
 - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - 5. Aligning, adjusting, and checking instructions.
 - 6. Demonstration and training video recording, if available.
- E. **Maintenance and Service Schedules:** Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
- F. **Spare Parts List and Source Information:** Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. **Maintenance Service Contracts:** Include copies of maintenance agreements with name and telephone number of service agent.
- H. **Warranties and Bonds:** Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. **Emergency Manual:** Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. **Product Maintenance Manual:** Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- C. **Operation and Maintenance Manuals:** Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

- D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
- E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original project record documents as part of operation and maintenance manuals.
- F. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
- B. Related Requirements:
 - 1. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.2 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set of marked-up record prints.
 - 2. Number of Copies: Submit copies of record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit one paper-copy set of marked-up record prints.
 - b. Final Submittal:
 - 1) Submit PDF electronic files of scanned record prints and three set(s) of prints.
 - 2) Print each drawing, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit one paper copy and annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one paper copy and annotated PDF electronic files and directories of each submittal.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised Drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Record data as soon as possible after obtaining it.
 - c. Record and check the markup before enclosing concealed installations.
 2. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: DWG, Version: AutoCAD 2014 or later; Microsoft Windows operating system.
 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 3. Refer instances of uncertainty to Architect for resolution.
- C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 3. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.

B. Format: Submit record Specifications as annotated PDF electronic file.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.

B. Format: Submit record Product Data as annotated PDF electronic file.

2.4 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
 - 3. Demonstration and training video recordings.

1.2 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

1.3 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
 - 1. At completion of training, submit complete training manual(s) for Owner's use prepared and bound in format matching operation and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to demonstration and training.

1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project record documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
 - 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.

- f. Special operating instructions and procedures.
- 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
- 5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
- 6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
- 7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
- 8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."

3.2 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
 - 2. Owner will furnish an instructor to describe Owner's operational philosophy.
 - 3. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner, through Architect with at least seven days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.

3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
 - 1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Video Recording Format: Provide high-quality color video recordings with menu navigation in format acceptable to Architect.
- C. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.

- D. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

END OF SECTION 017900

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Footings and non-exposed foundation walls.
 - 2. Exposed foundation walls.
 - 3. Slabs-on-grade.
 - 4. Supported slabs.
- B. Related Sections include the following:
 - 1. Division 32 Section "Concrete Paving" for concrete pavement and walks.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- E. Material Certificates: For each of the following, signed by manufacturers:
 1. Cementitious materials.
 2. Admixtures.
 3. Curing compounds.
 4. Floor and slab treatments.
 5. Bonding agents.
 6. Adhesives.
 7. Vapor retarders.
 8. Repair materials.
- F. Floor surface flatness and levelness measurements to determine compliance with specified tolerances.
- G. Field quality-control test and inspection reports.
- H. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: An independent agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 1. ACI 301, "Specification for Structural Concrete,"
 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

- F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- G. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Ready-mix concrete manufacturer.
 - c. Concrete subcontractor.
 - d. Architect and Engineer.
 - e. Owner's Testing Agency.
 - 2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints forms and form removal limitations, vapor-retarder installation, anchor rod and anchorage device installation tolerances, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.

2.2 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Plywood, metal, or other approved panel materials.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

- D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.
- E. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- F. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- B. Plain-Steel Wire: ASTM A 82, as drawn.
- C. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

2.4 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.5 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project unless noted otherwise:
 - 1. Portland Cement: ASTM C 150, Type I gray or supplement with the following:
 - a. Fly Ash: ASTM C 618, Class C or F (in footing mix only, mix 25% of cement content.).
 - b. Ground Granulated Blast-Furnace Slag: (in footing mix only, max 35% of Cement content).ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
 - 1. Maximum Coarse-Aggregate Size: 1 inch (25 mm) nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M and potable.

2.6 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.7 VAPOR BARRIER/ RETARDERS

- A. Plastic Vapor Retarder: ASTM E 1745, Class A, not less than 15 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.
 - 1. Products:
 - a. Fortifiber Corporation; Moistop Ultra 15.
 - b. Raven Industries Inc.; Vapor Block 15.
 - c. Reef Industries, Inc.; Vapor Guard T85.
 - d. Stego Industries, LLC; Stego Wrap, 15 mils.
- B. Granular Fill: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a 3/8-inch (9.5-mm) sieve, 10 to 30 percent passing a No. 100 (0.15-mm) sieve, and at least 5 percent passing No. 200 (0.075-mm) sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates.

2.8 CURING MATERIALS

- C. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
 - 1. Products:
 - a. Axim Concrete Technologies; Cimfilm.
 - b. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Aquafilm.
 - c. Dayton Superior Corporation; Sure Film.
 - d. Euclid Chemical Company (The); Eucobar.
 - e. L&M Construction Chemicals, Inc.; E-Con.
 - f. Meadows, W. R., Inc.; Sealtight Evapre.
 - g. Sika Corporation, Inc.; SikaFilm.
 - h. Symons Corporation, a Dayton Superior Company; Finishing Aid.
- D. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

- E. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- F. Water: Potable.
- G. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
 - 1. Products:
 - a. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; High Seal.
 - b. Dayton Superior Corporation; Safe Cure and Seal (J-19).
 - c. Euclid Chemical Company (The); Diamond Clear VOX.
 - d. L&M Construction Chemicals, Inc.; Dress & Seal WB.
 - e. MBT Protection and Repair, Div. of ChemRex; MasterKure-N-Seal VOC.
 - f. Meadows, W. R., Inc.; Vocomp-20.
 - g. Sonneborn, Div. of ChemRex; Kure-N-Seal.
 - h. Symons Corporation, a Dayton Superior Company; Cure & Seal 18 Percent E.

2.8 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.9 REPAIR MATERIALS

- A. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested according to ASTM C 109/C 109M.

2.10 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- A. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
1. Fly Ash: 25 percent.
 2. Combined Fly Ash and Pozzolan: 25 percent.
 3. Ground Granulated Blast-Furnace Slag: 35 percent.
 4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
- B. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing or high-range water-reducing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Footings and Non-exposed Foundation Walls: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 3000 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.48.
 3. Slump Limit: 4 inches (100 mm) or 8 inches (200 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
 4. 5 sack mix minimum, 470# cement.
- B. Exposed Foundation Walls: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4000 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 3. Slump Limit: 4 inches (100 mm) or 8 inches (200 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
 4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch (25-mm) nominal maximum aggregate size.
 5. 6 sack mix minimum, 564# cement.
- C. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 3,500 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.48.

3. Slump Limit: 4 inches (100 mm) or 8 inches (200 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
4. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.

D. Exterior Concrete (Supported Slabs): Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4,000 psi (24.1 MPa) at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.48.
3. Slump Limit 4 inches (100 mm) or 8 inches (200 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
1. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch (25-mm) nominal maximum aggregate size.

2.12 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.13 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
1. Class B, 1/4 inch (6 mm) for smooth-formed finished surfaces.
 2. Class C, 1/2 inch (13 mm) for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.

- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 - 2. Install dovetail anchor slots in concrete structures as indicated.

3.3 VAPOR RETARDERS

- A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.
 - 2. Seal all penetrations with +/-24" square pieces of the vapor retarder and with slip-fit over penetrations and tape, including all four sides. Taping around penetration without this piece will not be permitted.

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.5 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
 - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
 2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 4. Slope surfaces uniformly to drains where required.
 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

- F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- G. Hot-Weather Placement: Comply with ACI 301 and as follows:
 - 1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.7 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, to be covered with a coating or covering material applied directly to concrete.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces to receive trowel finish.
- C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighen until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 2. Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-foot- (3.05-m-) long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed 3/16 inch (4.8 mm).
- D. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
1. Comply with flatness and levelness tolerances for trowel finished floor surfaces.
- E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.9 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

3.10 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
 - 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.11 LIQUID FLOOR TREATMENTS

- A. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.12 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension in solid concrete, but not less than 1 inch (25 mm) in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 2. After concrete has cured at least 14 days, correct high areas by grinding.
 - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 - 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 - 5. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive, patching mortar and concrete.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.13 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
 - 1. Steel reinforcement placement.
 - 2. Headed bolts and studs.
 - 3. Verification of use of required design mixture.
 - 4. Concrete placement, including conveying and depositing.
 - 5. Curing procedures and maintenance of curing temperature.
- D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 - 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 - 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
 - 5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - 6. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
 - 7. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
 - 8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
 10. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
 11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
 12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
 13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 14. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.
- E. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 24 hours of finishing.

3.14 PROTECTION OF LIQUID FLOOR TREATMENTS

- A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer

END OF SECTION 033000

SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Concrete masonry units.

1.2 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For reinforcing steel. Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315.
- C. Samples for Verification: For each type and color of exposed masonry unit and colored mortar.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type and size of product. For masonry units, include data on material properties.
- B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
 - 1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.
 - 2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

PART 2 - PRODUCTS

2.1 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.

- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
 - 1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.2 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
 - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
- B. Integral Water Repellent: Provide units made with integral water repellent for exposed units.
- C. CMUs: ASTM C 90.
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi (14.8 MPa).
 - 2. Density Classification: Normal weight
 - 3. Available products:
 - a. Grand Blanc Cement Products
 - b. National Block Company
 - c. Best block Company
 - 4. Size: Nominal face dimension of 8"x16" and nominal depth as indicated on drawings.
 - 5. Both hollow and solid block as indicated.
 - 6. Exposed corners (including door jambs) to be bullnosed (radius profile) typical unless otherwise noted. Bullnosed units shall be fabricated and not manually bullnosed in the field.

2.3 CONCRETE LINTELS

- A. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated.

2.4 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150/C 150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

- D. Aggregate for Mortar: ASTM C 144.
 - 1. White-Mortar Aggregates: Natural white sand or crushed white stone.
- E. Aggregate for Grout: ASTM C 404.
- F. Water: Potable.

2.5 REINFORCEMENT

- A. Uncoated-Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).
- B. Masonry-Joint Reinforcement, General: ASTM A 951/A 951M.
 - 1. Interior Walls: Hot-dip galvanized carbon steel.
 - 2. Exterior Walls: Hot-dip galvanized carbon steel.
 - 3. Wire Size for Side Rods: 0.148-inch (3.77-mm) diameter.
 - 4. Wire Size for Cross Rods: 0.148-inch (3.77-mm) diameter.
 - 5. Wire Size for Veneer Ties: 0.148-inch (3.77-mm) diameter.
 - 6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches (407 mm) o.c.
 - 7. Provide in lengths of not less than 10 feet (3 m).
- C. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder or truss type with single pair of side rods.
 - 1. Provide @ single-wythe CMU walls.
 - 2. Provide @ 4" CMU veneer.
 - a. Coordinate installation to not conflict with adjustable ties tied back to structural backup. Install in alternate courses.
 - 3. Install at 16" O.C. unless otherwise noted on drawings.

2.6 TIES AND ANCHORS

- A. General: Ties and anchors shall extend at least 1-1/2 inches (38 mm) into veneer but with at least a 5/8-inch (16-mm) cover on outside face.
- B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
 - 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M, with ASTM A 153/A 153M, Class B-2 coating.
 - 2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
 - 3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches (100 mm) wide.
 - 1. Wire: Fabricate from [3/16-inch- (4.76-mm-)] [1/4-inch- (6.35-mm-)] diameter, hot-dip galvanized-steel wire.
- D. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- (6.35-mm-) diameter, hot-dip galvanized-steel wire.
 2. Tie Section: Triangular-shaped wire tie made from 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized-steel wire.
- E. Partition Top Anchors: 0.105-inch- (2.66-mm-) thick metal plate with a 3/8-inch- (9.5-mm-) diameter metal rod 6 inches (152 mm) long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.
- F. Rigid Anchors: Fabricate from steel bars 1-1/2 inches (38 mm) wide by 1/4 inch (6.35 mm) thick by 24 inches (610 mm) long, with ends turned up 2 inches (51 mm) or with cross pins unless otherwise indicated.
1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M.

2.7 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.
- B. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D 226/D 226M, Type I (No. 15 asphalt felt).

2.8 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
1. Basis-of-Design Product: Subject to compliance with requirements, provide PROSOCO, Inc ; Sure Klean® 600. or a comparable product by one of the following:
 - a. Diedrich Technologies, Inc.; a division of Sandell Construction Solutions.
 - b. EaCo Chem, Inc.

2.9 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
1. Do not use calcium chloride in mortar or grout.
 2. Use portland cement-lime mortar unless otherwise indicated.
 3. For exterior masonry, use portland cement-lime mortar.
 4. For reinforced masonry, use portland cement-lime mortar.
 5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.
 - 1. For masonry below grade or in contact with earth, use Type S.
 - 2. For reinforced masonry, use Type S.
 - 3. For mortar parge coats, use Type S.
 - 4. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.
 - 5. For interior nonload-bearing partitions, Type O may be used instead of Type N.
- D. Grout for Unit Masonry: Comply with ASTM C 476.
 - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
 - 2. Provide grout with a slump of 8 to 11 inches (200 to 280 mm) as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- B. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

3.2 TOLERANCES

- A. Dimensions and Locations of Elements:
 - 1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
 - 2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
 - 3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.
- B. Lines and Levels:
 - 1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2-inch (12-mm) maximum.

2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
2. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm).

3.3 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- C. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- D. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- E. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.4 MORTAR BEDDING AND JOINTING

- A. Lay brick and CMUs as follows:
 1. Bed face shells in mortar and make head joints of depth equal to bed joints.
 2. Bed webs in mortar in all courses of piers, columns, and pilasters.
 3. Bed webs in mortar in grouted masonry, including starting course on footings.
 4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
- B. Lay solid masonry units and brick with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.5 MASONRY-JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).
 - 1. Space reinforcement not more than 16 inches (406 mm) o.c.
 - 2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
 - 3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.

3.6 ANCHORING MASONRY TO STRUCTURAL STEEL

- A. Anchor masonry to structural steel, where masonry abuts or faces structural steel, to comply with the following:
 - 1. Provide an open space not less than 1 inch (25 mm) wide between masonry and structural steel unless otherwise indicated. Keep open space free of mortar and other rigid materials.
 - 2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
 - 3. Space anchors as indicated, but not more than 24 inches (610 mm) o.c. vertically and 36 inches (915 mm) o.c. horizontally.

3.7 CONTROL AND EXPANSION JOINTS

- A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry as follows:
 - 1. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.
 - 2. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.
- C. Form expansion joints in brick as follows:
 - 1. Build in compressible joint fillers where indicated.
 - 2. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch (10 mm) for installation of sealant and backer rod specified in Section 079200 "Joint Sealants."
- D. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 079200 "Joint Sealants," but not less than 3/8 inch (10 mm).

1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.8 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 2. Limit height of vertical grout pours to not more than 60 inches (1520 mm).

3.9 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
- B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.
 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
- D. Testing Frequency: One set of tests for each 5000 sq. ft. (464 sq. m) of wall area or portion thereof.
- E. Clay Masonry Unit Test: For each type of unit provided, according to ASTM C 67 for compressive strength.
- F. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- G. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

- H. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.
- I. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

3.10 REPAIRING, POINTING, AND CLEANING

- A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
 - 3. Protect adjacent surfaces from contact with cleaner.
 - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
 - 6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

3.11 MASONRY WASTE DISPOSAL

- A. Do not use masonry waste as a fill material. Legally dispose of masonry waste off site.

END OF SECTION 042000

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Miscellaneous steel framing and supports.
- B. Products furnished, but not installed, under this Section include the following:
 - 1. Loose steel lintels.

1.2 ACTION SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
- B. Delegated-Design Submittal: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ladders.

2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.

2.3 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting".

- B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.4 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.
- C. Weld corners and seams continuously to comply 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. At exposed connections, finish exposed welds and surfaces smooth and blended.
- D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Locate joints where least conspicuous.
- E. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c.

2.5 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

2.6 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.
- B. Galvanize loose steel lintels located in exterior walls.

2.7 FINISHES, GENERAL

- A. Finish metal fabrications after assembly.

2.8 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
- B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 - 1. Shop prime with primers specified in Section 099123 "Interior Painting" unless otherwise indicated.
- C. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning".

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 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. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

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3.2 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 055000

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Steel pipe and tube railings.

1.2 ACTION SUBMITTALS

- A. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- B. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E894 and ASTM E935.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Steel Pipe and Tube Railings:
 - 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. R & B Wagner, Inc.
 - b. VIVA Railings, LLC.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.
- B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails:

- a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
- b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
- c. Uniform and concentrated loads need not be assumed to act concurrently.

2.3 METALS, GENERAL

- A. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.4 STEEL AND IRON

- A. Tubing: ASTM A500 (cold formed) or ASTM A513.
- B. Pipe: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

2.5 FASTENERS

- A. General: Provide the following:
 1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5 for zinc coating.

2.6 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

2.7 FABRICATION

- A. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- B. Form work true to line and level with accurate angles and surfaces.
- C. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 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 flux immediately.

4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- D. Form changes in direction by bending or by inserting prefabricated elbow fittings.
- E. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- F. Close exposed ends of railing members with prefabricated end fittings.
- G. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.
- H. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

2.8 STEEL AND IRON FINISHES

- A. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- B. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 2. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3.5 m).
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

3.2 ATTACHING RAILINGS

- A. Attach railings to wall with wall brackets. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- B. Secure wall brackets and railing end flanges to building construction as follows:
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 2. For hollow masonry anchorage, use toggle bolts.

3.3 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.

END OF SECTION 055213

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wood blocking, cants, and nailers.
 - 2. Wood furring.
 - 3. Plywood backing panels.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.

1.3 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
- B. Evaluation Reports: For the following, from ICC-ES:
 - 1. Wood-preservative-treated wood.
 - 2. Fire-retardant-treated wood.
 - 3. Metal framing anchors.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. For exposed lumber indicated to receive a stained or natural finish, [mark grade stamp on end or back of each piece] [or] [omit grade stamp and provide certificates of grade compliance issued by grading agency].
 - 3. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

- C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
 - 1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWP U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
 - 3. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
 - 1. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
 - 2. At Exterior conditions, Provide "Exterior Fire-X", pressure – impregnated fire-retardant lumber and plywood as manufactured by Hoover Treated Wood Products, or equal.

- C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
- E. Application: Treat items indicated on Drawings, and the following:
 - 1. Concealed blocking.
 - 2. Plywood backing panels.

2.4 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Cants.
 - 4. Furring.
 - 5. Grounds.
- B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.
- C. Concealed Boards: 19 percent maximum moisture content and any of the following species and grades:
 - 1. Mixed southern pine or southern pine; No. 2 grade; SPIB.
 - 2. Eastern softwoods; No. 2 Common grade; NeLMA.
 - 3. Northern species; No. 2 Common grade; NLGA.

2.5 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: Plywood, DOC PS 1, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch (19-mm) nominal thickness.

2.6 FASTENERS

- A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.
 - 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

2.7 METAL FRAMING ANCHORS

- A. Allowable design loads, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.
- B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.
 - 1. Use for interior locations unless otherwise indicated.
- C. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.
 - 1. Use for wood-preservative-treated lumber and where indicated.

2.8 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to suit width of sill members indicated.
- B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).
- C. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

- E. Do not splice structural members between supports unless otherwise indicated.
- F. Comply with AWPAC M4 for applying field treatment to cut surfaces of preservative-treated lumber.
- G. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- H. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).

3.2 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet enough that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Glass-fiber blanket.
 - 2. Mineral-wool blanket (Sound attenuation insulation).
 - 3. High Density Rigid Insulation.

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Research reports.

PART 2 - PRODUCTS

2.1 GLASS-FIBER BLANKET

- A. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
 - 1. Manufacturers:
 - a. CertainTeed Corporation.
 - b. Guardian Fiberglass, Inc.
 - c. Johns Manville.
 - d. Knauf Fiber Glass
 - e. Owens Corning.
 - f. Or approved equal.
 - 2. Where glass-fiber blanket insulation is indicated by the following thicknesses, provide blankets in batt or roll form with thermal resistances indicated:
 - a. 3-1/2 inches (92 mm) thick with a thermal resistance of 13 deg F x h x sq. ft./Btu at 75 deg F (1.9 K x sq. m/W at 24 deg C).
 - b. 5-1/2 inches (140 mm) thick with a thermal resistance of 21 deg F x h x sq. ft./Btu at 75 deg F (3.3 K x sq. m/W at 24 deg C).

2.2 MINERAL-WOOL BLANKETS (Sound Batt Insulation)

- A. Mineral-Wool Blanket, Unfaced: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Thermafiber, Inc.; an Owens Corning company; FS-15 or a comparable product by one of the following:
 - a. Industrial Insulation Group, LLC (IIG-LLC).
 - b. Roxul Inc.
 - 2. Minimum 3" thick.

2.3 HD RIGID INSULATION

- A. Extruded Polystyrene Board, Type VI (use under raised floor slabs as indicated on drawings)
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Dow Chemical Company (The); STYROFOAM Brand HIGHLOAD 40 Insulation, or a comparable product by one of the following:
 - a. DiversiFoam Products.
 - b. Kingspan Insulation.
 - c. Owens Corning.
 - d. Soprema, Inc.
 - 2. Thickness: 4 inches.
 - 3. R Value: NA.

2.4 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
 - 1. Spray Polyurethane Foam Insulation: ASTM C 1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
- B. Insulation Anchors, Spindles, and Standoffs: As recommended by manufacturer.
- C. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.
- E. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- F. Stuff glass-fiber loose-fill insulation into miscellaneous voids and cavity spaces where indicated as well as where an exterior wall or roof area is void of any insulative material. Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).

END OF SECTION 072100

SECTION 075419 - POLYVINYL-CHLORIDE (PVC) ROOFING (Repair & Patching)

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Adhered polyvinyl-chloride (PVC) roofing system.
 - 2. Roof insulation.
 - 3. Walkway Pads.

1.2 DEFINITIONS

- A. Roofing Terminology: Definitions in ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Verification: For the following products:
 - 1. Sheet roofing, of color required.

1.5 INFORMATIONAL SUBMITTALS

- A. Research/Evaluation Reports: For components of roofing system, from ICC-ES.
- B. Sample Warranties: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing system to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

- 1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain components including roof insulation, and fasteners for roofing system from manufacturer approved by membrane roofing manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
- B. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.
- C. Roofing System Design: Tested by a qualified testing agency to resist the following uplift pressures:
 - 1. Roofing system shall be designed to accommodate ASCE 7-10 windspeeds of 115 mph; risk category II.
- D. Energy Star Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.
- E. Energy Performance: Roofing system shall have an initial solar reflectance of not less than 0.86 and an emissivity of not less than 0.82 when tested according to CRRC-1.
- F. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- G. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.3 PVC ROOFING

- A. PVC Sheet: ASTM D 4434/D 4434M, Type III, fabric reinforced and fabric backed.
 - 1. Basis-of-Design Product: Subject to compatibility with existing membrane, provide Johns Manville; a Berkshire Hathaway company; "JM PVC-60 Mil" or a comparable product by one of the following:
 - a. Carlisle SynTec Incorporated.
 - b. Duro-Last Roofing, Inc.
 - c. Flex Membranes International.
 - d. GAF Materials Corporation.
 - 2. Thickness: 60 mils (1.5 mm), nominal.
 - 3. Exposed Face Color: Black (or match existing).

2.4 AUXILIARY ROOFING MATERIALS (As required)

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.
 - 1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
- B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as PVC sheet.
- C. Bonding Adhesive: Manufacturer's standard.
- D. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roofing to substrate, and acceptable to roofing system manufacturer.
- E. Miscellaneous Accessories: Provide metal termination bars, metal battens, pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.5 ROOF INSULATION

- A. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Johns Manville; a Berkshire Hathaway company; "Flat ENRGY 3" or a comparable product by one of the following:
 - a. Atlas Roofing Corporation.
 - b. Carlisle SynTec Incorporated.
 - c. Firestone Building Products.
 - d. GAF Materials Corporation.
 - e. Insulfoam LLC; a Carlisle company.
 - f. Rmax, Inc.

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- B. Tapered Insulation: Provide factory-tapered fabricated insulation boards to match the existing slope of the roof, but having no less than a slope of 1/4 inch per 12 inches (1:48).
- C. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where required for sloping to drain. Fabricate to existing slopes.

2.6 INSULATION ACCESSORIES

- A. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.
- B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof cover board to substrate or to another insulation layer.
- C. Cover Board: ASTM C 1289, Type II, Class 4, Grades 1, 2 and 3, high density polyisocyanurate board with mineral coated fiber glass reinforced facers, 1/4 inch (6 mm) thick.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Johns Manville; a Berkshire Hathaway company; "Invinso Roof Board" or a comparable product by one of the following:
 - a. Atlas Roofing Corporation.
 - b. Carlisle SynTec Incorporated.
 - c. Firestone Building Products.
 - d. GAF Materials Corporation.
 - e. Insulfoam LLC; a Carlisle company.
 - f. Rmax, Inc.

2.7 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch (5 mm) thick and acceptable to roofing system manufacturer.

PART 3 - EXECUTION

3.1 ROOFING INSTALLATION, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions.
- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.
- C. Install roofing and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition.

3.2 INSULATION INSTALLATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Install tapered insulation under area of roofing to conform to existing slopes (as may be required).
- C. Install insulation under area of roofing to match existing thicknesses.
- D. Mechanically Fastened Insulation (as may be required): Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
 - 1. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.
- E. Install cover boards over insulation to match existing, if present.
 - 1. Fasten cover boards to resist uplift pressure.
 - 2. Set cover board in manufacturer recommended adhesive, firmly pressing and maintaining cover board in place.

3.3 ADHERED ROOFING INSTALLATION

- A. Adhere roofing over area to receive roofing according to roofing system manufacturer's written instructions. Unroll roofing and allow to relax before retaining.
 - 1. Install sheet according to ASTM D 5036.
- B. Accurately align roofing, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- C. Bonding Adhesive: Apply to substrate and underside of roofing at rate required by manufacturer, and allow to partially dry before installing roofing. Do not apply to splice area of roofing.
- D. In addition to adhering, mechanically fasten roofing securely at terminations, penetrations, and perimeter of roofing.
- E. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roofing and sheet flashings according to manufacturer's written instructions, to ensure a watertight seam installation.
 - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet.
 - 2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
 - 3. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.
- F. Spread sealant bed over deck-drain flange at roof drains, and securely seal roofing in place with clamping ring.

3.4 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.5 WALKWAY INSTALLATION

- A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.6 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075419

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.
- B. All penetrations through corridor walls, corridor ceilings, storage rooms or other fire rated walls (as determined by Architect) shall be firestopped.

1.2 PERFORMANCE REQUIREMENTS

- A. General: For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
- B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814:
 - 1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
 - 2. L-Rated Systems: Provide through-penetration firestop systems with L-ratings of not more than 3.0 cfm/sq. ft (0.01524cu. m/s x sq. m) at both ambient temperatures and 400 deg F (204 deg C).
- C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
 - 1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
 - 2. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.
- D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each through-penetration firestop system, submit documentation, including illustrations, from a qualified testing and inspecting agency, showing each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item.
 - 1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular through-penetration firestop condition, submit illustration, with

modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

- C. Qualification Data: For Installer.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FMG according to FMG 4991, "Approval of Firestop Contractors."
- B. Installation Responsibility: Assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single qualified installer.
- C. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:
 - 1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
 - 2. Through-penetration firestop systems are identical to those tested per testing standard referenced in "Part 1 Performance Requirements" Article. Provide rated systems bearing classification marking of qualified testing and inspecting agency.
- D. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
- E. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by Owner's inspecting agency and Fire Marshal, if required by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application in the Through-Penetration Firestop System Schedule or on Drawings that are produced by one of the following manufacturers:
 - 1. Grace, W. R. & Co. - Conn.
 - 2. Hilti, Inc.
 - 3. 3M; Fire Protection Products Division.

2.2 FIRESTOPPING

- A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

- B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated.

PART 3 - EXECUTION

3.1 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

- A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
- C. Install fill materials for firestop systems by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.
- D. Identification: Identify through-penetration firestop systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of edge of the firestop systems so that labels will be visible to anyone seeking to remove penetrating items or firestop systems. Use mechanical fasteners for metal labels. Include the following information on labels:
 - 1. The words "Warning - Through-Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.
 - 3. Through-penetration firestop system designation of applicable testing and inspecting agency.
 - 4. Date of installation.
 - 5. Through-penetration firestop system manufacturer's name.
 - 6. Installer's name.

3.2 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage an independent inspecting agency to inspect through-penetration firestops. Independent inspecting agency shall comply with ASTM E 2174 requirements including those related to qualifications, conducting inspections, and preparing test reports.

- B. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.
- C. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM SCHEDULE

- A. Where UL-classified systems are indicated, they refer to alpha-alpha-numeric designations listed in UL's "Fire Resistance Directory" under product Category XHEZ.
- B. Firestop Systems for Metallic Pipes, Conduit, or Tubing :
 - 1. UL-Classified Systems: W-L 1036.
- C. Firestop Systems for Nonmetallic Pipe, Conduit, or Tubing :
 - 1. UL-Classified Systems: W-L 2097.
- D. Firestop Systems for Electrical Cables :
 - 1. UL-Classified Systems: W-L 3081.
- E. Firestop Systems for Cable Trays :
 - 1. UL-Classified Systems: W-L 4004.
- F. Firestop Systems for Insulated Pipes:
 - 1. UL-Classified Systems: W-L 5053.

END OF SECTION 078413

SECTION 078446 - FIRE-RESISTIVE JOINT SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes fire-resistive joint systems for the following:
 - 1. Bottom-of-Wall joints.
 - 2. Head-of-wall joints.

1.2 PERFORMANCE REQUIREMENTS

- A. General: Provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly in which fire-resistive joint systems are installed.
- B. Joint Systems in and between Fire-Resistance-Rated Constructions: Provide systems with assembly ratings equaling or exceeding the fire-resistance ratings of construction that they join, and with movement capabilities and L-ratings indicated as determined by UL 2079.
 - 1. Load-bearing capabilities as determined by evaluation during the time of test.
- C. Perimeter Fire-Resistive Joint Systems: For joints between edges of fire-resistance-rated floor assemblies and exterior curtain walls, provide systems of type and with ratings indicated below and those indicated in the Fire-Resistive Joint System Schedule at the end of Part 3, as determined by NFPA 285 and UL 2079.
 - 1. UL-Listed, Perimeter Fire-Containment Systems: Integrity ratings equaling or exceeding fire-resistance ratings of floor or floor/ceiling assembly forming one side of joint.
- D. For fire-resistive systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.3 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Shop Drawings: For each fire-resistive joint system.
- C. Qualification Data: For Installer.
- D. Field quality-control test reports.
- E. Research/Evaluation Reports: For each type of fire-resistive joint system.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FMG according to FMG 4991, "Approval of Firestop Contractors."
- B. Installation Responsibility: Assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single qualified installer.
- C. Fire-Test-Response Characteristics: Provide fire-resistive joint systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:
 - 1. Fire-resistance tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL or another agency performing testing and follow-up inspection services for fire-resistive joint systems acceptable to authorities having jurisdiction.
 - 2. Fire-resistive joint systems are identical to those tested per methods indicated in Part 1 "Performance Requirements" Article and comply with the following:
 - a. Fire-resistive joint system products bear classification marking of qualified testing and inspecting agency.
 - b. Fire-resistive joint systems correspond to those indicated by referencing system designations of the qualified testing and inspecting agency.
- D. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.
- E. Do not cover up fire-resistive joint system installations that will become concealed behind other construction until inspecting agency and building inspector of authorities having jurisdiction have examined each installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, fire-resistive joint systems that may be incorporated into the Work include, but are not limited to, those systems indicated in the Fire-Resistive Joint System Schedule at the end of Part 3.

2.2 FIRE-RESISTIVE JOINT SYSTEMS

- A. Compatibility: Provide fire-resistive joint systems that are compatible with joint substrates, under conditions of service and application, as demonstrated by fire-resistive joint system manufacturer based on testing and field experience.
- B. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing and inspecting agency for systems indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fire-resistive joint systems to comply with Part 1 "Performance Requirements" Article and fire-resistive joint system manufacturer's written installation instructions for products and applications indicated.
- B. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified independent inspecting agency to inspect fire-resistive joint systems and prepare inspection reports.
- B. Testing Services: Inspecting of completed installations of fire-resistive joint systems shall take place in successive stages as installation of fire-resistive joint systems proceeds. Do not proceed with installation of joint systems for the next area until inspecting agency determines completed work shows compliance with requirements.
 - 1. Inspecting agency shall state in each report whether inspected fire-resistive joint systems comply with or deviate from requirements.
- C. Remove and replace fire-resistive joint systems where inspections indicate that they do not comply with specified requirements.
- D. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and fire-resistive joint systems comply with requirements.

3.3 FIRE-RESISTIVE JOINT SYSTEM SCHEDULE

- A. Designation System for Joints in or between Fire-Resistance-Rated Constructions: Alphanumeric systems listed in UL's "Fire Resistance Directory" under Product Category XHBN.
- B. Bottom-of-Wall Fire-Resistive Joint Systems (FRJS-1):
 - 1. UL-Classified Systems: BW-S-0001; Hilti CP601S Elastomeric Firestop Sealant or equal.
 - 2. Assembly Rating: 2 hours.
 - 3. Nominal Joint Width: $\frac{3}{4}$ inch maximum.
 - 4. L-Rating at Ambient: Less than 1 cfm/lin. ft.
 - 5. L-Rating at 400 deg F (204 deg C): Less than 1 cfm/lin. ft.
- C. Head-of-Wall Fire-Resistive Joint Systems (FRJS-2):
 - 1. UL-Classified Systems: HW-D-0024; Passive Fire Protection Partners #4100NS or equal.
 - 2. Assembly Rating: 2 hours.
 - 3. Nominal Joint Width: $\frac{3}{4}$ inch maximum.
 - 4. Movement Capabilities: Class II – 33 percent compression or extension.

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5. L-Rating at Ambient: Less than 1 cfm/lin. ft.
6. L-Rating at 400 deg F (204 deg C): Less than 1 cfm/lin. ft.

D. Head-of-Wall Fire-Resistive Joint Systems (FRJS-3):

1. UL-Classified Systems: HW-D-0031; 3M Firedam Spray 100 or equal.
2. Assembly Rating: 2 hours.
3. Joint Width: 2 inches maximum.
4. Movement Capabilities: Class II - 25 percent compression or extension.
5. L-Rating at Ambient: Less than 1 cfm/lin. ft.
6. L-Rating at 400 deg F (204 deg C): Less than 1 cfm/lin. ft.

END OF SECTION 078446

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes joint sealants for the following applications, including those specified by reference to this Section:
 - 1. Silicone joint sealants.
 - 2. Urethane joint sealants.
 - 3. Mildew-resistant joint sealants.
 - 4. Latex joint sealants.

1.2 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates for both exterior and interior applications.

1.3 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- C. Compatibility and adhesion test reports.

1.4 QUALITY ASSURANCE

- A. Preconstruction Compatibility and Adhesion Testing: Submit samples of materials that will contact or affect joint sealants to joint-sealant manufacturers for testing according to manufacturer's standard test method to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
- B. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to Project joint substrates according to the method in ASTM C 1193 that is appropriate for the types of Project joints.

1.5 WARRANTY

- A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
- B. VOC Content of Interior Sealants: Provide interior sealants and sealant primers that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
- C.
 - 1. Sealants: 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.

2.3 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 - 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. BASF Corporation-Construction Systems.
 - b. Pecora Corporation.
 - c. Polymeric Systems, Inc.
 - d. Sika Corporation.
 - e. Tremco Incorporated.
- B. Urethane, M, P, 50, T, NT: Multicomponent, pourable, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade P, Class 50, Uses T and NT.
 - a. BASF Corporation-Construction Systems.
 - b. Pecora Corporation.
 - c. Polymeric Systems, Inc.
 - d. Sika Corporation.
 - e. Tremco Incorporated.

- C. Urethane, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT.
- a. BASF Corporation-Construction Systems.
 - b. Pecora Corporation.
 - c. Polymeric Systems, Inc.
 - d. Sika Corporation.
 - e. Tremco Incorporated.
- D. Urethane, S, NS, 100/50, T, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Uses T and NT.
- a. BASF Corporation-Construction Systems.
 - b. Pecora Corporation.
 - c. Polymeric Systems, Inc.
 - d. Sika Corporation.
 - e. Tremco Incorporated.

2.4 SILICONE JOINT SEALANTS

- A. Silicone, S, NS, 100/50, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
- a. BASF Corporation-Construction Systems.
 - b. Pecora Corporation.
 - c. Polymeric Systems, Inc.
 - d. Sika Corporation.
 - e. Tremco Incorporated.
- B. Silicone, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.
- a. BASF Corporation-Construction Systems.
 - b. Pecora Corporation.
 - c. Polymeric Systems, Inc.
 - d. Sika Corporation.
 - e. Tremco Incorporated.

2.5 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.

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

- a. Dow Corning Corporation.
 - b. GE Construction Sealants; Momentive Performance Materials Inc.
 - c. Soudal USA.
 - d. Tremco Incorporated.

2.6 LATEX JOINT SEALANTS

- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

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

- a. BASF Corporation-Construction Systems.
 - b. May National Associates, Inc.; a subsidiary of Sika Corporation.
 - c. Pecora Corporation.
 - d. Tremco Incorporated.

2.7 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F (minus 32 deg C). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.8 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint

substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants.
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant.
 - a. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.
 - 2. Remove laitance and form-release agents from concrete.
 - a. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.2 INSTALLATION

- A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- B. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
- F. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.3 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.
 - 1. Joint Locations:
 - a. Isolation and contraction joints in cast-in-place concrete slabs.
 - b. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Urethane, M, P, 50, T, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Locations:
 - a. Control and expansion joints in unit masonry.
 - b. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Urethane, S, NS, 100/50, T, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
 - a. Custom color to be used at brick veneer.
- C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
 - 1. Joint Locations:
 - a. Control and expansion joints in tile flooring.
 - b. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Urethane, S, P, 25, T, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

- D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Locations:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Tile control and expansion joints.
 - c. Vertical joints on exposed surfaces of unit masonry, walls and partitions.
 - d. Other joints as indicated on Drawings.
 2. Joint Sealant: Urethane, S, NS, 25, NT.
 3. Joint-Sealant Color: As selected by Owner from manufacturer's full range of colors.
- E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.
1. Joint Locations:
 - a. Control joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
 - c. Other joints as indicated on Drawings.
 2. Joint Sealant: Acrylic latex.
 3. Joint-Sealant Color: As selected by Owner from manufacturer's full range of colors.
- F. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Locations:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints where indicated.
 - c. Other joints as indicated on Drawings.
 2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
 3. Joint-Sealant Color: As selected by Owner from manufacturer's full range of colors

END OF SECTION 079200

SECTION 081213 - HOLLOW METAL FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes hollow-metal frames.
- B. Related Requirements:
 - 1. Section 081416 "Flush Wood Doors" for wood doors installed in hollow-metal frames.

1.2 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include elevations, frame profiles, metal thicknesses, preparations for hardware, and other details.
- C. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amweld International, LLC.
 - 2. Ceco Door; ASSA ABLOY.
 - 3. Curries Company; ASSA ABLOY.
 - 4. Deansteel Manufacturing Company, Inc.
 - 5. Kewanee Corporation (The).
 - 6. Republic Doors and Frames.
 - 7. Steelcraft; an Allegion brand.

2.2 INTERIOR FRAMES

- A. Heavy-Duty Frames: SDI A250.8, Level 2.

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1. Physical Performance: Level B according to SDI A250.4.
2. Frames:
 - a. Materials: Uncoated, steel sheet, minimum thickness of 0.053 inch.
 - b. Sidelite Frames: Fabricated from same thickness material as adjacent door frame.
 - c. Construction: Full profile welded.
3. Exposed Finish: Prime.

2.3 BORROWED LITES

- A. Hollow-metal frames of uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
- B. Construction: Full profile welded.

2.4 FRAME ANCHORS

- A. Jamb Anchors:
 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (51 mm) wide by 10 inches (254 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
- B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch (1.0 mm), and as follows:
 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.5 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Power-Actuated Fasteners in Concrete: From corrosion-resistant materials.
- G. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.

- H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing).
- I. Glazing: Comply with requirements in Section 088000 "Glazing."
- J. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat.

2.6 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Sidelite and Transom Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 - 4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
 - 5. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 16 inches (406 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c., to match coursing.
 - b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c.
 - 6. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers.
- C. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
 - 1. Reinforce frames to receive nontemplated, mortised, and surface-mounted hardware.
 - 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- D. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
 - 1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
 - 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 - 3. Provide fixed frame moldings on secure side of interior frames.
 - 4. Provide loose stops and moldings on inside of hollow-metal work.

5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.7 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 1. Shop Primer: SDI A250.10.

2.8 ACCESSORIES

- A. Mullions: Join to adjacent members by welding.
- B. Grout Guards: Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Hollow-Metal Frames: Install hollow-metal frames for doors, transoms, sidelites, borrowed lites, and other openings, of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - b. Install frames with removable stops located on secure side of opening.
 - c. Install door silencers in frames before grouting.
 - d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - e. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - f. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
 4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.

5. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.
- B. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.
 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

3.2 ADJUSTING AND CLEANING

- A. Final Adjustments: Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

END OF SECTION 081213

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Solid-core doors with wood-veneer faces.
 - 2. Factory finishing flush wood doors.
 - 3. Bullet resistant doors.
- B. Related Requirements:
 - 1. Section 088000 "Glazing" for glass view panels in flush wood doors.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of door. Include factory-finishing specifications.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:
 - 1. Dimensions and locations of blocking.
 - 2. Dimensions and locations of mortises and holes for hardware.
 - 3. Dimensions and locations of cutouts.
 - 4. Undercuts.
 - 5. Requirements for veneer matching.
 - 6. Doors to be factory finished and finish requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Subject to compliance with requirements, provide Pre-finished "Aspiro Series" wood doors, Marshfield-Algoma by Masonite Architectural, or equal product by one of the following:
 - 1. Ampco, Inc.
 - 2. Buell Door Company Inc.
 - 3. Eggers Industries
 - 4. Graham; an Assa Abloy Group company.
 - 5. Ideal Architectural Doors & Plywood.
 - 6. Mohawk Flush Doors, Inc.; a Masonite company.
 - 7. Oshkosh Architectural Door Company.
 - 8. Vancouver Door Company.
 - 9. VT Industries Inc.

2.2 FLUSH WOOD DOORS, GENERAL (WD-1)

- A. Quality Standard: In addition to requirements specified, comply with AWI's, AWMAC's, and WI's "Architectural Woodwork Standards and WDMA I.S.1-A, "Architectural Wood Flush Doors."
- B. WDMA I.S.1-A Performance Grade:
 - 1. Heavy Duty unless otherwise indicated.
 - 2. Extra Heavy Duty: Public restrooms, multi-purpose rooms, study rooms and where indicated.
- C. Particleboard-Core Doors:
 - 1. Particleboard: ANSI A208.1, Grade LD-1, made with binder containing no urea-formaldehyde.
 - 2. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
 - 3. Provide doors with glued-wood-stave or structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.

2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Solid-Core Doors:
 - 1. Grade: Premium, with Grade AA faces.
 - 2. Species: Select red oak.
 - 3. Cut: Plain sliced (flat sliced).
 - 4. Match between Veneer Leaves: Book match.
 - 5. Assembly of Veneer Leaves on Door Faces: Quarter sawn.
 - 6. Core: Particleboard.
 - 7. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering.

2.4 BULLET RESISTANT DOORS (WD-2)

- A. Basis-of Design: TSS Bullet Resistant Wood Door, as manufactured by Total Security Solutions, or approved equivalent product.
- B. Design Performance:
 - 1. Core: wood core lined with ballistic sheet fiberglass.
 - 2. Veneer: Select red oak, Grade AA faces.
 - 3. Cut: Plain sliced (flat sliced).
 - 4. Match between Veneer Leaves: Book match.
 - 5. Assembly of Veneer Leaves on Door Faces: Quarter Sawn.
 - 6. Frame: welded hollow metal.
 - 7. Ballistic Rating: comply with UL Standard 752, Level 3.
- C. Glazing: as specified in Section 088856, Ballistic Resistant Glazing in sizes noted on the Door Schedule.

2.5 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 - 1. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied.
- C. Openings: Factory cut and trim openings through doors.
 - 1. Light Openings: Trim openings with moldings of material and profile indicated.
 - 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."

2.6 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 - 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors that are indicated to receive transparent finish.
- C. Transparent Finish:
 - 1. Grade: Premium.
 - 2. Finish: AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" System 11, catalyzed polyurethane.
 - 3. Staining: As selected by Architect from manufacturer's full range.
 - 4. Sheen: Satin.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
 - 1. Install fire-rated doors according to NFPA 80.
 - 2. Install smoke- and draft-control doors according to NFPA 105.

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- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 - 1. Clearances: Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated.
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

END OF SECTION 081416

SECTION 087100 - DOOR HARDWARE

PART - GENERAL

- 1.1 Refer to "General and Special Conditions", and "Instructions to Bidders", Division 1 of Specifications. Requirements of these Sections and the project drawings shall govern work in this section.
- 1.2 Work Included:
- A. Furnish all items of Finish Hardware specified, scheduled, shown or required herein except those items specifically excluded from this section of the specification.
 - B. Related work:
 - 1. Division 00 00 00 – Procurement and Contracting Requirements
 - 2. Division 01 00 00 – General Requirements
 - 3. Division 06 00 00 – Wood, Plastics, and Composites
 - 4. Division 08 00 00 – Openings
 - 5. Division 10 00 00 – Specialties
 - 6. Division 11 00 00 – Equipment
 - 7. Division 26 00 00 – Electrical
 - 8. Division 27 00 00 – Communications
 - 9. Division 28 00 00 – Electronic Safety and Security
 - C. Specific Omissions: Hardware for the following is specified or indicated elsewhere, unless specifically listed in the hardware sets:
 - 1. Cabinet Hardware.
 - 2. Signs, except as noted.
 - 3. Folding partitions, except cylinders where detailed.
 - 4. Sliding aluminum doors
 - 5. Chain link and wire mesh doors and gates
 - 6. Access doors and panels
 - 7. Overhead and Coiling doors
- 1.3 Quality Assurance
- A. Requirements of Regulatory Agencies:
 - 1. Furnish finish hardware to comply with the requirements of laws, codes, ordinances, and regulations of the governmental authorities having jurisdiction where such requirements exceed the requirements of the Specifications.
 - 2. Furnish finish hardware to comply with the requirements of the regulations for public building accommodations for physically handicapped persons of the governmental authority having jurisdiction and to comply with Americans with Disabilities Act.

3. Provide hardware for fire-rated openings in compliance with NFPA 80 and state and local building code requirements. Provide only hardware that has been tested and listed by UL for types and sizes of doors required and complies with requirements of door and door frame labels.

B. Hardware Supplier:

1. Shall be an established firm dealing in contract builders' hardware. He must have adequate inventory, qualified personnel on staff and be located within 100 miles of the project. The distributor must be a factory-authorized dealer for all materials required. The supplier shall be or have in employment an Architectural Hardware Consultant (AHC).

C. Electrified Door Hardware Supplier:

1. Shall be an experienced door hardware supplier who has completed projects with electrified door hardware similar in material, design, and extent to that indicated for this project, whose work has resulted in construction with a record of successful in-service performance, and who is acceptable to manufacturer of primary materials.
2. Shall prepare data for electrified door hardware, including shop drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this project.
3. Shall have experience in providing consulting services for electrified door hardware installations.

D. Pre-installation Meeting:

1. Before hardware installation, General Contractor/Construction Manager will request a hardware installation meeting be conducted on the installation of hardware; specifically that of locksets, closers, exit devices, overhead stops and coordinators. Manufacturer's representatives of the above products, in conjunction with the hardware supplier for the project, shall conduct the meeting. Meeting to be held at job site and attended by installers of hardware for aluminum, hollow metal and wood doors. Meeting to address proper coordination and installation of hardware, per finish hardware schedule for this specific project, by using installation manuals, hardware schedule, templates, physical product samples and installation videos.
2. When any electrical or pneumatic hardware is specified this meeting shall also include the following trades/installers: Electrical, Security, Alarm systems and Architect.
3. Convene one week or more prior to commencing work of this Section.
4. The Hardware Supplier shall include the cost of this meeting in his proposal.

E. Manufacturer:

1. Obtain each type of hardware (latch and locksets, hinges, closers, etc.) from a single manufacturer, although several may be indicated as offering products complying with requirements.
2. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated.

1.4 Submittals:

A. Hardware Schedule

1. Submit number of Hardware Schedules as directed in Division 1.

2. Follow guidelines established in Door & Hardware Institute Handbook (DHI) Sequence and Format for the Hardware Schedule unless noted otherwise.
3. Schedule will include the following:
 - a. Door Index including opening numbers and the assigned Finish Hardware set.
 - b. Preface sheet listing category only and manufacturer's names of items being furnished as follows:

CATEGORY	SPECIFIED	SCHEDULED
Hinges	Manufacturer A	Manufacturer B
Lock sets	Manufacturer X	Manufacturer X
Kick Plates	Open	Manufacturer Z

- c. Hardware Locations: Refer to Article 3.1 B.2 Locations.
- d. Opening Description: Single or pair, number, room locations, hand, active leaf, degree of swing, size, door material, frame material, and UL listing.
- e. Hardware Description: Quantity, category, product number, fasteners, and finish.
- f. Headings that refer to the specified Hardware Set Numbers.
- g. Scheduling Sequence shown in Hardware Sets.
- h. Product data of each hardware item, and shop drawings where required, for special conditions and specialty hardware.
- i. Electrified Hardware system operation description.
- j. "Vertical" scheduling format only. "Horizontal" schedules will be returned "Not Approved."
- k. Typed Copy.
- l. Double-Spacing.
- m. 8-1/2 x 11 inch sheets
- n. U.S. Standard Finish symbols or BHMA Finish symbols.

B. Product Data:

1. Submit, in booklet form Manufacturers Catalog cut sheets of scheduled hardware.
2. Submit product data with hardware schedule.

C. Samples:

1. Prior to submittal of the final hardware schedule and prior to final ordering of finish hardware, submit one sample, if required, of each type of exposed hardware unit, finished as required and tagged with full description for coordination with schedule.
2. Samples will be returned to the supplier. Units, which are acceptable and remain undamaged through submittal, review and field comparison procedures may, after final check of operation, be used in the work, within limitations of keying coordination requirements.

D. Key Schedule:

1. Submit detailed schedule indicating clearly how the Owner's final keying instructions have been followed.
2. Submit as a separate schedule.

E. Electrified Hardware Drawings:

1. Submit elevation drawings showing relationship of all electrical hardware components to door and frame. Indicate number and gage of wires required.

- a. Include wiring drawing showing point to point wire hook up for all components.
 - b. Include system operations descriptions for each type of opening; describe each possible condition.
 - F. Submit to General Contractor/Construction Manager, the factory order acknowledgement numbers for the various hardware items to be used on the project. The factory order acknowledgement numbers shall help to facilitate and expedite any service that may be required on a particular hardware item. General Contractor/Construction Manager shall keep these order acknowledgement numbers on file in the construction trailer.
- 1.5 Product Delivery, Storage, and Handling:
- A. Label each item of hardware with the appropriate door number and Hardware Schedule heading number, and deliver to the installer so designated by the contractor.
- 1.6 Existing Conditions:
- A. Where existing doors, frames and/or hardware are to remain, conditions, preparations and functions shall be field verified to confirm compatibility with specified hardware. Where any incompatibility is discovered, notify the contractor or construction manager immediately and provide a suggested solution based on industry standard business practices.
- 1.7 Warranties:
- A. Refer to Division 1 for warranty requirements.
 - B. Special Warranty Periods:
 - 1. Closers shall carry manufacturer's 25-year warranty against manufacturing defects and workmanship.
 - 2. Locksets shall carry manufacturer's 7-year warranty against manufacturing defects and workmanship.
 - 3. Exit Devices shall carry manufacturer's 10-year warranty against manufacturing defects and workmanship.
 - 4. Balance of items shall carry a manufacturer's 1-year warranty against manufacturing defects and workmanship.
 - C. During the warranty period, replace defective work, including labor, materials and other costs incidental to the work.

PART 2 - PRODUCT

- 2.1 Furnish each category with the products of only one manufacturer unless specified otherwise; this requirement is mandatory whether various manufacturers are listed or not.

2.2 Provide the products of manufacturer designated or if more than one manufacturer is listed, the comparable product of one of the other manufacturers listed. Where only one manufacturer or product is listed, it is understood that this is the owner's Building Standard and "no substitution" is allowed.

A. Hinges:

1. Furnish hinges of class and size as listed in sets.
2. Numbers used are Ives (IVE).
3. Equal products from Hager, McKinney and Stanley will be accepted.

B. Locksets and Latchsets – Heavy Duty Cylindrical Type:

1. Function numbers listed are Falcon.
2. Provide 2-3/4 inch backset.
3. Provide strikes with extended lips where required to protect trim from being marred by latch bolt. Provide strike lips that do not project more than 1/8" beyond doorframe trim at single doors and have 7/8" lip to center at pairs of 1-3/4" doors.
4. Locksets and Latchsets:
 - a. Falcon T series
 - b. Sargent 10 line

C. Exit Devices:

1. Exit devices shall be touchpad style, fabricated of brass, bronze, stainless steel, or aluminum, plated to the standard architectural finishes to match the balance of the door hardware.
2. Touchpad shall extend a minimum of one half of the door width. All latchbolts to be deadlatching type.
3. End-cap shall be flush with the external mechanism case. End caps that overlap and project above the mechanism case are unacceptable.
4. Strikes shall be roller type and come complete with a locking plate to prevent movement.
5. All rim and vertical rod exit devices shall have passed a 5 million(5,000,000) cycle test based on ANSI A156.3, 1994, Grade 1 test standards and certified by an independent testing lab.
6. Provide cylinder dogging on panic exit hardware where noted in hardware sets.
7. Exit devices shall be UL listed panic exit hardware. All exit devices for fire rated openings shall be UL labeled fire exit hardware.
8. Lever trim for exit devices shall be vandal-resistant type.
9. Devices:
 - a. Falcon 24/25 series
 - b. Sargent 80 series

D. Electric Strike:

1. Electric strikes shall provide remote release of latchbolts. They shall be designed for use with the type locks shown at each opening where required. Strikes will be UL Listed for Burglary-Resistant Electric Door Strike, and where required, shall be UL listed as electric strikes for Fire Doors or Frames. Faceplates shall be stainless steel with finish as specified for each opening. The locking components shall be stainless steel to resist damage and abuse.

2. Solenoids shall be of the continuous duty type for the voltage specified. Plug connectors will be furnished. Strikes shall have an adjustable backbox to compensate for misalignment of door and frame.
3. Numbers used in sets are Von Duprin.
 - a. Locknetics CS/RS series
 - b. Von Duprin 6000 series

E. Closers:

1. Door closers shall have fully hydraulic, full rack and pinion action.
2. Spring power shall be continuously adjustable over the full range of closer sizes, and allow for reduced opening force for the physically handicapped. Hydraulic regulation shall be by tamper-proof, non-critical valves. Closers shall have separate adjustment for latch speed, general speed, and backcheck.
3. Refer to door and frame details and furnish accessories such as drop plates, panel adapters, spacers and supports as required to correctly install door closers. State degree of door swing in the hardware schedule.
4. Falcon Series as listed in sets.
5. Sargent 1331 & 1431 series are acceptable.

F. Overhead Holders and Stops:

1. Type, function and fasteners must be same as Glynn-Johnson specified. Size per manufacturer's selector chart. Plastic end caps, hold open mechanisms and shock blocks are not allowed. End caps must be finished same as balance of unit.
2. Manufacture products using base material of Brass/Bronze for US3, US4, & US10B finished products and 300 Stainless Steel for US32 & US32D finished products.
3. Type, function, and fasteners must be the same as Glynn-Johnson specified. Size per manufacturer's selector chart.
 - a. Glynn-Johnson
 - b. Rixson

G. Kick Plates:

1. Furnish .050 inches thick, beveled four sides, countersunk fasteners, 10" high x door width less 2" at single doors and less 1" at pairs. Where glass or louvers prevent this height, supply with height equal to height of bottom rail less 2".
2. Any BHMA manufacturing product meeting above is acceptable.

H. Bumpers:

1. Wrought, forged, or cast, approximately 2-1/2 inch diameter, convex or concave rubber center, concealed fasteners.
 - a. Ives WS406/WS407
 - b. BHMA L02101.

I. Miscellaneous:

1. Furnish items not categorized in the above descriptions but specified by manufacturer's names in Hardware Sets.

J. Fasteners:

1. Furnish fasteners of the proper type, size, quantity and finish. Use machine screws and expansion shields for attaching hardware to concrete or masonry, and wall grip inserts at hollow wall construction. Furnish machine screws for attachment to reinforced hollow metal doors and frames and reinforced aluminum doors and frames. Furnish full thread wood screws for attachment to solid wood doors and frames. "TEK" type screws are not acceptable.
2. **Sex bolts will not be permitted on reinforced metal doors or wood doors where blocking is specified.**

2.3 Finishes:

- A. Generally, Satin Chrome, US26D/BHMA 626. Provide finish for each item as indicated in sets.

2.4 Templates and Hardware Location:

- A. Furnish hardware made to template. Supply required templates and hardware locations to the door and frame manufacturers.
- B. Furnish metal template to frame/door supplier for continuous hinge.
- C. Refer to Article 3.1 B.2, Locations, and coordinate with templates.

2.5 Cylinders and Keying:

- A. All cylinders for this project will be supplied by one supplier regardless of door type and location.
- B. The Finish Hardware supplier will meet with Architect and/or Owner to finalize keying requirements and obtain keying instructions in writing.
 1. Supplier shall include the cost of this service in his proposal.
- C. Provide a cylinder for all hardware components capable of being locked.
- D. Provide cylinders master and grand master keyed to existing Sargent system according to Owner's instructions. Provide change keys, master keys and grand master keys as required by Owner.
 1. Supplier shall include the cost of this service in his proposal.

PART 3 - EXECUTION

3.1 Installation

A. General:

1. Install hardware according to manufacturers installations and template dimensions. Attach all items of finish hardware to doors, frames, walls, etc. with fasteners furnished and required by the manufacture of the item.
2. Provide blocking/reinforcement for all wall mounted Hardware.

3. Reinforced hollow metal doors and frames and reinforced aluminum door and frames will be drilled and tapped for machine screws.
4. Solid wood doors and frames: full thread wood screws. Drill pilot holes before inserting screws.

B. Locations:

1. Dimensions are from finish floor to center line of items.
2. Include this list in Hardware Schedule.

CATEGORY

DIMENSION

Hinges

Door Manufacturer's Standard

Flush Bolt Levers

72" and 12"

Levers

Door Manufacturer's Standard

Exit Device Touchbar

Per Template

C. Field Quality Inspection:

1. Inspect material furnished, its installation and adjustment, and instruct the Owner's personnel in adjustment, care and maintenance of hardware.
2. Locksets and exit devices shall be inspected after installation and after the HVAC system is in operation and balanced, to insure correct installation and proper operation.
3. Closers shall be inspected and adjusted after the HVAC system is in operation and balanced, to insure correct installation and proper operation.
4. A written report stating compliance, and also locations and kinds of noncompliance shall be forwarded to the Architect with copies to the Contractor, hardware distributor, hardware installer and building owner.

D. Technical and Warranty Information:

1. At the completion of the project, the technical and warranty information coalesced and kept on file by the General Contractor/Construction Manager shall be given to the Owner or Owner's Agent. In addition to both the technical and warranty information, all factory order acknowledgement numbers supplied to the General Contractor/Construction Manager during the construction period shall be given to the Owner or Owner's Agent. The warranty information and factory order acknowledgement numbers shall serve to both expedite and properly execute any warranty work that may be required on the various hardware items supplied on the project.
2. Submit to General Contractor/Construction Manager, two copies each of parts and service manuals and two each of any special installation or adjustment tools. Include for locksets, exit devices, door closers and any electrical products.

3.2 Hardware Sets:

Hardware Group No. 01

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	PANIC HARDWARE	25-R-NL	626	FAL
1	EA	MORTISE CYLINDER	LA KWY	626	SAR
1	EA	ELECTRIC STRIKE	RS300 12/24 VDC	⚡ 630	LOC
1	EA	SURFACE CLOSER	SC81A HDPA FC	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	POWER SUPPLY	(BY SECURITY CONTRACTOR)		
1	EA	ACCESS CONTROL	(BY SECURITY CONTRACTOR)	⚡	

PRESENTING AN AUTHORIZED CREDENTIAL WILL ENERGIZE THE ELECTRIC STRIKE TO ALLOW ACCESS.
FREE EGRESS IS ALWAYS ALLOWED.

COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT
AND ALL RELATED TRADES.

Hardware Group No. 02

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	PANIC HARDWARE	25-R-NL	626	FAL
1	EA	MORTISE CYLINDER	LA KWY	626	SAR
1	EA	ELECTRIC STRIKE	RS300 12/24 VDC	⚡ 630	LOC
1	EA	SURFACE CLOSER	SC81A HDPA FC	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	POWER SUPPLY	(BY SECURITY CONTRACTOR)		
1	EA	ACCESS CONTROL	(RE-USE EXISTING)	⚡	

PRESENTING AN AUTHORIZED CREDENTIAL WILL ENERGIZE THE ELECTRIC STRIKE TO ALLOW ACCESS.
FREE EGRESS IS ALWAYS ALLOWED.

COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT
AND ALL RELATED TRADES.

Hardware Group No. 03

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	T581P6 SAR LA DAN	626	FAL
1	EA	ELECTRIC STRIKE	CS750	⚡ 630	LOC
1	EA	SURFACE CLOSER	SC81A RW/PA FC	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	POWER SUPPLY	(BY SECURITY CONTRACTOR)		
1	EA	ACCESS CONTROL	(BY SECURITY CONTRACTOR)	⚡	

PRESENTING AN AUTHORIZED CREDENTIAL WILL ENERGIZE THE ELECTRIC STRIKE TO ALLOW ACCESS.
FREE EGRESS IS ALWAYS ALLOWED.

COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT
AND ALL RELATED TRADES.

Hardware Group No. 04

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	T581P6 SAR LA DAN	626	FAL
1	EA	ELECTRIC STRIKE	CS750	⚡ 630	LOC
1	EA	SURFACE CLOSER	SC81A DS FC	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	POWER SUPPLY	(BY SECURITY CONTRACTOR)		
1	EA	ACCESS CONTROL	(BY SECURITY CONTRACTOR)	⚡	

PRESENTING AN AUTHORIZED CREDENTIAL WILL ENERGIZE THE ELECTRIC STRIKE TO ALLOW ACCESS.
FREE EGRESS IS ALWAYS ALLOWED.

COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT
AND ALL RELATED TRADES.

Hardware Group No. 05

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	651	IVE
1	EA	PANIC HARDWARE	25-R-NL	US32	FAL
1	EA	MORTISE CYLINDER	LA KKY	625	SAR
1	EA	ELECTRIC STRIKE	RS300 12/24 VDC	⚡ 630	LOC
1	EA	SURFACE CLOSER	SC81A DS FC	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	629	IVE
1	EA	POWER SUPPLY	(BY SECURITY CONTRACTOR)		
1	EA	ACCESS CONTROL	(BY SECURITY CONTRACTOR)	⚡	

PRESENTING AN AUTHORIZED CREDENTIAL WILL ENERGIZE THE ELECTRIC STRIKE TO ALLOW ACCESS.
FREE EGRESS IS ALWAYS ALLOWED.

COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT
AND ALL RELATED TRADES.

Hardware Group No. 06

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	T581P6 SAR LA DAN	626	FAL
1	EA	ELECTRIC STRIKE	CS750	✈ 630	LOC
1	EA	OH STOP	450S	652	GLY
1	EA	SURFACE CLOSER	SC81A RW/PA FC	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	POWER SUPPLY	(BY SECURITY CONTRACTOR)		
1	EA	ACCESS CONTROL	(BY SECURITY CONTRACTOR)	✈	

THE ELECTRIC STRIKE MAY ENERGIZED REMOTELY TO ALLOW ACCESS. FREE EGRESS IS ALWAYS ALLOWED.

COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

Hardware Group No. 07

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1			* RE-USE EXISTING HARDWARE *		

Hardware Group No. 08

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ENTRY / OFFICE LOCK	T521P6 SAR LA DAN	626	FAL
1	EA	SURFACE CLOSER	SC81A RW/PA FC	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE

Hardware Group No. 09

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ENTRY / OFFICE LOCK	T521P6 SAR LA DAN	626	FAL
1	EA	OH STOP	450S	652	GLY
1	EA	SURFACE CLOSER	SC81A RW/PA FC	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE

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DOOR HARDWARE
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Hardware Group No. 10

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	CLASSROOM LOCK	T561P6 SAR LA DAN	626	FAL
1	EA	SURFACE CLOSER	SC81A RW/PA FC	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE

Hardware Group No. 11

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	CLASSROOM LOCK	T561P6 SAR LA DAN	626	FAL
1	EA	SURFACE CLOSER	SC81A RW/PA FC	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP/HOLDER	WS40	626	IVE
1	SET	GASKETING	870AA-S	AA	ZER
1	EA	AUTO-DOOR BOTTOM	368AA	AA	ZER

MOUNT CLOSER TOP JAMB.

Hardware Group No. 12

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW SH 4.5 X 4.5 NRP	652	IVE
1	EA	ASYLUM LOCK	T411P6 SAR LA DAN	626	FAL
1	EA	ELECTRIC STRIKE	6211 FSE DS	⚡ 630	VON
1	EA	OH STOP	100S	652	GLY
1	EA	SURFACE CLOSER	SC71A RW/PA (MOUNT TOP JAMB)	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	SET	GASKETING	870AA-S	AA	ZER
1	EA	AUTO-DOOR BOTTOM	368AA	AA	ZER
1	EA	POWER SUPPLY	(BY SECURITY CONTRACTOR)		
2	EA	ACCESS CONTROL	(BY SECURITY CONTRACTOR)	⚡	

PRESENTING AN AUTHORIZED CREDENTIAL WILL ENERGIZE THE ELECTRIC STRIKE TO ALLOW PASSAGE THROUGH THE OPENING. AN AUTHORIZED CREDENTIAL IS REQUIRED ON EACH SIDE OF THE OPENING. THE SYSTEM WILL BE INSTALLED AND WILL OPERATE PER ALL APPLICABLE CODE.

COORDINATE SYSTEM OPERATION AND COMPONENT LOCATIONS WITH THE OWNER, THE ARCHITECT AND ALL RELATED TRADES.

Hardware Group No. 13

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	PRIVACY LOCK	T301S DAN	626	FAL
1	EA	SURFACE CLOSER	SC81A RW/PA FC	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE

Hardware Group No. 14

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	PASSAGE SET	T101 DAN	626	FAL
1	EA	SURFACE CLOSER	SC81A RW/PA FC	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE

Hardware Group No. 15

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	T581P6 SAR LA DAN	626	FAL
1	EA	SURFACE CLOSER	SC81A DS FC	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE

Hardware Group No. 16

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ENTRY / OFFICE LOCK	T521P6 SAR LA DAN	626	FAL
1	EA	OH STOP & HOLDER	450H	652	GLY
1	EA	SURFACE CLOSER	SC81A RW/PA FC	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE

Hardware Group No. 17

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ENTRY / OFFICE LOCK	T521P6 SAR LA DAN	626	FAL
1	EA	SURFACE CLOSER	SC81A RW/PA FC	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP/HOLDER	WS40	626	IVE

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Hardware Group No. 18

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	PASSAGE SET	T101 DAN	626	FAL
1	EA	SURFACE CLOSER	SC81A RW/PA FC	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP/HOLDER	WS40	626	IVE

Hardware Group No. 19

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ENTRY / OFFICE LOCK	T521P6 SAR LA DAN	626	FAL
1	EA	WALL STOP	WS406/407CCV	630	IVE

Hardware Group No. 20

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	PASSAGE SET	T101 DAN	626	FAL
1	EA	WALL STOP	WS406/407CCV	630	IVE

Hardware Group No. 21

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	T581P6 SAR LA DAN	626	FAL
1	EA	WALL STOP	WS406/407CCV	630	IVE

Hardware Group No. 22

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	PASSAGE SET	T101 DAN	626	FAL
1	EA	SURFACE CLOSER	SC81A DS FC	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE

Hardware Group No. 23

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	PUSH PLATE	8200 4" X 16"	630	IVE
1	EA	PULL PLATE	8302 8" 4" X 16"	630	IVE
1	EA	SURFACE CLOSER	SC81A RW/PA FC	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE

Hardware Group No. 24

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	CLASSROOM LOCK	T561P6 SAR LA DAN	626	FAL
1	EA	SURFACE CLOSER	SC81A RW/PA FC	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	SET	GASKETING	870AA-S	AA	ZER
1	EA	AUTO-DOOR BOTTOM	368AA	AA	ZER

MOUNT CLOSER PULL SIDE.

END OF SECTION

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Glass for doors and interior borrowed lites.
 - 2. Privacy applied glass film.
 - 3. Glazing sealants and accessories.

1.2 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- D. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Preconstruction adhesion and compatibility test report.

1.5 QUALITY ASSURANCE

- A. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

1.6 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
 - 1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

1.7 WARRANTY

- A. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Vitro Architectural Glass, or comparable product by one of the following:
 - 1. AGC Glass Company North America, Inc.
 - 2. Guardian Industries Corp.; SunGuard.
 - 3. Oldcastle BuildingEnvelope™.
 - 4. Pilkington North America.
 - 5. Schott North America, Inc.
 - 6. Trulite Glass & Aluminum Solutions, LLC.
 - 7. Viracon, Inc.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.
- B. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II, unless otherwise noted.

2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: "Glazing Manual."
 - 2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
- D. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.
- B. Tinted Annealed Float Glass: ASTM C 1036, Type I, Class 2 (tinted), Quality-Q3.
- C. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
- D. Heat-Strengthened Float Glass: ASTM C 1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
- E. Laminated Fully Tempered Float Glass: ASTM 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3 with manufacturer's standard, ASTM C1172, polyvinyl butyral, or cured resin interlayer.

2.5 GLAZING SEALANTS

- A. General:
 - 1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

2.6 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
 1. AAMA 804.3 tape, where indicated.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.

2.7 MISCELLANEOUS GLAZING MATERIALS

- A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- E. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.8 APPLIED PRIVACY FILM

- A. Basis-of-Design Product: Subject to compliance with requirements, provide 3M Crystal Glass Finishes, Type 7725SE-324 Frosted Crystal, as manufactured by 3M Commercial Solutions, or comparable product.
- B. Performance Requirements:
 1. Ultraviolet Transmission (ASTM E 903): 20%
 2. Visible Light Transmittance (ASTM E903 & E 308): 72%
 3. Visible Light Reflectance (ASTM E 903): 12%
 4. Solar Heat Gain: 64%
 5. Solar Heat Reflectance: 10%
 6. Shading Coefficient @ 90 degrees (normal incidence) ASTM E 905: 0.82

PART 3 - EXECUTION

3.1 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.2 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- F. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.3 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Install gaskets so they protrude past face of glazing stops.

3.4 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.

3.5 MONOLITHIC GLASS SCHEDULE

- A. Glass Type (MG-10): Clear annealed or heat-strengthened float glass.
 - 1. Minimum Thickness: 6 mm.
- B. Glass Type (MG-11): Clear fully tempered float glass.
 - 1. Minimum Thickness: 6 mm.
 - 2. Safety rated glazing.

END OF SECTION 088000

SECTION 088856 – BALLISTIC RESISTANCE GLAZING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Bullet resistant products of the following types:
 - 1. Transaction windows.
 - 2. Hollow metal windows.
 - 3. Detention glazing.
 - 4. Glazing in bullet resistant doors.

1.2 RELATED SECTIONS

- A. Section 06 10 00 - Rough Carpentry.

1.3 REFERENCES

- A. American National Standards Institute (ANSI): 1. ANSI Z97.1 - Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.
- B. ASTM International (ASTM):
 - 1. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
 - 2. ASTM C1036 - Standard Specification for Flat Glass.
 - 3. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass.
 - 4. ASTM C1349 - Standard Specification for Architectural Flat Glass Clad Polycarbonate.
 - 5. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications.
 - 6. ASTM E84 - Test method for the Surface Burning Characteristics of Building Materials.
 - 7. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
- C. American Welding Society (AWS): AWS D1.1 - Structural Welding Code - Steel.
- D. National Institute of Justice (NIJ): NIJ Standard 0108.01 - Standard for Ballistic Resistant Protective Materials.
- E. Underwriters Laboratories (UL):
 - 1. UL 752 - Standard for Bullet Resisting Equipment. (September 5th, 2005)
 - 2. UL 972 - Standard for Burglary Resisting Glazing Material.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 33 00 - Administrative Requirements.
- B. Product Data:
 - 1. Manufacturer's data sheets on each product to be used.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Installation methods.
- C. Shop Drawings:

1. Submit shop drawings prepared by the manufacturer showing plans, sections, elevations, layouts, profiles and product component locations, including anchorage, bracing, fasteners, accessories and finishes.
 2. Include dimensioned elevation of each type opening assembly in project; indicate sizes and locations of hardware, and lites if specified.
 3. Schedule: Indicate each opening assembly in project; cross-referenced to plans, elevations, and details.
- D. Design Data: Bullet resistance analysis design calculations for specific project conditions, certifying system conformance to specified performance requirements.
- E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square representing actual product, color, and patterns.
- F. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
- G. Closeout submittals: Warranty documents, issued and executed by manufacturer of systems, countersigned by Contractor.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified with a minimum documented experience of five years.
- B. Installer Qualifications: Company specializing in installation of products specified with minimum three years documented experience.
- C. Pre-installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, and manufacturer's installation instructions.
- D. Coordination of Work: Coordinate layout and installation of components with other construction supported by, or penetrating through, ceilings, including light fixtures, HVAC equipment, fire-suppression system, and partitions.
- E. Coordination: Bullet resistant protection shall be provided in the sizes and in the configuration indicated on the Drawings. Furnish hardware necessary for the joining of the components specified. Provide components complete with adhesives, fasteners, and other devices required for complete assembly.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's unopened, undamaged packaging, with manufacturer's labels intact.
- B. Remove wraps or covers from doors and frames upon delivery at the building site. Clean and touch-up scratches or disfigurement caused by shipping or handling promptly.
- C. Store products in manufacturer's unopened packaging until ready for installation. Store assemblies, off the ground and on end, to prevent damage to face corners and edges. Store assemblies covered to protect them from damage but permitting air circulation.

1.7 SEQUENCING

- A. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.

1.8 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.9 WARRANTY

- A. Manufacturer's Standard Warranty: 1 year from date of manufacture.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Total Security Solutions, which is located at: 935 Garden Ln.; Fowlerville, MI 48836; ASD Toll Free Tel: 866-304-5070; Fax: 517-223-0805;
Web: https://tssbulletproof.com/?utm_source=arc&utm_medium=referral&utm_campaign=digital-outbound
- B. Substitutions: equivalent to performance requirements.
- C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

2.2 BULLET RESISTANT HOLLOW METAL FRAME

- A. Basis-of-Design: TSS Bullet Resistant Hollow Metal Frame shall be of the "non-ricochet" type. This design is intended to permit the encapture and retention of an attacking projectile, lessening the potential of a random injury or lateral penetration. Frames shall be factory prepped and prime painted a gray finish. Glazing must not be removable from the threat side of the sash.
- B. Wall Thickness: 16 gauge.
- C. Frame Design: Fixed frame.
- D. Window Bottom Edge: Provide continuous S.S. 'U'-channel running along countertop.
- E. Window Size: As noted on drawings.

2.3 BULLET RESISTANT GLAZING (BR-1)

- A. Glazing shall be Bullet Resistant Level 3, 1 ¼" LP 1250BR Polycarbonate/Acrylic Laminated, nominal weight 7.7 lbs/sf, as shown on the drawings. All acrylic pieces shall meet or exceed UL 752 testing for ballistic integrity. All edges of acrylic shall be filed, sanded after cutting to remove rough edges and then polished until "water clear" transparent. All through holes for fasteners shall be 3/8" in diameter and be drilled clean. Chipped edges at through-hole exit points are not acceptable. All acrylic pieces shall be supported in the proper glazing channel designed for this purpose.

2.4 BULLET RESISTANT SPEAKER HOLE AND BACKER SYSTEM

- A. Basis-of-Design: TSS Speak Hole and Backer System, consisting of custom prefabricated bullet resistant wall section panels with secure air passage through the window transaction point as required for voice transmission. Provide all required mounting hardware with powder coated finish.
- B. Deal Tray:
 - 1. Deal Tray Recessed: Model TSS-RT1208, 16 inches by 8 inches (305 mm by 203 mm) from the outside edge of flanges with a clear open depth under of no less than 1-1/2 inches (38 mm). Fabricate of a minimum 16 gauge (1.5 mm) stainless steel, with a No. 3 finish.

2.5 FABRICATION

- A. Welds in accordance with requirements and standard practices of the American Welding Society. Exposed welds shall be ground flush and finished smooth.
- B. Joints and connections shall be tight, providing hairline joints and true alignment of adjacent members.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until openings and installing surfaces have been properly prepared.
 - 1. Verify openings are in accordance with approved shop drawings.
 - 2. Verify that supports have been installed in accordance with the Drawings.
- B. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install products in accordance with approved submittals, manufacturer's instructions and requirements of UL 752.
 - 1. Install equipment plumb, level, rigid and in true alignment.
 - 2. Use proper anchoring devices. Exposed anchor holes shall be used for anchors.
 - 3. Install hardware as required for a complete installation.
 - 4. Where applicable, install fire-rated assemblies in accordance with NFPA 80.
 - 5. Adjust operating parts for proper operation, non-binding.
 - 6.
- B. Installation Tolerances: Do not exceed the following installation tolerances:
 - 1. Squareness: Plus or minus 1/16 inch (1.6 mm) measured on a line, 90 degrees from one jamb,

- at the upper corner of the frame at the other jamb.
2. Alignment: Plus or minus 1/16 inch (1.6 mm) measured on jambs on a horizontal line parallel to the plane of the wall.
 3. Twist: Plus or minus 1/16 inch (1.6 mm) measured at face corners of jambs on parallel lines perpendicular to the plane of the wall.
 4. Plumb: Plus or minus 1/16 inch (1.6 mm) measured on the jamb at the floor.

3.4 PROTECTION

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

END OF SECTION 088856

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Non-load-bearing steel framing systems for interior partitions.
 - 2. Extruded aluminum partition gap closure.
 - 3. Suspension systems for interior ceilings and soffits.

1.2 ACTION SUBMITTALS

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

1.3 QUALITY ASSURANCE

- A. Sample Panels: Build sample wall to verify selections made under Sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.
 - 1. Build sample of typical exterior wall, minimum dimension of 60 inches (1500 mm) long by 48 inches (1200 mm) high by full thickness. Show all wall components including but not limited to: Metal studs, sheathing, vapor barrier, insulation, flashing, masonry, masonry accessories, etc. Include window jamb and sill as well. Coordinate with other sections.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
 - 2. Protective Coating: ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized unless otherwise indicated.
- B. Studs and Runners: ASTM C 645.

1. Steel Studs and Runners:
 - a. Minimum Base-Metal Thickness: 0.0269 inch (0.683 mm) or as required by performance requirements for horizontal deflection.
 - b. Depth: As indicated on Drawings
- C. Slip-Type Head Joints: Where indicated, provide one of the following:
 1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
 2. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Steel Network Inc. (The); VertiClip SLD Series.
 - 2) Superior Metal Trim; Superior Flex Track System (SFT).
- D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 1. Minimum Base-Metal Thickness: 0.0269 inch (0.683 mm).
- E. Cold-Rolled Channel Bridging: Steel, 0.0538-inch (1.367-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
 1. Depth: 1-1/2 inches (38 mm).
 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.
- F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 1. Minimum Base-Metal Thickness: 0.0296 inch (0.752 mm).
 2. Depth: As indicated on Drawings.
- G. Resilient Furring Channels: 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound transmission.
 1. Configuration: Asymmetrical or hat shaped.
- H. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
 1. Depth: As indicated on Drawings.
 2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch (0.8 mm).
 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
- I. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (32 mm), wall attachment flange of 7/8 inch (22 mm), minimum uncoated-metal thickness of 0.0179 inch (0.455 mm), and depth required to fit insulation thickness indicated.

2.3 PARTITION GAP CLOSURE (Where partitions abut glazing)

- A. Basis-of-Design: Subject to compliance with requirements, provide Mullion Mate® - Series 40 Partition Closures, Model "Mullion Mate 5", as manufactured by Gordon, Inc., 5023 Hazel Road, Bossier City, LA 71111 (800) 747-8954, or approved equivalent.
1. Materials: 6063-T5 or T6 aluminum extrusions with a tensile strength of 31 KSI per ASTM B221, ASTM B221M.
 2. Factory Supplied Caulk: ASTM C920, Type S, Grade NS, Class 35, Use NT, G, A. Federal Specification TT-S-00230C Type II, Class A. NSF Nonfood Compounds Category Code P1.
 3. Accessories: Mullion Mate End Capes, Type MMEC-487.
 4. Finish: Factory clear anodized.

2.4 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
- B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.
- C. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch (1.367 mm) and minimum 1/2-inch- (13-mm-) wide flanges.
1. Depth: As indicated on Drawings.
- D. Furring Channels (Furring Members):
1. Cold-Rolled Channels: 0.0538-inch (1.367-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
 2. Steel Studs and Runners: ASTM C 645.
 - a. Minimum Base-Metal Thickness: 0.0269 inch (0.683 mm).
 - b. Depth: As indicated on Drawings.
 3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22 mm) deep.
 - a. Minimum Base-Metal Thickness: 0.0296 inch (0.752 mm).
 4. Resilient Furring Channels: 1/2-inch- (13-mm-) deep members designed to reduce sound transmission.
 - a. Configuration: Asymmetrical or hat shaped.
- E. Grid Suspension System for Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong World Industries, Inc.; Drywall Grid Systems.

- b. Chicago Metallic Corporation; 640-C Drywall Furring System.
- c. USG Corporation; Drywall Suspension System.

2.5 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide one of the following:
 - 1. Asphalt-Saturated Organic Felt: ASTM D 226/D 226M, Type I (No. 15 asphalt felt), nonperforated.
 - 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
 - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.2 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 4. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
- E. Z-Shaped Furring Members:
1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches (610 mm) o.c.
 2. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (305 mm) from corner and cut insulation to fit.
- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.3 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

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- a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 - 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 4. Do not attach hangers to steel roof deck.
 - 5. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Interior gypsum board.
 - 2. Bullet resistant fiberglass panels.
 - 3. Tile backing panels.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each texture finish indicated on same backing indicated for Work.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Gypsum Co.
 - b. BPB America Inc.
 - c. Georgia-Pacific Gypsum.
 - d. Lafarge North America Inc.
 - e. National Gypsum Company.

- f. PABCO Gypsum.
 - g. Temple.
 - h. USG Corporation.
 - B. Gypsum Board, Type X: ASTM C 1396/C 1396M.
 - 1. Thickness: 5/8 inch (15.9 mm).
 - 2. Long Edges: Tapered.
 - C. Flexible Gypsum Board: ASTM C 1396/C 1396M. Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.
 - 1. Thickness: 1/4 inch (6.4 mm).
 - 2. Long Edges: Tapered.
 - D. Gypsum Ceiling Board: ASTM C 1396/C 1396M.
 - 1. Thickness: 5/8 inch (12.7 mm).
 - 2. Long Edges: Tapered.
 - E. Abuse-Resistant Gypsum Board: ASTM C 1396/C 1396M gypsum board, tested according to ASTM C 1629/C 1629M.
 - 1. Core: 5/8 inch (15.9 mm), Type X.
 - 2. Surface Abrasion: ASTM C 1629/C 1629M, meets or exceeds Level 1 requirements.
 - 3. Indentation: ASTM C 1629/C 1629M, meets or exceeds Level 1 requirements.
 - 4. Soft-Body Impact: ASTM C 1629/C 1629M, meets or exceeds Level 1 requirements.
 - 5. Long Edges: Tapered.
 - 6. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
 - F. Bullet Resistant Fiberglass Panels: composed of multiple layers of woven roving ballistic grade fiberglass cloth impregnated with a thermoset polyester resin and compressed into flat rigid sheets as manufactured by TSS Total Armor Bullet Resistant Fiberglass Panels, or approved equivalent.
 - 1. Nominal Thickness: 1/2" thick.
 - 2. Ballistic level: 3.
 - 3. Density: 5.0 lbs/sq.ft.
 - 4. Test Criteria/Performance Level: UL 752/Level 3; .44 Mag, 240 Gr., 1350 ft. per sec. SWC; NIJ 0108.01/Level IIIA; .44 Mag, 158 Gr., 1400 ft. per sec. SWC.
 - G. Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
 - 1. Core: 5/8 inch (15.9 mm), Type X.
 - 2. Long Edges: Tapered.
 - Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- 2.4 TILE BACKING PANELS
- A. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178/C 1178M, with manufacturer's standard edges.
 - 1. Basis of Design: Subject to compliance with requirements, provide "DensShield Tile Backer" by Georgia-Pacific Gypsum or equal.
 - 2. Core: 5/8 inch (15.9 mm), Type X.
 - 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
2. Shapes:
 - a. Cornerbead.
 - b. Bullnose bead.
 - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - d. L-Bead: L-shaped; exposed long flange receives joint compound.
 - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - f. Expansion (control) joint.
 - g. Curved-Edge Cornerbead: With notched or flexible flanges.

2.6 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.

D. Joint Compound for Exterior Applications:

1. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.

E. Joint Compound for Tile Backing Panels:

1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.

2.7 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
 - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound-Attenuation Blankets: As specified in Section 072100 "Thermal Insulation."
- E. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
- F. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

PART 3 - EXECUTION

3.1 APPLYING AND FINISHING PANELS

- A. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- B. Comply with ASTM C 840.
- C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- D. For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- E. Prefill open joints and damaged surface areas.
- F. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- G. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 2: Panels that are substrate for tile.
 - 3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
 - 4. Level 5: Where indicated on Drawings.

- a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
- H. Bullet Resistant Fiberglass Panels: Install behind gypsum board surfaces, as indicated on drawings, with industrial adhesives, mastics, screws, or bolts. Maintain bullet resistant rating at junctures with concrete floor, door and window frames and other penetrations. Installation tolerances shall not exceed 1/16" (1.6 mm) for square-ness, alignment, twist and plumb.
 - a. Joints: all joints shall be reinforced by a back-up layer of bullet resistant material that shall be 4" (2" on each panel) or a 2" overlap minimum.
 - b. Bullet resistance of the joint, as reinforced, shall be at least equal to that of the panel.
- I. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.
- J. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

3.2 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 092900

SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Porcelain tile.
 - 2. Glazed wall tile.
 - 3. Solid polymer thresholds.
 - 4. Waterproof membrane for thinset applications.
 - 5. Crack isolation membrane.
 - 6. Metal edge strips.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples:
 - 1. Each type and composition of tile and for each color and finish required.
 - 2. Solid polymer thresholds.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 5 percent of amount installed for each type (but not less than 10 full size units of each type), composition, color, pattern, and size indicated.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer employs Ceramic Tile Education Foundation Certified Installers or] installers recognized by the U.S. Department of Labor as Journeyman Tile Layers.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide Standard-grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

2.2 TILE PRODUCTS

- A. Porcelain Tile Type (PT-1, PT-2, PT-3): Porcelain Stone Floor Tile
 - 1. Basis of Design: Subject to compliance with requirements, provide Crossville "Color Blox 2.0" porcelain stone floor tile.
 - 2. Face Size (PT-1 and PT-2): 24" x 24".
 - 3. Thickness: 10.5 mm.
 - 4. Face: Plain with square edges.
 - 5. Dynamic Coefficient of Friction: Not less than 0.50-0.60.
 - 6. Pattern: Refer to floor finish plans.
 - 7. Tile Colors: Refer to 'Material Finish / Color Schedule Section 000200'.
 - 8. Grout Color: Refer to 'Material Finish / Color Schedule Section 000200' for color selections.
 - 9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Cove Base (PT-3):
 - 1) Module size 6 x 12 inches.
 - 2) Tile Colors: Refer to 'Material Finish / Color Schedule Section 000200'.
 - 3) Grout Color: Refer to 'Material Finish / Color Schedule Section 000200' for color selections.
- B. Porcelain Tile Type (PT-4): Mosaic Floor Tile
 - 1. Basis of Design: Subject to compliance with requirements, provide Crossville "Color Blox 2.0" mosaic floor tile.
 - 2. Face Size: 3" x 3".
 - 3. Thickness: 6.4 mm.
 - 4. Face: Plain with square edges.
 - 5. Dynamic Coefficient of Friction: Not less than 0.50-0.60.
 - 6. Pattern: Refer to floor finish plans.
 - 7. Tile Colors: Refer to 'Material Finish / Color Schedule Section 000200'.
 - 8. Grout Color: Refer to 'Material Finish / Color Schedule Section 000200' for color selections.
 - 9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

C. Porcelain Tile Type (PT-5): Porcelain Stone Floor Tile

1. Basis of Design: Subject to compliance with requirements, provide Crossville "Color Blox 2.0" porcelain stone floor tile.
2. Face Size: 6" x 6".
3. Thickness: 9.5 mm.
4. Face: Plain with square edges.
5. Dynamic Coefficient of Friction: Not less than 0.50-0.60.
6. Pattern: Refer to floor finish plans.
7. Tile Colors: Refer to 'Material Finish / Color Schedule Section 000200'.
8. Grout Color: Refer to 'Material Finish / Color Schedule Section 000200' for color selections.
9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

D. Porcelain Tile Type (PT-6): Porcelain Stone Accent Tile

1. Basis of Design: Subject to compliance with requirements, provide Corssville "Color Blox 2.0" porcelain accent tile.
2. Face Size: 4" x 12".
3. Thickness: 9.5 mm.
4. Face: Plain with square edges.
5. Dynamic Coefficient of Friction: Not less than 0.50-0.60.
6. Pattern: Refer to elevations.
7. Tile Colors: Refer to 'Material Finish / Color Schedule Section 000200'.
8. Grout Color: Refer to 'Material Finish / Color Schedule Section 000200' for color selections.
9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

E. Porcelain Tile Type (PT-7): Porcelain Stone Wall Tile

1. Basis of Design: Subject to compliance with requirements, provide Crossville "Color Blox 2.0" porcelain stone wall tile.
2. Face Size: 12" x 24".
3. Thickness: 9.5 mm.
4. Face: Plain with square edges.
5. Pattern: Refer to elevations.
6. Tile Colors: Refer to 'Material Finish / Color Schedule Section 000200'.
7. Grout Color: Refer to 'Material Finish / Color Schedule Section 000200' for color selections.
8. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

F. Ceramic Tile Type (CT-1): Glazed Ceramic Tile Accent Wall

Basis of Design: Subject to compliance with requirements, provide Marazzi, Costa Clara Accent tile.

1. Face Size: 3" x 12".
2. Face: Plain with square edges.
3. Dynamic Coefficient of Friction: Not less than 0.50-0.60.
4. Pattern: Refer to elevations.
5. Tile Colors: Refer to 'Material Finish / Color Schedule Section 000200'.

6. Grout Color: Refer to 'Material Finish / Color Schedule Section 000200' for color selections.
7. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

G. Ceramic Tile Type (CT-2): Ceramic Tile Back Splash

Basis of Design: Subject to compliance with requirements, provide Crossville, "Color by Numbers" accent tile.

1. Face Size: 4" x 12".
2. Face: Plain with square edges.
3. Thickness: 6.35.
4. Dynamic Coefficient of Friction: Not less than 0.50-0.60.
5. Pattern: Refer to elevations.
6. Tile Colors: Refer to 'Material Finish / Color Schedule Section 000200'.
7. Grout Color: Refer to 'Material Finish / Color Schedule Section 000200' for color selections.
8. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

2.3 THRESHOLDS

- A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes. Refer to drawings for required profiles.
1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch (1.5 mm) above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/4 inch or less above adjacent floor surface.
- B. Solid Polymer Thresholds: Cast, nonporous, filled polymer, not coated, laminated or of composite construction with through body colors meeting ANSI Z124.3 or ANSI Z124.6.
1. Subject to compliance with requirements, provide "Corian Solid Surface" threshold.
 2. Thickness: 1/2".
 3. Color: Refer to Material Color / Finish Schedule, specification section 000200.
 4. Profile: As indicated on drawings.

2.4 CRACK ISOLATION MEMBRANE

- A. General: Manufacturer's standard product that complies with ANSI A118.12 for standard performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

2.5 SETTING MATERIALS

- A. Latex-Portland Cement Mortar (Thinset): ANSI A118.4.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. ARDEX GmbH.
- b. Boiardi Products Corporation; a QEP company.
- c. Bonsal American, an Oldcastle company.
- d. Bostik, Inc.
- e. Laticrete International, Inc.
- f. MAPEI Corporation.
- g. TEC; H.B. Fuller Construction Products Inc.
2. For wall applications, provide nonsagging mortar.

2.6 GROUT MATERIALS

A. High-Performance Tile Grout: ANSI A118.7.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ARDEX GmbH.
 - b. Boiardi Products Corporation; a QEP company.
 - c. Bonsal American, an Oldcastle company.
 - d. Bostik, Inc.
 - e. Custom Building Products.
 - f. Laticrete International, Inc.
 - g. MAPEI Corporation.
 - h. TEC; H.B. Fuller Construction Products Inc.
2. Polymer Type: Liquid-latex form for addition to prepackaged dry-grout mix.

2.7 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic, designed specifically for flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.
 1. Basis of Design: Subject to compliance with requirements, provide Schluter-Rondec
 2. Radius: symmetrically rounded outer corner with 1/4" (6 mm) radius along the surface edge
 3. Color: Refer to Material Color / Finish Schedule, specification section 000200.
 4. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Blanke Corporation.
 - b. Ceramic Tool Company, Inc.
 - c. Schluter Systems L.P.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 2. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 CERAMIC TILE INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
 - a. Tile floors in wet areas.
 - b. Tile floors consisting of tiles 8 by 8 inches (200 by 200 mm) or larger.
 - c. Tile floors consisting of rib-backed tiles.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Where accent tile differs in thickness from field tile, vary setting bed thickness so that tiles are flush.

- F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
- G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - 1. Ceramic Mosaic Tile: 1/16 inch.
 - 2. Glazed Wall Tile: 1/16 inch.
 - 3. Porcelain Tile: 1/8 inch.
- H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 - 1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
- J. Thresholds: Install thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
 - 1. Fill joints between such thresholds and adjoining tile set on crack isolation membrane with elastomeric sealant.
- K. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.
- L. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

3.4 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations, Concrete Subfloor:
 - 1. Porcelain Tile Installation (Typical floor areas): TCNA F113; thinset mortar.
 - a. Porcelain Tile Type: Typical floor tile.
 - b. Thinset Mortar: Latex-portland cement mortar.
 - c. Grout: High-performance sanded grout.
- B. Interior Wall Installations, Metal Studs or Furring:
 - 1. Ceramic Tile Installation: TCNA W245 or TCNA W248; thinset mortar on glass-mat, water-resistant gypsum backer board.
 - a. Ceramic Tile Type: Typical wall tile.
 - b. Thinset Mortar: Latex-portland cement mortar.
 - c. Grout: High-performance unsanded grout.

END OF SECTION 093013

SECTION 095123 - ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes acoustical tiles, modular open wood plank and concealed suspension systems for ceilings.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each exposed finish.
- C. Product test reports.
- D. Research/evaluation reports.
- E. Maintenance data.

1.3 QUALITY ASSURANCE

- A. Acoustical Testing Agency Qualifications: An independent testing laboratory, or an NVLAP-accredited laboratory.
- B. Fire-Test-Response Characteristics:
 - 1. Fire-Resistance Characteristics: Where indicated, provide acoustical tile ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - a. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 2. Surface-Burning Characteristics: Acoustical tiles complying with ASTM E 1264 for Class A materials, when tested per ASTM E 84.
 - a. Smoke-Developed Index: 450 or less.
- C. Preinstallation Conference: Conduct conference at Project site.

1.4 EXTRA MATERIALS

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

1. Acoustical Ceiling Units: Full-size tiles equal to 2 percent of quantity installed.
2. Suspension System Components: Quantity of each concealed grid and exposed component equal to 2 percent of quantity installed.

PART 2 - PRODUCTS

2.1 ACOUSTICAL TILE CEILINGS, GENERAL

- A. Acoustical Tile Standard: Comply with ASTM E 1264.
- B. Metal Suspension System Standard: Comply with ASTM C 635.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- D. Wire Hangers, Braces, and Ties: Zinc-coated carbon-steel wire; ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 1. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm) diameter wire.
- E. Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

2.2 ACOUSTICAL TILES FOR ACOUSTICAL TILE CEILING (ACT-1)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide USG "Radar Acoustical Panels, Climaplus Performance" or comparable product by Armstrong or Certainteed.
- B. Color: White
- C. Modular Size: 2' x 2' x 5/8"
 1. USG Radar Panels #2230.
- D. Edge: FLB.
- E. Grid: 9/16".
- F. NRC Rating: .55.

2.3 WOOD PLANK CEILING SYSTEM (ACT-2)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Wood Grilles "Series 1000" as manufactured by 9Wood, or a comparable product.

- B. Species: maple veneer.
- C. Typical Modular Size: 5 1/4" x 3/4".
 - 1. Wood Linear, Style 1100 Cross Piece Grille.
 - 2. Members per Lineal Foot (spaces between members): 3
 - 3. Clear Dimension between Members: 3 1/4".
- D. Edge Profile: Square.
- E. Reveal Edge: 3/4"
- F. Grid: 15/16".
- G. Fire Rating: Class 1A.
- H. Finish: Stained with clear matte sheen finish.
 - 1. Stain per manufacturer's standard pallet as selected by architect.

2.4 METAL SUSPENSION SYSTEM FOR ACOUSTICAL TILE CEILING (ACT-1)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide USG "DXT" or a comparable product by one of the following:
 - 1. Armstrong
 - 2. Chicago Metallic Corp.
- B. Color: White.

2.5 METAL SUSPENSION SYSTEM FOR WOOD PLANK CEILING (ACT-2)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide USG "DX" or a comparable product by one of the following:
 - 1. Armstrong
 - 2. Chicago Metallic Corp.
- B. Grid system: 15/16" T-Bar main and cross tee suspended frame. Provide cross tees, wall angles and miscellaneous connectors to produce a framework in compliance with ASTM C635.
- C. Color: White.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

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- B. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders.
- C. Suspend ceiling hangers from building's structural members, plumb and free from contact with insulation or other objects within ceiling plenum. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers, use trapezes or equivalent devices. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 - 1. Do not support ceilings directly from permanent metal forms or floor deck; anchor into concrete slabs.
 - 2. Do not attach hangers to steel deck tabs.
- D. Install suspension system runners for flat and curved ceilings so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- E. Install acoustical tiles in coordination with suspension system and exposed moldings and trim. Place splines or suspension system flanges into kerfed edges so tile-to-tile joints are closed by double lap of material.
- F. Install Wood Linear Wave ceiling planks in accordance with manufacturer's installation instructions. Install with undamaged edges and fitted accurately to suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide neat, precise fit, as required.

END OF SECTION 095123

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Resilient base.
 - 2. Resilient molding accessories.
 - 3. Rubber stair accessories.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches (300 mm) long, of each resilient product color, texture, and pattern required.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.4 Warranty

- A. Product warranty: Manufacturer's standard 10-year warranty.

1.5 PROJECT CONDITIONS

- A. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE (RB-1 and RB-2)

- A. Resilient Base:
 - 1. Manufacturers: Subject to compliance with requirements, provide Roppe Corporation "Pinnacle Rubber Wall Base" or equal product by the following:

- a. Allstate Rubber Corp.; Stoler Industries.
- b. Armstrong World Industries, Inc.
- c. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
- d. Endura Rubber Flooring; Division of Burke Industries, Inc.
- e. Estrie Products International; American Biltrite (Canada) Ltd.
- f. Flexco, Inc.
- g. Johnsonite
- h. Mondo Rubber International, Inc.
- i. Musson, R. C. Rubber Co.
- j. Nora Rubber Flooring; Freudenberg Building Systems, Inc.
- k. PRF USA, Inc.
- l. VPI, LLC; Floor Products Division.

- B. Resilient Base Standard: ASTM F 1861.
- C. Material Requirement: Type TS (rubber, vulcanized thermoset).
- D. Manufacturing Method: Group I (solid, homogeneous).
- E. Minimum Thickness: 0.125 inch (3.2 mm).
- F. Height: As noted on drawings.
- G. Lengths: Coils in manufacturer's standard length.
- H. Outside Corners: Preformed.
- I. Inside Corners: Preformed.
- J. Finish: Low luster.
- K. Colors and Patterns: Refer to 'Material Finish / Color Schedule Section 000200' for color selections.

2.2 RESILIENT MOLDING ACCESSORY

- A. Resilient Molding Accessory:
 - 1. Manufacturers: Subject to compliance with requirements, provide Roppe Corporation Resilient Molding Accessories or equal products by the following:
 - a. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
 - b. Flexco, Inc.
 - c. Johnsonite
 - d. R.C.A. Rubber Company (The).
 - e. VPI, LLC; Floor Products Division.
- B. Material: Rubber.
- C. Colors and Patterns: Refer to 'Material Finish / Color Schedule Section 000200' for color selections.

2.3 RUBBER STAIR ACCESSORIES

- A. Rubber Stair Tread / Riser: Manufacturers: Subject to compliance with requirements, provide Roppe "Rubber 95," tapered nose, with riser, or approved equal.
1. Fire-Test-Response Characteristics:
 - a. As determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
 2. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
 4. Stair Treads: ASTM F2169.
 5. Literature of some stair-tread manufacturers does not indicate whether rubber products are thermoset or thermoplastic according to ASTM F2169.
 6. Type: TS (rubber, vulcanized thermoset).
 7. Class: 2 (pattern; embossed, grooved, or ribbed).
 8. Finish: Hammered.
 9. Insert specific requirements in "Group" Subparagraph below to suit Project. For example, insert quantity of abrasive strips required per tread or specific contrasting strip locations.
 10. Nosing Style: Tapered.
 11. Thickness: 1/8" gauge.
 12. Static Coefficient of Friction: Less than 0.50.
 13. Size: Lengths and depths to fit each stair tread in one piece
 14. Integral Risers: Smooth, flat; in height that fully covers substrate.
- B. Landing Tile: Matching treads; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.
- C. Colors and Patterns: Refer to 'Material Finish / Color Schedule Section 000200' for color selections.

2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Cove Base Adhesives: Not more than 50 g/L.
- C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates for Accessories: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.
 - 4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.
 - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient products until they are same temperature as the space where they are to be installed.
 - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.2 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.

3.3 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of carpet and resilient floor covering that would otherwise be exposed.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

END OF SECTION 096513

SECTION 096516 - RESILIENT SHEET FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Vinyl sheet flooring.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color, texture, and pattern specified.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.4 WARRANTY

- A. Manufacturers standard 15-year warranty.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for resilient sheet flooring installation and seaming method indicated.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient sheet flooring, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.

2.2 VINYL SHEET FLOORING

- A. Products: Subject to compliance with requirements, provide Alto "Reliance 25" slip resistant flooring or approved equal:
- B. Product Standard: ASTM F303, Type 1, Class A, safety flooring.

- C. Thickness and Wear Layer: 2.5 mm / .10" homogenous construction.
- D. Weight: 6.27 lbs./yd . (3.4 kg/m²)
- E. Sheet Width: 6.6 feet (2.0 m).
- F. Static Coefficient of Friction: .8 dry and .9 wet in accordance to ASTM D2047.
- G. Indentation: Less than or equal to 0.10 mm.
- H. Seamless-Installation Method: Heat welded.
- I. Colors and Patterns: Refer to 'Material Finish / Color Schedule Section 000200' for color selections.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient sheet flooring manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit resilient sheet flooring and substrate conditions indicated.
- C. Seamless-Installation Accessories:
 - 1. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.
- D. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient sheet flooring manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates according to resilient sheet flooring manufacturer's written instructions to ensure adhesion of resilient sheet flooring.
- B. Concrete Substrates: Prepare according to ASTM F710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by resilient sheet flooring manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by resilient sheet flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 10 pH.

4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of [3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)] <Insert rate> in 24 hours.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient sheet flooring until materials are the same temperature as space where they are to be installed.
 1. At least 48 hours in advance of installation, move flooring and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient sheet flooring.

3.2 RESILIENT SHEET FLOORING INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient sheet flooring.
- B. Unroll resilient sheet flooring and allow it to stabilize before cutting and fitting.
- C. Lay out resilient sheet flooring as follows:
 1. Maintain uniformity of flooring direction.
 2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches (152 mm) away from parallel joints in flooring substrates.
 3. Match edges of flooring for color shading at seams.
 4. Avoid cross seams.
- D. Scribe and cut resilient sheet flooring to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend resilient sheet flooring into toe spaces, door reveals, closets, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on resilient sheet flooring as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Adhere resilient sheet flooring to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- H. Seamless Installation:

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1. Heat-Welded Seams: Comply with ASTM F1516. Rout joints and heat weld with welding bead to fuse sections permanently into a seamless flooring installation. Prepare, weld, and finish seams to produce surfaces flush with adjoining flooring surfaces.
 2. Chemically Bonded Seams: Bond seams with chemical-bonding compound to fuse sections permanently into a seamless flooring installation. Prepare seams and apply compound to produce tightly fitted seams without gaps, overlays, or excess bonding compound on flooring surfaces.
- I. Floor Polish: Remove soil, adhesive, and blemishes from flooring surfaces before applying liquid floor polish.
1. Apply one coat.

END OF SECTION 096516

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Luxury vinyl floor tile (LVT).

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

1. Show details of special patterns.

C. Samples: Full-size units of each color and pattern of floor tile required.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.5 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer in spaces to receive floor tile.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer.

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 LUXURY VINYL FLOOR TILE (LVT-1)

- A. Products: Subject to compliance with requirements, provide Patcraft, "Crossover" Loose Lay, Luxury Vinyl Tile or a comparable product from the following:
 - 1. Tarkett
 - 2. Shaw Contract
 - 3. Armstrong World Industries
 - 4. Mannington Commercial
 - 5. Mohawk Flooring
- B. Tile Standard: ASTM F 1700.
 - 1. Class: Class III, printed film vinyl tile.)
 - 2. Type: B, embossed surface.
- C. Thickness: 0.197" (5 mm).
- D. Wear Layer: 20 mil (0.508 mm)
- E. Finish: ExoGuard
- F. Size: 7" wide x 48" long.
- G. Colors and Patterns: Refer to 'Material Finish / Color Schedule Section 000200' for color selections.

INSTALLATION MATERIALS

- H. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
4. Moisture Testing: Perform tests recommended by floor covering manufacturer and as follows. Proceed with installation only after substrates pass testing.
 - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
 1. At existing concrete slabs scheduled to receive resilient floor tile, skimcoat entire existing surface with trowelable leveling and patching compound.
- D. Do not install floor tiles until they are the same temperature as the space where they are to be installed.
 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.2 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 1. Lay tiles square with room axis or as indicated.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
 1. Lay tiles with grain running in one direction.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- F. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

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- G. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.3 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- B. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 096536 - STATIC-CONTROL RESILIENT FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Static-control, rubber floor tile (ESD).

B. Related Requirements:

1. Section 096513 "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with static-control resilient flooring.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to static-control resilient flooring including, but not limited to, the following:
 - a. Examination and preparation of substrates to receive static-control resilient flooring.
 - b. Installation techniques required for specified products.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of static-control resilient flooring. Include floor-covering layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
- C. Samples: For each type of static-control resilient flooring and in each color, pattern, and texture required, in manufacturer's standard size, but not less than 6 by 9 inches (150 by 230 mm).

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.6 WARRANTY

- A. 10 Year limited commercial warranty.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in installation techniques required by manufacturer for specified static-control resilient flooring.
 - 1. Engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required for specified products.

1.8 PROJECT CONDITIONS

- A. Maintain ambient temperatures in spaces to receive static-control resilient flooring within range recommended by manufacturer for period recommended in writing before installation, during installation, and after installation.
- B. Close spaces to traffic during static-control resilient flooring installation.
- C. Close spaces to traffic for period recommended in writing by manufacturer after static-control resilient flooring installation.
- D. Install static-control resilient flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 STATIC-CONTROL, RUBBER FLOOR TILE

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Static Smart, ESD Rubber Tile, "Northland Series" or approved equal.
 - 1. ASTM F1344. Class I, Type B.
- B. Static-Control Properties: As determined by testing identical products in accordance with test method indicated by an independent testing and inspecting agency.
 - 1. Electrical Resistance:
 - a. Material: Point-to-point and point-to-ground resistances between 1.0×10^6 ohms and 1.0×10^9 ohms when tested in accordance with ANSI / ESD STM 7.1
 - b. Critical Radiant Flux: Class I, less than 0.45 W/cm^2 .
- C. Thickness: 0.08 inch (2.0 mm).
- D. Size: 24 by 24 inches (610 by 610 mm).

- E. Colors and Patterns: Refer to 'Material Finish / Color Schedule Section 000200' for color selections.
- F. Smoke Density: Less than 450 in accordance to ASTM 662-06 (NFPA 258).
- G. Static Load: 1,100 PSI in accordance to ASTM F-970-07 (modified).
- H. Slip Resistance: Less than 0.6 in accordance to ASTM D2047.
- I. Maintenance Floor Tiles: Special floor tiles inscribed "Conductive floor. Do not wax."

2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified portland cement or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Static-Control Adhesive: Provided or approved by manufacturer; type that maintains electrical continuity of floor-covering system to ground connection.
- C. Grounding Strips: Provided or approved by manufacturer; type and size that maintains electrical continuity of floor-covering system to ground connection.
- D. Integral-Flash-Cove Base Accessories:
 - 1. Cove Strip: 1-inch (25-mm) radius support strip provided or approved by manufacturer.
 - 2. Corners: Metal inside and outside corners and end stops provided or approved by floor-covering manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates in accordance with manufacturer's written instructions to ensure successful installation of static-control resilient flooring and electrical continuity of floor-covering systems.
- B. Concrete Substrates: Prepare in accordance with ASTM F710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with floor-covering adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended in writing by manufacturer. Proceed with installation only after substrate alkalinity is not less than 6 or more than 8 pH unless otherwise recommended in writing by flooring manufacturer.
 - 4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m) and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

- a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install static-control resilient flooring until it is same temperature as space where it is to be installed.
 - 1. Move static-control resilient flooring and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- E. Sweep and vacuum substrates to be covered by static-control resilient flooring immediately before installation.

3.2 INSTALLATION, GENERAL

- A. Install static-control resilient flooring in accordance with manufacturer's written instructions.
- B. Extend grounding strips beyond perimeter of static-control resilient floor-covering surfaces to ground connections.
 - 1. For adhesively installed flooring, embed grounding strips in static-control adhesive.
- C. Scribe, cut, and fit static-control resilient flooring to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
 - 1. Extend static-control resilient flooring below built-in items and permanent, but movable, items that allow for a flexible layout where indicated on Drawings.
- D. Extend static-control resilient flooring into toe spaces, door reveals, closets, and similar openings.
- E. Extend static-control resilient flooring to center of door openings where flooring or color transitions occur.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on static-control resilient flooring as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.
- G. Adhesive Installation: Adhere static-control resilient flooring to substrates using a full spread of static-control adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- H. Integral-Flash-Cove Base: Cove static-control flooring 4 inches (102 mm) up vertical surfaces. Support static-control resilient flooring at horizontal and vertical junction with cove strip. Butt at top against cap strip.

3.3 INSTALLATION OF FLOOR TILE

- A. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so floor tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half floor tile at perimeter.
 - 1. Lay floor tiles in pattern indicated on Drawings.
- B. Match floor tiles for color and pattern by selecting floor tiles from cartons in same sequence as manufactured and packaged if so numbered. Discard broken, cracked, chipped, or deformed floor tiles.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to test electrical resistance of static-control resilient flooring in accordance with ASTM F150 for compliance with requirements.
 - 1. Arrange for testing after the following:
 - a. Static-control adhesives have fully cured.
 - b. Static-control resilient flooring has stabilized to ambient conditions.
 - c. Ground connections are completed.
- B. Static-control resilient flooring will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of static-control resilient flooring.
- B. Protect static-control resilient flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- C. Cover static-control resilient flooring and protect from rolling loads until Substantial Completion.

END OF SECTION 096536

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Static Resistant Carpet Tile (ESD).
 - 2. Modular Carpet Tile (CPT).

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For carpet tile installation, plans showing the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
 - 2. Carpet tile type, color, and dye lot.
 - 3. Type of subfloor.
 - 4. Type of installation.
 - 5. Pattern of installation.
 - 6. Pattern type, location, and direction.
 - 7. Type, color, and location of insets and borders.
 - 8. Type, color, and location of edge, transition, and other accessory strips.
 - 9. Transition details to other flooring materials.
- C. Samples: For each exposed product and for each color and texture required.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the manufacturer.

1.8 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE (ESD-2)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Static Smart Plus, "Level 3 Landmark Series, or approved equal.
 - 1. Install flooring system including grounding components, in accordance with manufacturers recommendations.
 - 2. Static-Control Properties: As determined by testing identical products in accordance with test method indicated by an independent testing and inspecting agency.
- B. Finish / Color Schedule. Refer to 'material Finish / Color Schedule Section 000200' for color selections.
- C. Fiber Type: Premium Branded ECO Solution Q Nylon.
- D. Dye Method: 100% Solution Dyed.
- E. Construction Type: Tufted.
- F. Pile Height: 0.121 in (3.07 mm).
- G. Primary Backing: Non-woven synthetic.
- H. Secondary Backing: EcoWorx Backing, 100% PVC free, Phthalate-Free, Recyclable, and made from Recycled material.
- I. Stitches per inch: 11.0.

- J. Gage: 1/12.
- K. Tufted Yarn Weight: 19 oz. per sq. yd. (644.21 g/m²)
- L. Flammability: ASTM E-648 Class 1.
- M. Smoke Density: ASTM E-662 NBS: Less than 450.
- N. Electrostatic Propensity:
 - 1. ESD STM 97.2 (w/Conductive Footware): Less than 20V.
 - 2. AATCC 134-06 (w/o Conductive Footware): Less than 0.4 kV (400 volts)
- O. Electric Resistance: ANSI / ESD S7.1: 1.0×10^6 – 1.0×10^9 Ohms.
- P. Warranty: Lifetime Limited Commercial Warranty.

2.2 (CPT-1)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Mannington, “CoDi Automata”, or approved equal.
 - 1. Color: Refer to ‘Material Finish / Color Schedule Section 000200’ for color selections.
- B. Pattern: As selected by Architect.
- C. Fiber Type: Type 6, 6 Nylon.
- D. Dye Method: Solution Dyed.
- E. Construction Type: Patterned loop.
- F. Pile Thickness: 0.083 inches (2.11 mm) for finished carpet tile.
- G. Stitches per inch: 10.33 (40.67 per 10 cm).
- H. Gage: 5/64 (50.39 per 10cm).
- I. Total Weight: 19.0 oz./sq. yd. (644g/cm).
- J. Backing: Infinity 2 Modular.
- K. Size: 18” by 36” (45.72 cm x 91.44 cm).

2.3 CARPET (CPT-2)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Shaw Contracts, “All Access Path Tile”, or approved equal.
- B. Color: Refer to ‘Material Finish / Color Schedule Section 000200’ for color selections.

- C. Pattern: Path Tile 5T034.
- D. Fiber Type: Ecosolution Q Nylon.
- E. Backing: Ecworx Tile
- F. Tufted Weight: 28 oz sq yd.
- G. Gage: ½ in (47.2 per 10 cm).
- H. Finished Pile Thickness: 0.115 in (2.92 mm).
- I. Size: 24" by 24" (61 cm x 61 cm).

2.4 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Concrete Slabs:
 - 1. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft. (304.8 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

3.2 PREPARATION

- A. General: Comply with CRI's "CRI Carpet Installation Standards" and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.

- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.
- C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. General: Comply with CRI's "CRI Carpet Installation Standard," Section 18, "Modular Carpet" and with carpet tile manufacturer's written installation instructions.
- B. Install static-control flooring system in accordance with manufacturer's written instructions.
 - 1. Extend grounding strips beyond perimeter of static-control resilient floor-covering surfaces to ground connections.
 - 2. For adhesively installed flooring, embed grounding strips in static-control adhesive.
 - 3. Scribe, cut, and fit static-control flooring to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
 - 4. Extend static-control flooring below built-in items and permanent, but movable, items that allow for a flexible layout where indicated on Drawings.
- C. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.
- D. Maintain dye-lot integrity. Do not mix dye lots in same area.
- E. Maintain pile-direction patterns recommended in writing by carpet tile manufacturer. Review with Architect for approval.
- F. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- G. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- H. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
- I. Install pattern parallel to walls and borders.
- J. Install carpet tile recessed plate attached to all flush mounted floor electrical / communications boxes.

- K. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to test electrical resistance of static-control resilient flooring in accordance with ASTM F150 for compliance with requirements.
 - 1. Arrange for testing after the following:
 - a. Static-control adhesives have fully cured.
 - b. Static-control resilient flooring has stabilized to ambient conditions.
 - c. Ground connections are completed.
- B. Static-control resilient flooring will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports, and submit to architect.

END OF SECTION 096813

SECTION 096933 – LOW PROFILE FIXED HEIGHT ACCESS FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Access-flooring panels.
 - 2. Understructure.
 - 3. Floor panel coverings.
- B. Related Requirements:
 - 1. Section 260526 "Grounding and Bonding for Electrical Systems" for connection to ground of access-flooring understructure.

1.3 COORDINATION

- A. Coordinate location of mechanical and electrical work in underfloor cavity to prevent interference with access-flooring pedestals.
- B. Mark pedestal locations on subfloor using a grid to enable mechanical and electrical work to proceed without interfering with access-flooring pedestals.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review connection with mechanical and electrical systems.
 - 2. Review requirements related to sealing the plenum.
 - 3. Review procedures for keeping underfloor space clean.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include layout of access-flooring system and relationship to adjoining Work based on field-verified dimensions.

1. Details and sections with descriptive notes indicating materials, finishes, fasteners, typical and special edge conditions, accessories, and understructures.

C. Samples:

1. Floor Covering: Full-size units for each color and texture specified.
2. Exposed Metal Accessories: Approximately 10 inches (250 mm) in length.
3. One complete full-size floor panel, pedestal, and understructure unit for each type of access-flooring system required.

D. Samples for Initial Selection: For each type of product and exposed finish.

E. Samples for Verification: For the following products:

1. Floor Covering: Full-size units.
2. Exposed Metal Accessories: Approximately 10 inches (250 mm) in length.
3. One complete full-size floor panel, pedestal, and understructure unit for each type of access-flooring system required.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of access-flooring system.
- C. Product Test Reports: For each type of flooring material and exposed finish, for tests performed by a qualified testing agency.
- D. Seismic Design Calculations: For seismic design of access-flooring systems including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Preconstruction Test Reports: For preconstruction adhesive field test.

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. Flooring Panels: 2% of total quantity required.
 2. Pedestals: 2% of total quantity required.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Mockups: Build mockups to verify selections made under Sample submittals to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Build mockup of typical access-flooring assembly as shown on Drawings. Size to be an area no fewer than five floor panels in length by five floor panels in width.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install access flooring until spaces are enclosed, subfloor has been sealed, ambient temperature is between 50 and 90 deg F (10 and 32 deg C), and relative humidity is not less than 20 and not more than 70 percent.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Calculations shall be performed using a current seismic program and submitted to a local structural engineer licensed in the state where the project is located. The structural engineer shall sign and seal these calculations confirming that these calculations meet all local and state codes for seismic pedestal assemblies. A signed copy of these calculations must be given to the architect and local building department as required.
- B. Structural Performance: Provide access-flooring systems capable of complying with the following performance requirements according to testing procedures in CISCA's "Recommended Test Procedures for Access Floors":
 1. Concentrated Loads: 1250 lbf with the following deflection and permanent set:
 - a. Top-Surface Deflection: 0.10 inch.
 - b. Permanent Set: 0.010 inch.
 2. Ultimate Loads: 1800 lbf.
 3. Rolling Loads: With local or overall deformation not to exceed 0.040 inch (1.02 mm).
 - a. CISCA Wheel 1: 10 passes at 1200 lbf.
 - b. CISCA Wheel 2: 10,000 passes at 800 lbf.
 4. Pedestal Axial Load Test: 5000 lbf.
 5. Pedestal Overturning Moment Test: 1000 lbf x inches.
 6. Uniform Load Test: 600 lbf/sq. ft. with a maximum top-surface deflection not to exceed 0.040 inch (1.02 mm) and a permanent set not to exceed 0.010 inch (0.25 mm).
 7. Drop Impact Load Test: 150 lb.
- C. Fire Performance:
 1. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

- a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 50 or less.
2. Combustion Characteristics: ASTM E 136.

2.2 MANUFACTURERS

- A. Source Limitations: Obtain access-flooring system from single source from single manufacturer.

2.3 FLOOR PANELS

- A. Floor Panels, General: Provide modular panels interchangeable with other field panels without disturbing adjacent panels or understructure.
1. Size: Nominal 24 by 24 inches.
 2. Height: 6" (152 mm) nominal height.
 3. Attachment to Understructure: By gravity.
- B. Cementitious-Core Steel Panels: Fabricated from cold-rolled steel sheet, with the die-cut flat top sheet and die-formed and stiffened bottom pan welded together, and with metal surfaces protected against corrosion by manufacturer's standard factory-applied finish. Fully grout internal spaces of completed units with manufacturer's standard cementitious fill.
1. Access floor system shall be as manufactured by Tate Access Floors, Inc. and shall consist of the ConCore 1250 access floor panel supported by a bolted stringer understructure system or approved equal by Haworth, Inc (TecCrete 1250).
- C. Exposed-Concrete-Surface Panels: Fabricated with bottom pan that is die formed from metallic-coated steel sheet and filled with lightweight concrete that is reinforced and bonded to pan by shear ties. Surface is to be prepped for carpet tile as scheduled.

2.4 UNDERSTRUCTURE

- A. Pedestals: Assembly consisting of base, column with provisions for height adjustment, and head (cap); made of steel.
1. Provide pedestals designed for use in seismic applications.
 2. Base: Square or circular base with not less than 16 sq. in. of bearing area.
 3. Column: Of height required to bring finished floor to elevations indicated. Weld to base plate.
 4. Provide vibration-proof leveling mechanism for making and holding fine adjustments in height over a range of not less than 2 inches and for locking at a selected height, so deliberate action is required to change height setting and prevent vibratory displacement.
 5. Head: Designed to support the panel system indicated.
 - a. Provide sound-deadening pads or gaskets at contact points between heads and panels.
 - b. Bolted Assemblies: Provide head with four holes aligned with holes in floor panels for bolting of panels to pedestals.

2.5 FLOOR PANEL COVERINGS

- A. FloorScore Compliance: Floor panel coverings shall comply with requirements of FloorScore Standard.
- B. Carpet Tile: Static Dissipative Carpet Tile as located on drawings and type indicated in Material Finish/Color Schedule – Section 000200.

2.6 FABRICATION

- A. Fabrication Tolerances:
 - 1. Size: Plus or minus 0.020 inch of required size.
 - 2. Squareness: Plus or minus 0.015 inch between diagonal measurements across top of panel.
 - 3. Flatness: Plus or minus 0.035 inch, measured on a diagonal on top of panel.
- B. Panel Markings: Clearly and permanently mark floor panels on their underside with panel type and concentrated-load rating.
- C. Cutouts: Fabricate cutouts in floor panels for cable penetrations and service outlets. Provide reinforcement or additional support, if needed, to make panels with cutouts comply with structural performance requirements.
 - 1. Number, Size, Shape, and Location: As indicated on drawings and mechanical and electrical specifications.
 - 2. Grommets: Where indicated, fit cutouts with manufacturer's standard grommets; or, if size of cutouts exceeds maximum grommet size available, trim edge of cutouts with manufacturer's standard plastic molding with tapered top flange. Furnish removable covers for grommets.
 - 3. Provide foam-rubber pads for sealing annular space formed in cutouts by cables.

2.7 ACCESSORIES

- A. Adhesives: Manufacturer's standard adhesive for bonding pedestal bases to subfloor.
- B. Service Outlets: Standard UL-listed and -labeled assemblies, for recessed mounting flush with top of floor panels; for power, communication, and signal services; and complying with the following requirements:
 - 1. Cover and Box Type: As provided by electrical contractor.
 - 2. Location: In center of panel quadrant unless otherwise indicated.
 - 3. Receptacles and Wiring: Electrical receptacles and wiring for service outlets are specified elsewhere.
- C. Occupant Adjustable Diffusers: To be provided by mechanical contractor. Coordinate sizes and reinforcing as required.
- D. Plenum-Wall Brush Grommets: Self-sealing cable brush grommet with usable area required for passage of low voltage cabling through plenum walls – coordinate exact quantity and locations with Owner's low voltage contractor. Plenum-wall brush grommets not required at wall with fire ratings as conduit is to be provided. Frame of aluminum with passageway consists of intermediate layer of flexible EPDM rubber and interwoven nylon filaments. Provide units with plastic cable tray for support of cables and protection of wallboard.

- E. Closures: Where underfloor cavity is not enclosed by abutting walls or other construction, provide metal-closure plates with manufacturer's standard finish.
- F. Panel Lifting Device: Panel manufacturer's standard portable lifting device for each type of panel required for each computer room.
- G. Perimeter Support: Provide manufacturer's standard method for supporting panel edge and forming transition between access flooring and adjoining floor coverings at same level as access flooring.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer and manufacturer's representative present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Verify that substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, foreign deposits, and debris that might interfere with attachment of pedestals.
 - 2. Verify that concrete floor sealer and finish have been applied and cured.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Lay out floor panel installation to keep the number of cut panels at floor perimeter to a minimum. Avoid using panels cut to less than 6 inches (152 mm).
- B. Locate each pedestal, complete any necessary subfloor preparation, and vacuum subfloor to remove dust, dirt, and construction debris before beginning installation.

3.3 INSTALLATION

- A. Install access-flooring system and accessories under supervision of access-flooring manufacturer's authorized representative to produce a rigid, firm installation that complies with performance requirements and is free of instability, rocking, rattles, and squeaks.
- B. Adhesive Attachment of Pedestals: Set pedestals in adhesive, according to access-flooring manufacturer's written instructions, to provide full bearing of pedestal base on subfloor.
- C. Adjust pedestals to permit top of installed panels to be set flat, level, and to proper height.
- D. Install flooring panels securely in place, properly seated with panel edges flush. Do not force panels into place.
- E. Scribe perimeter panels to provide a close fit with adjoining construction with no voids greater than 1/8 inch (3 mm) where panels abut vertical surfaces.

- F. Cut and trim access flooring and perform other dirt-or-debris-producing activities at a remote location or as required to prevent contamination of subfloor under already-installed access flooring.
- G. Grounded Flooring Access Panel Systems: Ground flooring system as recommended by manufacturer and as needed to comply with performance requirements for electrical resistance of floor coverings.
 - 1. Panel-to-Understructure Resistance: Not more than 10 ohms as measured without floor coverings.
- H. Underfloor Dividers: Scribe and install underfloor-cavity dividers to closely fit against subfloor surfaces, and seal with mastic.
- I. Closures: Scribe closures to closely fit against subfloor and adjacent finished-floor surfaces. Set in mastic and seal to maintain plenum effect within underfloor cavity.
- J. Clean dust, dirt, and construction debris caused by floor installation, and vacuum subfloor area as installation of floor panels proceeds.
- K. Seal underfloor air cavities at construction seams, penetrations, and perimeter to control air leakage, according to manufacturer's written instructions.
- L. Install access flooring without change in elevation between adjacent panels and within the following tolerances:
 - 1. Plus or minus 1/8 inch (3 mm) from a level plane over entire access-flooring area. Coordinate with contractor to insure level and consistent transition from adjacent floor systems.

3.4 PROTECTION

- A. Prohibit traffic on access flooring for 24 hours and removal of floor panels for 72 hours after installation to allow pedestal adhesive to set.
- B. After completing installation, vacuum access flooring and cover with continuous sheets of reinforced paper or plastic. Maintain protective covering until time of Substantial Completion.
- C. Replace access-flooring panels that are stained, scratched, or otherwise damaged or that do not comply with specified requirements.

END OF SECTION 096900

SECTION 097823 – INTERIOR PHENOLIC WALL PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

1. Pre-manufactured panel system including mounting hardware and specified accessories.

1.2 RELATED SECTIONS

1. Section 06100 - Rough Carpentry; furring, blocking, and other carpentry work that is not exposed to view.
2. Section 06402 - Interior Architectural Woodwork; for interior woodwork other than wall systems not included in this section.
3. Section 09260 - Gypsum Board Assemblies; for metal support systems not included in this section.

1.3 REFERENCES

1. American Society for Testing and Materials (ASTM) E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - a) Class 1/A - Flame Spread 0-25, Smoke Developed 450 or less.
 - b) Class 2/B - Flame Spread 26-75, Smoke Developed 450 or less.
 - c) Class 3/C - Flame Spread 76-200, Smoke Developed 450 or less
2. Architectural Woodwork Institute (AWI) Quality Standards.
3. National Electrical Manufacturer's Association (NEMA)

1.4 SUBMITTALS

1. Submit under provisions of Section 01300.
2. Product Data: Manufacturer's Safety Data Sheets (MSDS) on each product to be used, including:
 - a) Preparation instructions and recommendations.
 - b) Storage and handling requirements and recommendations.
 - c) Installation methods.
3. Shop Drawings: Shop drawings in sufficient detail to show fabrication, installation, anchorage, and interface of the work of this Section with adjacent work.
4. Selection Samples: For each finish product specified, one complete set of color samples representing manufacturer's standard range of available colors and patterns.

1.5 QUALITY ASSURANCE

1. Manufacturer Qualifications:
 - a) Firm experienced in successful production of wall systems similar to that indicated for the Project, with sufficient production capacity to produce required units without

- causing delay in the work.
- b) Provide certificate signed by panel manufacturer certifying that products comply with specified requirements.

2. Installer Qualifications: Demonstrate successful experience in installing architectural woodwork similar in type and quality to those required for this project.

1.6 DELIVERY, STORAGE, AND HANDLING

1. Do not deliver wall system until painting, wet work, grinding, and similar operations that could damage, soil, or deteriorate wall system have been completed in installation areas as specified by AWI 1700-G-3.
2. If panels are stored prior to installation, store them flat in completely enclosed areas, out of the weather. If panels must be stored in other than installation areas, store only in areas where environmental conditions comply with manufacturers recommendations. Do not expose panels to continuous direct sunlight, nor to extremes in temperature and humidity. Store products in manufacturer's packaging until ready for installation.
3. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.7 PROJECT CONDITIONS

1. Do not deliver or install wall system until building is enclosed, wet work is complete and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period as specified by AWI 1700-G-3.
2. Do not install wall system until normal lighting conditions exist. Normal lighting conditions are described as those in place when the project is finished. This includes, but not limited to, design lighting (wall washers, spot lights and flood lights, and similar fixtures) and natural lighting.
3. Wall, ceilings, floors, and openings must be level, plumb, straight, in-line and square as specified by AWI 1700-G-3.
4. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits. Panels shall be conditioned in the environment in which they will be installed for a minimum of 72 hours prior to installation. The recommended environment is 75 degrees F (24 degrees C) and 45 percent relative humidity.
5. Environmental Conditions: Comply with Woodwork Manufacturer's recommendations for optimum temperature and humidity conditions for woodwork during its storage and installation. Do not install woodwork until these conditions have been attained and stabilized so that woodwork is within plus or minus 1.0 percent of optimum moisture content from date of installation through remainder of construction period.

1.8 WARRANTY

1. Manufacturer warrants any product it has manufactured and sold against defects in materials or workmanship for a period of five years from the date of original purchase and acceptance for use. This warranty extends to products assembled / installed and used in the manner intended and does not cover damage or failure caused by: misuse, abuse or accidents, exposure to extreme temperature, improper installation, improper maintenance and exposure to water or excessive humidity or excessive moisture.

PART 2 PRODUCTS

2.1 MANUFACTURERS

1. Acceptable Manufacturer: Panel Specialists, Inc.; 3115 Range Rd., Temple, TX 76504. ASD. Toll Free Tel: (800) 947-9422. Tel: (254) 774-9800. Fax: (254) 774-7222. Email: psiwalls@panelspec.com. Web: <http://www.panelspec.com>.
2. Substitutions: approved equivalent.
3. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 PANEL SYSTEMS

1. Provide prefinished decorative panels where shown on the drawings, as specified herein, and as needed for a complete and proper installation.
2. Comply with applicable requirements of "Architectural Woodwork Quality Standards" in the production and installation of the wall panel system as published by the Architectural Woodwork Institute (AWI) unless otherwise indicated.
3. Panel System (PWP-1): #312 as manufactured by Panel Specialists, Inc. A progressive panel system with an exposed divider molding creating a 9/16 inch (12 mm) wide x .018 inch (5 mm) edge band reveal horizontally and vertically between edge banded panels. Recommended for vertical and horizontal interior installations. Maximum panel length for horizontal installations is 96 inches (2438 mm).
 - a) Panel Thickness: 7/16 inches (11.1 mm).
 - b) Horizontal Reveal: System to provide a reveal of 9/16 inch (12 mm) between panels.
 - c) Vertical Reveal: System to provide a reveal of 9/16 inch (12 mm) between panels.
 - d) Panel Edge Finish: Panel edges to be finished with .018 inch (.5 mm) PVC edge banding, except as noted in material specifications.
 - e) Panel Finish: Refer to Room Finish Schedule and drawings.
 - f) Main Laminated Panel Fire Rating:
 - i. Fire Rating: ASTM E84, Class A.
 - g) Panel Dimensions: Refer to drawings.
 - h) Molding: All moldings to be .062" thick (at structural areas) 6063 alloy aluminum with T5 temper.
 - i. Divider Moldings
 1. #312, 9/16" Channel Divider Molding
 - ii. Edge Trim
 1. #304, 1/2" Edge Trim Molding
 - i) Finishes:
 - i. Panel Face:

- 1. Finish: Refer to Material Finish/Color Schedule.
- ii. Panel Face Pattern Direction:
 - 1. Vertical
- iii. Panel Edge Banding:
 - 1. 0.5 mm PVC Platinum.
- iv. Aluminum Molding Finish:
 - 1. Clear Anodized.

2.3 MATERIALS

- 1. Phenolic Panels
 - a) Panels to be durable 3/8" Compact Laminate panels formed from melamine resin saturated overlay and decorative papers bonded to a core of phenolic resin impregnated kraft papers to provide superior impact and moisture resistance.
 - b) Phenolic panels may be interchanged with HPL faced particle board from the same laminate manufacturer Wilsonart, or Pionite.

PART 3 EXECUTION

3.1 EXAMINATION

- 1. Do not begin installation until substrates have been properly prepared according to AWI 1700-G-3.
- 2. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 FIELD DIMENSIONS

- 1. Where wall system is indicated to be fitted to other construction, check actual dimensions of other constructions by accurate field measurements before manufacturing wall system; show recorded measurements on final shop drawings. Coordinate manufacturing schedule with construction progress to avoid delay of work.
- 2. Where field measurements cannot be made without delaying the work, guarantee dimensions and proceed with manufacture of wall system without field measurements coordinate other construction to ensure that actual dimensions correspond to guaranteed dimensions.

3.3 PREPARATION

- 1. Panels must be acclimated to ambient temperature and humidity conditions in accordance with manufacturer's specifications prior to installation. Refer to PSI installation guide for proper, handling, storage and acclimation procedures.
- 2. Clean surfaces thoroughly prior to installation.
- 3. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.4 INSTALLATION

1. Install in accordance with manufacturer's instructions.
2. When interior paneling is on an exterior wall or in a wet area, provide a barrier sheet of plastic film between the outside wall and the panels in order to prevent condensation affecting the stability of the panels.
3. Field cutting of all wall systems should be accomplished using carbide tools. All face penetrations and cutouts should have a minimal 1/8 inch (3 mm) radius in corners according to NEMA Standards Publication LD 3-2005.
4. All wall systems should receive an "S" bead of panel mastic on the back of the panel during installation.
5. For vertical applications, wall systems shall be mechanically fastened to horizontal metal furring strapping spaced 24 inches (610 mm) O.C. Furring straps shall be no less than 18-ga 3-1/2 inches (89 mm) wide, continuously. Metal strapping to be installed to the drywall studs prior to the application of the gypsum board by the framing contractor. For panels installed with a horizontal orientation, strapping is recommended but not necessary

3.5 PROTECTION

1. Protect installed products until completion of project.
2. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 097823

SECTION 098433.11 - SOUND-ABSORBING WALL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sound-absorbing wall panels, custom-fabricated and metal-encased.

1.02 REFERENCES

- A. ASTM International
 - 1. ASTM C423 Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - 2. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 3. ASTM E795 Standard Practices for Mounting Test Specimens During Sound Absorption Tests.

1.03 SYSTEM DESCRIPTION

- A. Performance Requirements:
 - 1. Surface Burning Characteristics (ASTM E84):
 - a. Flame Spread: 25 maximum.
 - b. Smoke Developed: 450 maximum.

1.04 SUBMITTALS

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.
- B. Product Data: Submit product data sheet, for specified products.
- C. Shop Drawings: Submit shop drawings showing layout, edge profiles and panel components, including anchorage, accessories, finish colors and textures.
- D. Samples: Submit selection and verification samples of finishes, colors and textures.
- E. Test Reports: Certified test reports showing compliance with specified performance requirements.
 - 1. Standard Systems: Submit certified copies of previous test reports substantiating performance of system in lieu of retesting.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with Division 1 Product Requirements Section.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

1.06 PROJECT CONDITIONS

- A. Environmental Requirements: Do not install panels until wet work, such as concrete and plastering, is complete; the building is enclosed; and the temperature and relative humidity are stabilized at 60 - 80 degrees F (16 - 27 degrees C) and 35% MINIMUM RH and 55% MAXIMUM RH, respectively. All products constructed with wood or wood fiber content must be stored for at least 72 hours in the controlled environment specified herein prior to installation to allow the materials to stabilize.

PART 2 PRODUCTS

2.01 SOUND-ABSORBING WALL PANELS (AWP-1, AWP-2)

- A. Manufacturer: Kinetics Noise Control, Inc.
1. Kinetics Noise Control, Inc., PO Box 655, 6300 Irelan Place, Dublin, OH 43017; Telephone: (614) 889-0480; Fax: (614) 889-0540; E-mail: intsales@kineticsnoise.com; Web site: www.kineticsnoise.com.
 2. Fabric Wall, 3555 Scarlet Oak Blvd., St. Louis, MO 63122, Telephone (877) 765-8283, Fax: (636) 923-0045, E-mail: inquiry@fabric-wall.com, Web site: www.fabric-wall.com.
- B. Substitutions: approved equivalent.

2.02 MANUFACTURED UNITS

- A. KNP Perforated Metal Panels (AWP-1):
1. Model KNP-F (flat) thickness: 2 inches (51 mm).
 2. Size: As indicated on the drawings.
 - a. Standard sizes for flat (KNP-F) panels: as noted on drawings.
 3. Construction: 22 gage galvanized steel, perforated with 3/32 inch (2.4 mm) holes on 3/16 inch (4.8 mm) staggered centers, providing 23% open area. 20 gage steel channel/stiffener framing. 2 inches (51 mm) thick, black glass fiber batt insulation with medium density skin.
 4. Finish: Manufacturer's standard powder coated paint finish.
 - a. Color: As selected from panel manufacturer's range of standard colors.
 5. Sound Absorption (ASTM C423, A mounting): Noise Reduction Coefficient of 0.90.
 6. Mounting Accessories: Z-clip top and L- bottom support angles.
- B. Fabric Wrapped Acoustic Panels (AWP-2):
1. Model FWAP: 1 inch (25 mm) thick.
 2. Size: 4' x 8' standard panels, and as indicated on the drawings.
 3. Construction: 1" thick 6-7 pcf fiberglass utilizing a 1" fabric track frame; all components Class A per ASTM E84.
 4. Fabric: Guilford Anchorage, standard fabric.
 - a. Color: As indicated on Material Finish/Color Schedule.
 5. Sound Absorption: Noise Reduction Coefficient of 0.80.
 6. Mounting: In accordance with manufacturer's recommended installation methods.

PART 3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

- A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions and product carton instructions for installation.

3.02 EXAMINATION

- A. Site Verification of Conditions: Verify that substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturer's instructions.
 - 1. Verify that stud spacing is 16 inches (406 mm) o.c., maximum, for panels installed over open studs.
 - 2. Do not install panels until unsatisfactory conditions are corrected.

3.03 CLEANING

- A. Follow manufacturer's instructions for cleaning panels soiled during installation. Replace panels that cannot be cleaned to as new condition.
- B. Keep site free from accumulation of waste and debris.

END OF SECTION 098433.11

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following interior substrates:
 - 1. Concrete masonry units (CMU).
 - 2. Steel.
 - 3. Galvanized metal.
 - 4. Gypsum board.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each finish and for each color and texture required.
- C. Product List: Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.3 QUALITY ASSURANCE

- A. MPI Standards:
 - 1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
 - 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.
 - 3. Finishes are to be as follows:
 - a. All soffits and gypsum board ceilings are to receive a 'G1' flat finish.
 - b. All gypsum board walls are to receive a 'G3' egg shell finish.
 - c. All hollow metal door frames are to receive a 'G5' semi-gloss finish.
- B. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 - 2. Apply benchmark samples after permanent lighting and other environmental services have been activated.

3. Final approval of color selections will be based on benchmark samples.
 - a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

1.4 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
 1. Quantity: Furnish an additional 5 percent, but not less than 2 gal. of each material and color applied.

PART 2 - PRODUCTS

2.1 PAINT, GENERAL

- A. Material Compatibility:
 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
 1. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
 2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
 3. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
 4. Flat Topcoat Paints: VOC content of not more than 50 g/L.
 5. Nonflat Topcoat Paints: VOC content of not more than 150 g/L.
 6. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
 7. Floor Coatings: VOC not more than 100 g/L.
 8. Shellacs, Clear: VOC not more than 730 g/L.
 9. Shellacs, Pigmented: VOC not more than 550 g/L.
 10. Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
 11. Zinc-Rich Industrial Maintenance Primers: VOC content of not more than 340 g/L.
 12. Pre-Treatment Wash Primers: VOC content of not more than 420 g/L.
- C. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
2. Restricted Components: Paints and coatings shall not contain any of the following:
 - a. Acrolein.
 - b. Acrylonitrile.
 - c. Antimony.
 - d. Benzene.
 - e. Butyl benzyl phthalate.
 - f. Cadmium.
 - g. Di (2-ethylhexyl) phthalate.
 - h. Di-n-butyl phthalate.
 - i. Di-n-octyl phthalate.
 - j. 1,2-dichlorobenzene.
 - k. Diethyl phthalate.
 - l. Dimethyl phthalate.
 - m. Ethylbenzene.
 - n. Formaldehyde.
 - o. Hexavalent chromium.
 - p. Isophorone.
 - q. Lead.
 - r. Mercury.
 - s. Methyl ethyl ketone.
 - t. Methyl isobutyl ketone.
 - u. Methylene chloride.
 - v. Naphthalene.
 - w. Toluene (methylbenzene).
 - x. 1,1,1-trichloroethane.
 - y. Vinyl chloride.

D. Colors: As indicated in Material Finish / Color Schedule.

2.2 BLOCK FILLERS

- A. Interior/Exterior Latex Block Filler: MPI #4.
 1. VOC Content: E Range of E2.
- B. Interior/Exterior Epoxy Block Filler: MPI #116.
 1. VOC Content: E Range of E2.

2.3 PRIMERS/SEALERS

- A. Interior Latex Primer/Sealer: MPI #50.
 1. VOC Content: E Range of E1.

2.4 METAL PRIMERS

- A. Quick-Drying Alkyd Metal Primer: MPI #76.
 - 1. VOC Content: E Range of E1.

2.5 LATEX PAINTS

- A. Interior Latex (Flat): MPI #53 (Gloss Level 1).
 - 1. VOC Content: E Range of E1.
- B. Interior Latex (Eggshell): MPI #52 (Gloss Level 3).
 - 1. VOC Content: E Range of E1.
- C. Interior Latex (Semigloss): MPI #54 (Gloss Level 5).
 - 1. VOC Content: E Range of E1.

2.6 QUICK-DRYING ENAMELS

- A. Quick-Drying Enamel (Semigloss): MPI #81 (Gloss Level 5).
 - 1. VOC Content: E Range of E1.

2.7 ALKYD PAINTS

- A. Interior Alkyd (Semigloss): MPI #47 (Gloss Level 5).
 - 1. VOC Content: E Range of E2.
 - 2. Environmental Performance Rating: EPR 1.

2.8 EPOXY

- A. Interior / Exterior Epoxy (water based): MPI #115.
- B. Pigmented Epoxy / Polyamide: MPI #77.

2.9 STAIN

- A. Interior Stains (solvent based): MPI #90.
 - 1. VOC Content: E Range of E1.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Wood: 15 percent.
 - 3. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION AND APPLICATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:
 - 1. Mechanical Work:
 - a. Uninsulated metal piping.
 - b. Uninsulated plastic piping.
 - c. Pipe hangers and supports.
 - d. Tanks that do not have factory-applied final finishes.
 - e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 - f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
 - 2. Electrical Work:

- a. Telephone backer boards.
 - b. Electrical equipment that is indicated to have a factory-primed finish for field painting.
- E. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- F. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.3 INTERIOR PAINTING SCHEDULE

A. CMU Substrates:

- 1. Epoxy System: MPI INT 4.2G.
 - a. Prime Coat: Interior/exterior epoxy block filler.
 - b. Intermediate Coat: Interior alkyd matching topcoat.
 - c. Topcoat: Interior/Exterior epoxy (water based).

B. Steel Substrates:

- 1. Quick-Drying Enamel System: MPI INT 5.1A. (Use on Hollow Metal Frames, Steel Lintels)
 - a. Prime Coat: Quick-drying alkyd metal primer.
 - b. Intermediate Coat: Quick-drying enamel matching topcoat.
 - c. Topcoat: Quick-drying enamel (semigloss).
- 2. Latex System: MPI INT 5.1.Q. (Use on Exposed Steel Roof Framing and Roof Deck)
 - a. Prime Coat: Quick-drying alkyd metal primer.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex (flat).

C. Gypsum Board Substrates (Ceilings and Soffits):

- 1. Latex System: MPI INT 9.2A.
 - a. Prime Coat: Interior latex primer/sealer.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex (flat).

D. Gypsum Board Substrates (Walls):

- 1. Latex System: MPI INT 9.2A.
 - a. Prime Coat: Interior latex primer/sealer.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex (eggshell).

END OF SECTION 099123

SECTION 101419 - DIMENSIONAL LETTER SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast dimensional characters.
2. Cutout dimensional characters.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For dimensional letter signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
3. Show message list, typestyles, graphic elements, and layout for each sign.
4. Show locations of electrical service connections.
5. Include diagrams for power, signal, and control wiring.

C. Samples: For each dimensional character type and for each color and texture specified.

D. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: For exterior signage, allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- 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.

2.2 DIMENSIONAL CHARACTERS

- A. Cast Characters: Characters with uniform faces, sharp corners, and precisely formed lines and profiles, and as follows:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Gemini Incorporated; Clear Aluminum Letters or a comparable product by one of the following:
 - a. ACE Sign Systems, Inc.
 - b. Advance Corporation; Braille-Tac Division.
 - c. ASI-Modulex, Inc.
 - d. Grimco, Inc.
 - e. Innerface Sign Systems, Inc.
 - f. Metal Arts; Div. of L&H Mfg. Co.
 - g. Mohawk Sign Systems.
 - h. Nelson-Harkins Industries.
 - i. Signature Signs, Incorporated.
 - j. Signs Fab, Inc.
 - k. Southwell Company (The).
 - l. Supersine Company (The).
 - 2. Character Material: Cast bronze.
 - 3. Character Height: As indicated on drawings.
 - 4. Character Thickness: Varies with respect to height.
 - a. 4" = 5/8" thick.
 - b. 6" = 3/4" thick.
 - c. 8" = 3/4" thick.
 - d. 12" = 1" thick.
 - e. 18" = 1 1/2" thick.
 - 5. Finish: Brushed.
 - 6. Color: Clear coat, semi-gloss.
 - 7. Font: As selected by Architect from Manufacturer's full line.
 - 8. Mounting: Flush mounting with concealed studs mounts for each individual character.
 - 9. Style: Flat face.

- B. Cutout (Flat-Cut) Characters: Characters with uniform faces; square-cut, smooth edges; precisely formed lines and profiles; and as follows:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Gemini Incorporated; Flat Cut Metal or a comparable product by one of the following:
 - a. ACE Sign Systems, Inc.
 - b. Advance Corporation; Braille-Tac Division.
 - c. ASI-Modulex, Inc.
 - d. Grimco, Inc.
 - e. Innerface Sign Systems, Inc.
 - f. Metal Arts; Div. of L&H Mfg. Co.
 - g. Mohawk Sign Systems.
 - h. Nelson-Harkins Industries.
 - i. Signature Signs, Incorporated.
 - j. Signs Fab, Inc.
 - k. Southwell Company (The).
 - l. Supersine Company (The).
 2. Character Material: Clear Aluminum.
 3. Character Height: As indicated on drawings.
 4. Thickness: Manufacturer's standard for size of character [Minimum 0.25 inch (6.35 mm)].
 5. Finish: Brushed.
 6. Color: Clear coat, semi-gloss.
 7. Mounting: Projected spacer mounting for 2-inch distance from wall.

2.3 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:
1. Use concealed fasteners and anchors unless indicated to be exposed.
 2. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.
 3. Exposed Metal-Fastener Components, General:
 - a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
 4. Sign Mounting Fasteners:
 - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
 - b. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.

2.4 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
1. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 2. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
 3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 4. Internally brace signs for stability and for securing fasteners.
 5. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
 6. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.

2.5 ALUMINUM FINISHES

- A. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.
1. Organic Coating: Thermosetting, modified-acrylic enamel primer/topcoat system complying with AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm), medium gloss.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
 3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Mounting Methods:
1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

- a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
2. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
- a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.
- C. Remove temporary protective coverings and strippable films as signs are installed.

END OF SECTION 101419

SECTION 102113.17 – PHENOLIC-CORE TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes phenolic-core units as follows:
 - 1. Toilet Enclosures (Phenolic Core): Floor mounted, overhead braced.
 - 2. Urinal Screens (Phenolic Core): Wall hung and post supported.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each exposed finish.

PART 2 - PRODUCTS

2.1 PHENOLIC-CORE TOILET PARTITION UNITS

- A. Basis-of-Design: Subject to compliance with requirements, provide Bradley “Phenolic-Core, Series 400 – Sentinel” Overhead Braced toilet partitions and Bradley “Phenolic-Core” urinal screen with continuous wall bracket and support post to ceiling.
 - 1. Accurate Partitions Corporation.
 - 2. Ampco.
 - 3. Bobrick.
 - 4. Capitol Partitions, Inc.
 - 5. General Partitions Mfg. Corp.
 - 6. Global Steel Products Corp.
 - 7. Metpar Corp.
 - 8. Weis-Robart Partitions, Inc.
- B. Door, Panel and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges. Provide minimum 3/4-inch- (19-mm-) thick doors and pilasters and minimum 1/2-inch- (13-mm-) thick panels.
 - 1. Facing Sheet Color: Refer to ‘Material Finish / Color Schedule Section 000200’ for color selections.
 - 2. Core Color: Manufacturer's standard dark color.
- C. Pilaster Shoes and Sleeves (Caps): Stainless steel, ASTM A 666, Type 302 or 304.

- D. Brackets (Fittings):
 - 1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.
- E. Urinal Screen Post: Manufacturer's standard post design of 1-3/4-inch- (44-mm-) square, aluminum tube with satin finish; with shoe and sleeve (cap) matching that on the pilaster.

2.2 ACCESSORIES

- A. Hardware and Accessories: Manufacturer's heavy-duty institutional operating hardware and accessories.
 - 1. Material: Stainless steel.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use hot-dip galvanized or other rust-resistant, protective-coated steel.

2.3 FABRICATION

- A. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, fasteners, and anchors at pilasters to suit floor conditions. Make provisions for setting and securing continuous head rail at top of each pilaster. Provide shoes at pilasters to conceal supports and leveling mechanism.
- B. Doors: Unless otherwise indicated, provide 24-inch- (610-mm-) wide in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide out-swinging doors with a minimum 32-inch- (813-mm-) wide clear opening for compartments indicated to be accessible to people with disabilities.
 - 1. Hinges: Heavy-duty self-closing stainless steel continuous hinge with no visible springs. Hinge should be adjusted to hold doors open at any angle up to 90 degrees.
 - 2. Latch and Keeper: Manufacturer's heavy-duty surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with accessibility requirements of authorities having jurisdiction at compartments indicated to be accessible to people with disabilities.
 - 3. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent door from hitting compartment-mounted accessories.
 - 4. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
 - 5. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with accessibility requirements of authorities having jurisdiction. Provide units on both sides of doors at compartments indicated to be accessible to people with disabilities.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
 - 1. Confirm location and adequacy of blocking and supports required for installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 - 1. Maximum Clearances:
 - a. Pilasters and Panels: 1/2 inch (13 mm).
 - b. Panels and Walls: 1 inch (25 mm).
 - 2. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.
 - a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches (44 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact. Securely attach post to ceiling construction with appropriate concealed support above ceiling.

3.3 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113.17

SECTION 102600 - WALL PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Corner guards.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of wall and corner protection showing locations and extent.
 - 1. Include plans, elevations, sections, and attachment details.
- C. Samples: For each exposed product and for each color and texture specified, 12 inches (300 mm) long.

1.3 INFORMATIONAL SUBMITTALS

- A. Product certificates.
- B. Material certificates.
- C. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1.

2.2 CORNER GUARDS

- A. Surface-Mounted, Plastic-Cover Corner Guards: Manufacturer's standard assembly consisting of snap-on, resilient plastic cover installed over retainer; including mounting hardware; fabricated with 90- or 135-degree turn or match angle of wall.
 - 1. Basis-of-Design Product: Construction Specialties, Inc. "SSM-20AN" series partial height acrovyn corner guard (angle to match wall angle), or a comparable product by one of the following:
 - 2. Manufacturers:
 - a. American Floor Products Co., Inc.
 - b. ARDEN Architectural Specialties, Inc.
 - c. Balco, Inc.
 - d. InPro Corporation
 - e. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - f. Korogard Wall Protection Systems; Division of RJF International Corporation.
 - g. Pawling Corporation.
 - h. Tepromark International, Inc.
 - 3. Cover: Extruded rigid plastic, minimum 0.078-inch (2.0-mm) wall thickness;
 - a. Profile: Nominal 2-inch- (50-mm-) long leg and 1/4-inch (6-mm) corner radius.
 - b. Height: 4 feet (1.2 m).
 - 1) Provide 3 feet high unit at partial height walls.
 - c. Color and Texture: As selected by Architect from manufacturer's full range. Multiple colors may be selected for guards to match wall paint color.
 - 4. Retainer: Minimum 0.060-inch- (1.5-mm-) thick, 1-piece, extruded aluminum.
 - 5. Top and Bottom Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.
 - 6. End Wall Guard: At end walls requiring corner guards, provide Construction Specialties, Inc. "SSM-25AN", consisting of (2) corner guards with matching, self adhearing plastic sheet spacer at end of wall, spanning between the (2) corner guards. Install per manufacturer's recommendations.

2.3 MATERIALS

- A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required, thickness as indicated.
- B. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.
- C. Adhesive: As recommended by protection product manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- B. Mounting Heights: Install wall and door protection in locations and at mounting heights indicated on Drawings.
- C. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.
 - 1. Provide anchoring devices and suitable locations to withstand imposed loads.
 - 2. Where splices occur in horizontal runs of more than 20 feet (6.1 m), splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches (305 mm) apart.
 - 3. Adjust end and top caps as required to ensure tight seams.

3.2 CORNER GUARD SCHEDULE

- A. Locations: Install wall protection at all gypsum board outside corners occurring within corridors only. This includes partitions and furred out areas. Do not install corner guards on masonry, or where other wall cladding finishes are applied.

END OF SECTION 102600

SECTION 102800 - TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:

1. Washroom accessories.
2. Underlavatory guards.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Schedule:
1. Identify locations using room designations indicated on Drawings.
 2. Identify products using designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 WASHROOM ACCESSORIES

- A. Basis-of-Design Product: The design for accessories is based on products indicated. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
1. A & J Washroom Accessories, Inc.
 2. American Specialties, Inc.
 3. Bobrick Washroom Equipment, Inc.
 4. Bradley Corporation.
 5. General Accessory Manufacturing Co. (GAMCO).
- B. Grab Bar: TA-1, TA-2, TA-3.
1. Basis-of-Design Product: Bobrick B-5806.
 2. Mounting: Flanges with concealed fasteners.
 3. Material: Stainless steel, 0.05 inch thick.
 - a. Finish: Smooth, No. 4, satin finish.
 4. Outside Diameter: 1-1/4 inches.
 5. Configuration and Length: As indicated on Drawings.
- C. Mirror Unit: TA-4

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TOILET AND BATH ACCESSORIES
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1. Basis-of-Design Product: Bobrick B-290.
 2. Frame: Stainless-steel angle.
 - a. Corners: Mitered and mechanically interlocked.
 3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
 - a. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
 4. Size: As indicated on drawings. If not indicated, provide 24"W x 48"H.
- D. Bumper/Clothes Hook: TA-5
1. Basis-of-Design product: B-212.
 2. Mounting: Surface mounted.
 3. Material: Stainless Steel.
- E. Clothes Hook: TA-7
1. Basis-of-Design product: Bobrick 76717.
 2. Finish: Stainless steel No. 4 finish (satin).
- F. Toilet Tissue Dispenser: TA-8
1. Basis-of-Design product: Bobrick B-4288
 2. Mounting: Surface mounted.
 3. Material: Stainless steel.
 4. Provide theft resistant toilet tissue spindle.
- G. Soap Dispenser: TA-9
1. Basis-of-Design product: Bobrick B-818615
 2. Mounting: Surface mounted.
 3. Material: Stainless steel.
- H. Surface Mounted Sanitary Napkin Disposal: TA-10
1. Basis-of-Design product: Bobrick B-254
 2. Mounting: Surface mounted.
 3. Material: Stainless steel.
- I. Paper Towel Dispenser: TA-11
1. Basis-of-Design product: Bobrick B-4262
 2. Mounting: Surface mounted.
 3. Material: Stainless steel.
- J. Mop Shelf: TA-12
1. Basis-of-Design product: Bobrick B-224
 2. Mounting: Surface mounted.
 3. Material: Stainless steel.
 4. Provide with (4) mop holders and 3 rag hooks.
 5. Length: 36 inches.

- K. Folding Shower Seat: TA-13
 - 1. Basis-of-Design product: Bobrick B-5191
 - 2. Mounting: wall mounted.
 - 3. Material: Stainless steel.
- L. Surface Mounted Seat Cover Dispenser: TA-14
 - 1. Basis-of-Design product: Bobrick B-221
 - 2. Mounting: Surface mounted.
 - 3. Material: Stainless steel.

2.2 UNDERLAVATORY GUARDS: TA-6

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Plumberex Specialty Products, Inc.
 - 2. TCI Products.
 - 3. Truebro, Inc.
- B. Underlavatory Guard:
 - 1. Description: Provide insulating pipe covering for supply and drain piping assemblies. The install lavatory protective enclosure that prevent direct contact with and burns from piping. Provide 'Lav Shield' as provided by Truebro (IPS Corporation) model #2018 or approved equal with tamper resistant screws. Provide factory cut models where available (coordinate with mechanical).
 - 2. Material and Finish: Impact-resistant, stain-resistant and chemical resistant rigid vinyl with China white finish.
- C. Provide at all wall mounted lavatories and as noted on drawings.

2.3 FABRICATION

- A. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

END OF SECTION 102800

SECTION 104413 - FIRE EXTINGUISHER CABINETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes fire protection cabinets for fire extinguishers.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Maintenance data.

1.3 QUALITY ASSURANCE

- A. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.
- B. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- C. Coordinate sizes and locations of fire protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
- B. Stainless-Steel Sheet: ASTM A 666, Type 304.
- C. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.2 FIRE PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.

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FIRE EXTINGUISHER CABINETS
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1. Basis-of-Design: Subject to compliance with requirements, provide Larsen's Manufacturing Co., Architectural Series, Model #SS-2409-R3, or equal by one of the following:
 - a. Fire End & Croker Corporation;
 - b. J. L. Industries, Inc., a division of Activar Construction Products Group;.
 - c. Kidde Residential and Commercial Division, Subsidiary of Kidde plc;.
 - d. Modern Metal Products, Division of Technico Inc.; Insert product name or designation.
 - e. Moon-American;.
 - f. Potter Roemer LLC;.
 - g. Watrous Division, American Specialties, Inc.
- B. Cabinet Construction: Nonrated. Provide fire-rated cabinets when located in fire-rated walls.
- C. Cabinet Material: Stainless-steel sheet.
- D. Semirecessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.
 1. Rolled-Edge Trim: 2-1/2-inch (64-mm) backbend depth.
- E. Cabinet Trim Material: Stainless-steel sheet.
- F. Door Material: Stainless-steel sheet.
- G. Door Style: Vertical duo panel with frame.
- H. Door Glazing: Tempered float glass (clear).
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
- J. Accessories:
 1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
 2. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
 3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.
 - a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."
 - 1) Location: Applied to cabinet door.
 - 2) Application Process: Engraved.
 - 3) Lettering Color: Black.
 - 4) Orientation: Vertical.
- K. Finishes:

1. Manufacturer's standard baked-enamel paint for the following:
 - a. Interior of cabinet.
2. Stainless Steel: No. 4.

2.3 FABRICATION

- A. Fire Protection Cabinets: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Miter and weld joints and grind smooth.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed and prepare recesses as required by type and size of cabinet and trim style.
- B. Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
- C. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.
- D. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and maintenance data.
- C. Warranty: Sample of special warranty.

1.3 QUALITY ASSURANCE

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
- C. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
 - 2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet and mounting bracket indicated.

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FIRE EXTINGUISHERS
104416-2

1. Basis-of-Design Product: Subject to compliance with requirements, provide Larsen's Manufacturing Co. "MP5-A" fire extinguisher (U.O.N) or comparable product by one of the following:
 - a. Amerex Corporation.
 - b. Ansul Incorporated; Tyco International Ltd.
 - c. Badger Fire Protection; a Kidde company.
 - d. Buckeye Fire Equipment Company.
 - e. Fire End & Croker Corporation.
 - f. J. L. Industries, Inc.; a division of Activar Construction Products Group.
 - g. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
 - h. Moon-American.
 - i. Pem All Fire Extinguisher Corp.; a division of PEM Systems, Inc.
 - j. Potter Roemer LLC.
 - k. Pyro-Chem; Tyco Safety Products.
2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine fire extinguishers for proper charging and tagging.
 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.
- C. All fire Extinguishers to be installed in cabinets at locations shown on drawings.

END OF SECTION 104416

SECTION 105113 - METAL LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Knock down box lockers.

1.2 ACTION SUBMITTALS

A. Product data.

B. Shop Drawings: Include plans, elevations, sections, details, attachments to other work, and locker identification system and numbering sequence.

C. Samples: For each color specified.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.

1. Warranty Period for Knocked-Down Metal Lockers: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Requirements: For lockers indicated to be accessible, comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC A117.1.

2.2 KNOCKED-DOWN BOX LOCKERS

- A. Basis of Design: Subject to compliance with requirements, provide List Industries "Superior Standard Classic KD Box Lockers" or equal, by the following:
 - 1. Art Metal.
 - 2. ASI Storage Solutions.
 - 3. General Storage Systems.
 - 4. Lyon Workspace Products.
 - 5. Penco Products, Inc.
- B. Configuration: Four tier lockers. 12" Wide x 15" Deep x 15" High.
- C. Doors: One piece; fabricated from 0.048-inch (1.2-mm) nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.
 - 1. Stiffeners: Manufacturer's standard full-height stiffener fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet; welded to inner face of doors.
 - 2. Door Style: Standard vented panel as follows:
 - a. Concealed Vents: Slotted perforations in top.
- D. Body: Assembled by riveting or bolting body components together. Fabricate from unperforated steel sheet with thicknesses as follows:
 - 1. Tops, Bottoms, and Intermediate Dividers: 0.024-inch (0.61-mm) nominal thickness, with single bend at sides.
 - 2. Backs and Sides: 0.024-inch (0.61-mm) nominal thickness, with full-height, double-flanged connections.
- E. Frames: Channel formed; fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.
- F. Hinges:
 - 1. Continuous Hinges: Manufacturer's standard, steel, full height, 16 ga.
- G. Recessed Door Handle: Projecting finger pull.
- H. Locks: No built in lock. Provide hasp for Owner's provided locks.
- I. Identification Plates: Manufacturer's standard, etched, embossed, or stamped aluminum plates, with numbers and letters at least 3/8 inch (9 mm) high.
- J. Hooks: None.
- K. Continuous Zee Base: Fabricated from manufacturer's standard thickness, but not less than 0.060-inch (1.52-mm) nominal-thickness steel sheet.
 - 1. Height: 4 inches (102 mm).
- L. Filler Panels: Fabricated from 0.036-inch (0.91-mm) nominal-thickness steel sheet.

- M. Finished End Panels: Fabricated from 0.024-inch (0.61-mm) nominal-thickness steel sheet.
- N. Materials:
 - 1. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
- O. Finish: Baked enamel or powder coat.
 - 1. Color: As selected by Architect from manufacturer's full range.

2.3 FABRICATION

- A. Fabricate metal lockers square, rigid, without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.
- B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments. Factory weld frame members of each metal locker together to form a rigid, one-piece assembly.
- C. Equipment: Provide each locker with an identification plate.
- D. Knocked-Down Construction: Fabricate metal lockers using nuts, bolts, screws, or rivets for nominal assembly at Project site.
- E. Continuous Base: Formed into channel or zee profile for stiffness, and fabricated in lengths as long as practical to enclose base and base ends of metal lockers; finished to match lockers.
- F. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.
- G. Finished End Panels: Designed for concealing unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of non-recessed metal lockers; finished to match lockers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install lockers level, plumb, and true; shim as required, using concealed shims.
 - 1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches (910 mm) o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
 - 2. Anchor single rows of metal lockers to walls near top and bottom of lockers.
- B. Knocked-Down Lockers: Assemble with standard fasteners, with no exposed fasteners on door faces or face frames.

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- C. Trim: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
 - 1. Attach filler panels with concealed fasteners.

END OF SECTION 105113

SECTION 112419 – VACUUM CLEANING SYSTEM

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. Description

1. The work included in this section shall include furnishing and installing all materials and systems necessary for a Central Vacuum System suitable for the project, as indicated on the drawings and in accordance with the following specifications.
2. Contractor is obligated to make himself aware of the proposed equipment space allocations, as noted on the architectural, structural, mechanical, and electrical drawings. This is to include, but not be limited to, floor openings and enclosure requirements, clearance dimensions, location of vacuum equipment, and electrical parameters.
3. All bids shall be subject to the approval of the Owner and Architect/Engineer for compliance to this description and for evaluation of qualifications.

B. Scope of Work

1. Submit detailed drawings to the Architect/Engineer for approval prior to any manufacturing or installation. Drawings shall show the materials, details of construction and all attachments to building and equipment under other contracts.
2. The work required consists of all labor, materials, equipment, and necessary appliances to design, fabricate, install equipment, and adjust, complete and ready for use of the central vacuum system in accordance with the drawings.
3. In general, materials shall include, but are not limited to:
 - a. Vacuum Unit
 - b. Inlet Valves
 - c. Cleaning Tools
 - e. Piping and Fittings
4. Vacuum testing of system.
5. System startup.

C. System Requirements

1. Size of system is indicated on the drawings.
2. System shall be installed in accordance with the plans and all inlet valves shall be located approximately where shown. Coordinate exact locations of inlet valves with Construction Manager.

1.3 PRE-INSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.

1.4 SUBMITTALS

- A. Product Data, Shop Drawings:

1. Show: Submit complete shop drawings including:
 - a. Scaled drawings (plans, elevations, sections and details) with dimensions.
 - b. Equipment dimensions, required clearances, controls and electrical requirements and rough-in.
 - c. Show field measurements, locations and sizes of blocking and reinforcements and attachments to other work.
2. Materials List: Accompanying the shop drawings, submit a complete list of all materials proposed to be furnished and installed under this section, giving manufacturer's name and products.

- B. Instruction Manual:

1. Upon completion of the installation, the contractor shall provide the owner with three (3) copies of an instruction manual. Each instruction manual shall contain the following:
 - a. Complete operating, maintenance and repair instruction.
 - b. Cataloged list of spare parts.

1.5 QUALITY ASSURANCE

- A. Qualifications of Installers:

1. For the actual fabrication, installation, and testing of work under this section, use only thoroughly trained and experienced workmen completely familiar with the items required and the manufacturer's current recommended methods of installation.
2. The system shall be installed only by an installer who is certified by the manufacturer or by a mechanical/plumbing contractor with experience in this type of installation and installers that have a minimum of five (5) years' experience.
3. In acceptance or rejection of the finished installation, no allowance will be made for lack of skill on the part of the installers.
4. In the interest of the Owner, the total responsibility for materials, equipment and warranty shall lie directly with the manufacturer of the equipment.

1.6 STORAGE AND HANDLING

- A. Protection of Materials: System contractor shall provide storage space for contractor's material, properly protected from damage by the elements and otherwise maintained and in clean condition, at a point convenient to the installation area.
- B. Replacements: In the event of damage, make all repairs and replacements necessary to the approval of the Architect/Engineer and at no additional cost to the owner.

1.7 PROJECT/SITE CONDITIONS

- A. Field Coordination: Coordinate locations of piping and inlet valves with other trades through the Construction Manager.

1.8 SEQUENCING AND SCHEDULING

- A. Coordinate all work with job site superintendent and all applicable trades.

1.9 WARRANTY

- A. The equipment supplier shall include a full parts and labor warranty covering all defects in materials and workmanship (for all new parts and equipment). The duration of the warranty shall be one year from the date of Owner acceptance of the installed system, or eighteen (18) months from the shipping date, whichever is less.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Comply with Requirements.

2.2 MATERIALS

- A. Equipment:
 - 1. General: All Vacuum Components shall be of sufficient capacity to serve the areas indicated on the drawings and shall be manufactured by one of the manufacturers designated herein or shall be an equal approved in advance by the Architect/Engineer.
 - a. MD Central Vacuums
 - b. Nuera Air
 - c. Vacu-maid Central Vacuum Systems
 - d. Johnny Vac
 - e. Allegro
 - f. Orbit
 - 2. The Architect/Engineer reserves the right to reject any materials list which contains equipment from various manufacturers.
- B. Central Vacuum System:
 - 1. Basis-of-Design: Subject to compliance with requirements, provide Cana-Vac CV 587 Central Vacuum Unit, or approved equivalent product.
 - 2. Vacuum Properties:
 - a. Material: metal construction.
 - b. Motor: 4.7 inch single stage through flow type.
 - c. Weight: 29 lbs.
 - d. Intakes: 2.
 - e. Power: 540 airwatts
 - f. Water Lift: 114".

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- g. Capacity: 4.22 gal (16 litre).
- h. Filtration: micro-filtration.

3. Accessory Kit:

- 1. Basis-of-Design: Subject to compliance with requirements, provide Standard Central Vac Kit, Model HY-4404AP, or approved equivalent product.
- 2. General Properties:
 - a. Hose: 30' vinyl, crushproof.
 - b. Telescopic Wand: 38".
 - c. Floor Brush: 12".
 - d. Tools: crevice, horse hair dusting brush and upholstery.
 - e. Accessories: hose hanger.

D. Piping:

- 1. All piping and fittings shall be 2" PVC.
- 2. Piping and fittings shall be sized in accordance with drawings and/or sized accordingly for number of operators specified.
- 3. Hangers of an approved type shall be used to properly secure and support all piping. On horizontal runs, supports shall be located every 6-12' apart, or as required.

PART 3 - TESTING INSTRUCTION MAINTENANCE

3.1 TESTING

- A. Air flow shall be such that when the maximum number of operators for which the system was designed are using the system, available air flow at hose end meets the minimum requirements set forth by the manufacturer for this vacuum system.
- B. Five days prior to completion date, the Owner shall direct his maintenance personnel to be available to receive instructions from the contractor on maintaining the system. The Owner shall be responsible for preventative maintenance of the system from the date it is put into operation.

3.3 TRAINING

- A. Provide training to the user by a certified manufacturer's representative on the operation and maintenance of the installed system.

END OF SECTION 112419

SECTION 122413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes manual dual roll shades and motorized shade operators.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, details of installation, operational clearances, wiring diagrams, and relationship to adjoining Work.
 - 1. Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.
- C. Coordination Drawings: Drawn to scale and coordinating penetrations and ceiling-mounted items.
- D. Samples: For each exposed finish and for each color and texture required.
- E. Window Treatment Schedule: Use same designations indicated on Drawings.
- F. Maintenance data.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Fire-Test-Response Characteristics: Provide products passing flame-resistance testing according to NFPA 701 by a testing agency acceptable to authorities having jurisdiction.
- C. Comply with WCMA A 100.1.
- D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 ROLLER SHADES (RS-1)

- A. Products: Subject to compliance with requirements, provide one of the following:
- B. Basis-of-Design Product: Vertical roll-up, single and dual roller window shade. Dual roller window shades will have different types of fabric on each roller. Housing will be extruded aluminum, including brackets, fasteners, and other components necessary for complete installation. Subject to compliance with requirements, provide shades as manufacturer by Draper, Inc. as follows or other manufacturers, listed below:
1. Dual roller, manually operated, roller shades:
 - a. Draper, Inc. - Access Dual Roller FlexShade.
 - b. Mounting: Concealed or Surface Mount, as indicated on drawings.
 - c. Provide with dual shades – Sunscreen and Room Darkening.
 2. Subject to compliance with requirements, other manufacturers include the following:
 - a. Hunter Douglas, Inc.; Hunter Douglas Window Fashions Division.
 - b. Levolor; Levolor-Kirsch Window Fashions; a Newell Rubbermaid Company.
 - c. Lutron Shading Solutions by VIMCO.
 - d. MechoShade Systems, Inc.
- C. Shade Band Material:
- a. Sunscreen
 - 1) Material: SheerWeaver Series PW4650 (Phifer).
 - 2) Color: As designated on Material Finish / Color Schedule.
 - 3) Content: 83% vinyl, 17% polyester core
 - 4) Material Openness Factor: 3 percent.
 - 5) Weight / Sq. Yard: 13.3 oz.; Thickness: .026 in.
 - 6) UV Blockage: 97 percent
 - b. Room Darkening
 - 1) Material: SunBloc Series SB9185
 - 2) Color: As designated on Material Finish / Color Schedule.
 - 3) Material Openness Factor: 100 percent opacity.
 - 4) Content: 25% fiberglass, 75% PVC coating
 - 5) Weight / Sq. Yard: 12 oz., Thickness: .013 in.
- D. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
1. Chain-Retainer Type: Clip, jamb mount.
 2. Spring Lift-Assist Mechanisms: Provide for shadebands that weigh more than 10 lb (4.5 kg)] or for shades as recommended by manufacturer, whichever criterion is more stringent.
- E. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Roller Drive-End Location: Right side of interior face of shade.
 2. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
- F. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.
- G. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.
- H. Method of installation:
1. At locations where ceiling is directly adjacent to the shade housing, the unit is to be recessed in ceiling and surface mounted to wall with screws or other acceptable means of attachment. At these locations provide pocket-style headbox. Refer to drawings for locations.
 - a. Housing Case:
 - 1) Rectangular enclosure for two rollers fabricated from extruded aluminum with white paint finish and stamped steel end caps
 - 2) Housing designed to be installed separately from shade as part of ceiling system installation. Shade and operating mechanism can be site installed later after construction operations that might damage shade are complete.
 - 3) Closure panel: Bottom closure panel forms slot for passage of shades and is removable for access to shades and operating mechanisms.
 - 4) Bottom perimeter flange provides support and trim for acoustical ceiling panels.
 2. At locations where no ceiling is directly adjacent to the shade housing, the unit is to be surface mounted to wall with screws or other acceptable means of attachment. At these locations provide finished snap on fascia and end caps. Refer to drawings for locations.

2.2 ROLLER SHADE FABRICATION

- A. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):
1. Shade Units Installed between (Inside) Jambs: Edge of shade not more than 1/4 inch (6 mm) from face of jamb. Length equal to head to sill dimension of opening in which each shade is installed.
 2. Shade Units Installed Outside Jambs: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
 3. Unit sizes are to be as indicated on the drawings or to the maximum size that the material permits to minimize the number of units. Units are to be symmetrical within all spaces when one unit will not suffice.
- B. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.
- C. Bottom shade slat: Minimum 1/8 by 1 inch (3 mm by 25 mm) aluminum slat encased in heat seamed hem.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Field verify window dimensions prior to fabrication.
- B. Coordinate requirements for blocking and structural supports to ensure adequate means for installation of window shades.
- C. Coordinate requirements for power supply, conduit, and wiring required for window shade motors and controls.
- D. Prior to installation, verify type and location of power supply.

3.2 ROLLER SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions, and located so shade band is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.
- B. Connections: Connect motorized operators to building electrical system.
- C. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.
- D. Clean roller shade surfaces after installation, according to manufacturer's written instructions.

3.3 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain roller shades. Refer to Division 01 Section Demonstration and Training."

END OF SECTION 122413

SECTION 123216 – MANUFACTURED CASEWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Manufactured casework, countertops and accessories.
- B. Solid surface countertops.

1.2 RELATED SECTIONS

- A. Division 6 - Carpentry: Framing and blocking in walls, floors and ceiling to support equipment.
- B. Division 9 - Resilient Flooring: base for casework including floor cabinets and table legs.
- C. Division 22: Sinks, faucets, fittings, traps, stops, tail pieces, vacuum breakers, and other fixtures, electrical and mechanical runs and connections.
- D. Division 26: Connections for electrical service lines, wire and conduit to service fixtures.

1.3 REFERENCES

- A. ADA (ATBCB ADAAG): Americans with Disabilities Act Accessibility Guidelines.
- B. ANSI 208.1: Standards for Particleboard.
- C. Architectural Woodwork Institute (AWI): Quality Standards.
- D. NEMA LD 3: High Pressure Decorative Laminates.

1.4 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Test reports certifying that the casework finish complies with manufacturer's standards for chemical and physical resistance performance requirements.
 - 2. Performance test reports from an independent testing lab on each specified top material.
 - 3. Preparation instructions and recommendations.
 - 4. Storage and handling requirements and recommendations.
 - 5. Installation methods.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Indicate locations of blocking and reinforcements required for installing casework.
 - 2. Include indicators of exposed conduits, if required, for service fittings.
 - 3. Indicate locations of and clearances from adjacent walls, doors, windows, other building components, and other equipment.
 - 4. Include coordinated dimensions for equipment specified in other Sections or provided by Owner.
- C. Certifications:
 - 1. Submit certified product test data in accordance with ANSI A161.1, NEMA LD3, and general

- static load testing as specified, performed and certified by an independent testing agency.
2. Submit certification stating that all casework will comply with AWI's "Architectural Woodwork Quality Standards".
3. Material Samples: For each finish selected.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Not less than 5 years experience in the actual production of specified products. Submit documentation of plant facilities and capacity to provide casework for this Project.
- B. Installer Qualifications: Firm with 5 years experience in installation or application of systems similar in complexity to those required for this Project, plus the following.
 1. Authorized distributor of manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Casework shall be protected in transit.
- B. Store products under cover in a ventilated building not exposed to extreme temperature and humidity changes prior to installation. Do not store or install casework in building until concrete, masonry, and drywall/plaster work is dry.
- C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction if applicable.

1.7 PROJECT CONDITIONS

- A. For delivery and installation of casework and equipment, building conditions shall comply with AWI Standard 1700-G-3 and 1700-G-4 and be as follows:
 1. Flooring required to be placed under casework and equipment installed.
 2. Wood or metal blocking (wall grounds) installed within partitions to allow for immediate installation upon delivery.
 3. Heating and air conditioning systems providing consistent temperature and humidity conditions to comply with by AWI Standard 1700-G-4 and 1700-G-5.
 - a. Relative humidity not less than 40 percent, nor more than 60 percent.
 - b. Temperatures not less than 65 degrees F (18 degrees C) and not greater than 80 degrees F (27 degrees C) in areas of casework and equipment installation.
 4. Overhead mechanical, electrical and plumbing rough-in work is complete.
 5. Wet operations complete prior to delivery.
 6. Ceiling grids (with or without ceiling tiles), overhead soffits, ductwork and lighting installed.
 7. Painting complete.

1.8 WARRANTY

- A. Casework Manufacturer Warranty: 5 years from date of delivery. Warranty is for the conditions indicated below, and when notified in writing from Owner, manufacturer shall promptly investigate and address said deficiencies.
 1. Defects in materials and workmanship.

2. Deterioration of material and surface performance below minimum standards as certified by independent third party testing laboratory.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design: Subject to compliance with requirements, provide manufactured casework by Case Systems, Inc. or other approved equal product including but not limited to the following:
 1. TMI Systems Design Corporation.
 2. Or approved equal.

2.2 DESIGN

- A. Flush Overlay Door Design:
 1. Drawer fronts and hinged doors shall overlay the cabinet body. Maintain a maximum 1/8 inch (3.2 mm) reveal between pairs of doors, between door and drawer front, or between multiple drawer fronts within the cabinet
- B. Interior woodwork grade: AWI, custom grade
- C. ADAAG, Americans with Disabilities Act Requirements: The following requirements shall be met.
 1. Countertop height: With or without cabinet below, not to exceed a height of 34 inches (864 mm) A.F.F., (Above Finished Floor), at a surface depth of 24 inches (610 mm).
 2. Kneespace clearance: Shall be minimum 29 inches (737 mm) A.F.F. at apron, and 30 inches (762 mm) clear span width.
 3. 12 inches (305 mm) deep shelving, adjustable or fixed: Not to exceed a range from 9 inches (229 mm) A.F.F. to 54 inches (1372 mm) A.F.F.
 4. Wardrobe cabinets: Shall be furnished with rod/shelf adjustable to 48 inches (1219 mm) A.F.F. at a maximum 21 inches (533 mm) shelf depth.
 5. Sink cabinet clearances: In addition to above, upper kneespace frontal depth shall be no less than 8 inches (203 mm), and lower toe frontal depth shall be no less than 11 inches (279mm), at a point 9 inches (229 mm) A.F.F., and as further described in Volume 56, Section 4.19.

2.3 PERFORMANCE

- A. Casework shall conform to the following minimum performance requirements for static load performance:
 1. Base cabinet construction/racking test: 800 lbs. (363 kg).
 2. Cabinet front joint loading test: 425 lb (193 kg).
 3. Wall cabinet static load test: 2,000 lb (907 kg).
 4. Drawer front joint loading test: 600 lb (272 kg).
 5. Drawer construction/static load test: 750 lb (340 kg).
 6. Cabinet adjustable shelf support device/static load test: 300 lb (136 kg).

2.4 MATERIALS AND COMPONENTS

- A. Laminated Plastics/Finishes:
1. High-pressure plastic laminate, .030 inch (.76 mm) in thickness, for exterior surfaces shall meet NEMA LD3-2000 VGL standards including thickness.
 - a. Exterior Color:
 - 1) Refer to 'Material Finish / Color Schedule Section 000200' for color selections
 - 2) Where wood grain laminates are used, direction of wood grain shall be vertical on door, end panels, fascia panels, and exposed backs; horizontal on drawer faces, aprons, and top rails.
 2. Plastic Laminate Balancing Sheet: White high-pressure cabinet-liner, .020 inch (.051 mm) in thickness shall meet NEMA LD3-2000 CLS standards. Provide for balancing exterior surface laminates.
 3. Countertop High-Pressure Plastic Laminate:
 - a. High-pressure plastic laminate, textured finish .050 inch (1.27 mm) thickness.
 - b. Countertop Colors:
 - 1) As indicated in Material Finish / Color Schedule.
 - c. Heavy gauge neutral colored backing sheet for balanced construction.
 4. Pressure Fused Laminate (for concealed surfaces):
 - a. Melamine resin impregnated, 120 gram PSM minimum, thermofused to core under pressure.
 - b. Comply with NEMA LD3-2000 VGL standards and NEMA LD3-2000 CLS standards.
 - c. White pressure fused laminate for cabinet interiors behind door and drawers and interiors of all closed cabinets.
 - d. Balanced at all concealed surfaces with same thermofused melamine. Unsurfaced coreboard or simple backers not allowed.
- B. Core Materials: Particleboard, minimum 47 lb. (21.3 kg) density, of balanced 3-ply construction with moisture content not to exceed 8 percent. Particleboard shall conform to ANSI A208.1, Grade M-3.
- C. Edging Types: Provide one or more of the following in accordance with "Edging Locations":
1. 3 mm thick PVC: Solid, high-impact, purified, color-thru, acid resistant, pre-lamination primed edging, machine-applied with hot melt adhesives, automatically trimmed, inside/outside length-radiused for uniform appearance, buffed and corner-radiused for consistent design.
- D. Edging Locations. Provide the above specified edging types at the following locations, of the following colors:
1. Door/Drawer-Front edging shall be 3mm PVC.
 - a. Color selected by Architect to match adjacent laminates.
 2. Forward edge of cabinet end panel, top, bottom, door/drawer front spacer rail, interior dividers, and shelf shall be 3mm PVC.
 - a. Color selected by Architect to match adjacent laminates.
- E. Hardware
1. Hinges:
 - a. 2 ¾ inch, 5-knuckle steel butt hinges made from 0.095 inch thick metal with hospital tip.
 2. Pulls: Comply with ADA requirements.
 - a. Wire design, 4 inches (101.6 mm):
 - 1) Stainless Steel.
 3. Drawer Slides:
 - a. Standard Drawers: Self-closing design, epoxy powder coated White, with positive in-

- stop, out-stop, and out-keeper to maintain drawer in 80 percent open position. Captive nylon rollers, front and rear. Minimum dynamic (operational) load rating of 100 pounds (45 kg) at 50,000 cycles.
- b. File Drawers: Full extension, 3-part progressive opening slide, minimum 100 lb (45 kg), zinc plated or epoxy coated at manufacturer's option.
 - 1) Provide body mounted molded rails for hanging file system for legal or letter size as indicated. Cutting or machining of drawer body/face not allowed.
 - c. Paper Storage Drawers: Full extension, 3-part progressive opening slide, minimum 100 lb (45 kg), zinc plated or epoxy coated at manufacturer's option.
4. Catches: Catch shall provide opening resistance in compliance with the Americans with Disabilities Act.
- a. Provide top-mounted magnetic catch for base and wall cabinet door. Provide two at each tall cabinet door. Catch housing shall be molded in White. LH-340ADA.
 - b. LH-345 Roller catch for mobile cabinets.
5. Adjustable Shelf Supports: Design shall include keel to retard shelf slide-off, and slot for ability to mechanically attach shelf to clip. Load rating shall be minimum 300 lb (136 kg) each support without failure. Cabinet interior sides shall be flush, without shelf system permanent projection.
6. Wardrobe Rod: Shall be 1-1/16 inches (27 mm) rod, supported by LH-363 flanges.
7. Coat Hooks:
- a. Double coat hooks, wall mount.
8. Locks: Shall be 5 disc tumbler lock keyed alike and master keyed. Dull chrome finish. Lock core shall be removable.

2.5 CABINET CONSTRUCTION

A. Workmanship:

- 1. Exposed exterior cabinet surfaces shall be .030 inch (.76 mm) high-pressure laminate. Laminate surface/balancing liner to core under controlled conditions by approved and regulated laminating methods to assure a premium lamination. Natural-setting hybrid P.V.A. Type III water resistant adhesives that cure through chemical reaction, containing no health or environmentally hazardous ingredients, shall be used.
 - a. Methods requiring heat are not allowed.
 - b. "Contact" methods of laminating are not allowed.
- 2. Cabinet parts shall be accurately machined and bored for premium grade quality joinery construction utilizing automatic machinery to insure consistent sizing of modular components. End panels shall be doweled to receive bottom and top.
- 3. Back panel shall be fully bound (dadoed) into, and recessed 7/8 inch (22.2 mm) from the back of cabinet sides, top, and bottom to insure rigidity and a fully closed cabinet. Cabinet back shall be mechanically fastened from rear of body for tight interior fit and sealed with full-perimeter high-strength hot-melt adhesive.
- 4. Drawer bottom shall be fully bound (dadoed) and glued into and recessed 1/2 inch (12.7 mm) up from the bottom of sides, back, and sub-front. Sides of drawer shall be doweled to receive drawer back and sub-front.
- 5. 3/4 inch (19.1 mm) thick hang rails shall be mechanically fastened to end panels of all wall, base, and tall cabinets for extra rigidity and to facilitate installation.
- 6. All cases shall be square, plumb, and true.
- 7. Provide removable back panels and closure panels for plumbing access at sink cabinets, and where required.

B. Detailed Requirements For Cabinet Construction:

- 1. Sub-Base:

- a. Cabinet sub-base shall be separate and continuous water resistant exterior grade plywood with concealed fastening to cabinet bottom. Ladder-type jobsite construction of individual front, back, and intermediates, to form a secure and level platform to which cabinets attach. No cabinet sides-to-floor will be allowed.
 - b. Sub-base at exposed cabinet end panels shall be recessed 1/4 inch (6.4 mm) from face of finished end, for flush installation of finished base material by other trades.
2. Structural Cabinet Body:
 - a. Cabinet parts shall be accurately machined and bored for premium grade quality joinery construction utilizing automatic machinery to ensure consistent sizing of modular components. Dowel end panels to receive bottom and top.
 - b. Cabinets over 36 inches (914 mm) wide shall be furnished with a mechanically fastened, yet removable, vertical divider to reduce horizontal member/shelf deflection. Wall cabinets shall have a clear inside nominal depth of 12 inches (305 mm) unless detailed otherwise.
3. Cabinet Top and Bottom:
 - a. Solid sub-top shall be furnished for all base and tall cabinets.
 - b. At cabinets over 36 inches (914 mm), bottoms and tops shall be mechanically joined by a fixed divider.
 - c. Exterior exposed wall cabinet bottoms shall be Pressure Fused white laminate both sides. Assembly devices shall be concealed on bottom side of wall cabinets.
4. Cabinet Ends:
 - a. Holes drilled for adjustable shelves 1-1/4 inches (32 mm) on center.
 - b. Exposed exterior cabinet ends shall be laminated with high-pressure plastic laminate, balanced with high-pressure cabinet-liner interior surface.
5. Fixed And Adjustable Shelves:
 - a. Thickness shall be 1 inch.
 - b. Shelves shall meet the loading/deflection standards of the National Particleboard Association.
6. Cabinet Backs:
 - a. Cabinet backs shall be minimum 1/2 inch (12.7 mm) thick, inset from rear of body, and fully bound (dadoed) four sides. Rear, unexposed, side of back perimeter shall be toe-nailed with mechanical fasteners for tight interior fit and direct connection of back panel to body, and sealed with full-perimeter high-strength hot-melt adhesive.
 - b. Provide 3/4 inch (19 mm) thick hang rails fastened to back/body as specified in this Section. Hang rails shall be located at rear of cabinet back and fastened to cabinet sides. Provide minimum of 2 at base, 2 at wall, and 3 at tall cabinets.
 - c. Exposed exterior backs shall be high-pressure plastic laminate balanced with high-pressure cabinet-liner.
7. Door And Drawer Fronts:
 - a. Overlay Design: Laminated door and drawer fronts shall be 13/16 inch (20.6 mm) thick for all hinged and sliding doors. Drawer fronts and hinged doors shall overlay the cabinet body. Maintain a maximum 1/8 inch (3.2 mm) reveal between pairs of doors, between door and drawer front, or between multiple drawer fronts within the cabinet. Laminated door and drawer fronts shall be 13/16 inch (20.6 mm) thick for all hinged and sliding doors.
 - b. Front Rail: Provide minimum 3/4 inch (19.1 mm) by 6 inches (152 mm) by full width cabinet body rails immediately behind all door/drawer and multiple drawer horizontal joints to maintain exact body dimensions, close off reveal, and be locator for lock strikes.

8. Drawers:
 - a. Drawer fronts shall be applied to separate drawer body component sub-front.
 - b. Drawer sides shall be doweled and glued to receive front and back, machine squared and held under pressure to set.
 - c. Typical 1/2 inch (12.7 mm) drawer bottom, recessed, shall be fully bound (dadoed) into front, sides, and back. Routing, in drawer body for bottom, shall receive continuous glue.
 - d. Reinforce drawer bottoms with 1/2 inch (12.7 mm) by 4 inches (101.6 mm) front-to-back intermediate underbody stiffeners, mechanically fastened. One at 24 inches (610 mm), two at 36 inches (914 mm), and over.
 - e. Paper storage drawers shall be fitted with full width hood at back.
9. Vertical and Horizontal Dividers:
 - a. Natural hardboard 1/4 inch (6.4 mm) thick, smooth both faces. Secured in cabinet with molded plastic clips.

2.6 COUNTERTOP CONSTRUCTION

- A. Refer to Section 123623.13 – Plastic Laminate Clad Countertops and Section 123661.16 – Solid Surfacing Countertops.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not store or install casework in facility until concrete, masonry, drywall and plaster work is dry within limits acceptable to the casework manufacturer.
- B. Do not begin installation until substrates have been properly prepared.
 1. Walls and openings are plumb, straight and square.
 2. Concrete floors level within 1/8 inch (3 mm) level per 10 foot (3000 mm) run, non-accumulative, when tested with a straight edge in any one direction.

3.2 COORDINATION

- A. Verify site dimensions of cabinet locations in building prior to fabrication.
- B. Coordination with Mechanical, Plumbing and Electrical Contractors: Coordinate work of this Section with work of other Sections including but not limited to:
 1. Water, piping, electrical devices, and wiring.
 2. Installation of fittings according to Shop Drawings and manufacturer's written instructions.
 3. Setting bases and flanges of sink and countertop-mounted fittings in sealant recommended by manufacturer of sink or countertop material.
 4. Anchorage of fittings and piping, unless otherwise indicated.

3.3 INSTALLATION

- A. Install casework in accordance with manufacturer's instructions.
 1. Installation of casework shall be plumb, level, true and straight, with no distortions.

2. Use concealed shims as required.
 3. Where casework or equipment butts against other finished work, scribe and cut for an accurate fit.
 4. Lubricate operating hardware as recommended by the manufacturer.
- B. Install countertop and edge surfaces in one plane with flush hairline. Locate joints only where shown on Shop Drawings.
1. Provide required holes and cutouts for service fittings.
 2. Seal unfinished edges and cutouts in plastic-laminate countertops with heavy coat of polyurethane varnish.
 3. Provide scribe moldings for closures at junctures of countertop, curb, and splash, with walls as recommended by manufacturer for materials involved. Match materials and finish to adjacent casework. Use chemical-resistant, permanently elastic sealing compound where recommended by manufacturer.
 4. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

3.4 PROTECTION

- A. Inspect casework for damaged or soiled areas; remove, refinish, and touch-up as required.
- B. Protect installed products until completion of project.
- C. Touch-up, repair or replace damaged products before Substantial Completion.
- D. Remove cartons, debris, sawdust, scraps and similar items and leave spaces clean, and casework ready for Owner's use.
- E. Provide the services of a qualified manufacturer's representative to demonstrate operation and maintenance procedures of the installed casework and equipment to the Owners personnel.

END OF SECTION 123216

SECTION 123623.13 - PLASTIC-LAMINATE-CLAD COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes plastic-laminate countertops.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
- C. Samples:
 - 1. Plastic laminates, for each color, pattern, and surface finish.

1.3 QUALITY ASSURANCE

- A. Fabricator Qualifications: Certified participant in AWI's Quality Certification Program.
- B. Installer Qualifications: Certified participant in AWI's Quality Certification Program.

1.4 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install countertops until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE COUNTERTOPS

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades indicated for construction, installation, and other requirements.
- B. Grade: Custom.
- C. High-Pressure Decorative Laminate: NEMA LD 3, Grade HGS.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Formica Corporation.
 - b. Nevamar; a Panolam Industries International, Inc. brand.
 - c. Pionite; a Panolam Industries International, Inc. brand.
 - d. Wilsonart.
- D. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 1. As indicated in Material Finish / Color Schedule Section 000200.
- E. Edge Treatment: 3-mm PVC edging.
- F. Core Material at Sinks: exterior-grade plywood.
- G. Core Thickness: 3/4 inch (19 mm).
 1. Build up countertop thickness to 1-1/2 inches (38 mm) at front, back, and ends with additional layers of core material laminated to top.

2.2 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard unless otherwise indicated.
 1. Wood Moisture Content: 5 to 10 percent.
- B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
 1. Particleboard: ANSI A208.1, Grade M-2.
 2. Softwood Plywood: DOC PS 1.

2.3 ACCESSORIES

- A. Grommets for Cable Passage through Countertops: 1-1/4-inch (32-mm) OD, black, molded-plastic grommets and matching plastic caps with slot for wire passage.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Doug Mockett & Company, Inc.

2.4 FABRICATION

- A. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of 1 inch (25 mm) over base cabinets. Ease edges to 1/16" radius.
- B. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

- C. Shop cut openings to maximum extent possible to receive appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
 - 1. Seal edges of openings in countertops with a coat of varnish.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.

3.2 INSTALLATION

- A. Grade: Install countertops to comply with same grade as item to be installed.
- B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.
 - 1. Provide cutouts for appliances, plumbing fixtures, electrical work, and similar items.
 - 2. Seal edges of cutouts by saturating with varnish.
- C. Field Jointing: Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required.
 - 1. Secure field joints in plastic-laminate countertops with concealed clamping devices located within 6 inches (150 mm) of front and back edges and at intervals not exceeding 24 inches (600 mm). Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.
- D. Install countertops level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).
- E. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- F. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
 - 1. Install countertops with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
 - 2. Secure backsplashes to walls with adhesive.
 - 3. Seal junctures of tops, splashes, and walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

END OF SECTION 123623.13

SECTION 123661.16 - SOLID SURFACING WINDOW SILLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Solid surface material interior window sills.

1.2 ACTION SUBMITTALS

- A. Product Data: For countertop materials.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts.
- C. Samples: For each type of material exposed to view.

PART 2 - PRODUCTS

2.1 SOLID SURFACE WINDOW SILLS MATERIALS

- A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Affinity Surfaces; a brand of Domain Industries, Inc.
 - b. Avonite Surfaces.
 - c. DuPont Corian
 - d. LG Chemical, Ltd.
 - e. Meganite Inc.
 - f. Samsung Chemical USA, Inc.
 - 2. Colors and Patterns: Refer to material finish / color schedule Section 000200.

2.2 WINDOWSILL FABRICATION

- A. Fabricate windowsills according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."
 - 1. Grade: Premium.
- B. Configuration:
 - 1. Front: Straight edge with eased corners,

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- C. Windowsills: 1/2-inch- (12.7-mm-).
- D. Joints: Fabricate windowsills without joints.

2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by solid surface material manufacturer.
- B. Sealant: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Secure window sills to substrate with adhesive according to solid surface material manufacturer's written instructions.
- B. Bond joints with adhesive and draw tight as window sills are set. Mask areas of window sills adjacent to joints to prevent adhesive smears.
- C. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
- D. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 123661.16

SECTION 123661.19 – QUARTZ AGGLOMERATE COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Quartz agglomerate countertops and interior sills.

1.2 ACTION SUBMITTALS

- A. Product Data: For countertop materials.
- B. Shop Drawings: For countertops. Submit dimensioned shop drawings showing countertop layouts, joinery, edge conditions, terminations, substrate construction and holes.
- C. Samples: For each type of material exposed to view. Countertop material, 6" square.

1.3 QUALITY ASSURANCE

- A. Fabricator qualifications: Minimum (5) five years documented experience in fabricating quartz surfacing countertops similar in scope and complexity to this project, using water-cooled cutting tools.
- B. Installer qualifications: Minimum of (5) five years documented installation experience for projects similar in scope and complexity to this project, and currently certified by the manufacturer as an acceptable installer.

1.4 WARRANTY

- A. Manufacturer's Limited Warranty: Standard (10) ten year commercial limited warranty against defects in quartz surfacing sheet materials.

PART 2 - PRODUCTS

2.1 QUARTZ AGGLOMERATE COUNTERTOP MATERIALS

- A. Quartz Agglomerate: Solid sheets consisting of up to 93% quartz aggregate combined with polyester resins and proprietary pigments that are fabricated using vacuum vibro-compaction technology.
 - 1. Basis-of-Design: Subject to compliance with requirements, provide Wilsonart Quartz, or a comparable product by one of the following:
 - a. Cosentino USA.
 - b. LG Hausys America, inc.
 - c. Approved equivalent product manufacturer.

2. Material Thickness: 0.79" thick (2 cm).
3. Physical Characteristics:
 - a. Flexural Strength: >6,000 psi, ASTM D 790.
 - b. Flexural Strain: 0.375%, ASTM D 790.
 - c. Flexural Modulus: .3.75 MPsi, ASTM D 790.
 - d. Stain Resistance: No effect to moderate effect (24 hour), NEMA Ld-3.
 - e. Abrasion Resistance: .100in. lbs, ASTM C 501
 - f. Density: >2.1 g/cu.m per ASTM C 97.
 - g. Compression Strength: >20,000 psi per ASTM C 170.
 - h. Moisture Absorption: <0.03% per ASTM C 97.
 - i. Surface Burning Characteristics: Class I and Class A per ASTM E 84.
4. Quartz Finish: Polished finish with glossometer reading greater than 45.
5. Edge Detail: as selected from manufacturer's standard offerings.
6. Colors and Patterns: Refer to material finish / Color Schedule Section 000200.

2.2 COUNTERTOP FABRICATION

- A. Fabricate components in shop, to greatest extent practicable, in sizes and shapes indicated according to approved shop drawings and Wildonart Quartz Fabrication manual.
- B. Joint seams: form joint seams between quartz surfacing components with specified seam adhesive. Complete joints inconspicuous in appearance and without voids. Provide joint reinforced, if required by manufacturer, for particular installation conditions.
- C. Cutouts and Holes: provide holes and cutouts for service fixtures and similar countertop-mounted items as indicated. Form cutouts to required template or pattern, with smooth, even curves and eased edges.
- D. Countertops: 0.78" (2 cm) thick, quartz agglomerate with integral edge.
- E. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with quartz agglomerate manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
- F. Joints: Fabricate countertops without joints, or in most practical sized sections for joining in the field.
 1. Joint locations: not where a countertop section <36" long would result, unless unavoidable.

2.3 INSTALLATION MATERIALS

- A. Joint Adhesive: Methacrylate-based adhesive for chemically bonding quartz surfacing seams. Color complementary to quartz surfacing sheet material. UL 2818 GREENGUARD Gold certified and complying with SCAQMD Rule 1168.
 1. Basis-of-Design Product: Wilsonart Hard Surface Adhesive, or equivalent.
 2. Adhesives shall have a VOC content of 70 g/L or less.

- B. Sealant: Siliconized acrylic latex sealant, for general applications to fill gaps between countertops and at terminating substrates. Comply with ASTM C 384, Type OP. Grade NF, and SCAQMD Rule 1168.
 - 1. Basis-of-Design Product: Wilsonart, color matched caulk, or equivalent.
 - 2. Color: Complementary to quartz surfacing color.
- C. Construction Adhesive: Countertop manufacturer's recommended silicone-based construction adhesive according to manufacturer's published fabrication instructions.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine substrates to receive quartz agglomerate countertops and conditions under which countertops will be installed, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops. Substrates must be sound, flat, smooth and free from dust or other surface contaminants. Correct any unsatisfactory conditions before proceeding with installation.
- B. Install quartz surfacing components plumb, level, and true according to approved shop drawings and manufacturer's published installation instructions.
 - 1. Fasten quartz surfacing components to base cabinets or other supporting substrates with suitable adhesives acceptable to manufacturer.
- C. Fill gaps between countertop and terminating substrates with specified silicone sealant.
- D. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
- E. Repair minor surface marring for quartz surfacing components, if permissible by architect, according to manufacturer's published installation instructions. Remove and replace quartz surfacing components that are damaged and cannot be satisfactorily repaired.

3.2 CLEANING AND PROTECTION

- A. Clean quartz surfacing components according to manufacturer's published maintenance instructions.
- B. Completely remove excess adhesives and sealants from finished surfaces.
- C. Protect completed work from damage during remainder of construction period.

END OF SECTION 123661.19

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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 work of this Section.

1.2 SUMMARY

- A. This Section includes mechanical general administrative and procedural requirements. The following requirements are included in this Section to supplement the requirements specified in Division 01 Specification Sections.

1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the

Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

1. AABC - Associated Air Balance Council; www.aabc.com.
 2. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
 3. ABMA - American Boiler Manufacturers Association; www.abma.com.
 4. AGA - American Gas Association; www.aga.org.
 5. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
 6. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
 7. ANSI - American National Standards Institute; www.ansi.org.
 8. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
 9. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
 10. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
 11. ASTM - ASTM International; www.astm.org.
 12. AWS - American Welding Society; www.aws.org.
 13. AWWA - American Water Works Association; www.awwa.org.
 14. CDA - Copper Development Association; www.copper.org.
 15. CGA - Compressed Gas Association; www.cganet.com.
 16. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
 17. CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
 18. CSI - Construction Specifications Institute (The); www.csiresources.org.
 19. FM Approvals - FM Approvals LLC; www.fmglobal.com.
 20. HI - Hydraulic Institute; www.pumps.org.
 21. ICC - International Code Council; www.iccsafe.org.
 22. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
 23. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
 24. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
 25. NADCA - National Air Duct Cleaners Association; www.nadca.com.
 26. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
 27. NEBB - National Environmental Balancing Bureau; www.nebb.org.
 28. NECA - National Electrical Contractors Association; www.necanet.org.
 29. NEMA - National Electrical Manufacturers Association; www.nema.org.
 30. NETA - InterNational Electrical Testing Association; www.netaworld.org.
 31. NFPA - National Fire Protection Association; www.nfpa.org.
 32. NSF - NSF International; www.nsf.org.
 33. NSPE - National Society of Professional Engineers; www.nspe.org.
 34. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
 35. STI - Steel Tank Institute; www.steeltank.com.
 36. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
 37. UL - Underwriters Laboratories Inc.; www.ul.com.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 PERFORMANCE REQUIREMENTS

- A. Systems Components Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

1.5 QUALITY ASSURANCE

- A. Scope of Work: Furnish all labor, material, equipment, technical supervision, and incidental services required to complete, test and leave ready for operation the mechanical systems as specified and as indicated on Drawings.

1. Contract Documents are complimentary, and what is required by one shall be as binding as if required by all. In the event of inconsistencies or disagreements within the Construction Documents bids shall be based on the most expensive combination of quality and quantity of the work indicated.

- B. Ordinances and Codes: Perform all Work in accordance with applicable Federal, State and local ordinances and regulations, the Rules and Regulations of ASHRAE, NFPA, SMACNA and UL, unless otherwise indicated.

1. Notify the Architect/Engineer in writing before submitting a proposal should any changes in Drawings or Specifications be required to conform to the above codes, rules or regulations.
2. If the Contractor performs any work knowing it to be contrary to such laws, ordinances, rules and regulations, and without notice to A/E, the Contractor shall bear all costs arising from corrective measures.

- C. Source Limitations: Obtain equipment and other components of the same or similar systems through one source from a single manufacturer.

- D. Tests and Inspections: Perform all tests required by state, city, county and/or other agencies having jurisdiction. Provide all materials, equipment, etc., and labor required for tests.

- E. Performance Requirements: Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the trades involved.

- F. Sequence and Schedule: Perform work to avoid interference with the work of other trades. Remove and relocate work which in the opinion of the Owner's Representatives causes interference.

- G. Labeling Requirement for Packaged Equipment: Electrical panels on packaged mechanical equipment shall bear UL label or label of other Nationally Recognized Testing Laboratory (NRTL) (Intertek, CSA, etc.).

1.6 CODES, PERMITS AND FEES

- A. Unless otherwise indicated, all required permits, licenses, inspections, approvals and fees for Mechanical Work shall be secured and paid for by the Contractor. All Work shall conform to all applicable codes, rules and regulations.

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- B. Rules of local utility companies shall be complied with. Check with each utility company supplying service to the installation and determine all devices including, but not limited to, all valves, meter boxes, and meters which will be required and include the cost of all such items in proposal.
- C. All work shall be executed in accordance with the rules and regulations set forth in local and state codes. Prepare any detailed drawings or diagrams which may be required by the governing authorities. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications shall govern.
- D. Refer to Division 22 Section "Domestic Water Piping" for purchase and installation of potable water meters.

1.7 DRAWINGS

- A. The drawings show the location and general arrangement of equipment, piping and related items. They shall be followed as closely as elements of the construction will permit.
- B. Examine the drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly. Provide fittings, valves, and accessories as required to meet actual conditions.
- C. Deviations from the drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer.
- D. The Architectural and Structural Drawings take precedence in all matters pertaining to the building structure, Mechanical Drawings in all matters pertaining to Mechanical Trades and Electrical Drawings in all matters pertaining to Electrical Trades. Where there are conflicts or differences between the drawings for the various trades, report such conflicts or differences to the Architect/Engineer for resolution.
- E. Drawings are not intended to be scaled for rough-in or to serve as shop drawings. Take all field measurements required to complete the Work.

1.8 MATERIAL AND EQUIPMENT MANUFACTURERS

- A. Equipment: All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new and shall be standard products of manufacturers regularly engaged in the production of plumbing, heating, ventilating and air conditioning equipment and shall be the manufacturer's latest design.
- B. If an approved manufacturer is other than the manufacturer used as the basis for design, the equipment or product provided shall be equal in size, quality, durability, appearance, capacity, and efficiency through all ranges of operation, shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified, shall be compatible with the other components of the system and shall comply with the requirements for Items Requiring Prior Approval specified in this section of the Specifications. All costs to make these items of equipment comply with these requirements including, but not limited to, piping, sheet metal, electrical work, and building alterations shall be included in the original Bid.

- C. All package unit equipment and skid mounted mechanical components that are factory assembled shall meet, in detail, the products named and specified within each section of the Mechanical and Electrical Specifications.
- D. Changes Involving Electrical Work: The design of the mechanical systems is based on the equipment scheduled on the Drawings. Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified with no additional cost to project. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
 - 1. Where equipment changes are made that involve additional Electrical Work (larger size motor, additional wiring of equipment, etc.) the Mechanical Trades involved shall compensate the Electrical Trades for the cost of the additional Work required.

1.9 INSPECTION OF SITE

- A. Visit the site, examine and verify the conditions under which the Work must be conducted before submitting Proposal. The submitting of a Proposal implies that the Contractor has visited the site and understands the conditions under which the Work must be conducted. No additional charges will be allowed because of failure to make this examination or to include all materials and labor to complete the Work.
- B. No contract sum adjustments or contract time extensions will be made for Contractor claims arising from conditions which were or could have been observable, ascertainable or reasonably foreseeable from a site visit or inquiry into local conditions affecting the execution of the work.

1.10 ITEMS REQUIRING PRIOR APPROVAL

- A. Bids shall be based upon manufactured equipment specified. All items that the Contractor proposes to use in the Work that are not specifically named in the Contract Documents must be submitted for review prior to bids. Such items must be submitted in compliance with Division 01 specifications. Requests for prior approval must be accompanied by complete catalog information, including but not limited to, model, size, accessories, complete electrical information and performance data in the form given in the equipment schedule on the drawings at stated design conditions. Where items are referred to by symbolic designations on the drawings, all requests for prior approval shall bear the same designations.
 - 1. Equipment to be considered for prior approval shall be equal in quality, durability, appearance, capacity and efficiency through all ranges of operation, shall fulfill the requirements of equipment arrangement and space limitations of the equipment shown on the plans and/or specified and shall be compatible with the other components of the system.
 - 2. All costs incurred to make equipment comply with other requirements, including providing maintenance, clearance, piping, sheet metal, electrical, replacement of other components, and building alterations shall be included in the original bid.
- B. Voluntary alternates may be submitted for consideration, with listed addition or deduction to the bid, but will not affect the awarding of the contract.

1.11 ACTION SUBMITTALS

- A. Submit for review in compliance with Division 01.
- B. Equipment and material submittals required are indicated in the Mechanical; Fire Suppression; Plumbing; and Heating, Ventilating and Air Conditioning Sections. Refer to Division 01 for submittal quantities.
- C. Submittals shall be in groupings of similar or related items. Plumbing fixture submittals shall be in one package including all fixtures intended to be used for this project. Incomplete submittal groupings will be returned "Rejected". Submit product data with identification mark number or symbol numbers as specified or scheduled on the Mechanical Drawings.
- D. Submittals shall be project specific. Standard detail drawings and schedule not clearly indicating which data is associated with this Project will be returned "Rejected".
- E. If deviations (not substitutions) from Contract Documents are deemed necessary by the Contractor, details of such deviations, including changes in related portions of the project and the reasons therefore, shall be included with the submittal for approval.

1.12 INFORMATIONAL SUBMITTALS

- A. Shop Drawings:
 - 1. Prepare shop drawings to scale for the Architect/Engineer for review.
 - 2. Shop drawings shall be reviewed by the Mechanical Contractor for completeness and accuracy prior to submitting to the Architect/Engineer for review. The shop drawings shall be dated and signed by the Mechanical Contractor prior to submission.
 - 3. No equipment shall be shipped from stock or fabricated until shop drawings for them have been reviewed by the Architect/Engineer. Review is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Any action indicated is subject to the requirement of the plans and specifications.
 - a. By the review of shop drawings, the Architect/Engineer does not assume responsibility for actual dimensions or for the fit of completed work in position, nor does such review relieve Mechanical Trades of full responsibility for the proper and correct execution of the work required.
 - b. Contractor is responsible for:
 - 1) Dimensions, which shall be confirmed and correlated at the job site.
 - 2) Fabrication processes and techniques of construction.
 - 3) Quantities.
 - 4) Coordination of Contractor's work with all other trades.
 - 5) Satisfactory performance of Contractor's work.
 - 6) Temporary aspects of the construction process.
- B. Coordination Drawings:
 - 1. Submit project specified coordination drawings for review in compliance with Division 01 Specification Sections.

1.13 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Instructional Manuals:

1. Submit project specific Operation and Maintenance Instructional Manuals for review in compliance with Division 01 Specification Sections.
2. Provide complete operation and maintenance instructional manuals covering all mechanical equipment herein specified, together with parts lists. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. One copy of all manuals shall be furnished for Owner. Maintenance and operating instructional manuals shall be provided when construction is approximately 75 percent complete.
3. Format: Submit operation and maintenance manuals in the following format:
 - a. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
 - 1) Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - 2) Enable inserted reviewer comments on draft submittals.
4. The operating and maintenance instructions shall include a brief, general description for all mechanical systems including, but not limited to:
 - a. Routine maintenance procedures.
 - b. Lubrication chart listing all types of lubricants to be used for each piece of equipment and the recommended frequency of lubrication.
 - c. Trouble-shooting procedures.
 - d. Contractor's telephone numbers for warranty repair service.
 - e. Submittals.
 - f. Recommended spare parts list.
 - g. Names and telephone numbers of major material suppliers and subcontractors.
 - h. System schematic drawings.

B. Record Drawings:

1. Submit record drawings in compliance with Division 01.
2. Contractor shall submit to the Architect/Engineer, record drawings on electronic media or vellum which have been neatly marked to represent as-built conditions for all new mechanical work.
3. The Contractor shall keep accurate note of all deviations from the construction documents and discrepancies in the underground concealed conditions and other items of construction on field drawings as they occur. The marked up field documents shall be available for review by the Architect, Engineer and Owner at their request.

C. Warranties:

1. Warranty: Comply with the requirements in Division 01 Specification Sections. Contractor shall warranty that the mechanical installation is free from defects and agrees to replace or repair, to the Owner's satisfaction, any part of this mechanical installation which becomes defective within a period of one year (unless specified otherwise in other Mechanical; Fire Suppression; Plumbing; or Heating, Ventilating and Air Conditioning Sections) from the date of substantial completion following final

acceptance, provided that such failure is due to defects in the equipment, material, workmanship or failure to follow the contract documents.

2. File with the Owner any and all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

1.14 INSTRUCTION OF OWNER PERSONNEL

- A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of mechanical equipment and systems at agreed upon times. A minimum of 24 hours of formal instruction to Owner's personnel shall be provided for each building. Additional hours are specified in individual specification sections.
- B. For equipment requiring seasonal operation, perform instructions for other seasons within six months.
- C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- D. In addition to individual equipment training provide overview of each mechanical system. Utilize the as-built documents for this overview.
- E. Prepare and insert additional data in operation and maintenance manual when need for such data becomes apparent during instruction.

1.15 WARRANTY

- A. Warranty: Comply with the requirements in Division 01 Specification Sections. Contractor shall warranty that the mechanical installation is free from defects and agrees to replace or repair, to the Owner's satisfaction, any part of this mechanical installation which becomes defective within a period of one year (unless specified otherwise in other Mechanical; Fire Suppression; Plumbing; or Heating, Ventilating and Air Conditioning Sections) from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship or failure to follow the contract documents.
- B. File with the Owner any and all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.1 MECHANICAL DEMOLITION WORK

- A. Demolition of existing mechanical equipment and materials shall be done by the Contractor unless otherwise indicated. Include items such as, but not limited to, existing piping, pumps, ductwork, supports, and equipment where such items are not required for the proper operation of the modified system.

- B. Include draining of piping systems where required for demolition, modification of, or connection to existing systems.
- C. In general, demolition work is indicated on the Drawings. However, the Contractor shall visit the job site to determine the full extent and character of this Work.
- D. Unless specifically noted to the contrary, removed materials shall not be reused in the work. Salvaged materials that are to be reused shall be stored safe against damage and turned over to the appropriate trade for reuse.
 - 1. Salvaged materials of value that are not to be reused shall remain the property of the Owner unless such ownership is waived.
 - 2. Remove items from the systems and turn over to the Owner in their condition prior to removal. The Owner will move and store these materials.
 - 3. Items on which the Owner waives ownership shall become the property of the Contractor, who shall remove and legally dispose of same, away from the premises.
- E. Work that has been cut or partially removed shall be protected against damage until covered by permanent construction.
- F. Clean and flush the interior and exterior of existing relocated equipment and its related piping, valves, and accessories that are to be reused of mud, debris, pipe dope, oils, welding slag, loose mill scale, rust, and other extraneous material so that the existing equipment and accessories can be repainted and repaired as required for the proper operation and performance of the relocated equipment.
- G. Where existing equipment is to be removed, cap piping under floor, behind face of wall, above ceiling, or at mains.
- H. Cap ductwork and cap piping immediately adjacent to demolition as soon as demolition commences in order to allow existing systems to remain in operation.
 - 1. Cap or plug piping with same or compatible piping material.
 - 2. Cap or plug ducts with same or compatible ductwork material.

3.2 REFRIGERANT HANDLING

- A. Refrigerant Installation and Disposal: Perform all work related to refrigerant contained in chillers, cooling coils, air conditioners, and similar equipment, including related piping, in strict accordance with the following requirements:
 - 1. ASHRAE Standard 15 and Related Revisions: Safety Code for Mechanical Refrigeration.
 - 2. ASHRAE Standard 34 and Related Revisions: Number Designation and Safety Classification of Refrigerants.
 - 3. United States Environmental Protection Agency (US EPA) requirements of Section 8 08 (Prohibition of Venting and Regulation of CFC) and applicable State and Local regulations of authorities having jurisdiction.
- B. Recovered refrigerant is the property of the Contractor. Dispose of refrigerant legally, in accordance with applicable rules and regulations.

3.3 WORK IN EXISTING BUILDINGS

- A. The Owner will provide access to existing buildings as required. Access requirements to occupied buildings shall be identified on the project schedule. The Contractor, once Work is started in the existing building, shall complete same without interruption so as to return work areas as soon as possible to Owner.
- B. Adequately protect and preserve all existing and newly installed Work. Promptly repair any damage to same at Contractor's expense.
- C. Consult with the Owner's Representative as to the methods of carrying on the Work so as not to interfere with the Owner's operation any more than absolutely necessary. Accordingly, all service lines shall be kept in operation as long as possible and the services shall only be interrupted at such time as will be designated by the Owner's Representative.
- D. Prior to starting work in any area, obtain approval for doing so from a qualified representative of the Owner who is designated and authorized by the Owner to perform testing and abatement, if necessary, of all hazardous materials including but not limited to, asbestos. The Contractor shall not perform any inspection, testing, containment, removal or other work that is related in any way whatsoever to hazardous materials under the Contract.

3.4 TEMPORARY SERVICES

- A. Provide temporary service as described in Division 01.
- B. The existing building will be occupied during construction. Maintain mechanical services and provide necessary temporary connections and their removal at no additional cost to the Owner.

3.5 WORK INVOLVING OTHER TRADES

- A. Certain items of equipment or materials specified in the Mechanical Division may have to be installed by other trades due to code requirements or union jurisdictional requirements. In such instances, the Contractor shall complete the work through an approved, qualified subcontractor and shall include the full cost for same in proposal.

3.6 ACCEPTANCE PROCEDURE

- A. Upon successful completion of start-up and recalibration, but prior to building acceptance, substantial completion and commencement of warranties, the Architect/Engineer shall be requested in writing to observe the satisfactory operation of all mechanical control systems.
- B. The Contractor shall demonstrate operation of equipment and control systems, including each individual component, to the Owner and Architect/Engineer.
- C. After correcting all items appearing on the punch list, make a second written request to the Owner and Architect/Engineer for observation and approval.

- D. After all items on the punch list are corrected and formal approval of the mechanical systems is provided by the Architect/Engineer, the Contractor shall indicate to the Owner in writing the commencement of the warranty period.
- E. Operation of the following systems shall be demonstrated:
 - 1. Air Handling Systems.
 - 2. Chilled Water Systems.
 - 3. Heating Systems.
 - 4. Exhaust Systems.
- F. For systems requiring seasonal operation, demonstrate system performance within six months when weather conditions are suitable.

END OF SECTION 20 0500

PARTNERS 21-130
MECHANICAL GENERAL REQUIREMENTS
20 0500 - 12

SECTION 20 0510 - BASIC MECHANICAL MATERIALS AND METHODS

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 22 Section "Domestic Water Piping" for flushing and cleaning of potable water piping.
 - 3. Division 23 Section "Piping Systems Flushing and Chemical Cleaning" for flushing and cleaning of HVAC piping.

1.2 SUMMARY

- A. This section includes mechanical materials and installation methods common to mechanical piping systems, sheet metal systems and equipment. This section supplements all other Division 20, 21, 22, and 23 Mechanical Sections, and Division 01 Specification Sections.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- D. The following are industry abbreviations for plastic materials:
 - 1. CPVC: Chlorinated polyvinyl chloride plastic.
 - 2. PE: Polyethylene plastic.
 - 3. PVC: Polyvinyl chloride plastic.
- E. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Transition fittings.

2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
- B. Comply with NSF 14, "Plastics Piping System Components and Related Materials," for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.
- C. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for potable domestic water piping and components.
- D. Comply with NSF 372, "Drinking Water System Components – Lead Content" for potable domestic water piping and components.
- E. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- F. Duct Joint and Seam Welding: Qualify procedures and personnel according to the following:
 1. AWS D9.1, "Sheet Metal Welding Code."
- G. Soldering: Qualify processes and operators according to AWS B2.3/2.3M, "Specification for Soldering Procedure and Performance Qualification."
- H. Installer Qualifications:
 1. Installers of Grooved Components: Installers shall be certified by the grooved component manufacturer as having been trained and qualified to join piping with grooved couplings, fittings, and specialties.
 2. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Storage and Protection: Provide adequate weather protected storage space for all mechanical equipment and materials deliveries to the job site. Storage locations will be designated by the Owner's Representative. Equipment stored in unprotected areas must be provided with temporary protection.
 1. Protect equipment and materials from theft, injury or damage.
 2. Protect equipment outlets, pipe and duct openings with temporary plugs or caps.

3. Materials with enamel or glaze surface shall be protected from damage by covering and/or coating as recommended in bulletin "Handling and Care of Enameled Cast Iron Plumbing Fixtures", issued by the Plumbing Fixtures Manufacturer Association, and as approved.
4. Electrical equipment furnished by Mechanical Trades and installed by the Electrical Trades: Turn over to Electrical Trades in good condition, receive written confirmation of same.
5. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
6. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations. Coordinate with other trades to ensure accurate locations and sizes of mechanical spaces, chases, slots, shafts, recesses and openings.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Install Work to avoid interference with work of other trades including, but not limited to, Architectural and Electrical Trades. Remove and relocate any work that causes an interference at Contractor's expense.
- D. Coordinate requirements for and provide access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
- E. The mechanical trades shall be responsible for all damage to other work caused by their work or through the neglect of their workers.
 1. All patching and repair of any such damaged work shall be performed by the trades which installed the work. The cost shall be paid by the Mechanical Trades.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 21, 22, and 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 21, 22, and 23 piping Sections for special joining materials not listed below.
- B. Unions: Pipe Size 2 Inches and Smaller:
 - 1. Ferrous pipe: Malleable iron ground joint type unions.
 - 2. Unions in galvanized piping system shall be galvanized.
 - 3. Copper tube and pipe: Bronze unions with soldered joints.
- C. Flanges: Pipe Sizes 2-1/2 Inch and Larger:
 - 1. Ferrous pipe: Standard weight, forged steel weld neck flanges.
 - 2. Copper tube and pipe: Slip-on bronze flanges.
- D. 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 thickness or specific material is 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.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- E. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated. Square head bolts and nuts are not acceptable.
- F. Solder Filler Metals: ASTM B 32, lead-free, antimony-free, silver-bearing alloys. Include water-flushable flux according to ASTM B 813.
- G. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Welding Materials: Comply with Section II, Part C, of ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.
- I. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.4 PIPE THREAD COMPOUNDS

- A. General: Pipe thread compounds for the fluid service compatible with piping materials provided.
- B. Potable Water Service and Similar Applications: Compounds acceptable to U.S. Department of Agriculture (USDA) or Food and Drug Administration (FDA). Compounds containing lead are prohibited.
- C. Galvanized Steel: Inorganic zinc-rich coatings or corrosion inhibited proprietary compounds to coat raw carbon steel surfaces, in lieu of subsequent painting. Compounds containing lead are prohibited.

1. Manufacturers:
 - a. Carboline "Carbo-Zinc 12."
 - b. Tnemec.
 - c. Koppers.

D. Natural Gas System: Use either of the following:

1. Tetrafluoroethylene (Teflon) tape 2 to 3 mils thick for threaded joints.
 - a. Manufacturers:
 - 1) Cadillac Plastic.
 - 2) Permacel.
 - 3) Other approved.
2. Lead-free pipe thread compounds suitable for service.
 - a. Manufacturers:
 - 1) HCC Holdings, Inc.; Hercules Pro Dope.
 - 2) Mill-Rose Company (The); Clean-Fit Products; Blue Monster Thread Sealant.
 - 3) Oatey; Great Blue Pipe Joint Compound.
 - 4) RectorSeal LLC: A CSW Industrials Company; No. 5, No.5 Special, and No. 5 Sub-Zero Pipe Thread Sealants.

2.5 TRANSITION.FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser Industries, Inc.; DMD Div.
 - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
 - d. JCM Industries.
 - e. Smith-Blair, Inc.
 - f. Viking Johnson.
 2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
 3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
 4. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 1. Manufacturers:
 - a. Thompson Plastics, Inc.

- C. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
 - 1. Manufacturers:
 - a. NIBCO INC.
 - b. NIBCO, Inc.; Chemtrol Div.
- D. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
 - 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Fernco, Inc.
 - c. Mission Rubber Company.
 - d. Plastic Oddities, Inc.
 - e. Can-Tex Industries Division of Harsco Corp. "CT-Adaptors".
 - f. Joint Inc., "Caulder".

2.6 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Brass Unions, Brass Nipples, Brass Couplings: For systems up to 286 deg F.
- D. Dielectric-Flange Kits: Include full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Capitol Manufacturing Co.
 - d. GF Piping Systems; George Fischer Central Plastics.
 - e. Epco Sales, Inc.
 - f. Pipeline Seal and Insulator, Inc.
 - g. Watts Water Technologies, Inc.; Watts Regulator Co.
 - h. Zurn Industries, Inc.; Wilkins Div.
 - 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- E. Dielectric Nipple/Waterway Fittings: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, male NPT threaded, or grooved ends; and 300-psig minimum working pressure at 230 deg F.

1. Manufacturers:
 - a. ASC Engineered Solutions; Gruvlok Manufacturing; DI-LOK Nipples.
 - b. Elster Group; Perfection Corp.; ClearFlow.
 - c. Precision Plumbing Products, Inc.; ClearFlow.
 - d. Sioux Chief Manufacturing Co., Inc.
 - e. Tyco Fire & Building Products; Grinnell Mechanical Products; Figure 407 ClearFlow.
 - f. Victaulic Co. of America; Style 47 ClearFlow.

2.7 MODULAR MECHANICAL SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve or pipe and core drilled hole.
 1. Manufacturers:
 - a. Advance Products & Systems, Inc.; Innerlynx.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.; Thunderline Link Seal.
 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 3. Pressure Plates: Carbon steel. Include two for each sealing element.
 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.8 SLEEVES

- A. Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, and 0.375 inch wall black.
- B. Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, and 0.375 inch wall galvanized, plain ends.
- C. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 1. Underdeck Clamp: Clamping ring with set screws.

2.9 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping or Piping in High Humidity Areas: One-piece, cast-brass type with polished chrome-plated finish.

- c. Insulated Piping: One-piece, stamped-steel type with spring clips.
- d. Bare Piping in Finished Spaces: One-piece, stamped-steel type.
- e. Bare Piping in Unfinished Service Spaces or Equipment Rooms: Split-plate, stamped-steel type with concealed hinge and set screw.

2. Existing Piping: Use the following:

- a. Chrome-Plated Piping or Piping in High Humidity Areas: Split-casting, cast-brass type with chrome-plated finish.
- b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
- c. Bare Piping: Split-plate, stamped-steel type with set screw or spring clips.

2.10 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.11 EPOXY BONDING COMPOUND

- A. Two-component system suitable for bonding wet or dry concrete to each other and to other materials.
- B. Manufacturers:
 - 1. Euco 452 #450; Euclid Chemical Co.
 - 2. Epobond; L & M Construction Chemicals.
 - 3. Sikadur 87; Sika Corp.

2.12 LEAK DETECTOR SOLUTION

- A. Commercial leak detector solution for pipe system testing.
- B. Manufacturers:
 - 1. American Gas and Chemicals Inc.; Leak Tec.
 - 2. Cole-Parmer Inst. Co.; Leak Detector.
 - 3. Guy Speaker Co. Inc.; Squirt 'n Bubbles.

2.13 PIPE ROOF PENETRATION ENCLOSURES

- A. Manufacturers:
 - 1. Pate Company (The); pca Series.
 - 2. Portals Plus, Inc.

3. Thybar Corporation; Thycurb.
- B. Prefabricated roof curb with:
1. Minimum 18 gage welded galvanized steel construction.
 2. Integral base plate.
 3. Factory installed insect and decay resistant wood nailer.
 4. Factory installed 1-1/2 inch thick, 3 pounds per cubic foot density rigid insulation.
 5. EPDM compression molded rubber cap for single or multiple pipes as required.
 6. Stainless steel draw-band clamps.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Refer to piping application schedules on the Drawings.
- B. Install piping according to the following requirements and Division 21, 22, and 23 Sections specifying piping systems, and in accordance with manufacturer's instructions.
- C. 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. The Drawings shall be followed as closely as elements of construction will permit.
- D. During the progress of construction, protect open ends of pipe, fittings, and valves to prevent the admission of foreign matter. Place plugs or flanges in the ends of all installed work whenever work stops. Plugs shall be commercially manufactured products.
- E. Prior to and during laying of pipe, maintain excavations dry and clear of water and extraneous materials. Provide minimum 4 inches of clearance in all directions for pipe passing under or through building grade beams.
- F. Weld-o-lets and thread-o-lets can be used for annular flow measuring devices, temperature control components, and thermal wells in steel pipe. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.
- G. Brazolets can be used for annular flow measuring devices, temperature control components, and thermal wells in copper tube. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.
- H. Clean and lubricate elastomer joints prior to assembly.
- I. Clean damaged galvanized surfaces and touch-up with a zinc rich coating.
- J. Install piping to conserve building space and not interfere with use of space.
- K. Group piping whenever practical at common elevations.
- L. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

1. Install piping to allow for expansion and contraction at locations where piping crosses building or structure expansion joints.
- M. Slope piping and arrange systems to drain at low points.
- N. Slope horizontal piping containing non-condensable gases 1 inch per 100 feet, upward in the direction of the flow.
- O. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- P. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- Q. In concealed locations where piping, other than black steel, cast-iron, or galvanized steel, is installed through holes or notches in studs, joists, rafters or similar members less than 1-1/2 inches from the nearest edge of the member, the pipe shall be protected by shield plates. Protective shield plates shall be a minimum of 1/16 inch thick steel, shall cover the area of the pipe where the member is notched or bored, and shall extend a minimum of 2 inches above sole plates and below top plates.
- R. Do not penetrate building structural members unless specifically indicated on drawings.
- S. Install piping above accessible ceilings to allow sufficient space for ceiling panel and light fixture removal.
- T. Install valves with stems upright or horizontal, not inverted.
- U. Provide clearance for installation of insulation and access to valves and fittings.
- V. Install piping to permit valve and equipment servicing. Do not install piping below valves and/or terminal equipment. Do not install piping above electrical equipment.
- W. Install piping at indicated slopes. Provide drain valves with hose end connections and caps at all piping low points, where piping is trapped and at all equipment.
- X. Install piping free of sags and bends.
- Y. Install fittings for changes in direction and branch connections.
- Z. Unless otherwise indicated or specified, install branch connections to mains using tee fittings in main pipe:
 1. Branch connected to bottom of main pipe for HVAC systems. Side connection is acceptable. Connection above centerline of main is unacceptable. For up-feed risers, connect branch to top of main pipe.
 2. Branch connected to top of main for steam and condensate, plumbing systems, compressible gasses, and vacuum.
- AA. Install piping to allow application of insulation.
- BB. Select system components with pressure rating equal to or greater than system operating pressure.

- CC. After completion, fill, clean, and treat systems. Refer to Division 23 Sections "Hydronic Piping," "Piping Systems Flushing and Chemical Cleaning," and "HVAC Water Treatment."
- DD. Install escutcheons for penetrations of walls below ceiling, and ceilings.
- EE. Sleeves are not required for core-drilled holes in poured concrete walls.
- FF. Permanent sleeves are not required for holes formed by removable PE sleeves in poured concrete walls.
- GG. Install sleeves for pipes passing through footings and foundation walls, masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces of walls.
 - a. Exception: Extend sleeves installed in floors 2 inches above finished floor level.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Schedule 40 Black Steel Sleeves: For pipes smaller than NPS 12 penetrating interior walls.
 - b. 0.375 Inch Wall Black Steel Sleeves: For pipes NPS 12 and larger penetrating interior walls.
 - c. Schedule 40 Galvanized Steel Sleeves: For pipes smaller than NPS 12 penetrating floors, and roof slabs.
 - d. 0.375 Inch Wall Galvanized Steel Sleeves: For pipes NPS 12 and larger penetrating floors and roof slabs.
 - e. For pipes penetrating floors with membrane water proofing provide cast iron sleeve with clamping flanges. Secure/seal membrane to sleeves with clamping flanges.
 - 4. Seal sleeves in concrete floors roof slabs and masonry walls with grout.
 - 5. Seal sleeves in plaster/gypsum-board partitions with plaster or dry wall compound and caulk with non-hardening silicone sealant to provide airtight installation.
 - 6. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- HH. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and modular mechanical seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing modular mechanical seals.
 - 1. Install Schedule 40 galvanized steel pipe for sleeves smaller than 12 inches in diameter.
 - 2. Install 0.375 galvanized steel pipe for sleeves 12 inches and larger in diameter.
 - 3. Modular Mechanical Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble modular mechanical seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- II. Existing Underground, Exterior-Wall and Slab on Grade Pipe Penetrations: Seal core drilled pipe penetrations using modular mechanical seals. Allow for 1-inch annular clear space between pipe and cored opening for installing modular mechanical seals.

1. Modular Mechanical Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of cored hole. Assemble modular mechanical seals and install in annular space between pipe and cored opening. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- JJ. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.
1. Seal openings around pipes in sleeves through walls, floors and ceilings, and where floors, fire rated walls and smoke barriers are penetrated. Firestop materials shall be UL listed and shall have a fire rating equal to or greater than the penetrated barrier.
 2. Refer to Division 07 Specification Sections for materials and UL Classified firestop systems.
- KK. Pipe Roof Penetration Enclosures:
1. Coordinate delivery of roof penetration enclosures to jobsite.
 2. Locate and set curbs on roof.
 3. Framing, flashing, and attachment to roof structure are specified under Division 07.
 4. Attach cap to curbs, cut pipe boots to fit pipe, and clamp boots to pipe or conduit.
- LL. Verify final equipment locations for roughing-in.
- MM. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 21, 22, and 23 Sections specifying piping systems.
- B. Cut piping square.
- C. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- D. Remove scale, slag, dirt, oil, and debris from inside and outside of pipe and fittings before assembly.
- E. Clean damaged galvanized surfaces and touch-up with a zinc rich coating.
- F. Use standard long sweep pipe fittings for changes in direction. No mitered joints or field fabricated pipe bends will be permitted. Short radius elbows may be used where specified or specifically authorized by the Architect.
- G. Make tee connections with screwed tee fittings, soldered fittings or specified welded connections. Make welded branch connections with either welding tees or forged branch outlet fittings in accordance with ASTM A234, ANSI B16.9 and ANSI B16.11. For forged branch outlets, furnish forged fittings flared for improved flow where attached to the run, reinforced against external strains and to full pipe-bursting strength requirements. "Fishmouth" connections are not acceptable.
- H. Use eccentric reducers for drainage and venting of pipe lines; bushings are not permitted.

- I. Provide pipe openings using fittings for all systems control devices, thermometers, gauges, etc. Drilling and tapping of pipe wall for connections is prohibited.
- J. Provide temperature sensing device thermal wells and similar piping specialty connections.
- K. Provide instrument connections except thermal wells with specified isolating valves at point of connection to system.
- L. Locate instrument connections in accordance with manufacturer's instructions for accurate read-out of function sensed. Locate instrument connections for easy reading and service of devices.
- M. 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."
- N. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- O. 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.
- P. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
 - 1. Weld-o-lets and thread-o-lets can be used for annular flow measuring devices, temperature control components, and thermal wells. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.
- Q. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on gaskets and bolt threads.
 - 1. Assemble flanged joints with fresh-stock gasket and hex head nuts, bolts or studs. Make clearance between flange faces such that the connections can be gasketed and bolted tight without strain on the piping system. Align flange faces parallel and bores concentric; center gaskets on the flange faces without projection into the bore.
 - 2. Lubricate bolts before assembly to insure uniform bolt stressing. Draw up and tighten bolts in staggered sequence to prevent unequal gasket compression and deformation of the flanges. Do not mate a flange with a raised face to a companion flange with a flat face; machine the raised face down to a smooth matching surface and use a full face gasket. After the piping system has been tested and is in service at its maximum temperature, check bolting torque to provide required gasket stress.
- R. Grooved Joints: Assemble joints with grooved-end-pipe or grooved-end-tube coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Galvanized piping shall be cut grooved to prevent damage to galvanizing on internal pipe surfaces. The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's

field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. The manufacturer's representative shall periodically visit the jobsite and review installation. Contractor shall remove and replace any joints deemed improperly installed.

- S. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.
- T. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials. Refer to Application Schedules on the Drawings.
- U. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 3. PVC Nonpressure Piping: Join according to ASTM D 2855.
 - 4. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- V. Remake joints which fail pressure tests with new materials including pipe, fittings, gaskets and/or a filler.

3.3 ACCESS DOORS

- A. Provide access doors for installation by architectural trades. Provide access doors in the walls, as required to make all valves, controls, coils, motors, air vents, filters, electrical boxes and other equipment installed by the Contractor accessible. Minimum size 12 inches x 12 inches. Provide access doors in the ceiling, for accessibility as mentioned above, 24 inches x 24 inches minimum size. Areas with accessible ceilings (ceilings where lay-in panels are not fastened in place and can be individually removed without removal of adjacent tiles) will not require access doors. Refer to Division 08 Section "Access Doors and Frames" for manufacturers and model numbers and additional information.
- B. When access doors are in fire resistant walls or ceilings, they shall bear the Underwriters' Laboratories, Inc., Label, with time design rating equal to or greater than the wall or ceiling unless they were a part of the tested assembly.

3.4 EQUIPMENT CONNECTIONS

- A. Make connections to equipment, fixtures, and other items included in the work in accordance with the submittals and rough-in measurements furnished by the manufacturers of the particular equipment furnished.
 - 1. Any and all additional connections not shown on the drawings but shown on the equipment manufacturer's submittal or required for the successful operation of the equipment shall be installed as part of this Contract at no additional charge to the Owner.

- B. All piping connections to pumps, coils, and other equipment shall be installed without strain at the pipe connection of this equipment. When directed, remove the bolts in flanged connections or disconnect piping to demonstrate that piping has been so connected.

3.5 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, where indicated on Drawings, at final connection to each piece of equipment and at all control valves.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, where indicated on Drawings, at final connection to each piece of equipment and at all control valves.

3.6 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated. Housekeeping pad locations and sizes shall be coordinated by mechanical contractor prior to the placement of concrete slabs.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.
- E. For suspended equipment, furnish and install all inserts, rods, structural steel frames, brackets and platforms required. Obtain approval of Architect for same including loads, locations and methods of attachment.
- F. Equipment Rigging Over Roof Areas: Protect building structure against damage during equipment rigging. Make provisions to distribute load of equipment to main roof structure, and to prevent damage to roof decking, roofing, or purlins.
- G. The Contract Documents indicate items to be purchased and installed. The items are noted by a manufacturer's name, catalog number and/or brief description. The catalog number may not designate all the accessory parts for a particular application. Arrange with the manufacturer for the purchase of all items required for a complete installation.

3.7 PAINTING

- A. Painting of mechanical systems, equipment, and components is specified in Division 09.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.8 CONCRETE BASES

- A. Concrete housekeeping pads for floor mounted mechanical equipment shall be provided by Architectural Trades.
- B. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.
 - 1. Construct concrete bases as shown on Drawings or specified, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section.

3.9 EPOXY BONDING TO EXISTING MATERIALS

- A. Use epoxy bonding compound to set sleeves or pipes in existing concrete to bond new concrete and/or grout to existing materials or to bond dissimilar materials.
- B. The compound, when applied in accordance with the manufacturer's instructions, shall be capable of initial curing within 48 hours at temperatures as low as 40 deg F and shall be capable of bonding any combination of the following properly prepared materials: Wet or dry, cured or uncured concrete or mortar; vitrified clay; cast iron and carbon steel.

3.10 JACKING OF PIPE

- A. Do not jack pipe in place except upon prior approval of proposed materials and complete details of methods.

3.11 GROUTING

- A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.

- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

3.12 CUTTING, CORING AND PATCHING

- A. Refer to Division 01 Specification Sections for requirements for cutting, coring, patching and refinishing work necessary for the installation of mechanical work.
- B. All cutting, coring, patching and repair work shall be performed by the Contractor through approved, qualified subcontractors. Contractor shall include full cost of same in bid.

3.13 FLASHING

- A. Provide all flashing required for mechanical work. Refer to Division 07 Specification Sections.

3.14 LUBRICATION

- A. Provide all lubrication for the operation of the equipment until acceptance by the Owner. Contractor is responsible for all damage to bearings up to the date of acceptance of the equipment. Protect all bearings and shafts during installation. Thoroughly grease steel shafts to prevent corrosion. Provide covers as required for proper protection of all motors and other equipment during construction.

3.15 FILTERS

- A. Provide and maintain filters in air handling systems throughout the construction period and prior to final acceptance of the building. Do not run air handling equipment, including fan coil units, without all prefilters and final filters as specified.
- B. Immediately prior to final building acceptance by the Owner, Contractor shall:
 - 1. Replace all disposable type air filters with new units.

3.16 CLEANING

- A. Each Mechanical Trade shall be responsible for removing all debris daily as required to maintain the work area in a neat, orderly condition.
- B. After equipment, steam, condensate and HVAC water piping systems have been completed and tested, each entire system shall be cleaned and flushed. Refer to Division 23 Section "Piping Systems Flushing and Chemical Cleaning" for requirements. Provide temporary bypass piping and fittings, temporary valves and strainers, temporary water make-up piping with approved means of backflow prevention, and temporary pumps as needed to perform specified flushing and cleaning requirements.

- C. Prior to connection of new HVAC piping to existing HVAC piping systems, all new piping shall be subject to initial flushing, cleaning and final flushing. Refer to Division 23 Section "Piping Systems Flushing and Chemical Cleaning" for requirements. Provide temporary bypass piping and fittings, temporary valves and strainers, temporary water make-up piping with approved means of backflow prevention, and temporary pumps as needed to perform specified flushing and cleaning requirements.
- D. Flushing, cleaning, and disinfection of domestic water piping is specified in Division 22 Section "Domestic Water Piping."
- E. Exterior surfaces of all piping, ductwork and equipment shall be wiped down to remove excess dirt and debris prior to concealment by Architectural Trades work.
- F. Upon completion of work in each respective area, clean and protect work. Just prior to final acceptance, perform additional cleaning as necessary to provide clean equipment and areas to the Owner.

END OF SECTION 20 0510

PARTNERS 21-130
BASIC MECHANICAL MATERIALS AND METHODS
20 0510 - 20

SECTION 20 0513 - MOTORS

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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.
- B. Related Sections include the following:
 1. Division 20 Section "Mechanical General Requirements."
 2. Division 20 Section "Mechanical Vibration Controls" for mounting motors and vibration isolation devices.
 3. Division 20 Section "Variable Frequency Controllers".
 4. Division 21, 22, and 23 Sections for application of motors and reference to specific motor requirements for motor-driven equipment.

1.2 SUMMARY

- A. This Section includes basic requirements for factory-installed motors.

1.3 DEFINITIONS

- A. ABMA: American Bearing Manufacturers Association. (Formerly AFBMA: Anti-Friction Bearing Manufacturers Association.)

- B. Factory-Installed Motor: A motor installed by motorized-equipment manufacturer as a component of equipment.
- C. Packaged Self Contained Equipment: Equipment which includes component mechanical and electrical equipment mounted on common bases, skids or frames or in common enclosures with internal control and power wiring factory installed and ready to accept a single electrical service connection. Provide the equipment complete with enclosed controllers, main disconnect switches, control transformers, control devices, wiring and accessories as required.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: A Nationally Recognized Testing Laboratory (NRTL), acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
 - 1. Dayton.
 - 2. Toshiba Intl.
 - 3. Baldor Electric/Reliance.
 - 4. Rockwell Automation/Allen-Bradley.
 - 5. Nidec Motor Corporation; U.S. Electrical Motors.
 - 6. Regal Beloit/GE Commercial Motors.
 - 7. Regal Beloit/Leeson.
 - 8. Regal Beloit/Marathon.
 - 9. Siemens.

2.2 MOTOR REQUIREMENTS

- A. Motor requirements apply to factory-installed motors except as follows:
 - 1. Different ratings, performance, or characteristics for a motor are specified in another Section.

2. Manufacturer for a factory-installed motor requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.
3. Submersible motors integral to pumps and excluded from NEMA and EISA standards.

- B. Electrical Power Supply Characteristics: Coordinate electrical system requirements with Division 26.
- C. Electrical Power System Characteristics: As scheduled on the Drawings.
- D. Electrical Connection: Conduit connection boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide screwed conduit connection in end frame.

2.3 MOTOR CHARACTERISTICS

- A. Motors 1/2 HP and Larger: Three phase, unless otherwise indicated.
- B. Motors Smaller Than 1/2 HP: Single phase, unless otherwise indicated.
- C. Frequency Rating: 60 Hz.
- D. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.
- E. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.
- F. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.
- G. 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.
- H. Brake Horsepower Input: Shall not exceed 90 percent of the rated motor horsepower.
- I. Enclosure: Open dripproof (ODP) for motors installed indoors and out of the airstream. Totally-enclosed fan-cooled (TEFC) for motors installed outdoors or within the airstream.

2.4 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Fire pump motors, C-face motors, JP and JM frame motors, and motors over 200 horsepower shall be energy efficient motors. Efficiency of the motor shall be determined based on the NEMA MG1. The minimum efficiencies, nominal efficiencies and shall meet or exceed Table 12-11.

1800 RPM
OPEN DRIP-PROOF MOTORS
4 POLE

NOMINAL MINIMUM

1800 RPM
ENCLOSED MOTORS
4 POLE

NOMINAL MINIMUM

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MOTORS
20 0513 - 4

<u>HP</u>	<u>EFF</u>	<u>EFF</u>	<u>EFF</u>	<u>EFF</u>
1	82.5	81.5	82.5	81.5
1.5	84	82.5	84	82.5
2	84	82.5	84	82.5
3	86.5	85.5	87.5	86.5
5	87.5	86.5	87.5	86.5
7.5	88.5	87.5	89.5	88.5
10	89.5	88.5	89.5	88.5
15	91	90.2	91	90.2
20	91	90.2	91	90.2
25	91.7	91	92.4	91.7
30	92.4	91.7	92.4	91.7
40	93	92.4	93	92.4
50	93	92.4	93	93
60	93.6	93	93.6	93
75	94.1	93.6	94.1	93.6
100	94.1	93.6	94.5	94.1
125	94.5	94.1	94.5	94.1
150	95	94.5	95	94.5
200	95	94.5	95	94.5

1200 RPM
OPEN DRIP-PROOF MOTORS
6 POLE

3600 RPM
OPEN DRIP-PROOF MOTORS
2 POLE

	NOMINAL	MINIMUM	NOMINAL	MINIMUM
<u>HP</u>	<u>EFF</u>	<u>EFF</u>	<u>EFF</u>	<u>EFF</u>
1	80	78.5	--	--
1.5	84	82.5	82.5	81.5
2	85.5	84	84	82.5
3	86.5	85.5	84	82.5
5	87.5	86.5	85.5	84
7.5	88.5	87.5	85.5	86.5
10	90.2	89.5	88.5	87.5
15	90.2	89.5	89.5	88.5
20	91	90.2	90.2	89.5
25	91.7	91	91	90.2
30	92.4	91.7	91	90.2
40	93	92.4	91.7	91
50	93	93	92.4	91.7
60	93.6	93	93	92.4
75	93.6	93	93	92.4
100	94.1	93.6	93	92.4
125	94.1	93.6	93.6	93
150	94.5	94.1	93.6	93
200	94.5	94.1	94.5	94.1

- C. Efficiency: Motors 1 horsepower to 200 horsepower shall be premium efficient motors meeting requirements of NEMA Premium Efficiency Motor Program. Efficiency of the motor shall be determined based on the NEMA MG1. The nominal efficiencies shall meet or exceed Table 12-12.

Nominal Efficiencies For "NEMA Premium™" Induction Motors
Rated 600 Volts or Less (Random Wound)

HP	Open Drip-Proof			Totally Enclosed Fan-Cooled		
	<u>6-pole</u>	<u>4-pole</u>	<u>2-pole</u>	<u>6-pole</u>	<u>4-pole</u>	<u>2-pole</u>
1	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2	87.5	86.5	85.5	88.5	86.5	85.5
3	88.5	89.5	85.5	89.5	89.5	86.5
5	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10	91.7	91.7	89.5	91.0	91.7	90.2
15	91.7	93.0	90.2	91.7	92.4	91.0
20	92.4	93.0	91.0	91.7	93.0	91.0
25	93.0	93.6	91.7	93.0	93.6	91.7
30	93.6	94.1	91.7	93.0	93.6	91.7
40	94.1	94.1	92.4	94.1	94.1	92.4
50	94.1	94.5	93.0	94.1	94.5	93.0
60	94.5	95.0	93.6	94.5	95.0	93.6
75	94.5	95.0	93.6	94.5	95.4	93.6
100	95.0	95.4	93.6	95.0	95.4	94.1
125	95.0	95.4	94.1	95.0	95.4	95.0
150	95.4	95.8	94.1	95.8	95.8	95.0
200	95.4	95.8	95.0	95.8	96.2	95.4

Nominal Efficiencies For "NEMA Premium™" Induction Motors
Rated Medium Volts for 5kV or Less (Form Wound)

HP	Open Drip-Proof			Totally Enclosed Fan-Cooled		
	<u>6-pole</u>	<u>4-pole</u>	<u>2-pole</u>	<u>6-pole</u>	<u>4-pole</u>	<u>2-pole</u>
250	95.0	95.0	94.5	95.0	95.0	95.0
300	95.0	95.0	94.5	95.0	95.0	95.0
350	95.0	95.0	94.5	95.0	95.0	95.0
400	95.0	95.0	94.5	95.0	95.0	95.0
450	95.0	95.0	94.5	95.0	95.0	95.0
500	95.0	95.0	94.5	95.0	95.0	95.0

- D. Stator: Copper windings, unless otherwise indicated.
1. Multispeed motors shall have separate winding for each speed.
- E. Rotor: Squirrel cage, unless otherwise indicated.

- F. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA 9, L-10 life of 120,000 hours. Calculate bearing load with NEMA minimum V- belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- G. Temperature Rise: Match insulation rating, unless otherwise indicated.
- H. Insulation: Class F, unless otherwise indicated.
- I. Code Letter Designation:
 - 1. Motors 10 HP and Larger: NEMA starting Code (KVA Code) F or G.
 - 2. Motors Smaller Than 10 HP: Manufacturer's standard starting characteristic.
 - 3. Fire Pump Motors: NEMA starting Code (KVA Code) B.
- J. Enclosure: Cast iron for motors 7.5 hp and larger; rolled steel for motors smaller than 7.5 hp.
 - 1. Finish: Gray enamel.
- K. Sound Level: Not to exceed NEMA MG-1 12.54.

2.5 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
- B. Shaft Grounding: Provide a means to protect motor from common mode currents.
 - 1. Required for:
 - a. Motors used with variable frequency controllers.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Electro Static Technology, Inc.; Aegis SGR Conductive Microfiber.
- C. Source Quality Control: Perform the following tests on each motor according to NEMA MG 1:
 - 1. Measure winding resistance.
 - 2. Read no-load current and speed at rated voltage and frequency.
 - 3. Measure locked rotor current at rated frequency.
 - 4. Perform high-potential test.

2.6 ELECTRONICALLY COMMUTATED MOTOR (ECM)

- A. Furnish for equipment where specified or scheduled with ECM.
 - 1. Synchronous, constant torque, ECM with permanent magnet rotor. Rotor magnets to be time-stable, nontoxic ceramic magnets (Sr-Fe).
 - 2. Driven by a frequency converter with an integrated power factor correction filter. Conventional induction motors will not be acceptable.
 - 3. Each motor with an integrated variable-frequency drive, tested as one unit by manufacturer.
 - 4. Motor speed adjustable over full range from 0 rpm to maximum scheduled speed.
 - 5. Variable motor speed to be controlled by a 0- to 10 V-dc or 4- to 20-mA input.
 - 6. Integrated motor protection verified by UL to protect equipment against over-/undervoltage, overtemperature of motor, electronics, or both, overcurrent, locked rotor, and dry run (no-load condition).

2.7 SINGLE-PHASE MOTORS

- A. Type: One of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split-phase start, capacitor run.
 - 3. Capacitor start, capacitor run.
- B. Shaded-Pole Motors: For motors 1/20 hp and smaller only.
- C. 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.
- D. Bearings: Ball type for belt-connected motors and other motors with high radial forces on motor shaft; sealed, prelubricated-sleeve type for other single-phase motors.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

- A. All three phase motors 1/2 HP and above shall be tested by the Testing Agency.
- B. Prepare for acceptance tests as follows:
 - 1. Check motor nameplates for horsepower, speed, phase and voltage.
 - 2. Check coupling alignment and shaft end play.
 - 3. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
 - 4. Test interlocks and control features for proper operation.
 - 5. Verify that current in each phase is within nameplate rating.
- C. Testing: Perform the following field quality-control testing:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.15.1. Certify compliance with test parameters.
2. Jog motor as required to verify proper phase and shaft rotation. Immediately after start-up, check bearing temperature and smooth operation. Take current reading at full load using a clamp-on ammeter. If ammeter reading is over the rated full load current, determine reason for discrepancy and take necessary corrective actions. Record all readings, motor nameplate data and overload heater data.
3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.2 ADJUSTING

- A. Align motors, bases, shafts, pulleys and belts. Tension belts according to manufacturer's written instructions.

3.3 CLEANING

- A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean motors, on completion of installation, according to manufacturer's written instructions.

END OF SECTION 20 0513

SECTION 20 0516 - PIPE FLEXIBLE CONNECTORS, EXPANSION FITTINGS AND LOOPS

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 23 Section "Refrigerant Piping."

1.2 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.3 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping system fluids, materials, working pressures, and temperatures.
- B. Capability: Products shall absorb 150 percent of maximum axial movement between anchors.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of pipe flexible connector indicated.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of pipe expansion joint, signed by product manufacturer.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pipe expansion joints to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
- B. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components – Lead Content for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FLEXIBLE CONNECTORS

- A. Rubber Flexible Connectors/Expansion Joints: ASTM F 1123, fabric-reinforced rubber with external control rods or cables, and complying with FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
 - 1. Manufacturers:
 - a. Flex-Weld, Inc./Keflex.
 - b. Mason Industries, Inc.; Mercer Rubber Co.
 - c. Metraflex, Inc.
 - d. Senior Flexonics, Inc.; Pathway Division.
 - e. Twin City Hose, Inc.
 - f. Vibration Mountings & Controls, Inc.
 - 2. Arch Type: Single or multiple arches.
 - 3. Spherical Type: Single or multiple spheres.

- a. Working Pressure Ratings for NPS 1-1/2 to NPS 4: 225 psig at 170 deg F.
 - b. Working Pressure Ratings for NPS 5 and NPS 6: 225 psig at 170 deg F.
 - 4. Material: EPDM.
 - 5. End Connections: Full-faced, integral, steel flanges with steel retaining rings.
- B. Grooved Mechanical Flexible/Expansion Joint:
- 1. Manufacturers:
 - a. Anvil International, Inc.; Fig. 7420 Expansion Joint.
 - b. Victaulic Company; Model 77 Flexible Coupling, W77 AGS Flexible Coupling, and 177N QuickVic Installation-Ready Flexible Coupling.
 - 2. Description: Comprised of multiple flexible style couplings, and precision machined grooved end pipe nipples. Assembly uses factory installed ties to custom preset expansion joint in the expanded, compressed, or intermediate position.
 - 3. Gaskets: Synthetic rubber gasket of central cavity pressure-responsive design suitable for temperatures from minus 30 deg F to 230 deg F.
 - 4. Couplings: Ductile-iron housing with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
 - a. Flexible Type: To provide a flexible pipe joint which allows for vibration isolation, expansion, contraction, and deflection. Quantity and arrangement as recommended by manufacturer.

PART 3 - EXECUTION

3.1 FLEXIBLE CONNECTOR APPLICATIONS

- A. Use rubber flexible pipe connectors at the inlet and outlet water connections of base mounted pumps, chillers, and cooling towers, unless otherwise indicated.
 - 1. Rubber Flexible Connectors for Pipe Sized NPS 2 and Smaller: Twin-sphere with females union end connections.
 - 2. Rubber Flexible Connectors for Pipe Sized NPS 2-1/2 and Larger: Twin-sphere with floating flange end connections.
- B. Flexible Pipe Connectors for Refrigerant Pipe: Refer to Division 23 Section "Refrigerant Piping."

END OF SECTION 20 0516

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 21 Section "Fire-Suppression Piping" for listed or approved pressure gages.
 - 4. Division 21 fire pump sections for fire-pump flowmeter systems.
 - 5. Division 22 Section "Domestic Water Piping" for domestic and fire-protection water service meters inside the building.
 - 6. Division 23 Section "Fuel Gas Piping" for gas utility meters.

1.2 DEFINITIONS

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. FPR: Fiberglass reinforced plastic.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated; include performance curves.

1.4 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Schedule for the following indicating manufacturer's number, scale range, and location for each:
 - 1. Thermometers.
 - 2. Gages.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
- B. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components – Lead Content for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

- A. Manufacturers:
 - 1. AMETEK, Inc.; U.S. Gauge Div.
 - 2. Miljoco Corporation.
 - 3. REOTEMP Instrument Corporation.
 - 4. Terice, H. O. Co.
 - 5. Weiss Instruments, Inc.
 - 6. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- B. Case: Die-cast aluminum or Chrome-plated brass, 9 inches long.
- C. Tube: Red, blue, or green reading, organic-liquid filled, with magnifying lens.

- D. Tube Background: Satin-faced, nonreflective aluminum with permanent scale markings.
- E. Window: Glass or plastic.
- F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.
- G. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.
- H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.3 THERMOWELLS

- A. Manufacturers: Same as manufacturer of thermometer being used.
- B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer. Brass for compatible services less than 353 degrees F (178 degrees C); ANSI 18-8 stainless steel for all others to suit service. Furnish extension neck to accommodate insulation where applicable.

2.4 PRESSURE GAGES

- A. Manufacturers:
 - 1. AMETEK, Inc.; U.S. Gauge Div.
 - 2. Cambridge.
 - 3. Dwyer Instruments, Inc.
 - 4. Marsh Bellofram.
 - 5. Miljoco Corporation.
 - 6. Trerice, H. O. Co.
 - 7. Weiss Instruments, Inc.
 - 8. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.
 - 1. Case: Stainless steel, aluminum, or FRP, 6-inch diameter.
 - 2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
 - 3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
 - 4. Movement: Mechanical, with link to pressure element and connection to pointer.
 - 5. Dial: Satin-faced, nonreflective aluminum with permanent scale markings.
 - 6. Pointer: Red or other dark-color metal.
 - 7. Window: Glass or plastic.
 - 8. Ring: Stainless steel or chrome plated metal.
 - 9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
 - 10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
 - 11. Water: 0-100 PSIG (1 psi divisions to 50 psi; 5 psi divisions above 50 psi), liquid filled.

12. Range for Fluids under Pressure: 1-1/2 times expected working pressure. If not a standard scale, select next largest scale.

C. Pressure-Gage Fittings:

1. Valves: NPS 1/4 brass ball type.
2. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
3. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.5 TEST PLUGS

A. Manufacturers:

1. Peterson Equipment Co., Inc.
2. Miljoco Corporation.

- B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.

- C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F for cold services, and 500 psig at 275 deg F for hot services.

- D. Core Inserts: One or two self-sealing rubber valves.

1. Insert material for air, water, oil, or gas service at 20 to 200 deg F shall be Neoprene.
2. Insert material for air or water service at minus 30 to plus 275 deg F shall be Nordel.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

- A. Install liquid-in-glass thermometers in the following locations:

1. Inlet and outlet of each hydronic zone.
2. Inlet and outlet of each hydronic boiler and chiller.
3. Inlet and outlet of each hydronic coil in air-handling units and built-up central systems.

- B. Provide the following temperature ranges for thermometers:

1. Heating Hot Water: 30 to 240 deg F, with 2-degree scale divisions.
2. Chilled Water: 0 to 100 deg F, with 2-degree scale divisions.

3.2 GAGE APPLICATIONS

- A. Install dry-case-type pressure gages on inlet and outlet of each pressure-reducing valve.

- B. Install liquid-filled-case-type pressure gages at chilled- and condenser-water inlets and outlets of chillers.
- C. Install liquid-filled-case-type pressure gages at suction and discharge of each pump.

3.3 INSTALLATIONS

- A. Install direct-mounting thermometers and adjust vertical and tilted positions.
- B. Install thermowells with socket extending to center of pipe and in vertical position in piping tees where thermometers are indicated.
- C. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.
- D. Install ball valve and snubber fitting in piping for each pressure gage for fluids (except steam).
- E. Install test plugs in tees in piping.
- F. Install flow indicators, in accessible positions for easy viewing, in piping systems.

3.4 CONNECTIONS

- A. Install gages adjacent to machines and equipment to allow service and maintenance for gages, machines, and equipment.

3.5 ADJUSTING

- A. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION 20 0519

PARTNERS 21-130
METERS AND GAGES
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SECTION 20 0529 - HANGERS AND SUPPORTS

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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.
- B. Related Sections include the following:
 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 2. Division 20 Section "Mechanical General Requirements."
 3. Division 20 Section "Basic Mechanical Materials and Methods."
 4. Division 20 Section "Mechanical Vibration Controls" for vibration isolation devices.
 5. Division 20 Section "Pipe Flexible Connectors, Expansion Fittings and Loops" for pipe guides and anchors.
 6. Division 21 Section "Fire-Suppression System" for pipe hangers for fire-protection piping.
 7. Division 23 Section(s) "Metal Ducts for duct hangers and support.

1.2 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry Inc.

1.3 PERFORMANCE REQUIREMENTS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.

1.5 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Equipment supports.

1.6 QUALITY ASSURANCE

- A. MSS Standards: Pipe hangers, supports, and accessories shall comply with the following:
 - 1. MSS SP-58, Pipe Hangers and Supports – Materials, Design and Manufacture, Selection, Application, and Installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 HANGER ROD MATERIAL

- A. Threaded, hot rolled, steel rod conforming to ASTM A 36 or A575.
 - 1. Rod continuously threaded.
 - 2. Use of rod couplings is prohibited.

2.3 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article, and schedules and details on the Drawings for where to use specific hanger and support types.
 - 1. Hangers and Supports for Fire Protection Piping: UL listed or FMG approved.
- B. Manufacturers:
 - 1. Anvil; ASC Engineered Solutions.
 - 2. B-Line by Eaton.
 - 3. Carpenter & Paterson, Inc.
 - 4. Hilti USA.
 - 5. nVent Electric plc; CADDY.
 - 6. PHD Manufacturing, Inc.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.4 METAL INSULATION SHIELDS

- A. Manufacturers:
 - 1. Anvil; ASC Engineered Solutions.
 - 2. B-Line by Eaton.
 - 3. Carpenter & Paterson, Inc.
 - 4. nVent Electric plc; CADDY.
 - 5. PHD Manufacturing, Inc.
- B. Description: MSS SP-58, Type 40, protective shields. Shields shall span an arc of 180 degrees.
- C. Shield Dimensions for Pipe: Not less than the following:
 - 1. NPS 1/4 to NPS 2: 12 inches long and 0.048 inch thick.

2.5 PIPE COVERING PROTECTION SADDLES

A. Manufacturers:

1. Anvil; ASC Engineered Solutions.
2. B-Line by Eaton.
3. Carpenter & Paterson, Inc.
4. nVent Electric plc; CADDY.
5. PHD Manufacturing, Inc.

B. Description: MSS SP-58, Type 39A and Type 39B, for suspension of insulated hot pipe where heat losses are to be kept to a minimum.

1. Saddles shall match insulation thickness.
2. Saddle length: 12 inches.
3. Furnish with center rib for pipe sized NPS 12 and larger.

2.6 THERMAL-HANGER SHIELDS

A. Manufacturers:

1. American Mechanical Insulation Sales Inc. (AMIS).
2. B-Line by Eaton.
3. nVent Electric plc; CADDY.
4. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.

B. Description: Manufactured assembly consisting of insulation insert encased in 360 degree sheet metal shield.

1. Minimum Compressive Strength of Insert Material:
 - a. 100-psig- for sizes smaller than NPS 6.
 - b. 600-psig- for sizes NPS 6 and larger.

C. Insulation-Insert Material for Cold Piping: Full 360 degree, water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.

D. Insulation-Insert Material for Hot Piping: Full 360 degree, water-repellent treated, ASTM C 533, Type I calcium silicate.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

F. Include carbon steel ASTM A36 load distribution plates as required by load, pipe movement, hanger style, and hanger spacing.

G. Thermal-Hanger Shields for Flexible Foamed Elastomeric Insulated Piping:

1. Manufacturer:
 - a. B-Line by Eaton/Armacell; Armafix IPH.
 - b. Aeroflex USA, Inc.; Aerofix-U.
 - c. ZSi-Foster, Inc.; Cush-A-Therm.
2. Insulation-Insert Material for Copper Piping with Flexible Foamed Elastomeric Insulation: Use the following:
 - a. Flexible foamed elastomeric, ASTM 534, Type I-Tubular Grade 1 with PUR/PIP support inserts.

H. Thermal-Hanger Shields for Small Diameter Piping:

1. Manufacturer:
 - a. Hydra-Zorb Company; Klo-Shure Insulation Couplings.
2. Insulation-Insert Material for Small Diameter Piping with Flexible Foamed Elastomeric or Glass Fiber Insulation: Use the following:
 - a. Rigid Hytrel thermoplastic insulation coupling designed for use with pipe or tube NPS 4 and smaller, and insulation from 3/8 inch to 1-1/2 inch thick.

2.7 ROOF MOUNTED PIPING SUPPORTS

A. Low, Fixed-Height, Single-Base Stand: Assembly of base and horizontal member, and pipe support, for roof installation without membrane penetration.

1. Manufacturers:
 - a. B-Line by Eaton; Dura-Blok.
 - b. Eco Support Products.
 - c. MIFAB, Inc.; C-Port.
 - d. MIRO Industries; Conduit and Condensate Supports, and Rooftop Sleeper Support.
 - e. nVent Electric plc; CADDY.
 - f. Portable Pipe Hangers.
2. Base: Plastic, stainless steel, or recycled rubber.
3. Horizontal Member: Cadmium-plated-steel or galvanized-steel strut designed for use with standard strut clamps and accessories.

B. Low, Adjustable-Height, Single-Base Stand: Assembly of base, horizontal member, and adjustable vertical members, and pipe support, for roof installation without membrane penetration.

1. Manufacturers:
 - a. B-Line by Eaton; Dura-Blok.
 - b. Eco Support Products.
 - c. MIFAB, Inc.; C-Port.

- d. MIRO Industries; Conduit and Condensate Supports.
 - e. nVent Electric plc; CADDY.
 - f. Portable Pipe Hangers.
 - 2. Base: Plastic, stainless steel, or recycled rubber.
 - 3. Horizontal Member: Cadmium-plated-steel or galvanized-steel strut designed for use with standard strut clamps and accessories.
 - 4. Vertical Members: Threaded, hot rolled, steel rod conforming to ASTM A 36 or A575 with cadmium plated nuts and washers. Rod continuously threaded.
- C. Low, Fixed-Height, Single-Base Roller Stand: Assembly of base and horizontal roller, for roof installation without membrane penetration.
- 1. Manufacturers:
 - a. B-Line by Eaton; Dura-Blok.
 - b. Eco Support Products.
 - c. MIFAB, Inc.; C-Port.
 - d. MIRO Industries; Gas and Mechanical Supports.
 - e. nVent Electric plc; CADDY.
 - f. Portable Pipe Hangers.
 - 2. Base: Plastic, stainless steel, or recycled rubber.
 - 3. Horizontal Member: Cadmium-plated-steel rod and corrosion resistant roller designed for use with standard accessories.
- D. Low, Adjustable-Height, Single-Base Roller Stand: Assembly of base and horizontal roller, for roof installation without membrane penetration.
- 1. Manufacturers:
 - a. B-Line by Eaton; Dura-Blok.
 - b. Eco Support Products.
 - c. MIFAB, Inc.; C-Port.
 - d. MIRO Industries; Gas and Mechanical Supports.
 - e. nVent Electric plc; CADDY.
 - f. Portable Pipe Hangers.
 - 2. Base: Plastic, stainless steel, or recycled rubber.
 - 3. Horizontal Member: Cadmium-plated-steel rod and corrosion resistant roller designed for use with standard accessories.
 - 4. Vertical Members: Threaded, hot rolled, steel rod conforming to ASTM A 36 or A575 with cadmium plated nuts and washers. Rod continuously threaded.

2.8 ROOF MOUNTED EQUIPMENT SUPPORTS

- A. Non-Penetrating Equipment Supports: Assembly of two or more bases and horizontal members, for roof installation without membrane penetration.

1. Manufacturers:
 - a. B-Line by Eaton; Dura-Blok.
 - b. Eco Support Products.
 - c. MIFAB, Inc.; C-Port.
 - d. MIRO Industries; HD and LD Mechanical Unit Supports.
 - e. nVent Electric plc; CADDY.
 - f. Portable Pipe Hangers.
 2. Base: Plastic, stainless steel, or recycled rubber.
 3. Horizontal Member: Cadmium-plated-steel, galvanized-steel, or stainless steel strut, and planking; designed for use with standard strut clamps, all-thread rod, and accessories.
- B. Roof Rail-Type Equipment Stands: Welded 18 gage galvanized steel shell, base plate and counter flashing. Factory installed chemically treated wood nailer. Fully mitered end sections. Internal bulkhead reinforcement.
1. Roof Rail Type Supports: Coordinate installation and type with Architectural Trades. Top shall be level and extend a minimum of 10 inches above top of roof insulation.
 - a. Manufacturers:
 - 1) Pate.
 - 2) Thybar; TEMS Series.
 - 3) Roof Products and Systems.
 - 4) Greenheck.
 - 5) Creative Metals.

2.9 FASTENER SYSTEMS

- A. Post-Installed Anchors:
1. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened portland cement concrete, and tension and shear capacities appropriate for application. Exception: Do not use chemical fasteners to support hanger systems for fire protection piping.
 - a. Manufacturers:
 - 1) DeWalt Engineered by Powers.
 - 2) Hilti, Inc.
 - 3) ITW Ramset/Red Head.
 - 4) MKT Fastening, LLC.
 - b. Bonding Material: ASTM C 881, Type IV, Grade 3, 2-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
 - c. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
 - d. Washer and Nut: Zinc-coated steel.

2.10 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, 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 APPLICATIONS

- A. Refer to application schedules on the Drawings.
- B. For insulated pipe, oversize hanger elements to accommodate insulation thickness.
- C. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- D. Comply with MSS SP-58 for pipe hanger selections and applications that are not specified in piping system Sections.
- E. Use hangers and supports with galvanized, metallic coatings for outdoor applications or where exposed to outdoor conditions.
- F. Use hangers and supports with plastic coating, or galvanized metallic coatings for applications in corrosive atmospheres.
- G. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. MSS Type 8 or spring type to meet system requirements.
- J. 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. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 - 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 - 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 - 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

- K. Concrete Structure Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Anchor Devices, Concrete and Masonry: in accordance with Group I, Group II, Type 2, Class 2, Style 1 and Style 2, Group III and Group VIII or FS FF-S-325A. Furnish cast-in floor type equipment anchor devices with adjustable positions. Furnish built in anchor devices for masonry, unless otherwise approved by the Architect. Powder actuated anchoring devices shall not be used to support any mechanical systems components.
 2. Inserts, Concrete: TYPE 18 or 19. When applied to loads equivalent to piping in sizes NPS 2 and larger, and where otherwise required by imposed loads, a one foot length of 1/2 inch reinforcing rod shall be inserted and wired through wing slots. Proprietary type continuous inserts may be proposed and shall be submitted for approval.
 3. Use mechanical-expansion anchors where required in concrete construction.
 4. Use chemical fasteners where required in concrete construction.
- L. Hanger-Rod Attachments for Wood Construction: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. All Steel Ceiling Plates: UL listed and suitable for attachment to wood beams. For pipe sizes NPS 1/2 to NPS 2. Install in accordance with manufacturer's instructions to maintain listing.
 2. Threaded Side Beam Brackets: UL listed and FMG approved, suitable for attachment to wood beams. For pipe sizes NPS 2 to NPS 4. Install in accordance with manufacturer's instructions to maintain listing.
- M. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Use spring supports and sway braces TYPES 48, 49, 50, 51, 52, 53, 54, 55 or 56. For specific points:
 - a. Provide spring supports at point of support where vertical movement will occur.
 - b. For light loads and vertical movement less than 1/4 inch, TYPES 48 or 49 spring cushion supports.
 - c. For vertical movements in excess of 1/4 inch but less than 1/2 inch, TYPES 51, 52 or 53 variable spring supports shall be used, loaded to not more than 75 percent of published load rating.
 - d. For vertical movements of 1/2 inch and more, TYPES 54, 55 and 56 constant support spring hangers.
 - e. Sway braces; TYPE 50.
 - f. Variable spring hangers in accordance with referenced MSS Standards with "medium" allowable load change.
- N. Comply with MSS SP-58 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- O. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structural frame.
- B. Provide necessary piping and equipment supporting elements including: building structure attachments, supplementary steel, hanger rods, stanchions and fixtures, vertical pipe attachments, horizontal pipe attachments, anchors, guides, spring supports in accordance with the referenced codes, standards, and requirements specified. Support piping and equipment from building structure, not from roof deck, floor slab, other pipe, duct or equipment.
- C. At connections between piping systems, hangers and equipment of dissimilar metals, insulate, using dielectric insulating material, nonferrous piping against direct contact with the building steel by insulating the contact point of the hanger and pipe or the hanger and building steel. Test each point of dielectric insulation with an ohm meter to ensure proper isolation of dissimilar materials. Test shall be observed by the Owner's Representative and/or Architect.
- D. Use copper plated or plastic coated supporting element in contact with copper tubing or glass piping.
- E. File and paint cut ends and shop or field prime paint supporting element components.
- F. Secure Type 40 shields to support elements in a manner that prevents movement and damage to insulation and jacket materials.
- G. Hang piping parallel with the lines of the building, unless otherwise indicated. Route piping in an orderly manner and maintain gradient. Space piping and components so a threaded pipe fitting may be removed between adjacent pipes and so there will be not less than 1/2 inch of clear space between finished surfaces and piping. Arrange hangers on adjacent parallel service lines in line with each other.
- H. Flange loads on connected equipment shall not exceed 75 percent of maximum allowed by equipment manufacturer. Flange loads in liquid containing systems shall be checked in the presence of the Architect when piping is full of liquid. No flange load is allowed on pumps, vibration isolated equipment or flexible connectors.
- I. Spring supports, within specified limitations: Constant support type, where necessary to avoid transfer of load from support to support or onto connected equipment; otherwise, variable support type located at points subject to vertical movement.
- J. Incorporate pipe anchors into piping systems to maintain permanent pipe positions. Install alignment guides for the piping adjacent to and on each side of pipe expansion loops and expansion joints to maintain alignment. Construct anchors to secure entire circumference of the pipe.
- K. Where necessary, brace piping and supports against reaction, sway and vibration.
- L. Do not hang piping from joist pans, floor decks, roof decks, equipment, ductwork, or other piping.
- M. Install turnbuckles, swing eyes and clevises to accommodate temperature changes, pipe accessibility, and adjustment for load pitch. Rod couplings are not acceptable.

- N. Install hangers and supports for piping at intervals specified, at locations not more than 3 feet from the ends of each runout, not more than 3 feet from connections to equipment, and not over 25 percent of specified interval from each change in direction of piping and for concentrated loads such as valves, etc.
- O. Base the load rating for pipe support elements on loads imposed by insulated weight of pipe filled with water. The span deflection shall not exceed slope gradient of pipe.
- P. If structural steel, roofs, or tunnels will allow support spacing greater than that shown above, Contractor shall submit proposed support system along with structural calculations documenting the allowance of such spacing, in accordance with ANSI, B31.1, and MSS Guidelines.
- Q. Support vertical risers independently of connected horizontal piping whenever practical, with supports at the base and at intervals to accommodate system range of load with thermal conditions. Support vertical risers at each floor penetration for piping in shafts or chases. Guide for lateral stability. Fit horizontal piping connected to moving risers with two spring supports connected adjacent to riser, spaced according to required hanger spacing.
- R. For risers at temperatures of 100 deg F or less place riser clamps under fittings. Support carbon steel pipe at each operating level or floor and at not more than 15-foot intervals for pipe 2 inches and smaller, and at not more than 20 foot intervals for pipe 2-1/2 inches and larger.
- S. After the piping systems have been installed, tested and placed in satisfactory operation, firmly tighten hanger rod nut and jam nut and upset threads to prevent movement of fasteners.
- T. Attach pipe anchors and pipe alignment guides to the building structure where indicated. If not indicated, the method used is optional to the Contractor, subject to approval by the Architect. In the case of structural steel, make attachment by clamping in accordance with the American Institute of Steel Construction Specification for the Design, Fabrication and Erection of Structural Steel for Building.
- U. Attach supporting elements connected to structural steel columns to preclude vertical slippage and cascading failure.
- V. Attach pipe hangers and other supporting elements to roof purlins and trusses at panel points.
- W. Where eccentric loading beam clamps are approved and where other work is supported by similar eccentric loading support element from the same structural member, locate eccentric loading support elements to minimize structural member torsion load.
- X. Limit the location of supporting elements for piping and equipment, when supported from roof, to panel points of the bar joists.
- Y. Building structure shall not be reinforced except as approved by the Architect in writing.
- Z. Support piping and equipment from concrete building frame, not from roof or floor slabs unless otherwise indicated.
- AA. Use cast-in-place inserts in concrete beams and girders. Drilled anchors/wedge type inserts shall be used on vertical surfaces only. Coordinate with structural engineer.
- BB. Fastener System Installation:

1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- CC. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- DD. Install hangers and supports to allow controlled thermal 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.
- EE. Install lateral bracing with pipe hangers and supports to prevent swaying.
- FF. 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.
- GG. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- HH. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- II. Refer to individual piping sections for hanger spacing and hanger rod sizes.

3.3 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.

3.4 PAINTING

- A. Touch Up: 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. Equipment Supports: Painting is specified in Division 09 painting Sections.
- C. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- D. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 20 0529

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SECTION 20 0547 - MECHANICAL VIBRATION CONTROLS

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."

1.2 ACTION SUBMITTALS

- A. Product Data: Include load deflection curves for each vibration isolation device.

1.3 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Signed and sealed by a qualified professional engineer. Include the following:
 - 1. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.

2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, and spring deflection changes. Include certification that riser system has been examined for excessive stress and that none will exist.
3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.

1.4 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. Installation of these items is specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATION EQUIPMENT BASES

A. **Type A:** Direct Isolator Attachment

1. Unit to be isolated is so constructed that vibration isolators of the type specified may be directly attached, provided that the edge deflection of the isolated unit base over unsupported span between mountings does not exceed specified or manufacturer's limits. If units to be isolated will not meet required deflection provisions, Type B bases shall be provided.

B. **Type B:** Factory-fabricated, welded, structural-steel bases or rails.

1. Structural Steel Bases:

- a. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type WF or a comparable product by one of the following:
 - 1) Amber/Booth; a VMC Group Company.
 - 2) Kinetics Noise Control, Inc.
 - 3) Korfund Dynamics; a VMC Group Company.
 - 4) Vibration Eliminator Co., Inc.
 - 5) Vibration Isolation Co., Inc. (Pump Bases Only)
 - 6) Vibration Mountings & Controls; a VMC Group Company.
 - 7) Vibro-Acoustics.
- b. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails. Include supports for suction and discharge elbows for pumps.
- c. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.

- d. Support Brackets: Factory-welded steel angles on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
2. Structural-Steel Rails:
- a. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type ICS or a comparable product by one of the following:
 - 1) Amber/Booth; a VMC Group Company.
 - 2) Kinetics Noise Control, Inc.
 - 3) Korfund Dynamics; a VMC Group Company.
 - 4) Vibration Eliminator Co., Inc.
 - 5) Vibration Isolation Co., Inc. (Pump Bases Only)
 - 6) Vibration Mountings & Controls; a VMC Group Company.
 - 7) Vibro-Acoustics.
 - b. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails. Include supports for suction and discharge elbows for pumps.
 - c. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 - d. Support Brackets: Factory-welded steel angles on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- C. **Type C** Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for field-applied, cast-in-place concrete.
- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type BMK/KSL or a comparable product by one of the following:
 - a. Amber/Booth; a VMC Group Company.
 - b. Kinetics Noise Control, Inc.
 - c. Korfund Dynamics; a VMC Group Company.
 - d. Vibration Eliminator Co., Inc.
 - e. Vibration Isolation Co., Inc. (Pump Bases Only)
 - f. Vibration Mountings & Controls; a VMC Group Company.
 - g. Vibro-Acoustics.
 - 2. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails. Include supports for suction and discharge elbows for pumps.
 - 3. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 - 4. Support Brackets: Factory-welded steel angles on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
 - 5. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.
- D. **Type E** Existing Roof Curb:

1. Sound Isolation: Within perimeter of roof curb rails and as detailed on the Drawings:
 - a. Two layers of 2-inch thick board insulation, minimum 3-lb/cu. ft. density, glass fibers bonded with a thermosetting resin. Comply with ASTM C 612 Type IA or Type IB.
 - b. Two layers of 5/8-inch thick water-resistant gypsum core wall panel surfaced with paper on front, back, and long edges. Comply with ASTM C 1396.
 - c. One layer of 6-inch thick fiberglass blanket insulation.
2. Static Deflection: Nominal 1 inch, 2 inches, or 3 inches.

2.2 VIBRATION ISOLATORS

- A. **Type 1a** Elastomeric Isolator Pads: Oil- and water-resistant elastomer, arranged in single or multiple layers (maximum 3 layers separated by steel shims) to achieve 90 percent efficiency, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type W, Super W, WSW, and WSWSW or comparable products by one of the following:
 - a. Amber/Booth; a VMC Group Company.
 - b. Kinetics Noise Control, Inc.
 - c. Korfund Dynamics; a VMC Group Company.
 - d. Vibration Eliminator Co., Inc.
 - e. Vibration Mountings & Controls; a VMC Group Company.
 - f. Vibro-Acoustics.
 2. Material: Standard neoprene for indoor applications.
 3. Material: Bridge-bearing neoprene, complying with AASHTO M 251 for outdoor applications.
- B. **Type 1b** Elastomeric Isolator Pads: Oil- and water-resistant elastomer, single layer, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and 1/4 inch steel load bearing plate. Factory cut to sizes that match requirements of supported equipment.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type Super WMSW and MBSW or a comparable product by one of the following:
 - a. Amber/Booth; a VMC Group Company..
 - b. Kinetics Noise Control, Inc.
 - c. Korfund Dynamics; a VMC Group Company.
 - d. Vibration Eliminator Co., Inc.
 - e. Vibration Mountings & Controls; a VMC Group Company.
 - f. Vibro-Acoustics.
 2. Material: Standard neoprene for indoor applications.
 3. Material: Bridge-bearing neoprene, complying with AASHTO M 251 for outdoor applications.
- C. **Type 3** Spring Isolators: Freestanding, open-spring isolators.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type SLF or a comparable product by one of the following:
 - a. Amber/Booth; a VMC Group Company.
 - b. Kinetics Noise Control, Inc.
 - c. Korfund Dynamics; a VMC Group Company.
 - d. Vibration Eliminator Co., Inc.
 - e. Vibration Mountings & Controls; a VMC Group Company.
 - f. Vibro-Acoustics.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 100 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

D. **Type 4** Restrained Spring Isolators: Restrained single and multiple spring mounts.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Types SLR and SLRS or comparable products by one of the following:
 - a. Amber/Booth; a VMC Group Company.
 - b. Kinetics Noise Control, Inc.
 - c. Korfund Dynamics; a VMC Group Company.
 - d. Vibration Eliminator Co., Inc.
 - e. Vibration Mountings & Controls; a VMC Group Company.
 - f. Vibro-Acoustics.
2. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.3 VIBRATION ISOLATION HANGERS

A. **Type 8a** Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type 30N or a comparable product by one of the following:

- a. Amber/Booth; a VMC Group Company.
 - b. Kinetics Noise Control, Inc.
 - c. Korfund Dynamics; a VMC Group Company.
 - d. Vibration Eliminator Co., Inc.
 - e. Vibration Mountings & Controls; a VMC Group Company.
 - f. Vibro-Acoustics.
 2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 5. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
- B. **Type 8b** Spring Hangers with Vertical-Limit Stop: Precompressed combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type PC30N or a comparable product by one of the following:
 - a. Amber/Booth; a VMC Group Company.
 - b. Kinetics Noise Control, Inc.
 - c. Korfund Dynamics; a VMC Group Company.
 - d. Vibration Eliminator Co., Inc.
 - e. Vibration Mountings & Controls; a VMC Group Company.
 - f. Vibro-Acoustics.
 2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 5. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 7. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.

2.4 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
1. Powder coating on springs and housings.
 2. All hardware shall be electrogalvanized. Hot-dip galvanize metal components for exterior use.
 3. Baked enamel for metal components on isolators for interior use.

4. Color-code or otherwise mark vibration isolation devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation devices for compliance with requirements, installation tolerances, and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install roof curbs, equipment supports, and roof penetrations as specified in Division 07 Section "Roof Accessories."
- B. Install thrust limits at centerline of thrust, symmetrical on either side of equipment.

3.3 CONNECTIONS

- A. Provide flexible electrical connections in the form of large radius, 360 degree loop of flexible conduit for all vibrating isolated equipment. Any cooling water lines, compressed air, or other piping services (except inlet and outlet water connections for pumps, chillers or cooling tower) shall be made with 360 degree loops of reinforced neoprene hose, which are attached using nipples of appropriate gender. All service connections made with neoprene hose shall have shut-off valves between the hose and the supply service.
- B. Vibration isolate piping connected to vibration isolated equipment using Type 8a or 8b spring hangers, and with distance to be isolated as scheduled on the Drawings. Maximum spacing between isolators same as maximum distance between pipe hangers and supports.
- C. Vibration isolate ductwork connected to air handling units, return air fans, and vibration isolated equipment using Type 8a or 8b spring hangers, and in accordance with isolation distances scheduled on the Drawings.

3.4 EQUIPMENT BASES

- A. Fill concrete inertia bases, after installing base frame, with 3000-psi concrete; trowel to a smooth finish.
 1. Cast-in-place concrete materials and placement requirements are specified in Division 03.
- B. Concrete Bases: Anchor equipment to concrete base according to supported equipment manufacturer's written instructions.
 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.

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2. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
6. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.5 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:

1. Isolator deflection.
2. Snubber minimum clearances.

3.6 ADJUSTING

- A. Adjust isolators after piping systems have been filled and equipment is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop.
- D. Adjust active height of spring isolators.
- E. Adjust snubbers according to manufacturer's written recommendations.

3.7 CLEANING

- A. After completing equipment installation, inspect vibration isolation devices. Remove paint splatters and other spots, dirt, and debris.

3.8 DEMONSTRATION

END OF SECTION 20 0547

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

- A. Samples: For color, letter style, and graphic representation required for each identification material and device.
- B. Valve numbering scheme.

1.4 CLOSEOUT SUBMITTALS

- A. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in Maintenance Manuals.

1.5 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME (ANSI) A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.6 COORDINATION

- 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 location of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified:
 - 1. Seton.
 - 2. Brady.
 - 3. EMED.
 - 4. Craftmark.
 - 5. Brimar Industries, Inc.
 - 6. Marking Services Inc. (MSI).
 - 7. Kolbi Pipe Marker Co.

2.2 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.

1. Data:
 - a. Manufacturer, product name, model number, and serial number.
 - b. Capacity, operating and power characteristics, and essential data.
 - c. Labels of tested compliances.
2. Location: Accessible and visible.
3. Fasteners: As required to mount on equipment.

2.3 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
 1. Colors: Comply with ASME (ANSI) A13.1, unless otherwise indicated.
 2. Type and Size of Letters: Comply with ANSI A13.1, unless otherwise indicated.
 3. Legends: Spelled out in full or commonly used and accepted abbreviations.
 4. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
 5. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
 6. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- B. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.

2.4 DUCT IDENTIFICATION DEVICES

- A. Duct Markers: Vinyl, 2-inch minimum character height, with permanent pressure sensitive adhesive. Include direction and quantity of airflow, air handling unit or fan number, and duct service (such as supply, return, and exhaust).

2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme to match existing numbering scheme. Provide 5/32-inch hole for fastener.
 1. Material: 0.032-inch- thick brass.
 2. Valve-Tag Fasteners: Brass wire-link chain or beaded chain.

2.6 VALVE SCHEDULES

- A. Valve Schedules: For each piping system, on standard-size 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-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
2. Frame: Finished hardwood or extruded aluminum.
3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Division 20, 21, 22, and 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

- A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
 1. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
 2. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 3. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 4. Fans, blowers, primary balancing dampers, and mixing boxes.
 5. Packaged HVAC central-station and zone-type units.
- B. Area Served: Equipment serving different areas of a building other than where the equipment is installed shall be permanently marked in a manner that, in addition to identifying the equipment as specified in this Section, also identifies the area it serves.

3.3 PIPING IDENTIFICATION

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
 1. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, minimum 3/4 inch wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
 2. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, minimum 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.
- B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed 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 nonaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.

- C. Underground Pipe Markers: Install 6 to 8 inches below finished grade, directly above buried pipe.

3.4 DUCT IDENTIFICATION

- A. Identify ductwork with vinyl markers and flow direction arrows.
- B. Locate markers at air handling units, each side of floor and wall penetrations, near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

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; plumbing fixture supply stops; 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:
 1. Valve-Tag Size and Shape:
 - a. Cold Water: Minimum 1-1/2 inches, round or square.
 - b. Hot Water: Minimum 1-1/2 inches, round or square.
 - c. Fire Protection: Minimum 1-1/2 inches, round or square.
 - d. Gas: Minimum 1-1/2 inches, round or square.

3.6 VALVE-SCHEDULE INSTALLATION

- A. Mount valve schedule on wall in accessible location in each major equipment room.

3.7 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.8 CLEANING

- A. Clean faces of mechanical identification devices and glass frames of valve schedules.

3.9 SCHEDULES

- A. Paint colors are listed here for reference only. Painting is specified under Division 9.

PIPE LABELING AND COLOR CODING

<u>Pipe System Label</u>	<u>Drawing Abbrev.</u>	<u>Labels</u>
Sanitary Sewer	SAN	White on Green
Sanitary Vent	V	White on Green
Rain Conductor	RC	White on Green
Domestic Cold Water	CW	White on Green
Domestic Hot Water	HW	Black on Yellow
Domestic Hot Water Return	HWR	Black on Yellow
Natural Gas	G	Black on Yellow
Hot Water Htg. Supply	HWHS	Black on Yellow
Hot Water Htg. Return	HWHR	Black on Yellow
Terminal Unit Heating Sup.	THS	Black on Yellow
Terminal Unit Heating Ret.	THR	Black on Yellow
Chilled Water Supply	CHWS	White on Green
Chilled Water Return	CHWR	White on Green
Refrigerant Liquid	RL	Black on Yellow
Refrigerant Suction	RS	Black on Yellow
Fire Protection	FP	White on Red

<u>Service</u>	<u>Abbrev.</u>	<u>Labels</u>
Air Conditioning Supply	Supply Air	White on Green
Air Conditioning Return	Return Air	White on Green
Exhaust Systems	Exhaust Air	Black on Yellow
Outside Air Intake	Outside Air	White on Green
Mixed Air	Mixed Air	White on Green

END OF SECTION 20 0553

SECTION 20 0700 - MECHANICAL INSULATION

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 20 Section "Hanger and Supports" for thermal hanger shield inserts.
 - 4. Division 22 Section "Plumbing Fixtures: for protective shielding guards.
 - 5. Division 23 Section "Metal Ducts" for duct liners.

1.2 SUMMARY

- A. This Section includes mechanical insulation for pipe, duct, and equipment.

1.3 DEFINITIONS

- A. ASJ: All-service jacket.
- B. FSK: Foil, scrim, kraft paper.
- C. PVC: Polyvinyl Chloride.
- D. SSL: Self-sealing lap.

1.4 INDOOR PIPING INSULATION SYSTEMS DESCRIPTION

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are scheduled on the Drawings, or identified for each piping system and pipe size range.

1.5 INDOOR DUCT AND PLENUM INSULATION SYSTEMS DESCRIPTION

- A. Acceptable indoor duct and plenum insulation materials and thicknesses are scheduled on the Drawings.

1.6 EQUIPMENT INSULATION SYSTEMS DESCRIPTION

- A. Acceptable equipment insulation materials and thicknesses are scheduled on the Drawings.

1.7 FIELD-APPLIED JACKETING SYSTEMS DESCRIPTION

- A. Acceptable field-applied jacketing materials and thicknesses are scheduled on the Drawings, or identified for each piping system and pipe specialty.

1.8 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).

- 1. ESR Report: For fire-rated grease duct insulation.

1.9 INFORMATIONAL SUBMITTALS

1.10 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

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

- B. Ductwork Maximum Temperature Limits: Based on ASTM C 411 test procedures.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Prior to installation, protect insulation from exposure to water and from physical damage. Prior to installation, store insulation in manufacturer's original packaging.

1.12 COORDINATION

- A. Coordinate size and location of supports, hangers, and pre-insulated pipe shields/supports specified in Division 20 Section "Hangers and Supports."
- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork 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.

1.13 SCHEDULING

- A. Schedule insulation application after pressure testing systems. 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, GENERAL REQUIREMENTS

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. 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.
- C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- E. Adhesives used shall be fire resistant in their dry states and UL listed.

2.2 PIPE INSULATION MATERIALS

- A. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Aeroflex USA, Inc.; Aerocel Tube and Sheet.
 - b. Armacell LLC; AP Armaflex.
 - c. IK Insulation Group; K-Flex USA LLC; Insul-Tube and Insul-Sheet.
- B. Glass-Fiber, Preformed Pipe Insulation, Type I:
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Johns Manville; Micro-Lok.
 - b. Knauf Insulation; 1000 Pipe Insulation.
 - c. Manson Insulation Inc.; Alley-K.
 - d. Owens Corning; Fiberglas Pipe Insulation.
 - 2. Type I, 850 deg F Materials: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ or ASJ-SSL. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

2.3 DUCTWORK INSULATION MATERIALS

- A. Blanket Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. CertainTeed Corp.; Duct Wrap.
 - b. Johns Manville; Microlite EQ.
 - c. Knauf Insulation; Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap B.
 - e. Owens Corning; All-Service Duct Wrap.

2.4 EQUIPMENT INSULATION MATERIALS

- A. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Aeroflex USA, Inc.; Aerocel Tube and Sheet.
 - b. Armacell LLC; AP Armaflex.
 - c. IK Insulation Group; K-Flex USA LLC; Insul-Tube and Insul-Sheet.
- B. Large Diameter Pipe and Tank Insulation: Glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.
- C. Board Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. CertainTeed Corp.; Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.
 - d. Knauf Insulation; Insulation Board.

- e. Manson Insulation Inc.; AK Board.
- f. Owens Corning; Fiberglas 700 Series.

2.5 INSULATING CEMENTS

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

1. Products: Subject to compliance with requirements, provide one of the products specified.

- a. Insulco, Division of MFS, Inc.; SmoothKote.
- b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
- c. Rock Wool Manufacturing Company; Delta One Shot.

2.6 ADHESIVES

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

- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the products specified.

- a. Aeroflex USA, Inc.; Aeroseal and Aeroseal LVOC.
- b. Armacell LCC; 520 Adhesive.
- c. Foster Products Corporation, H. B. Fuller Company; 85-75.

- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the products specified.

- a. Childers Products, H.B. Fuller Company; CP-82.
- b. Foster Products Corporation, H. B. Fuller Company; 85-20.
- c. Johns Manville Industrial Insulation; S-90/80.
- d. Marathon Industries, Inc.; 225.
- e. Mon-Eco Industries, Inc.; 22-25.

- D. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the products specified.

- a. Dow Chemical Company (The); 739, Dow Silicone.
- b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
- c. P.I.C. Plastics, Inc.; Welding Adhesive.
- d. Red Devil, Inc.; Celulon Ultra Clear.
- e. Speedline Corporation; Speedline Vinyl Adhesive.

2.7 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Childers Products, H.B. Fuller Company; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Childers Products, H.B. Fuller Company; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

2.8 FACTORY-APPLIED JACKETS

A. Insulation systems indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.9 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
- C. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

- D. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as specified; roll stock ready for shop or field cutting and forming.
1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Airex Manufacturing, Inc.; E-Flex Guard.
 - b. Johns Manville; Zeston and Ceel-Co.
 - c. P.I.C. Plastics, Inc.; FG Series.
 - d. Proto PVC Corporation; LoSmoke.
 - e. Speedline Corporation; SmokeSafe.
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Color: White.
 4. Factory-fabricated tank heads and tank side panels.
- E. PVC Fitting Covers: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C, and including flexible glass fiber insulation inserts.
1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Airex Manufacturing, Inc.
 - b. Johns Manville; Zeston and Ceel-Co.
 - c. P.I.C. Plastics, Inc.; FG Series.
 - d. Proto PVC Corporation; LoSmoke.
 - e. Speedline Corporation; SmokeSafe.
 2. Adhesive: As recommended by manufacturer.
 3. Color: White.
 4. Factory-fabricated fitting covers:
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, and mechanical joints.
- F. Self-Adhesive Outdoor Jacket for Piping: Laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a fabric reinforced insulation cladding with natural aluminum stucco embossed facing.
1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. 3M VentureClad; 1579GCW-E.
 - b. Polyguard; Alumaguard.

2.10 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc., an American Biltrite company; 728 Cold Seal ASJ or comparable products by one of the following:

- a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. 3M Venture Tape.
 2. Width: 3 inches.
 3. Thickness: 9 mils.
 4. Adhesion: 70 ounces force/inch in width.
 5. Elongation: 3 percent.
 6. Tensile Strength: 45 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with rubber or acrylic adhesive; complying with ASTM C 1136 and UL listed.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc., an American Biltrite company; 491 FSK or 791 Cold Seal Acrylic FSK, or comparable products by one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. 3M Venture Tape.
 2. Width: 3 inches.
 3. Thickness: 6 mils.
 4. Adhesion (Rubber Adhesive): 100 ounces force/inch in width.
 5. Adhesion (Acrylic Adhesive): 90 ounces force/inch in width.
 6. Elongation: 3 percent.
 7. Tensile Strength: 35 lbf/inch in width.
 8. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc., an American Biltrite company; 370 White PVC tape, or comparable products by one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. 3M Venture Tape.
 2. Width: 2 inches.
 3. Thickness: 5 mils.
 4. Adhesion: 20 ounces force/inch in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 15 lbf/inch in width.

2.11 SECUREMENTS

- A. Bands:
1. Products: Subject to compliance with requirements, provide one of the products specified.

- a. PABCO-Childers Metals; Johns Manville Industrial Insulation; Pab-Bands and Fabstraps.
 - b. RPR Products, Inc.; Bands.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing or closed seal.
 3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.
 4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

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- diameter shank, length to suit depth of insulation indicated.
 - a. Products: Subject to compliance with requirements, provide one of the products specified.
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; CD.
 - 3) Midwest Fasteners, Inc.; CD.
 - 4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - a. Products: Subject to compliance with requirements, provide one of the products specified.
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.

2.12 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 and other conditions affecting performance of insulation application.
 1. Verify that systems and equipment 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

- 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 applies 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 COMMON INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and 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 the 4 o'clock or 8 o'clock position on 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 as recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. For services with surface temperatures below ambient, install a continuous unbroken vapor barrier. 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 thermal hanger 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 thermal hanger 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.

- K. Apply adhesives 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 the 4 o'clock or 8 o'clock position on the pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness. Where compression of insulation is possible, fabricate/install insulation per manufacturer's recommendations.
- 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. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

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 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.

- 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 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.
- 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:
 - 1. Terminate ductwork insulation at angle closure of fire damper sleeves.
 - 2. Install pipe insulation continuously through penetrations of fire-rated walls and partitions.
 - a. Firestopping is specified in Division 07 Section "Through-Penetration Firestop Systems."
- E. Insulation Installation at Floor Penetrations:
 - 1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at angle closure of fire damper sleeves.
 - 2. Pipe: Install insulation continuously through floor penetrations.
 - a. Seal penetrations through fire-rated assemblies according to Division 07 Section "Through-Penetration Firestop Systems."

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, 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, vessels, and equipment. 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.

3.6 FLEXIBLE ELASTOMERIC PIPE INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install 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 cut sections of sheet insulation of same thickness as pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 GLASS-FIBER AND MINERAL WOOL PIPE INSULATION INSTALLATION

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 but 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 PVC fitting covers when available.
2. When PVC fitting covers are not available, install preformed pipe insulation to outer diameter of pipe flange:
 - a. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - b. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with fiberglass or mineral wool blanket insulation as specified for system.
3. 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 PVC fitting covers when available.
2. When PVC fitting covers 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 PVC fitting covers when available.
2. When PVC fitting covers 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.

3.8 DUCT AND PLENUM INSULATION INSTALLATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with insulation pins.

1. 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 over compress 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.
2. 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 1 edge and 1 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 2 times the insulation thickness but not less than 3 inches.
3. 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.
4. 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.
5. 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.

3.9 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.

2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
 3. Protect exposed corners with secured corner angles.
 4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
 - d. Do not over compress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. 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.
 5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
 6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
 7. Stagger joints between insulation layers at least 3 inches.
 8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
 9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
 10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
 2. Seal longitudinal seams and end joints.
- C. Insulation Installation on Pumps:
1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch- diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
 2. Fabricate boxes from galvanized steel, at least 0.040 inch thick.
 3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.10 FIELD-APPLIED JACKET INSTALLATION

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- 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 self-adhesive jackets are indicated, install according to manufacturer's instructions and details on the drawings. Overlap seams arranged to shed water.

3.11 FINISHES

- A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system specified in Division 09 painting Sections.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

END OF SECTION 20 0700

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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 work of this section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 20 Section "Motors."

1.2 REFERENCES

- A. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- B. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- C. ANSI/NEMA MG 1 - Motors and Generators.

1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. EMI: Electromagnetic interference.
- C. LED: Light-emitting diode.
- D. RFI: Radio-frequency interference.
- E. THD: Total harmonic disturbance.
- F. VFC: Variable frequency controller. Variable frequency controllers may also be referred to as variable speed drives, variable frequency drives, VSDs, or VFDs in other Specification Sections or on the Drawings.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type and rating of VFC indicated.
 - 1. Include dimensions and finishes for VFCs.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.5 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Indicating power, control and instrument wiring including ladder diagrams for field work as well as factory assembled work. Manufacturer's drawings are acceptable only when modified and supplemented to reflect project conditions. The drawings shall include:
 - 1. Overall schematic (elementary) diagram in JIC form of the entire system of power and control circuitry. Indicate interfaces with control wiring by temperature controls contractor.
 - 2. Wiring diagrams showing the wiring layout of component assemblies or systems.
 - 3. Interconnection wiring diagrams showing terminations of interconnecting conductors between component assemblies, systems, control devices, and control panels complete with conductor identification, number of conductors, conductor and conduit size.
 - 4. Sequence of operation for components, assemblies or systems.
 - 5. Dimensional data.
- B. Product Certificates: For each VFC from manufacturer.
- C. Harmonic Analysis Report: Provide Project-specific calculations and manufacturer's statement of compliance with IEEE 519.
- D. Coordination Data for Motor-Driven Equipment: Accompanied by complete information concerning the respective motors including the following.
 - 1. Principal dimensions.
 - 2. Weights.
 - 3. Horsepower.

4. Voltage, phase, frequency.
5. Speed.
6. Class of insulation.
7. Enclosure type.
8. Frame.
9. Bearings including ABMA Rating Life (L-10 basis).
10. Design letter.
11. Manufacturer.
12. Service Factor

- E. Descriptive data shall include catalogues, guaranteed performance data with efficiency and power factor indicated at 75 percent and 100 percent of rated load and verification of conformance with other requirements of the Contract Documents. The information enumerated under NEMA MG1 Paragraph MG1-10.38, shall be arranged on one sheet for each motor.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals.

1.7 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. Product Options for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items. Refer to Division 01 Section "Product Requirements."
- C. 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.
- D. Comply with NFPA 70.
- E. Comply with IEEE 519 - Recommended Practice and Requirements for Harmonic Control in Electric Power Systems.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store VFCs in permanently enclosed and conditioned spaces.
- B. If stored in space that is not permanently enclosed and conditioned, remove loose packing and flammable materials from inside controllers and install temporary electric heating, with at least 250 W per controller.

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1.9 COORDINATION

- A. For Electrical Work Provided under Division 20, 22, and 23 Specifications: Furnish UL Listed components, in accordance with Division 26 Specifications and applicable NEMA and NEC (ANSI C 1) requirements. Provide wiring, external to electrical enclosures, in conduit.
- B. Provide Electrical Work required for the operation of components and assemblies provided as part of the Work under Division 20, 22, and 23 Specifications.
- C. Coordinate with temperature controls contractor for interfaces with temperature controls wiring.
- D. Mount line voltage (120 VAC) control components specified as part of the Work under Division 20, 22, and 23 Specifications.
- E. Refer to ELECTRICAL DRAWINGS and Division 26 Specifications for specified information regarding provisions for the arrangement of electrical circuits and components and for interface with Work specified under Division 20, 22, and 23 Specifications.
- F. The mechanical contractor shall furnish and install the variable frequency controller. Electrical trades shall make power connections to both load and line side of the VFC.

1.10 WARRANTY

- A. Warranty shall be 36 months from date of project acceptance. The warranty shall include all parts, labor, travel time and expenses.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Electrical Power Supply Characteristics: 480 volts, 3 phase, 60 hertz (Hz).
- B. Controller(s) shall be suitable for use with standard NEMA-B squirrel-cage induction motor(s) having a 1.15 Service Factor. At any time in the future, it shall be possible to substitute standard motor (equivalent horsepower, voltage and RPM) in the field.

2.2 VARIABLE FREQUENCY CONTROLLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - 1. ABB Group.
 - 2. Danfoss.
 - 3. Eaton Corporation.
 - 4. General Electric.
 - 5. Hitachi America, Ltd.
 - 6. Johnson Controls Incorporated (Private labeled ABB).

7. Mitsubishi Electric Automation, Inc.
 8. Square D; Schneider Electric.
 9. Toshiba International Corporation.
 10. Yaskawa Electric America, Inc.
- B. Provide variable frequency controllers as scheduled including coasting motor restart, and step over frequency.
1. The ratio of the total impedance to common system impedance shall be greater than or equal to 10.
 2. The voltage notch area shall be limited to 16-400 volt microseconds.
 3. The total harmonic disturbance (THD) as a result of voltage notching shall be 3 percent or less at the point of common coupling.
 4. The THD as a result of current notching shall be 100 percent or less at the point of common coupling.
- C. Provide 3 percent AC input line reactors sized appropriate for each current rating variable frequency controller.
- D. Variable frequency controller (VFC) shall comply with all applicable provisions of the National Electrical Code.
- E. Line side of the VFC shall have a displacement power factor of 0.95 or greater when motor is operating at 50 to 100 percent motor speed.
- F. VFC shall have efficiency greater than 85 percent when motor is operating at 50 to 100 percent motor speed.
- G. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
- H. Unit Operating Requirements:
1. Input AC Voltage Tolerance: Plus 10 and minus 5 percent of VFC input voltage rating.
 2. Input Frequency Tolerance: Plus 2 percent of VFC frequency rating.
- I. Each variable frequency controller shall consist of an adjustable frequency converter which shall convert input power into an adjustable frequency output in an ambient temperature of zero to 40 deg C. Output power shall be suitable capacity and waveform to provide stepless speed control of the specified horsepower motor throughout the required speed range under variable torque load not exceeding the motor's full-load rating.
- J. Provide fault detection and trip circuits to protect itself and the connected motor against line voltage transients, power line under voltage, output overvoltage and overcurrent. A disconnect with padlockable door interlocked external handle shall be supplied to disconnect the incoming power.
1. Minimum SCCR according to UL 508 shall be as indicated on the Drawings.
- K. Minimum output frequency shall be the lowest frequency at which the connected motor can be operated without overheating.
- L. Inverter shall contain current limiting circuitry, adjustable to 100 percent of motor full-load current to provide soft start, acceleration, and running without exceeding motor rated current. The current limit circuit shall be

of the type for variable torque load, which acts to diminish output frequency while limiting, without directly causing shutdown.

- M. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts. For safety, drive shall shut down and require manual reset and restart if automatic reset/restart function is not successful within three attempts.
- N. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.
- O. Isolate signal circuits from the power circuits and design to accept a speed signal from a remote process controller in the automatic mode and from the speed control potentiometer in the manual mode. A door-mounted switch shall provide mode selection. The selected signal shall control the motor speed between the adjustable minimum and maximum speed settings. Maximum speed shall be field adjustable to 100 percent of rated speed. The speed signal shall follow a linear time ramp, adjustable from 4-20 seconds to provide acceleration from zero to minimum speed. When minimum speed is reached, the speed signal shall follow the linear time ramp for acceleration and deceleration control.
- P. Mount the adjustable frequency inverter and other electrical components that provide the operation specified in a NEMA 1 enclosure. Equipment shall have external heat sinks, or air filters on all vents. The enclosure shall have hinged front access doors with latch. Cabinet to cabinet interconnecting wiring shall be factory dressed, tagged and harnessed, and shipped with one end attached.
- Q. Controller shall have the ability to step-over certain set frequencies that may cause a system to resonate. The controller shall have at least two manually set points of frequency in which the controller shall step-over during operation.
- R. Operating and monitoring devices for the inverter shall be door mounted and shall include the following:
 - 1. Manual Speed Control to set speed in the hand (manual) mode.
 - 2. Speed indicating meter, either in revolutions per minute, proportional to the applied frequency and voltage to indicate speed of the converter-powered motor or frequency (hertz).
 - 3. VFC "fault/reset" pilot light pushbutton combination with dry contact for external alarm. Fault alarm shall not actuate upon normal shutdown.
 - 4. Inverter "control power" indicator.
 - 5. Motor "running" indicator and two dry contacts that close when motor is running.
 - 6. Output current meter calibrated in "AC amps."
 - 7. Operating selector switches and indicating light to perform the following functions:
 - a. One hand-off-auto switch for the VFC with indicating lights (red-running, green-energized). In hand position, unit (VFC or bypass starter) shall start. In auto position, unit (VFC or bypass starter) shall start when remote dry contact is closed.
 - b. Unit shall be capable of being padlocked in the off position.
 - 8. Output voltmeter (0 - 600 VAC) (analog or digital).
- S. The VFC is to be provided with isolated 4-20 mA DC output signals proportional to speed, current and voltage for connection by others.

- T. The VFC shall be provided with the ability to communicate (monitoring) through RS485 connector.
- U. Remote speed control shall be a 3-15 psig pneumatic signal from a remote controller. Provide a pressure transducer in the VFC enclosure to convert the pneumatic signal to an electrical signal for automatic speed control.
- V. Remote speed control shall be 4-20 mA control signal from a remote controller.
- W. Variable frequency controller shall not cause motor to produce noise levels exceeding 80 dBA measured at a distance of 3 feet from the motor. If noise level of motor exceeds this amount, the contractor shall be responsible for correcting the problem.
- X. Provide connection points for system safety controls such as smoke detectors, freeze s-888888888tats, damper end switches, etc. as shown on mechanical temperature control drawings. Opening of a contact on safety controls wired to the drive shall shut down the motor(s).
- Y. VFCs specified on the drawings to have contactor motor selection, in order to operate "either one or both" motors connected to the VFC, shall have the separate motors controlled by horse power rated contactors. These contactors shall be capable of being controlled locally (by a switch in the panel door) or remotely. The contactors shall also have two convertible auxiliary contacts in order to sense contactor position.
- Z. VFCs specified on the drawings to operate "either" motor with contactor motor selection shall have separate horse power rated contactors to control each motor.
- AA. The contactors shall be interlocked in order that only one motor may run at a time. These contactors shall be capable of being controlled locally (by a switch in the panel door) or remotely. The contactors shall also have two convertible auxiliary contacts in order to sense contactor position.
- BB. Provide in each VFC, a relay, that upon loss of the automatic speed control signal shall:
 - 1. Automatically set the motor rpm to half speed. This loss of signal relay shall be manually adjustable to be able to set default speed to some other value than half speed if required later in the field.
- CC. Coordinate with the Temperature Controls Contractor for the interface of control wiring to the drive as required to meet the requirements of the temperature control drawings. Drive shall be furnished with internal control wiring configured in the factory to allow single connections of field wiring to terminal blocks in the drive by the Temperature Controls Contractor.
- DD. All indicating lights shall be push to test or LED.

2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: The controller shall be subject to, but not limited to, the following quality assurance controls, procedures and tests:
 - 1. Power transistors, SCRs and diodes shall be tested to ensure correct function and highest reliability.
 - 2. All printed circuit boards shall be tested at 50 deg C for 50 hours. The VFC manufacturer shall provide certification that the tests have been completed.

3. Every controller will be functionally tested with a motor to ensure that if the drive is started up according to the instruction manual provided, the unit will run properly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance.
- B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install and adjust materials and equipment in accordance with the manufacturer's instructions.
- B. Obtain the manufacturer's instructions for materials and equipment provided under the Contract in detail necessary to comply with the requirements of the Contract Documents.
- C. If unit is free standing, provide a concrete housekeeping pad.

3.3 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. Upon completion of each installation, conduct complete acceptance tests in the presence of duly notified authorities having jurisdiction and the Owner to demonstrate component, assembly or system performance in accordance with the requirements of the Contract Documents.
- C. In the event that a test demonstrates that a component assembly or system performance is deficient, the Owner may require additional tests after corrective work.
- D. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.
- E. Component assembly and systems acceptance is predicated upon completion of specified work and receipt by the Owner of data specified under "Submittals."
- F. Electrical testing of motors is specified in Division 20 Section "Motors."

3.4 ADJUSTING

- A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.
- B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- C. Adjust the trip settings of instantaneous-only circuit breakers and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to 6 times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed 8 times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Owner before increasing settings.
- D. Set the taps on reduced-voltage autotransformer controllers.
- E. Set field-adjustable circuit-breaker trip ranges.
- F. Set field-adjustable pressure switches.

3.5 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.
- B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.6 DEMONSTRATION

- A. The VFC supplier/support group shall provide the following additional services:
 - 1. On-site training of customer personnel in operation and maintenance of variable frequency controllers.
 - 2. Provide four copies of a troubleshooting manual and factory training manuals to help the building operator determine what steps must be taken to correct any problem that may exist in the system.
 - 3. Coordinate enrollment of customer personnel in factory-held service schools.

END OF SECTION 20 2923

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VARIABLE FREQUENCY CONTROLLERS
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SECTION 21 1100 - FIRE-SUPPRESSION SYSTEM

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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.
- B. Provisions of Division 20 Section "Mechanical General Requirements" apply to this Section.
- C. Related Sections include the following:

1. Division 10 Section "Fire-Protection Specialties" for cabinets and fire extinguishers.
2. Division 20 Section "Basic Mechanical Materials and Methods."
3. Division 20 Section "Hangers and Supports."
4. Division 21 fire pump sections for fire pumps, pressure-maintenance pumps, and pump controllers.
5. Division 21 clean-agent extinguishing system sections.
6. Division 28 Section "Fire Alarm" for alarm devices not specified in this Section.

1.2 DEFINITIONS

- A. Working Plans: Documents, including drawings, calculations, and material specifications prepared according to NFPA 13 and NFPA 14 for obtaining approval from authorities having jurisdiction.

1.3 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.4 PERFORMANCE REQUIREMENTS

- A. Standard Piping System Component Working Pressure: Listed for at least 175 psig
- B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Fire-suppression sprinkler system design shall be approved by authorities having jurisdiction.
 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 2. Sprinkler Occupancy Hazard Classifications, for bidding purposes, as follows:
 - a. Building Service Areas: Ordinary Hazard, Group 1.
 - b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
 - c. General Storage Areas: Ordinary Hazard, Group 1.
 - d. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
 - e. Office and Public Areas: Light Hazard.
 3. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: 0.10 gpm/sq. ft. over 1500-sq. ft. area.
 - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
 - c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm/sq. ft. over 1500-sq. ft. area.
 4. Maximum Protection Area per Sprinkler:
 - a. Office Spaces: 225 sq. ft.
 - b. Storage Areas: 130 sq. ft.
 - c. Mechanical Equipment Rooms: 130 sq. ft.

- d. Electrical Equipment Rooms: 130 sq. ft.
- e. Other Areas: According to NFPA 13 recommendations, unless otherwise indicated.

D. Water velocity in the piping system shall not exceed the following:

- 1. Aboveground mains: 32 ft./sec.
- 2. Sprinkler branch lines: 24 ft./sec.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.6 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- B. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Domestic water piping.
 - 2. HVAC hydronic piping.
 - 3. Items penetrating finished ceiling include the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
- D. Qualification Data: For qualified Installer.
- E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, the Owner's insurance underwriter including hydraulic calculations, if applicable.
 - 1. Sprinklers shall be referred to on drawings, submittals, and other documentation, by the sprinkler identification number (SIN) or model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.
- F. Fire-hydrant flow test report.

1.7 CLOSEOUT SUBMITTALS

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

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- B. Field quality-control reports.
- C. Operation and Maintenance Data: For sprinkler specialties to include in operation and maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- B. The provisions and requirements of the NFPA and the Owner's insurance underwriter constitute mandatory minimum requirements for the work of this Section.
- C. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:
- D. UL Standards: Comply with the following:
 - 1. UL 2901, "Antifreeze Solutions for Use in Fire Sprinkler Systems."
- E. Grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer.

1.9 COORDINATION

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STANDARD-WEIGHT BLACK STEEL PIPE AND FITTINGS

- A. Threaded-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, with factory- or field-formed threaded ends, and with factory applied antimicrobial coating on inner wall of pipe.
 - 1. Cast-Iron Threaded Flanges: ASME B16.1.
 - 2. Malleable-Iron Threaded Fittings: ASME B16.3.
 - 3. Gray-Iron Threaded Fittings: ASME B16.4.
 - 4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
 - 5. Steel Threaded Couplings: ASTM A 865.
- B. Plain-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, and with factory applied antimicrobial coating on inner wall of pipe.
 - 1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
 - 2. Steel Flanges and Flanged Fittings: ASME B16.5.
- C. Grooved-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, with factory- or field-formed, square-cut- or roll- grooved ends, and with factory applied antimicrobial coating on inner wall of pipe.
 - 1. Grooved-Joint Piping Systems:
 - a. Manufacturers:
 - 1) Anvil; Model 7401; ASC Engineered Solutions.
 - 2) Tyco Fire Protection Products by Johnson Controls Company; Grinnell G-Fire.
 - 3) Victaulic Co. of America; Style 005H, 009N.
 - b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
 - c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, rubber gasket listed for use with housing, and steel bolts and nuts.

2.3 SPRINKLER SPECIALTY FITTINGS

- A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping. Sprinkler specialty fittings shall have 300-psig working-pressure rating if fittings are components of high-pressure piping system.
- B. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.
 - 1. Manufacturers:
 - a. Elkhart Brass Mfg. Co., Inc.

C. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.

1. Manufacturers:

- a. CECA, LLC.
- b. Merit.

2.4 LISTED FIRE-PROTECTION VALVES

A. Valves: UL listed or FMG approved.

1. Valves shall have 175-psig minimum pressure rating.

B. Butterfly Valves: UL 1091.

1. NPS 2-1/2 and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with flanged or grooved ends.

a. Manufacturers:

- 1) McWane, Inc.; Kennedy Valve Div.
- 2) Mueller Company; ASC Engineered Solutions.
- 3) NIBCO.
- 4) Tyco Fire Protection Products by Johnson Controls Company.
- 5) Victaulic Co. of America; Series 705.

2.5 UNLISTED GENERAL-DUTY VALVES

A. Ball Valves NPS 2 and Smaller: MSS SP-110, 2-piece copper-alloy body with chrome-plated brass ball, 600-psig minimum CWP rating, blowout-proof stem, and threaded ends.

B. Check Valves NPS 2 and Smaller: MSS SP-80, Type 4, Class 125 minimum, swing type with bronze body, nonmetallic disc, and threaded ends.

C. Gate Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, solid wedge, and threaded ends.

2.6 SPRINKLERS

A. Sprinklers shall be UL listed or FMG approved, with 175-psig minimum pressure rating. Sprinklers shall have 300-psig pressure rating if sprinklers are components of high-pressure piping system.

B. Manufacturers:

- 1. Reliable Automatic Sprinkler Co., Inc.
- 2. Tyco Fire Protection Products by Johnson Controls Company.
- 3. Victaulic Co. of America.
- 4. Viking Corp.

- C. Automatic Sprinklers:
 - 1. With heat-responsive glass bulb element complying with the following:
 - a. UL 199, for nonresidential applications.
 - b. UL 1767, for early-suppression, fast-response applications.
- D. Sprinkler Types and Categories: Nominal 1/2-inch orifice for 165 deg F "Ordinary" temperature classification rating, unless otherwise indicated or required by application.
- E. Sprinkler types, features, and options as follows:
 - 1. Concealed ceiling sprinklers, including cover plate.
 - 2. Pendent sprinklers.
 - 3. Sidewall sprinklers.
 - 4. Upright sprinklers.
- F. Sprinkler Finishes: Chrome plated, bronze, and painted.
- G. Special Coatings: Wax, lead, and corrosion-resistant paint.
- H. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers. Escutcheons listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.
 - 1. Ceiling Mounting: Chrome-plated steel, 2 piece, with 3/4-inch vertical adjustment.
 - 2. Sidewall Mounting: Chrome-plated steel, one piece, flat.
- I. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler. Sprinkler guards listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in Part 1 "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.2 EXAMINATION

- A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.
- B. Examine walls and partitions for suitable thicknesses, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PIPING APPLICATIONS, GENERAL

- A. Flanges, flanged fittings, unions, nipples, grooved-joint couplings, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.

3.4 SPRINKLER SYSTEM PIPING APPLICATIONS

- A. Wet-Pipe Sprinklers: Use the following:

Pipe Type	<u>1 1/2" & Smaller</u>	<u>2"</u>	<u>2 1/2" – 3 1/2"</u>	<u>4"</u>	<u>5" – 6"</u>
Standard weight steel, threaded fittings	YES	YES	YES	YES	NO
Standard weight steel, grooved fittings	NO	NO	YES	YES	YES

3.5 VALVE APPLICATIONS

- A. The following requirements apply:
- Listed Fire-Protection Valves: UL listed or FMG approved for applications where required by NFPA 13.
 - Shutoff Duty: Use ball, butterfly, or gate valves.
 - Unlisted General-Duty Valves: For applications where UL-listed and FMG-approved valves are not required by NFPA 13.
 - Shutoff Duty: Use ball, butterfly, or gate valves.

3.6 JOINT CONSTRUCTION

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.
- B. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than NPS 8 with wall thickness less than Schedule 40 unless approved by authorities having jurisdiction and threads are checked by a ring gage and comply with ASME B1.20.1.
- C. Use of saddle style tees is not acceptable.
- D. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.
- All grooved couplings, fittings, gaskets, valves, and specialties shall be the product of a single manufacturer.

2. Steel Pipe: Square-cut or roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.
- E. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for additional requirements.

3.7 PIPING INSTALLATION

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping installation.
- B. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- C. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.
- D. Install sprinkler piping with drains for complete system drainage.
- E. Hangers and Supports: Comply with NFPA 13 for hanger materials.
 1. Install standpipe system piping according to NFPA 14.
 2. Install sprinkler system piping according to NFPA 13, except use of "C" clamps, or beam clamps of "C" pattern, or any modification thereof, is prohibited for supporting pipes larger than NPS 2-1/2.
 3. Refer to Division 20 Section "Hangers and Supports" for additional requirements.
- F. Fill wet-pipe sprinkler system piping with water.

3.8 VALVE INSTALLATION

- A. Install listed fire-protection valves, unlisted general-duty valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.

3.9 SPRINKLER APPLICATIONS

- A. Use the following sprinkler types:
 1. Rooms without Ceilings: Upright sprinklers.
 2. Rooms with Suspended Ceilings: Concealed sprinklers.
 3. Sprinkler Finishes:
 - a. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes; white polyester finish in natatoriums.
 - b. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.

4. Sprinkler Guards: For exposed sprinkler heads subject to damage.

3.10 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels and tiles.
- B. Do not install pendent wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space.

3.11 CONNECTIONS

- A. Install piping adjacent to equipment to allow service and maintenance.
- B. Connect piping to specialty valves, hose valves, specialties, fire department connections, and accessories.
- C. Connect alarm devices to fire alarm.

3.12 LABELING AND IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and in Division 20 Section "Mechanical Identification."

3.13 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 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. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 4. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
 5. Verify that equipment hose threads are same as local fire department equipment.
 6. Test each backflow prevention device according to authorities having jurisdiction and the device's reference standard.
- B. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.
- C. Verify that excess-pressure pumps and accessories are installed and operate correctly.
- D. Verify that air compressors and their accessories are installed and operate correctly.
- E. Verify that specified tests of piping are complete.
- F. Verify that damaged sprinklers and sprinklers with paint or coating not specified are replaced with new, correct type.

- G. Verify that sprinklers are correct types, have correct finishes and temperature ratings, and have guards as required for each application.
- H. Verify that potable-water supplies have correct types of backflow preventers.
- I. Adjust operating controls and pressure settings.
- J. Coordinate with fire alarm tests. Operate as required.
- K. Report test results promptly and in writing to Architect and authorities having jurisdiction.

3.14 CLEANING AND PROTECTION

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.
- C. Protect sprinklers from damage until Substantial Completion.

3.15 DEMONSTRATION

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

END OF SECTION 21 1100

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SECTION 21 2212 - CLEAN-AGENT EXTINGUISHING SYSTEMS (C6-Fluoroketone)

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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.
- B. Related Sections include the following:
 1. Division 20 Section "Mechanical General Requirements."
 2. Division 20 Section "Basic Mechanical Materials and Methods."

3. Division 21 Section "Fire Suppression System."

1.2 DEFINITIONS

- A. ATS: Acceptance Testing Specifications.
- B. EPO: Emergency Power Off.

1.3 SYSTEM DESCRIPTION

- A. Clean-agent fire-extinguishing system shall be an engineered double-shot system for total flooding of the hazard area including the room cavity below the ceiling and below the raised floor. Provide separate zones above and below the raised floor. If smoke is detected below the raised floor, agent shall be discharged in the underfloor zone only. If smoke is detected above the raised floor, agent shall be discharged in zones above and below the floor.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design clean-agent fire-extinguishing system and obtain approval from authorities having jurisdiction. Design system for Class A, B, and C fires as appropriate for areas being protected, and include safety factor. Use clean agent indicated and in concentration suitable for normally occupied areas.
- B. Performance Requirements: Discharge FK-5-1-12 within 10 seconds and maintain 6.6 percent concentration by volume at 70 deg F for 10-minute holding time in hazard areas.
 - 1. FK-5-1-12 concentration in hazard areas greater than 10.0 percent immediately after discharge or less than 6.5 percent throughout holding time will not be accepted without written authorization from Owner and authorities having jurisdiction.
 - 2. System Capabilities: Minimum 620-psig calculated working pressure and 360-psig initial charging pressure.
- C. Cross-Zoned Detection: Devices located in two separate zones. Sound alarm on activating single-detection device, and discharge extinguishing agent on actuating single-detection device in other zone.
- D. Verified Detection: Devices located in single zone. Sound alarm on activating single-detection device, and discharge extinguishing agent on actuating second-detection device.
- E. System Operating Sequence: As follows:
 - 1. Actuating First Detector: Visual indication on annunciator panel, energize audible alarm and visual alarms (slow pulse), shut down air-conditioning and ventilating systems serving protected area, close doors in protected area, and send signal to fire alarm system.
 - 2. Actuating Second Detector: Visual indication on annunciator panel, energize audible and visual alarms (fast pulse), shut down power to protected equipment, start time delay for extinguishing-agent discharge for 30 seconds, and discharge extinguishing agent. On agent discharge, release preaction valve to allow water to fill sprinkler system.

3. Extinguishing-agent discharge will operate audible alarms and strobe lights inside and outside the protected area.
 - F. Manual stations shall immediately discharge extinguishing agent when activated.
 - G. Operating abort switches will delay extinguishing-agent discharge while being activated, and switches must be reset to prevent agent discharge. Release of hand pressure on the switch will cause agent discharge if the time delay has expired.
 - H. EPO: Will terminate power to protected equipment immediately on actuation.
 - I. Low-Agent Pressure Switch: Initiate trouble alarm if sensing less than set pressure.
 - J. Power Transfer Switch: Transfer from normal to stand-by power source.
- 1.5 ACTION SUBMITTALS
- A. Product Data: For each type of product indicated.
- 1.6 INFORMATIONAL SUBMITTALS
- A. Shop Drawings: For clean-agent fire-extinguishing system signed and sealed by a qualified professional engineer.
 1. Include plans, elevations, sections, details, and attachments to other work.
 2. Include design calculations.
 3. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 4. Wiring Diagrams: For power, signal, and control wiring.
 - B. Delegated-Design Submittal: For clean-agent fire-extinguishing system signed and sealed by the qualified professional engineer.
 1. Indicate compliance with performance requirements and design criteria, including analysis data.
 2. Include design calculations for weight, volume, and concentration of extinguishing agent required for each hazard area.
 3. Indicate the Following on Reflected Ceiling Plans:
 - a. Ceiling penetrations and ceiling-mounted items.
 - b. Extinguishing-agent containers if mounted above floor, piping and discharge nozzles, detectors, and accessories.
 - c. Method of attaching hangers to building structure.
 - d. Other ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, and access panels.
 4. Indicate the Following on Occupied Work Area Plans:
 - a. Controls and alarms.

- b. Extinguishing-agent containers, piping and discharge nozzles if mounted in space, detectors, and accessories.
 - c. Equipment and furnishings.
- 5. Indicate the Following on Access Floor Space Plans:
 - a. Extinguishing-agent containers, piping and discharge nozzles, detectors, and accessories.
 - b. Method of supporting piping.
- 6. Indicate the Following on Ceiling Plans:
 - a. Extinguishing-agent containers, piping and discharge nozzles, detectors, and accessories.
 - b. Method of supporting piping.
 - c. Other equipment located in the ceiling space that is being protected including sprinkler piping, HVAC equipment, raceways, or conduit.
- C. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Domestic water piping.
 - 2. Items Penetrating Finished Ceiling Include the Following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
- D. Permit Approved Drawings: Working plans, prepared according to NFPA 2001, that have been approved by authorities having jurisdiction, the Owner's insurance underwriter. Include design calculations.

1.7 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Maintenance Data: For components to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of clean-agent extinguishing systems that are similar to those indicated for this Project in material, design, and extent.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of clean-agent extinguishing systems and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a NRTL acceptable to authorities having jurisdiction, and marked for intended use.

- D. The provisions and requirements of the NFPA and the Owner's insurance underwriter constitute mandatory minimum requirements for the work of this Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS/SYSTEM SUPPLIERS

- A. Manufacturers/System Suppliers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
1. Ansul; Sapphire Engineered System.
 2. Chemetron; 3M Novec 1230.
 3. Fenwal Protection Systems; Novec 1230.
 4. The Viking Corporation; Minimax Clean Agent Systems; MX 1230.

2.2 PIPING MATERIALS

- A. Refer to Part 3 "FK-5-1-12 Piping Applications" Article retained for applications of pipe, tube, fitting, and joining materials.
- B. Piping, Valves, and Discharge Nozzles: Comply with types and standards listed in NFPA 2001, Section "Distribution," for charging pressure of system.

2.3 PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, Type S, Grade B or ASTM A 106, Grade B; Schedule 40, or Schedule 80, seamless steel pipe.
1. Threaded Fittings:
 - a. Malleable-Iron Fittings: ASME B16.3, Class 300.
 - b. Flanges and Flanged Fittings: ASME B16.5, Class 300, unless Class 600 is indicated.
 2. Forged-Steel Welding Fittings: ASME B16.11, Class 3000, socket pattern.
 3. Grooved-End Fittings: FMG approved and UL listed, ASTM A 47/A 47M malleable iron or ASTM A 536 ductile iron, with dimensions matching steel pipe and ends factory grooved according to AWWA C606.
 - a. Grooved-Joint Piping Systems:
 - 1) Manufacturers:
 - a) ASC Engineered Products; Gruvlok Manufacturing.
 - b) Tyco Fire & Building Products; Grinnell Mechanical Products.
 - c) Victaulic Co. of America.
 - d) The Viking Corporation; VGS.

- B. 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 thickness or specific material is indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.
- D. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- E. Steel, Keyed Couplings: UL 213, AWWA C606, approved or listed for halon or clean-agent service, and matching steel-pipe dimensions. Include ASTM A 536, ductile-iron housing, rubber gasket, and steel bolts and nuts.

2.4 VALVES

- A. General Valve Requirements:
 - 1. UL listed or FM Approved for use in fire-protection systems.
 - 2. Compatible with type of clean agent used.
- B. Container Valves: With rupture disc or solenoid and manual-release lever, capable of immediate and total agent discharge and suitable for intended flow capacity.
- C. Valves in Sections of Closed Piping and Manifolds: Fabricate to prevent entrapment of liquid, or install valve and separate pressure relief device.
- D. Valves in Manifolds: Check valve; installed to prevent loss of extinguishing agent when container is removed from manifold.

2.5 EXTINGUISHING-AGENT CONTAINERS

- A. Description: Steel tanks complying with ASME Boiler and Pressure Vessel Code: Section VIII, for unfired pressure vessels. Include minimum working-pressure rating that matches system charging pressure, valve, pressure switch, and pressure gage.
 - 1. Finish: Red, enamel or epoxy paint.
 - 2. Manifold: Fabricate with valves, pressure switches, and connections for multiple storage containers, as indicated.
 - 3. Manifold: Fabricate with valves, pressure switches, selector switch, and connections for main- and reserve-supply banks of multiple storage containers.
 - 4. Storage-Tank Brackets: Factory- or field-fabricated retaining brackets consisting of steel straps and channels; suitable for container support, maintenance, and tank refilling or replacement.

2.6 FIRE-EXTINGUISHING CLEAN AGENT

- A. Clean Agent: FK-5-1-12 Dodecafluoro-2-methylpentan-3-one.

1. Manufacturer:
 - a. 3M; Novec 1230.

2.7 DISCHARGE NOZZLES

- A. Equipment manufacturer's standard one-piece brass or aluminum alloy of type, discharge pattern, and capacity required for application.

2.8 CONTROL PANELS

- A. Description: FMG approved or UL listed, including equipment and features required for testing, supervising, and operating fire-extinguishing system.
- B. Power Requirements: 120/240-V ac; with electrical contacts for connection to system components and fire alarm system, and transformer or rectifier as needed to produce power at voltage required for accessories and alarm devices.
- C. Enclosure: NEMA ICS 6, Type 1, enameled-steel cabinet.
 1. Mounting: Surface.
- D. Supervised Circuits: Separate circuits for each independent hazard area.
 1. Detection circuits equal to the required number of zones, or addressable devices assigned to the required number of zones.
 2. Manual pull-station circuit.
 3. Alarm circuit.
 4. Release circuit.
 5. Abort circuit.
- E. Provide the following control-panel features:
 1. Electrical contacts for shutting down fans, activating dampers, and operating system electrical devices.
 2. Automatic switchover to standby power at loss of primary power.
 3. Storage container, low-pressure indicator.
 4. Service disconnect to interrupt system operation for maintenance with visual status indication on the annunciator panel.
- F. Annunciator Panel: Graphic type showing protected, hazard-area plans and locations of detectors, abort, EPO, and manual stations. Include lamps to indicate device-initiating alarm, and electrical contacts for connection to control panel.
- G. Standby Power: Sealed, valve-regulated, recombinant lead acid batteries with capacity to operate system for 24 hours and alarm for minimum of 15 minutes. Include automatic battery charger that has a varying charging rate between trickle and high depending on battery voltage, and that is capable of maintaining

batteries fully charged. Include manual voltage control, dc voltmeter, dc ammeter, electrical contacts for connection to control panel, automatic transfer switch, and suitable enclosure.

2.9 DETECTION DEVICES

A. General Requirements for Detection Devices:

1. Comply with NFPA 2001, NFPA 72, and UL 268.
2. 24-V dc, nominal.

B. Ionization Detectors: Dual-chamber type, having sampling and referencing chambers, with smoke-sensing element.

C. Photoelectric Detectors: LED light source and silicon photodiode receiving element.

D. Signals to the Central Fire Alarm Control Panel: Any type of local system trouble is reported to the central fire alarm control panel as a composite "trouble" signal. Alarms on each system zone are individually reported to the central fire alarm control panel as separately identified zones.

2.10 MANUAL STATIONS

A. General Description: Surface FMG approved or UL listed, with clear plastic hinged cover, 120-V ac or low voltage compatible with controls. Include contacts for connection to control panel.

B. Manual Release: "MANUAL RELEASE" caption, and red finish. Unit can manually discharge extinguishing agent with operating device that remains engaged until unlocked.

C. Abort Switch: "ABORT" caption, momentary contact, with green finish.

D. EPO Switch: "EPO" caption, with yellow finish.

2.11 SWITCHES

A. Description: FMG approved or UL listed, where available, 120-V ac or low voltage compatible with controls. Include contacts for connection to control panel.

1. Low-Agent Pressure Switches: Pneumatic operation.
2. Power Transfer Switches: Key-operation selector, for transfer of release circuit signal from main supply to reserve supply.
3. Door Closers: Magnetic retaining and release device or electrical interlock to cause the door operator to drive the door closed.

2.12 ALARM DEVICES

A. Description: FMG approved or UL listed, low voltage, and surface mounting, unless otherwise indicated.

B. Bells: Minimum 6-inch diameter.

- C. Horns: 90 to 94 dBA.
- D. Strobe Lights: Translucent lens, with "FIRE" or similar caption.

2.13 ELECTRICAL POWER AND WIRING

- A. Electrical power, wiring, and devices are specified in Division 26.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with hazard-area leakage requirements, installation tolerances, and other conditions affecting work performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FK-5-1-12 PIPING APPLICATIONS

- A. Flanged pipe and fittings and flanged joints may be used to connect to specialties and accessories and where required for maintenance.
- B. NPS 2 and Smaller: Schedule 40, steel pipe; malleable-iron threaded fittings; and threaded joints.
- C. NPS 2-1/2 and Larger: Schedule 40, steel pipe; forged-steel welding fittings; and welded joints; or steel, grooved-end fittings; steel, keyed couplings; and grooved joints.

3.3 CLEAN-AGENT EXTINGUISHING PIPING INSTALLATION

- A. Install clean-agent extinguishing piping and other components level and plumb and according to manufacturers' written instructions.
- B. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic pipe installation and joint construction.
- C. Grooved Piping Joints: Groove pipe ends according to AWWA C606 dimensions. Assemble grooved-end steel pipe and steel, grooved-end fittings with steel, keyed couplings and lubricant according to manufacturer's written instructions.
- D. Install extinguishing-agent containers anchored to substrate.
- E. Install pipe and fittings, valves, and discharge nozzles according to requirements listed in NFPA 2001, Section "Distribution," and in ASME B31.1.
 - 1. Install valves designed to prevent entrapment of liquid or install pressure relief devices in valved sections of piping systems.

2. Support piping using supports and methods according to NFPA 13 and Division 20 Section "Hangers and Supports."
3. Install control panels, detection system components, alarms, and accessories, complying with requirements of NFPA 2001, Section "Detection, Actuation, and Control Systems," as required for supervised system application.

3.4 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to extinguishing-agent containers to allow service and maintenance.
- C. Connect electrical devices to control panel and to building's fire alarm system. Electrical power, wiring, and devices are specified in Division 28 Section "Fire Alarm."

3.5 LABELING

- A. Install labeling on piping, extinguishing-agent containers, other equipment, and panels according to NFPA 2001.
- B. Install signs at entry doors for protected areas to warn occupants that they are entering a room protected with a clean-agent fire extinguishing system.
- C. Install signs at entry doors to advise persons outside the room the meaning of the horn(s), bell(s), and strobe light(s) outside the protected space.

3.6 FIELD QUALITY CONTROL

- A. Comply with operating instructions and procedures of NFPA 2001, Section "Approval of Installations." Include the following tests and inspections to demonstrate compliance with requirements:
 1. Check mechanical items.
 2. Inspect extinguishing-agent containers and extinguishing agent, and check mountings for adequate anchoring to substrate.
 3. Check electrical systems.
 4. Check enclosure integrity. Comply with NFPA 2001, Section "Enclosure Inspection," and Appendix C, "Enclosure Integrity Procedure."
 5. Perform functional pre-discharge test.
 6. Perform system functional operational test including, EPO, abort, and manual release.
 7. Check remote monitoring operations.
 8. Check control-panel primary power source.
 9. Perform "puff" test on piping system, using nitrogen.
- B. Perform field-acceptance tests of each clean-agent extinguishing system when installation is complete. Perform system testing only after hazard-area enclosure construction has been completed and openings sealed. Comply with operating instructions and procedures of NFPA 2001, Section "Approval of Installations." Include the following to demonstrate compliance with requirements:

1. Perform functional predischARGE test.
 2. Perform system functional operational test.
 3. Check remote monitoring operations.
 4. Check control-panel primary power source.
 5. Perform "puff" test on piping system, using nitrogen.
- C. Correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment that cannot be corrected or does not perform as specified and indicated, then retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.
1. Report test results promptly and in writing to Architect and authorities having jurisdiction.
- D. Perform the following field tests and inspections and prepare test reports:
1. After installing clean-agent extinguishing piping system and after electrical circuitry has been energized, test for compliance with requirements.
 2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections "Inspection and Test Procedures" and "System Function Tests." Certify compliance with test parameters.
 3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 4. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
 5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Units will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

3.7 CLEANING

- A. Each pipe section shall be cleaned internally after preparation and before assembly by means of swabbing, using a suitable nonflammable cleaner. Pipe network shall be free of particulate matter and oil residue before installing nozzles or discharge devices.

3.8 SYSTEM FILLING

- A. Preparation:
1. Verify that piping system installation is completed and cleaned.
 2. Check for complete enclosure integrity.
 3. Check operation of ventilation and exhaust systems.
- B. Filling Procedures:
1. Fill extinguishing-agent containers with extinguishing agent and pressurize to indicated charging pressure.
 2. Install filled extinguishing-agent containers.

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3. Energize circuits.
4. Adjust operating controls.

3.9 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain clean-agent extinguishing systems.

END OF SECTION 21 2212

SECTION 22 0523 - GENERAL-DUTY VALVES FOR PLUMBING

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical Identification" for valve tags and charts.
 - 2. Division 21 fire-suppression piping and fire pump Sections for fire-protection valves.
 - 3. Division 22 Piping Sections for specialty valves applicable to those Sections only.
 - 4. Division 23 Section "General-Duty Valves for HVAC" for HVAC.
 - 5. Division 23 Section "Temperature Controls" for control valves and actuators.

1.2 SUMMARY

- A. This Section includes valves for general plumbing applications. Refer to piping Sections for specialty valve applications.

1.3 DEFINITIONS

- A. The following are standard abbreviations for valves:
 - 1. CWP: Cold working pressure.

2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. NRS: Nonrising stem.
4. OS&Y: Outside screw and yoke.
5. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.
 1. Certification that products for use in potable water systems comply with NSF 61 and NSF 372.

1.5 QUALITY ASSURANCE

- A. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.
- B. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
- C. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.

1.6 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 angle, gate, and globe valves closed to prevent rattling.
 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 5. Set butterfly valves closed or slightly open.
 6. Block 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 VALVES, GENERAL

- A. Isolation valves are scheduled on the Drawings. For other general plumbing valve applications, use the following:
 - 1. Shutoff Service: Ball valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- D. For valves not indicated in the Application Schedules, select valves with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends, except provide valves with threaded ends for condenser water, heating hot water, steam, and steam condensate services.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged, solder-joint, or threaded ends.
- 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 unless otherwise noted.
- F. Wetted surfaces of valves contacted by consumable water shall contain not more than 0.25 percent weighted average lead content.
 - 1. Exceptions:
 - a. Drain valves.
 - b. Valves in non-potable water systems.
 - c. Valves in other plumbing systems not intended for human consumption.
- G. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
- H. Valve Actuators:
 - 1. Lever Handle: For quarter-turn valves NPS 6 and smaller.
- I. Extended Valve Stems: On insulated valves.
- J. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
- K. Valve Grooved Ends: AWWA C606.
- L. Solder Joint: With sockets according to ASME B16.18.
 - 1. Caution: Disassemble valves when soldering, as recommended by the manufacturer, to prevent damage to internal parts.

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- M. Threaded: With threads according to ASME B1.20.1.
- N. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

- A. Bronze Ball Valves, General: MSS SP-110 and have bronze body complying with ASTM B 584, except for Class 250 which shall comply with ASTM B 61, full-depth ASME B1.20.1 threaded or solder ends, and blowout-proof stems.
- B. Two-Piece, Regular Port Bronze Ball Valves with Stainless-Steel Trim: Type 316 stainless-steel ball and stem, reinforced TFE seats, blow-out-proof stem, with adjustable stem packing, soldered or threaded ends; and 150 psig SWP and 600-psig CWP ratings.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; by Conbraco Industries, Inc.; Series 70LF-140/240.
 - b. Hammond Valve.
 - c. Kitz Corporation; Kitz Valves.
 - d. Milwaukee Valve Company; Model UPBA100S/150S.
 - e. NIBCO INC.; Models S-580-70-66-LF/T-580-70-66-LF.
 - f. Watts Water Technologies, Inc.

2.3 DRAIN VALVES

- A. Ball-Valve-Type, Hose-End Drain Valves:
 - 1. Bronze ball valve as specified in this Section. Lead free construction is not required.
 - 2. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.4 SOURCE QUALITY CONTROL

- A. Identification: Factory label or color coding to identify lead free valves.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. 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.

- C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. 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.
- F. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above center of pipe. Butterfly valves shall be installed with stem horizontal to allow support for the disc and the cleaning action of the disc.
- E. Install valves in position to allow full stem movement.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Lift Check Valves: With stem upright and plumb.

3.3 JOINT CONSTRUCTION

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

3.4 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.

END OF SECTION 22 0523

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SECTION 22 1116 - DOMESTIC WATER PIPING

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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.
- B. Related Sections include the following:
 1. Division 20 Section "Mechanical General Requirements."
 2. Division 20 Section "Basic Mechanical Materials and Methods" for materials and methods common to mechanical piping systems.
 3. Division 20 Section "Hangers and Supports."
 4. Division 20 Section "Meters and Gages" for thermometers, pressure gages, and fittings.
 5. Division 22 Section "General-Duty Valves for Plumbing."
 6. Division 22 Section "Domestic Water Piping Specialties" for water distribution piping specialties.

1.2 SUMMARY

- A. This Section includes domestic water piping inside the building.

1.3 PERFORMANCE REQUIREMENTS

- A. Where not indicated on the Drawings, provide components and installation capable of producing domestic water piping systems with 125 psig, unless otherwise indicated.

1.4 SYSTEMS DESCRIPTION

- A. Potable and non-potable domestic water piping system materials are scheduled on the Drawing.
- B. Refer to Application Schedules on the Drawings for valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Hot-Water-Piping, Balancing Duty: Calibrated balancing valves.
 - 2. Drain Duty: Hose-end drain valves.
- C. Transition and special fittings with pressure ratings at least equal to piping rating may be used unless otherwise indicated.

1.5 ACTION SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Fire-suppression-water piping.
 - 2. Domestic water piping.
 - 3. HVAC hydronic piping.

1.7 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Water Samples: Specified in Part 3 "Cleaning" Article.

1.8 QUALITY ASSURANCE

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

- B. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

1.9 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of water service.
 - 2. Do not proceed with interruption of water service without Owner's written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

- A. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.3 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L, water tube, drawn temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought- copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
 - 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.4 VALVES

- A. General-duty plumbing valves; and drain valves are specified in Division 22 Section "Plumbing Valves."
- B. Balancing valves are specified in Division 22 Section "Domestic Water Piping Specialties."

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earthwork."

3.2 PIPING SYSTEM INSTALLATION

- A. Basic piping installation requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
 - 1. Install hose-end drain valves at low points in water mains, risers, and branches.
 - 2. Install stop-and-waste drain valves where indicated.
- D. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Calibrated balancing valves are specified in Division 22 Section "Domestic Water Piping Specialties."
- E. Install domestic water piping level without pitch and plumb.

3.3 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."

3.4 HANGER AND SUPPORT INSTALLATION

- A. Pipe hanger and support devices are specified in Division 20 Section "Hangers and Supports." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - 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: MSS Type 49, spring cushion rolls, if indicated.
 - 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. Install supports according to Division 20 Section "Hangers and Supports."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for drawn-temper 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.
 - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 - 6. NPS 6: 10 feet with 5/8-inch rod.
 - 7. NPS 8: 10 feet with 3/4-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.
- G. 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 domestic water piping to distribution side of water meter with shutoff valve.
- C. Connect domestic water piping to existing domestic water distribution piping. Use dielectric fitting if connection dissimilar metals. Refer to Application Schedule on the Drawings and Division 20 Section "Basic Mechanical Materials and Methods" for dielectric fittings.
- D. Install piping adjacent to equipment and machines to allow service and maintenance.
- E. Connect domestic water piping to the following:
 - 1. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Plumbing Fixtures."

3.6 FIELD QUALITY CONTROL

- A. Inspect domestic water piping as follows:
 - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - 2. 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:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.

- b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- B. Test domestic water piping as follows:
 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 2. 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.
 3. 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.
 4. Cap and subject piping to static water pressure of 150 psig. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 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.

3.7 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 flow of hot water in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 5. Remove plugs used during testing of piping and plugs used 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 AND DISINFECTION

- A. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.
- B. Clean and disinfect potable and non-potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as 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. 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.

END OF SECTION 22 1116

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SECTION 22 1119 - DOMESTIC WATER PIPING SPECIALTIES

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 20 Section "Meters and Gages" for thermometers, pressure gages, and flow meters in domestic water piping.
 - 4. Division 22 Section "Domestic Water Piping " for water meters.
 - 5. Division 22 Section "Drinking Fountains, Water Coolers and Cuspidors" for water filters for water coolers.

1.2 PERFORMANCE REQUIREMENTS

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

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1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Diagram power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Flow Reports and Settings: For calibrated balancing valves.
- C. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- B. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
- C. NSF Compliance:
 - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
 - 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."
 - 3. Comply with NSF 372, "Drinking Water System Components – Lead Content" for components with wetted surfaces in contact with potable water.

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; Conbraco Industries, Inc.
 - b. FEBCO; a Division of Watts Water Technologies, Inc.
 - c. Watts Water Technologies, Inc.; Watts Regulator Co.
 - d. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Chrome plated.

2.2 BACKFLOW PREVENTERS

A. Beverage-Dispensing-Equipment Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; Conbraco Industries, Inc.
 - b. Watts Water Technologies, Inc.; Watts Regulator Co.
 - c. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1022.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/4 or NPS 3/8.
5. Body: Stainless steel or Acetal plastic.
6. End Connections: Threaded.

2.3 BALANCING VALVES

A. Calibrated Balancing Valves NPS 1/2:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Apollo Valves; by Conbraco Industries, Inc.
 - d. Bell & Gossett; Xylem Inc.
 - e. Flo Fab Inc.
 - f. Flow Design Inc.
 - g. Griswold Controls.
 - h. NIBCO INC.
 - i. IMI Indoor Climate; Tour & Andersson.
 - j. Taco, Inc.
 - k. Watts Water Technologies, Inc.; Watts Regulator Co.
2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.
3. Body: Dezincification resistant brass, or bronze.
4. Minimum Flow Rate: 0.3 gpm.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Calibrated Balancing Valves NPS 3/4 to NPS 2:

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

- a. Armstrong International, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Apollo Valves; by Conbraco Industries, Inc.
 - d. Bell & Gossett; Xylem Inc.
 - e. Flo Fab Inc.
 - f. Flow Design Inc.
 - g. Griswold Controls.
 - h. NIBCO INC.
 - i. IMI Indoor Climate; Tour & Andersson.
 - j. Taco, Inc.
 - k. Watts Water Technologies, Inc.; Watts Regulator Co.
2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.
 3. Body: Dezincification resistant brass, or bronze.
 4. Size: Same as connected piping, but not larger than NPS 2.
 5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.4 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Controls; Morris Group International; ST70.
 - b. Apollo Valves; Conbraco Industries, Inc.; Model MVD (34D Series).
 - c. Bradley Corporation.
 - d. Lawler Manufacturing Company, Inc.
 - e. Leonard Valve Company; Series 170-LF and 270-LF.
 - f. Watts Water Technologies, Inc.; Powers Division; Hydroguard Series LFe480, LFG480, and LFLM495.
 - g. Watts Water Technologies, Inc.; Watts Regulator Co.
 - h. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1070.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: 1/2-inch union or 3/8-inch compression; with integral check valves.
7. Accessories: Adjustable temperature-control knob.
8. Outlet Temperature Range: Adjustable from 85 deg F to 120 deg F. Set at 105 deg F .
9. Minimum Flow Rate: 0.5 gpm.
10. Valve Finish: Rough bronze.

2.5 OUTLET BOXES

A. Outlet Boxes:

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

- a. Sioux Chief Manufacturing Company, Inc.; Ox Box.
 - b. Oatey SCS.
 - c. Guy Gray Manufacturing Co., Inc.
2. Mounting: Recessed.
 3. Material and Finish: Enameled- or epoxy-painted-steel or Stainless-steel box and faceplate.
 4. Faucet: Combination, valved fitting or separate hot- and cold-water, valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
 5. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.
 6. Inlet Hoses: Two 60-inch- long, rubber household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.

B. Icemaker Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Sioux Chief Manufacturing Company, Inc.; Ox Box.
 - b. Oatey SCS.
 - c. LSP Products Group, Inc.
 - d. Acorn Engineering Company.
2. Mounting: Recessed.
3. Material and Finish: Enameled- or epoxy-painted-steel or Stainless-steel box and faceplate.
4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
5. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.6 FIRE-RATED OUTLET BOXES

A. Fire-Rated Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Sioux Chief Manufacturing Company, Inc.; Ox Box.
 - b. Oatey SCS; Fire-Rated Washing Machine Outlet Boxes.
2. Certification: Warnock Hersey certified for 1-hour and 2-hour fire-rated walls.
3. Mounting: Recessed. Using galvanized steel bracket.
4. Material and Finish: Bulk molded compound thermoset fire-rated plastic.
5. Faucets: Separate hot- and cold-water, 1/4-turn valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
6. Water Hammer Arrestors: Integral.
7. Drain: NPS 2 PVC tailpiece.
8. Drain Piece Metal Sleeve: Galvanized steel with integrated intumescent pad.
9. Box Pad: UL Classified Unifrax FyreWrap insulation material.

B. Fire-Rated Ice Maker Outlet Boxes:

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

- a. Sioux Chief Manufacturing Company, Inc.; Ox Box.
 - b. Oatey SCS; Fire-Rated Ice Maker Outlet Boxes.
2. Certification: Warnock Hersey certified for 1-hour and 2-hour fire-rated walls.
 3. Mounting: Recessed. Using galvanized steel bracket.
 4. Material and Finish: Bulk molded compound thermoset fire-rated plastic.
 5. Faucet: Cold-water, 1/4-turn valved fittings.
 6. Water Hammer Arrestors: Integral.
 7. Box Pad: UL Classified Unifrax FyreWrap insulation material.

2.7 WATER HAMMER ARRESTERS

A. Water Hammer Arresters (Copper Tube Type):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIFAB, Inc.
 - b. PPP Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Watts Water Technologies, Inc.; Watts Regulator Co.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

B. Water Hammer Arresters (Metal Bellows Type):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Precharged stainless steel bellows.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.8 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating: 125-psig minimum pressure rating at 140 deg F.
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.

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.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 1. Locate backflow preventers in same room as connected equipment or system.
 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 3. Do not install bypass piping around backflow preventers.
 4. Install strainer and soft-seated check valve upstream of backflow preventer. Exception: Fire protection backflow preventers.
- C. Install balancing valves in locations where they can easily be adjusted.
- D. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."
- E. Install water hammer arresters in water piping according to PDI-WH 201.
- F. Install air vents at high points of water piping.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping and specialties.

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Pressure vacuum breakers.
 - 2. Calibrated balancing valves.
 - 3. Outlet boxes.
- 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 Division 20 Section "Mechanical Identification."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
 - 1. Test each backflow prevention device according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.5 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves as follows:
 - 1. Set calibrated balancing valves at calculated presettings.
 - 2. Measure flow each station and adjust where necessary.
 - 3. Record settings and mark balancing devices.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 22 1119

SECTION 22 1316 - SANITARY WASTE AND VENT PIPING

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements".
 - 2. Division 20 Section "Basic Mechanical Materials and Methods".
 - 3. Division 22 Section "Drainage Piping Specialties".
 - 4. Division 22 Section "Chemical-Waste Piping" for chemical-waste and vent piping systems.
 - 5. Division 22 Section "Sewage Pumps."

1.2 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.3 SYSTEMS DESCRIPTIONS

- A. Sanitary waste and vent piping system materials are scheduled on the Drawing.

1.4 ACTION SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.

1.5 CLOSEOUT SUBMITTALS

- A. Field quality-control inspection and test reports.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Cast-iron soil pipe shall be marked with the collective trademark of Cast Iron Soil Pipe Institute (CISPI).
- C. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste 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. Notify Owner no fewer than two days in advance of proposed interruption of sanitary waste service.
 - 2. Do not proceed with interruption of sanitary waste service without Owner's written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
 - 1. Manufacturers:
 - a. ANACO-Husky; McWane Plumbing Group.
 - b. Ferguson Enterprises, Inc.; ProFlo (Private labeled IDEAL-TRIDON).
 - c. IDEAL-TRIDON.
 - d. MIFAB, Inc.
 - e. Mission Rubber Company; a division of MCP Industries, Inc.
 - f. Tyler Pipe; McWane Plumbing Group.
 - 2. Standards: CISPI 310.
 - 3. Description: NSF certified for compliance with CISPI 310. Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.3 COPPER TUBE AND FITTINGS

- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
 - 1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- A. Hard Copper Tube: ASTM B 88, Types M water tube, drawn temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
 - 3. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.4 SPECIALTY PIPE FITTINGS

- A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Manufacturers:
 - a. Dallas Specialty & Mfg. Co.
 - b. Fernco, Inc.
 - c. Logan Clay Products Company (The).
 - d. Mission Rubber Co.
 - e. NDS, Inc.

- f. Plastic Oddities, Inc.
- 2. Sleeve Materials:
 - a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Mission Rubber Co.
- C. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
 - 1. Manufacturers:
 - a. SIGMA Corp.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING SYSTEM 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. Basic piping installation requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- D. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.
- E. 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."

- F. 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 2 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.
- G. 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.
- H. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Sanitary Drain: 1/8-inch per foot downward in direction of flow, unless otherwise noted.
 - 2. Horizontal Sanitary Drainage Piping: 1/8-inch per foot downward in direction of flow, unless otherwise noted.
 - 3. Vent Piping: 1/8-inch per foot down toward vertical fixture vent or toward vent stack.
- I. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- J. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- B. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports are specified in Division 20 Section "Hangers and Supports." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Install individual, straight, horizontal piping runs according to the following:
 - 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. Install supports according to Division 20 Section "Hangers and Supports."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 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.
- 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.
 3. NPS 2-1/2: 108 inches with 1/2-inch rod.
 4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 5. NPS 6: 10 feet with 5/8-inch rod.
 6. NPS 8: 10 feet with 3/4-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 soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.

3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

3.6 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 20 Section "Mechanical Identification."

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 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.

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SANITARY WASTE AND VENT PIPING
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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.

END OF SECTION 22 1316

SECTION 22 1319 - DRAINAGE PIPING SPECIALTIES

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 22 Section "Plumbing Fixtures" for hair interceptors.

1.2 DEFINITIONS

- A. PVC: Polyvinyl chloride plastic.

1.3 ACTION SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary and storm piping specialty components.

1.6 COORDINATION

- A. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CAST-IRON CLEANOUTS

- A. Size: Cleanouts shall be same nominal size as the pipe they serve up to 4 inches. For pipes larger than 4 inches nominal size, minimum size of cleanout shall be 4 inches.
- B. Exposed Cast-Iron Cleanouts:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.; Series 58910.
 - b. MIFAB, Inc.; C1460.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; 4510 Series.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
 - 3. 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.
 - 4. Closure: Countersunk or raised-head, brass or bronze plug with tapered threads.
- C. Cast-Iron Floor Cleanouts (On-Grade Interior Floor Areas):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.; C1220-R.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 4023S-F.

- e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
- 2. Standard: ASME A112.36.2M.
 - 3. Type: Adjustable housing.
 - 4. Body or Ferrule: Cast iron.
 - 5. Clamping Device: Not required.
 - 6. Outlet Connection: Spigot.
 - 7. Closure: Brass, bronze, or plastic plug with tapered threads.
 - 8. Adjustable Housing Material: Cast iron with threads, set-screws or other device.
 - 9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy with scoriated cover in service areas, and recessed cover to accept floor finish material in finished floor areas.
 - 10. Frame and Cover Shape: Round.
 - 11. Top Loading Classification: Medium Duty.
 - 12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
- D. Cast-Iron Floor Cleanouts (Not-On-Grade Interior Floor Areas):
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.; C-1100-C-R-34.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 4333C.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
- 2. Standard: ASME A112.36.2M.
 - 3. Type: Adjustable housing.
 - 4. Body or Ferrule: Cast iron.
 - 5. Clamping Device: Required.
 - 6. Outlet Connection: Spigot.
 - 7. Closure: Brass, bronze, or plastic plug with tapered threads.
 - 8. Adjustable Housing Material: Cast iron with threads, set-screws or other device.
 - 9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy with scoriated cover in service areas, and recessed cover to accept floor finish material in finished floor areas.
 - 10. Frame and Cover Shape: Round.
 - 11. Top Loading Classification: Medium Duty.
 - 12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
- E. Cast-Iron Wall Cleanouts (Finished Wall Areas):
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.; Model 58790-20.
 - b. MIFAB, Inc.; C1460-RD.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.

- e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
- 2. Standard: ASME A112.36.2M. Include wall access.
 - 3. Body: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
 - 4. Closure: Countersunk or raised-head, drilled-and-threaded bronze or brass plug with tapered threads.
 - 5. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains (Toilet Rooms and Janitor's Closet) FD-1:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Sioux Chief Manufacturing Company, Inc.; Finish Line Adjustable Drainage System.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 2005Y-A.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
- 2. Standard: ASME A112.6.7.
- 3. Pattern: Floor drain.
- 4. Body Material: Gray iron.
- 5. Seepage Flange: Required.
- 6. Clamping Device: Required.
- 7. Outlet: Bottom unless otherwise noted.
- 8. Coating on Interior and Exposed Exterior Surfaces: Enamel.
- 9. Top or Strainer Material: Nickel bronze.
- 10. Top of Body and Strainer Finish: Nickel bronze.
- 11. Top Shape: Round, with vandal proof screws.
- 12. Dimensions of Top or Strainer: 7 inch diameter.
- 13. Top Loading Classification: Light Duty.
- 14. Inlet Fitting: Gray iron, with spigot outlet.

B. Cast-Iron Floor Drains (Showers) FD-2:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Sioux Chief Manufacturing Company, Inc.; Finish Line Adjustable Drainage System.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 2005Y-A.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.7.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Clamping Device: Required.
7. Outlet: Bottom unless otherwise noted.
8. Coating on Interior and Exposed Exterior Surfaces: Enamel.
9. Top or Strainer Material: Nickel bronze.
10. Top of Body and Strainer Finish: Nickel bronze.
11. Top Shape: Round, with vandal proof screws.
12. Dimensions of Top or Strainer: 5 inch diameter.
13. Top Loading Classification: Light Duty.
14. Inlet Fitting: Gray iron, with spigot outlet.

2.3 AIR-ADMITTANCE VALVES

A. Fixture Air-Admittance Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ayrlett, LLC.
 - b. Durgo, Inc.
 - c. Oatey.
 - d. ProSet Systems Inc.
 - e. RectorSeal.
 - f. Studor, Inc.
2. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.
3. Housing: Plastic.
4. Operation: Mechanical sealing diaphragm.
5. Size: Same as connected fixture or branch vent piping.

B. Stack Air-Admittance Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Durgo, Inc.
 - b. Oatey.
 - c. Studor, Inc.
2. Standard: ASSE 1050 for vent stacks.
3. Housing: Plastic.
4. Operation: Mechanical sealing diaphragm.
5. Size: Same as connected stack vent or vent stack.

2.4 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.
- B. Description: Manufactured assembly consisting of metal flashing collar and skirt extending at least 10 inches from pipe, with boot reinforcement and counterflashing fitting.
 1. Open-Top Vent Cap: Without cap.
 2. Low-Silhouette Vent Cap: With vandal-proof vent cap.
 3. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.5 TRAP SEAL PROTECTION DEVICES

- A. Barrier Type Trap Seal Protection Devices:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Smith, Jay R. Mfg. Co.; Quad Close Trap Seal Device Fig. 2692.
 - b. Rectorseal; a CSW Industrials Company; SureSeal Plus Inline Floor Drain Trap Sealer.
 2. Standard: ASSE 1072-2007.
 3. Sealing Element: Neoprene rubber or chemically resistant elastomer.
 4. Size: 3 inch.
 5. Gravity Drain Outlet Connection: Compression fit sealing gasket 80 durometer.

2.6 MISCELLANEOUS DRAINAGE PIPING SPECIALTIES

- A. Hub Outlets:
 1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
 2. Size: Same as connected waste piping with increaser fitting of size indicated.
- B. Sleeve Flashing Device:
 1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
 2. Size: As required for close fit to riser or stack piping.
- C. Stack Flashing Fittings:
 1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
 2. Size: Same as connected stack vent or vent stack.

2.7 FLASHING MATERIALS

- A. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:
 - 1. General Applications: 12 oz./sq. ft.
 - 2. Vent Pipe Flashing: 8 oz./sq. ft.
- B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- D. Fasteners: Metal compatible with material and substrate being fastened.
- E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- F. Solder: ASTM B 32, lead-free alloy.
- G. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.8 INSTALLATION

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.
- B. 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.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

- a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
 - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- F. Install fixture air-admittance valves on fixture drain piping.
- G. Install stack air-admittance valves at top of stack vent and vent stack piping.
- H. Install air-admittance-valve wall boxes recessed in wall.
- I. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- J. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- K. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- L. Install wood-blocking reinforcement for wall-mounting-type specialties.
- M. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- N. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.
- O. Install through-penetration firestop assemblies for penetrations of fire- and smoke-rated assemblies.
- 1. Comply with requirements in Division 07 Section "Penetration Firestopping."

2.9 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

2.10 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. 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 Division 07 Section "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.

2.11 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 1319

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DRAINAGE PIPING SPECIALTIES
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SECTION 22 4200 - PLUMBING FIXTURES

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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.
- B. Related Sections include the following:
- 1. Division 10 Section "Toilet and Bath Accessories."
 - 2. Division 20 Section "Mechanical General Requirements."
 - 3. Division 20 Section "Basic Mechanical Materials and Methods."

4. Division 22 Section "Drinking Fountains and Water Coolers."
5. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers; individual-fixture, water tempering valves; and specialty fixtures not included in this Section.
6. Division 22 Section "Drainage Piping Specialties" for floor drains, and specialty fixtures not included in this Section.

1.2 DEFINITIONS

- A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- C. PVC: Polyvinyl chloride plastic.
- D. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

1.4 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Diagram power, signal, and control wiring.
- B. Coordination Drawings: Counter cutout templates for mounting of counter-mounted plumbing fixtures.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For plumbing fixtures and trim to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
- F. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components – Lead Content for potable domestic water piping and components.
- G. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- H. Comply with applicable ANSI, ASME, ASSE, ASTM, ICC, NSF, and UL standards and other requirements specified for plumbing fixtures, trim, fittings, components, and features.

PART 2 - PRODUCTS

2.1 WATER CLOSETS

- A. Water Closets, WC-1:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.; Madera FloWise 16-1/2" Elongated Toilet.
 - b. Kohler Co.; Highcliff Ultra K-96057.
 - c. Sloan Valve Company.
 - d. Zurn Plumbing Products Group.
 - 2. Description: Accessible, floor-mounting, floor-outlet, vitreous-china fixture designed for flushometer valve operation.
 - a. Style: Flushometer valve.
 - 1) Bowl Type: Elongated with siphon-jet design. Include bolt caps matching fixture.
 - 2) Supply Spud Location: Top.
 - 3) Height: 16-1/2 to 16-3/4 inches, universal/accessible.
 - 4) Design Consumption: 1.6 gal./flush.
 - 5) Color: White.
 - b. Flushometer: FV-2-1.
 - c. Toilet Seat: TS-1.

2.2 HARD-WIRED SENSOR WATER CLOSET FLUSHOMETERS

A. Flushometers, FV-2-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.
 - b. Delany Products.
 - c. Delta Faucet Company; 81T201HWA.
 - d. Moen Commercial.
 - e. Sloan Valve Company (Basis of Design)
 - f. Zurn Plumbing Products Group.
2. Description: Flushometer for water-closet-type fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, courtesy flush feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.
 - a. Internal Design: Diaphragm or piston operation.
 - b. Style: Concealed.
 - c. Inlet Size: NPS 1.
 - d. Trip Mechanism: Hard-wired, electric-sensor actuator.
 - e. Consumption: 1.6 gal./flush.
 - f. Tailpiece Size: NPS 1-1/2 and standard length to top of bowl.
 - g. Transformer: 1 required for up to 8 flushometers.

2.3 URINALS

A. Urinals, UR-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.; Washbrook Urinal System.
 - b. Kohler Co.; Bardon K 4991-ETSS.
 - c. Sloan Valve Company (Basis of Design).
 - d. Zurn Industries, Inc.; EcoVantage.
2. Description: Wall-mounting, back-outlet, ultra-low water consumption, vitreous-china fixture designed for flushometer valve operation.
 - a. Type: High efficiency.
 - b. Strainer or Trapway: Open trapway with integral trap.
 - c. Design Consumption: Operates in the range of 1 gal./flush.
 - d. Color: White.
 - e. Supply Spud Size: NPS 3/4.
 - f. Supply Spud Location: Top.
 - g. Outlet Size: NPS 2 .
 - h. Flushometer: FV-1-1.
 - i. Fixture Support: Urinal chair carrier.

2.4 HARD WIRED SENSOR URINAL FLUSHOMETERS

A. Flushometers, FV-1-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.
 - b. Delany Products.
 - c. Delta Faucet Company; 81T231-HWA.
 - d. Moen Commercial.
 - e. Sloan Valve Company (Basis of Design).
 - f. Zurn Plumbing Products Group.
2. Description: Flushometer for urinal -type fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, courtesy flush feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.
 - a. Internal Design: Diaphragm or piston operation.
 - b. Style: Concealed.
 - c. Inlet Size: NPS 3/4.
 - d. Trip Mechanism: Hard-wired, electric-sensor actuator.
 - e. Consumption: 1.0 gal./flush.
 - f. Tailpiece Size: NPS 3/4 and standard length to top of fixture.
 - g. Transformer: 1 required for up to 8 flushometers.

2.5 TOILET SEATS

A. Toilet Seats, TS-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bemis Manufacturing Company; 1955SSC/1955SSCT.
 - b. Centoco Manufacturing Corp.
 - c. Church Seats; 295SSC/295SSCT.
 - d. Comfort Seats; a Jones Stephens Brand; Model Number C106SSC.
 - e. Ferguson Enterprises, Inc.; ProFlo PFTSCOF2000WH.
 - f. Olsonite Seat Company; Model 10SSC/10SSCT.
 - g. Plumbtech; Plumbing Technologies, LLC.
 - h. Sanderson Plumbing Products, Inc.; Beneke Div.
 - i. Zurn Plumbing Products Group; 5955STS-WH.
2. Description: Toilet seat for water-closet-type fixture.
 - a. Material: Molded, solid plastic.
 - b. Configuration: Open front without cover.
 - c. Size: Elongated.
 - d. Hinge Type: SC, self-sustaining, check.
 - e. Class: Standard commercial.
 - f. Color: White.

2.6 LAVATORIES

A. Lavatories, LAV-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.; Lucerne Model 0355.012.
 - b. Ferguson Enterprises, Inc.; ProFlo PF5504.
 - c. Kohler Co.; K 2005 Kingston.
 - d. Sloan Valve Company.
 - e. Zurn Plumbing Products Group; Z5344.
2. Description: Accessible, wall-mounting, vitreous-china fixture.
 - a. Type: With contoured back and side shields.
 - b. Size: 20 by 18 inches rectangular.
 - c. Faucet Hole Punching: Three holes, 2-inch centers.
 - d. Color: White.
 - e. Faucet: LF-1
 - f. Water Temperature Limiting Device: Required.
 - g. Drain: Grid with offset waste.
 - h. Drain Piping: NPS 1-1/4 chrome-plated, cast-brass P-trap; NPS 1-1/4, 17 gage tubular brass waste to wall; and wall escutcheon.
 - i. Fixture Support: Lavatory with concealed arms.

B. Lavatories, LAV-2:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.; Ovalyn 9482.
 - b. Ferguson Enterprises, Inc.; ProFlo PF5300.
 - c. Kohler Co.; K 2210 Caxton.
 - d. Sloan Valve Company; Model SS-3001.
 - e. Zurn Plumbing Products Group; Z5520.
2. Description: Accessible, under-counter mounting, vitreous-china fixture with unglazed rim, and concealed overflow.
 - a. Oval Lavatory Size: 19 by 16 inches.
 - b. Color: White.
 - c. Faucet: LF-1.
 - d. Water Temperature Limiting Device: Required.
 - e. Drain: Grid with offset waste.
 - f. Drain Piping: NPS 1-1/4 chrome-plated, cast-brass P-trap; NPS 1-1/4, 17 gage tubular brass waste to wall; and wall escutcheon.

2.7 LAVATORY FAUCETS

A. Lavatory Faucets, LF-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.; Fluent Single Control
 - b. Chicago Faucets
 - c. Delta Faucet Company
 - d. Geberit Manufacturing, Inc.
 - e. Kohler Co.
 - f. Moen Commercial.
 - g. Speakman Company.
 - h. T & S Brass and Bronze Works, Inc.
 - i. Zurn Plumbing Products Group.
2. Description: Single-control mixing faucet, vandal resistant, single hole.
 - a. Body Material: Commercial, solid brass.
 - b. Finish: Polished chrome plate.
 - c. Maximum Flow: 0.5 gal.
 - d. Mounting: Deck, concealed.
 - e. Valve Handle(s): Lever handle.
 - f. Inlet(s): NPS 1/2.
 - g. Spout Outlet: Vandal resistant aerator.
 - h. Operation: Self-closing, metering, with replaceable valve cartridge.

2.8 COUNTER-MOUNTING SINKS

A. Sinks, SK-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkay Manufacturing Co.
 - b. Franke Consumer Products, Inc., Commercial Div.
 - c. Just Manufacturing Company.
 - d. Moen Commercial.
2. Description: Single-bowl, under counter-mounting, stainless-steel sink.
 - a. Overall Dimensions: 23 inches left to right by 18 1/4 inches front to back.
 - b. Metal Thickness: 18 gage, with sound dampened underside.
 - c. Bowl:
 - 1) Dimensions: 21-1/4 inches by 15-3/4 inches by 7-1/2 inches deep.
 - 2) Drain: 3-1/2-inch grid.
 - d. Sink Faucet: SF-1.
 - e. Water Temperature Limiting Device: As required by code.
 - f. Drain Piping: NPS 1-1/2 chrome-plated, cast-brass P-trap; 17 gage tubular brass waste to wall; and wall escutcheon(s).
 - g. Disposer: D-1.

B. Sinks, SK-2:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkay Manufacturing Co.
 - b. Franke Consumer Products, Inc., Commercial Div.
 - c. Just Manufacturing Company.
 - d. Moen Commercial.
2. Description: Single-bowl, under counter-mounting, stainless-steel sink.
 - a. Overall Dimensions: 30-1/2 inches left to right by 18 1/2 inches front to back.
 - b. Metal Thickness: 18 gage, with sound dampened underside.
 - c. Bowl:
 - 1) Dimensions: 28 inches by 16 inches by 7-5/8 inches deep.
 - 2) Drain: 3-1/2-inch grid.
 - d. Sink Faucet: SF-1.
 - e. Water Temperature Limiting Device: As required by code.
 - f. Drain Piping: NPS 1-1/2 chrome-plated, cast-brass P-trap; 17 gage tubular brass waste to wall; and wall escutcheon(s).
 - g. Disposer: D-1.

2.9 SERVICE BASINS

A. Service Basins:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company.
 - b. Crane Plumbing, LLC; Fiat Products; an American Standard Brand.
 - c. Florestone Products Co., Inc.
 - d. Precast Terrazzo Enterprises, Inc.
 - e. Stern-Williams Co., Inc.
 - f. Crane Plumbing, LLC; Fiat Products; an American Standard Brand.
 - g. Ferguson Enterprises, Inc.; ProFlo.
 - h. Florestone Products Co., Inc.
 - i. Mustee, E. L. & Sons, Inc.
 - j. Swan; American Bath Group.
 - k. Zurn Plumbing Products Group; Light Commercial Operation.
2. Description: Flush-to-wall, floor-mounting, cast-polymer fixture with rim guard.
 - a. Shape: Square.
 - b. Size: 24 by 24 inches
 - c. Height: 10 inches.
 - d. Tiling Flange: On two side.
 - e. Rim Guard: On front top surfaces.

- f. Color: Not applicable.
- g. Faucet: SF-2.
- h. Drain: Grid with NPS 3 outlet.

2.10 SINK FAUCETS

A. Sink Faucets, SF-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc; Avery Pull Down Kitchen Faucet
 - b. Chicago Faucets.
 - c. Delta Faucet Company.
 - d. Kohler Co.
 - e. Moen Commercial.
 - f. Speakman Company.
 - g. T & S Brass and Bronze Works, Inc.
 - h. Zurn Plumbing Products Group.
2. Description: Kitchen sink style faucet. Coordinate faucet inlet with supplies and fixture hole; coordinate outlet with spout and fixture receptor.
 - a. Body Material: Commercial, solid brass.
 - b. Finish: Polished chrome plate.
 - c. Mixing Valve: Single handle.
 - d. Centers: N/A.
 - e. Mounting: Deck.
 - f. Handle(s): Lever, ADA compliant.
 - g. Operation: Noncompression, manual.
 - h. Inlet(s): NPS 3/8.
 - i. Spout Type: Spray hose with retractable spray head.
 - j. Spout Outlet: Aerator.
 - k. Maximum Flow Rate:
 - 1) 1.5 gpm .

B. Sink Faucets, SF-2:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.
 - b. Chicago Faucets; Model 897.
 - c. Delta Faucet Company; Model 28C2383.
 - d. Ferguson Enterprises, Inc.; ProFlo PF1118.
 - e. Kohler Co.
 - f. Moen Commercial.
 - g. Speakman Company; SC5811-RCP-LEV-5H-WHK.
 - h. Symmons Industries, Inc.
 - i. T & S Brass and Bronze Works, Inc.

- j. Zurn Plumbing Products Group.
2. Description: Service sink faucet with stops in shanks, vacuum breaker, hose-thread outlet, and pail hook. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor. Include 5 foot rubber hose and wall mounted hose clamp.
- a. Body Material: Commercial, solid brass.
 - b. Finish: Polished chrome plate.
 - c. Maximum Flow Rate: 2.5 gpm, unless otherwise indicated.
 - d. Mixing Valve: Two handle.
 - e. Centers: 8 inches.
 - f. Mounting: Back/wall.
 - g. Handle(s): Lever.
 - h. Inlet(s): NPS 1/2.
 - i. Spout Type: Rigid, solid brass with wall brace and pail hook.
 - j. Spout Outlet: Hose thread.
 - k. Vacuum Breaker: Required.
 - l. Operation: Noncompression, manual.

2.11 SHOWER FAUCETS

A. Shower Faucets:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. Acorn Controls; Morris Group International; SV16.
 - b. American Standard Companies, Inc.
 - c. Bradley Corporation.
 - d. Chicago Faucets.
 - e. Delta Faucet Company.
 - f. Kohler Co.; KP15611-4-CP w K304-KS-NA valve.
 - g. Lawler Manufacturing Co., Inc.
 - h. Leonard Valve Company.
 - i. Moen Commercial.
 - j. Powers; a Watts Water Technologies Co.
 - k. Speakman Company.
 - l. Symmons Industries, Inc.
 - m. Zurn Plumbing Products Group.
2. Description: Single-handle, ADA, thermostatic and pressure-balance valve. Include hot- and cold-water indicators; check stops; and shower head, arm, and flange. Coordinate faucet inlets with supplies and outlet with diverter valve.
- a. Body Material: Solid brass.
 - b. Finish: Polished chrome plate.
 - c. Maximum Flow Rate: 2.5 gpm, unless otherwise indicated.
 - d. Diverter Valve: Required.
 - e. Mounting: Concealed.

- f. Backflow Protection Device for Hand-Held Shower: Required.
- g. Operation: Compression, manual.
- h. Antiscald Device: ASSE 1016, integral with mixing valve.
- i. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
- j. Supply Connections: NPS 1/2.
- k. Shower Head Type: Ball joint and hand held, slide bar mounted.
- l. Shower Head Material: Metallic with chrome-plated finish.
- m. Spray Pattern: Adjustable.
- n. Integral Volume Control: Required.
- o. Shower-Arm Flow-Control Fitting: Not required.

2.12 FIXTURE SUPPLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. BrassCraft; a Masco Company.
 - 2. McGuire Mfg. Co., Inc.
 - 3. Any of the approved plumbing fixture manufacturers.
- B. Description: Chrome-plated brass, loose-key or screwdriver angle stops with brass stems; rigid, chrome-plated copper risers; and chrome-plated wall flanges.

2.13 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers (PSG-1):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Engineered Brass Co.
 - b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
 - c. McGuire Manufacturing Co., Inc.
 - d. Oatey; Dearborn Safety Series.
 - e. Plumberex Specialty Products Inc.
 - f. TCI Products; SG-200BV.
 - g. TRUEBRO, Inc.
 - h. Zurn Plumbing Products Group; Z8946-3-NT.
 - 2. 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.

2.14 FIXTURE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Josam Company.
 - 2. MIFAB Manufacturing Inc.

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3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Urinal Supports:

1. Description: For wall-mounting, urinal-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

C. Lavatory Supports:

1. Description: Lavatory carrier with concealed arms and tie rods for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

D. Sink Supports:

1. Description: For wall-mounting sink-type fixture. Include steel uprights with feet.
 - a. Type I, sink carrier with exposed arms and tie rods.
 - b. Type II, sink carrier with hanger plate, bear studs, and tie rod.
 - c. Type III, sink carrier with hanger plate and exposed arms.

2.15 DISHWASHER AIR-GAP FITTINGS

A. Dishwasher Air-Gap Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. B & K Industries, Inc.
 - b. Brass Craft Mfg. Co.; a Subsidiary of Masco Corporation.
 - c. Brasstech Inc.; Newport Brass Div.
 - d. Dearborn Brass; a div. of Moen, Inc.
 - e. Geberit Manufacturing, Inc.
 - f. JB Products; a Federal Process Corporation Company.
 - g. Sioux Chief Manufacturing Company, Inc.
 - h. Watts Brass & Tubular; a division of Watts Regulator Co.
2. Description: Fitting suitable for use with domestic dishwashers and for deck mounting; with plastic body, chrome-plated brass cover; and capacity of at least 5 gpm; and inlet pressure of at least 5 psig at a temperature of at least 140 deg F. Include 5/8-inch- ID inlet and 7/8-inch- ID outlet hose connections.
3. Hoses: Rubber and suitable for temperature of at least 140 deg F.
 - a. Inlet Hose: 5/8-inch ID and 48 inches long.
 - b. Outlet Hose: 7/8-inch ID and 48 inches long.

2.16 DISPOSERS

A. Disposers, D-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. In-Sink-Erator; a div. of Emerson Electric Co.; Badger 5XP.
2. Description: Continuous-feed, household type food-waste disposer. Include reset button; wall switch; corrosion-resistant chamber with jam-resistant, cutlery- or stainless-steel grinder or shredder; NPS 1-1/2 outlet; quick-mounting, stainless-steel sink flange; antisplash guard; and combination cover/stopper. Include cord with grounded plug.
 - a. Motor: 115-V ac, 1725 rpm, 3/4 hp with overload protection.

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 plumbing fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-mounting fixtures with tubular waste piping attached to supports.
- F. Install counter-mounting fixtures in and attached to casework.
- G. Install fixtures level and plumb according to roughing-in drawings. Install accessible fixtures at heights required by local codes.

- H. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
 - 1. Exception: Fixtures with flushometer valves, and faucets or valves with integral stops.
- I. Install ASSE 1070 water-temperature limiting devices on supplies for lavatories and sinks that will be used for handwashing, and where specified. Refer to Division 20 Section "Domestic Water Piping Specialties."
- J. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- K. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- L. Install protective shielding guards PSG-1 on exposed traps and supplies of lavatories, and sinks used for hand washing.
- M. Install toilet seats on water closets.
- N. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- O. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- P. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- Q. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- R. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- S. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.
- T. Install dishwasher air-gap fitting at each sink indicated to have air-gap fitting. Install in sink deck. Connect inlet hose to dishwasher and outlet hose to disposer.
- U. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- V. Set service basins in leveling bed of cement grout. Grout is specified in Division 20 Section "Basic Mechanical Materials and Methods."
- W. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Individual water line branches, waste lines, vents, and traps for connection to individual fixtures, fixture fittings and specialties shall be in accordance with the schedule on the Drawings.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding."
- E. Connect wiring according to Division 26 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Operate and adjust disposers. Replace damaged and malfunctioning units.
- C. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
- D. Replace washers and seals, or cartridges of leaking and dripping faucets and stops.

3.6 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - 2. Remove sediment and debris from drains.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

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3.7 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 4200

SECTION 22 4700 - DRINKING FOUNTAINS, WATER COOLERS, AND CUSPIDORS

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."

1.2 DEFINITIONS

- A. Accessible Drinking Fountain or Water Cooler: Fixture that can be approached and used by people with disabilities.
- B. Drinking Fountain: Fixture with nozzle for delivering stream of water for drinking.
- C. Fitting: Device that controls flow of water into or out of fixture.
- D. Fixture: Drinking fountain or water cooler.
- E. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

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1.3 ACTION SUBMITTALS

- A. Product Data: For each fixture indicated. Include rated capacities, furnished specialties, and accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Diagram power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Operation and Maintenance Data: For fixtures to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities for fixtures for people with disabilities.
- C. Regulatory Requirements: Comply with requirements in the U.S. Architectural & Transportation Barriers Compliance Board's "Uniform Federal Accessibility Standards (UFAS), 1985-494-187" about fixtures for people with disabilities.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.
- E. AHRI Standard: Comply with AHRI's "Directory of Certified Drinking Water Coolers" for style classifications.
- F. AHRI Standard: Comply with AHRI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with AHRI's "Directory of Certified Drinking Water Coolers" for type and style classifications.
- G. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.

PART 2 - PRODUCTS

2.1 PRESSURE (ELECTRIC) WATER COOLERS

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

- a. Elkay Manufacturing Co.; EZH2O System LZSTL8WSLK.
 - b. Halsey Taylor.
 - c. Haws Corporation.
 - d. Murdock Manufacturing; A Member of Morris Group International.
 - e. Oasis Corporation.
 - f. Sunroc Corp.
2. Description: Accessible, AHRI 1010, Type PB, pressure with bubbler, Style W, wall-mounting water cooler for adult/child-mounting height with bottle filling station.
- a. Cabinet: Bilevel with two attached cabinets baked enamel finish or vinyl-covered steel with stainless-steel top, and single filtered cooler with bottle filling station.
 - b. Bubbler: One, flexible or elastomeric overmolded, with adjustable stream regulator, located on each cabinet deck.
 - c. Control: Push bar.
 - d. Supply: NPS 3/8 with isolation valve.
 - e. Filter: Complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
 - f. Drain(s): Grid with NPS 1-1/4 minimum horizontal waste and trap complying with ASME A112.18.1.
 - g. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
 - 1) Capacity: 8 gph of 50 deg F cooled water from 80 deg F inlet water and 90 deg F ambient air temperature.
 - 2) Electrical Characteristics: 1/5 hp; 120-V ac; single phase; 60 Hz.
 - h. Bottle Filling Station: Recessed design constructed of 18 gage Type 300 series stainless steel and ABS plastic. Include:
 - 1) Electronic sensor for no-touch activation.
 - 2) Automatic 20-second shut-off timer.
 - 3) 1.1 gpm flow rate
 - 4) Anti-microbial protected plastic components.
 - i. Support: Refer to "Fixture Supports" Article.

2.2 DRINKING FOUNTAINS

A. Drinking Fountains (DF-1):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkay Manufacturing Co.; EDFP214C.
 - b. Halsey Taylor; HRFE.
 - c. Haws Corporation; 1109.
 - d. Murdock Manufacturing; A Member of Morris Group International; A151400B.
 - e. Oasis Corporation; FLF140PM.

- f. Sunroc Corp.; SF-3400.
- 2. Description: Style W, wall-mounting drinking fountain.
 - a. Material: Stainless steel.
 - b. Receptor Shape: Rectangular.
 - c. Back Panel: Stainless-steel wall plate behind drinking fountain.
 - d. Bubblers: One, flexible or elastomeric overmolded, with adjustable stream regulator, located on deck.
 - e. Control: Push button.
 - f. Supply: NPS 3/8 with isolation valve.
 - g. Drain: Grid with NPS 1-1/4 minimum horizontal waste and trap complying with ASME A112.18.2.
 - h. Support: Refer to "Fixture Supports" Article.

2.3 FIXTURE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Josam Co.
 - 2. MIFAB Manufacturing, Inc.
 - 3. Smith, Jay R. Mfg. Co.; A Member of Morris Group International.
 - 4. Tyler Pipe; Wade Div.
 - 5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
 - 6. Zurn Plumbing Products Group; Specification Drainage Operation.
- B. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.
 - 1. Type I: Hanger-type carrier with two vertical uprights.
 - 2. Type II: Bilevel, hanger-type carrier with three vertical uprights.
 - 3. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.
- B. Examine walls and floors for suitable conditions where fixtures are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.
- B. Use mounting frames for recessed water coolers, unless otherwise indicated.
- C. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.3 INSTALLATION

- A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.
- B. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.
- C. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing."
- E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- F. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- G. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding."
- D. Connect wiring according to Division 26 Section "Conductors and Cables."

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DRINKING FOUNTAINS, WATER COOLERS AND CUSPIDORS
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3.5 FIELD QUALITY CONTROL

- A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.
 - 1. Remove and replace malfunctioning units and retest as specified above.
 - 2. Report test results in writing.

3.6 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust water cooler temperature settings.

3.7 CLEANING

- A. After completing fixture installation, 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.

END OF SECTION 22 4700

SECTION 23 0130 - HVAC AIR-DISTRIBUTION SYSTEM CLEANING

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 23 Section "Metal Ducts."
 - 3. Division 23 Section "Duct Accessories."

1.2 SUMMARY

- A. Section includes cleaning HVAC air-distribution equipment, ducts, plenums, and system components.

1.3 DEFINITIONS

- A. ASCS: Air Systems Cleaning Specialist.
- B. NADCA: National Air Duct Cleaners Association.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For ASCS.

- B. Strategies and procedures plan.

1.5 CLOSEOUT SUBMITTALS

- A. Cleanliness verification report.

1.6 QUALITY ASSURANCE

- A. ASCS Qualifications: A certified member of NADCA.
 - 1. Certification: Employ an ASCS certified by NADCA on a full-time basis.
 - 2. Supervisor Qualifications: Certified as an ASCS or CVI by NADCA.
- B. UL Compliance: Comply with UL 181 and UL 181A for fibrous-glass ducts.
- C. Cleaning Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to HVAC air-distribution system cleaning including, but not limited to, review of the cleaning strategies and procedures plan.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 ACCEPTABLE AGENCIES

- A. Engage a NADCA member company with qualified ASCS to clean HVAC air distribution systems.
 - 1. Acceptable HVAC air distribution system cleaning companies in Michigan:
 - a. Dalton Environmental Cleaning Corp.; Whitmore Lake, MI.
 - b. DUCTZ of Southeast Michigan; Livonia, MI.
 - c. Dusty Ducts, Inc.; Livonia, MI.
 - d. Fresh Air Solutions, Inc.; Carleton, MI.
 - e. Safety King, Inc.; Shelby Township, MI.
 - f. Sani-Vac Service, Inc.; Warren MI.
 - g. Ventcon, Inc.; Allen Park, MI.

3.2 EXAMINATION

- A. Examine HVAC air-distribution equipment, ducts, plenums, and system components to determine appropriate methods, tools, and equipment required for performance of the Work.
- B. Perform "Project Evaluation and Recommendation" according to NADCA ACR 2016.

- C. Prepare written report listing conditions detrimental to performance of the Work.
- D. Proceed with work only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

- A. Prepare a written plan that includes strategies and step-by-step procedures. At a minimum, include the following:
 - 1. Supervisor contact information.
 - 2. Work schedule including location, times, and impact on occupied areas.
 - 3. Methods and materials planned for each HVAC component type.
 - 4. Required support from other trades.
 - 5. Equipment and material storage requirements.
 - 6. Exhaust equipment setup locations if required.
- B. Use the existing service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry and for inspection.
- C. Comply with NADCA ACR 2016, "Guidelines for Constructing Service Openings in HVAC Systems" Section.

3.4 CLEANING

- A. Comply with NADCA ACR 2016.
- B. Remove visible surface contaminants and deposits from within the HVAC system.
- C. Systems and Components to Be Cleaned:
 - 1. Air devices for supply and return air.
 - 2. Air-terminal units.
 - 3. Ductwork:
 - a. Supply-air ducts, including turning vanes and dampers.
 - b. Return-air ducts to the air-handling unit.
 - c. Exhaust-air ducts.
 - 4. Filters and filter housings.
- D. Collect debris removed during cleaning. Ensure that debris is not dispersed outside the HVAC system during the cleaning process.
- E. Particulate Collection:
 - 1. For particulate collection equipment, include adequate filtration to contain debris removed. Locate equipment downwind and away from all air intakes and other points of entry into the building.
 - 2. HEPA filtration with 99.97 percent collection efficiency for particles sized 0.3 micrometer or larger shall be used where the particulate collection equipment is exhausting inside the building,

- F. Control odors and mist vapors during the cleaning and restoration process.
- G. Mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning. Restore them to their marked position on completion of cleaning.
- H. System components shall be cleaned so that all HVAC system components are visibly clean. On completion, all components must be returned to those settings recorded just prior to cleaning operations.
- I. Clean all air-distribution devices, registers, grilles, and diffusers.
- J. Clean visible surface contamination deposits according to NADCA ACR 2016 and the following:
 - 1. Clean air-handling units, airstream surfaces, components, condensate collectors, and drains.
 - 2. Ensure that a suitable operative drainage system is in place prior to beginning wash-down procedures.
 - 3. Clean evaporator coils, reheat coils, and other airstream components.
- K. Duct Systems:
 - 1. Create service openings in the HVAC system as necessary to accommodate cleaning.
 - 2. Mechanically clean duct systems specified to remove all visible contaminants so that the systems are capable of passing the HVAC System Cleanliness Tests (see NADCA ACR 2016).
- L. Debris removed from the HVAC system shall be disposed of according to applicable Federal, state, and local requirements.
- M. Mechanical Cleaning Methodology:
 - 1. Source-Removal Cleaning Methods: The HVAC system shall be cleaned using source-removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and to safely remove these contaminants from the facility. No cleaning method, or combination of methods, shall be used that could potentially damage components of the HVAC system or negatively alter the integrity of the system.
 - a. Use continuously operating vacuum-collection devices to keep each section being cleaned under negative pressure.
 - b. Cleaning methods that require mechanical agitation devices to dislodge debris that is adhered to interior surfaces of HVAC system components shall be equipped to safely remove these devices. Cleaning methods shall not damage the integrity of HVAC system components or damage porous surface materials such as duct and plenum liners.
 - 2. Cleaning Mineral-Fiber Insulation Components:
 - a. Fibrous-glass thermal or acoustical insulation elements present in equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment while the HVAC system is under constant negative pressure and shall not be permitted to get wet according to NADCA ACR 2016.
 - b. Cleaning methods used shall not cause damage to fibrous-glass components and will render the system capable of passing the HVAC System Cleanliness Tests (see NADCA ACR 2016).
 - c. Fibrous materials that become wet shall be discarded and replaced.

3.5 CLEANLINESS VERIFICATION

- A. Verify cleanliness according to NADCA ACR 2016, "Verification of HVAC System Cleanliness" Section.
- B. Verify HVAC system cleanliness after mechanical cleaning and before applying any treatment or introducing any treatment-related substance to the HVAC system, including biocidal agents and coatings.
- C. Perform visual inspection for cleanliness. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.
- D. Verification of Coil Cleaning:
 - 1. Measure static-pressure differential across each coil.
 - 2. Coil will be considered clean if the coil is free of foreign matter and chemical residue, based on a thorough visual inspection.
- E. Prepare a written cleanliness verification report. At a minimum, include the following:
 - 1. Written documentation of the success of the cleaning.
 - 2. Site inspection reports, initialed by supervisor, including notation on areas of inspection, as verified through visual inspection.
 - 3. Surface comparison test results if required.
 - 4. Gravimetric analysis (nonporous surfaces only).
 - 5. System areas found to be damaged.
- F. Photographic Documentation: Comply with requirements in Division 01 Section "Photographic Documentation."

3.6 RESTORATION

- A. Restore and repair HVAC air-distribution equipment, ducts, plenums, and components according to NADCA ACR 2016, "Restoration and Repair of Mechanical Systems" Section.
- B. Restore service openings capable of future reopening. Comply with requirements in Division 23 Section "Metal Ducts." Include location of service openings in Project closeout report.
- C. Replace fibrous-glass materials that cannot be restored by cleaning or resurfacing. Comply with requirements in Division 23 Sections "Metal Ducts" and "Nonmetal Ducts."
- D. Replace damaged insulation according to "Division 23 Section "HVAC Insulation."

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- E. Ensure that closures do not hinder or alter airflow.
- F. New closure materials, including insulation, shall match opened materials and shall have removable closure panels fitted with gaskets and fasteners.
- G. Reseal fibrous-glass ducts. Comply with requirements in Division 23 Section "Nonmetal Ducts."

END OF SECTION 23 0130

SECTION 23 0500 - COMMON WORK RESULTS FOR HVAC

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 23 Section "Testing, Adjusting, and Balancing."

1.2 SUMMARY

- A. This Section includes common requirements for fans and air moving equipment.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Fan bearings.
2. V-belt fan drives.
3. Direct drive couplings.

1.4 QUALITY ASSURANCE

- A. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- B. Fan Performance Data: AMCA Standard 210.
- C. Sound Power Level Ratings:
1. Ducted Fans - Rated per AMCA 301, when tested per AMCA 300.
 2. Nonducted Fans - Rated in Zones at 5 feet from acoustic center of fan rated per AMCA 301, tested per AMCA 300 and converted per AMCA 302.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Do not operate equipment for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 FAN SHAFTS

- A. Fan Shafts: Ground from solid cold rolled steel, and proportioned to run at least 25 percent below the first critical speed.

2.3 FAN POWER TRANSMISSION

- A. V-Belt Type Fan Drives: In accordance with Engineering Standard Specification for Drives Using Multiple V-Belts, sponsored by the Mechanical Power Transmission Association and the Rubber Manufacturer's Association.
- B. A given manufacturer's V-belt drive, as applied to specific equipment provided under the Contract, shall conform to the equipment manufacturer's published recommendations, except as otherwise specified.
- C. Base horsepower rating of drive on minimum pitch diameter of small sheave.
- D. Locate belt drives outboard of bearings. Align drive and driven shafts by the four-point method.
- E. Adjust belt tension in accordance with the manufacturer's recommendations.
- F. Perform alignment and final belt tensioning in the presence of the Architect.

2.4 SHEAVES

- A. Furnish sheaves of machined cast iron or carbon steel, bushing type of fixed bore, secured to the shaft by key and keyway.
- B. For all constant speed fans at or above 2 inches of total static pressure, Contractor shall provide and install two sets of fixed sheaves. First set shall be installed for initial start-up and shall be based on scheduled data. The second set shall be installed after system balance is complete and shall be based on actual field conditions.
- C. For all constant speed fans below 2 inches total static pressure, Contractor shall provide and install two sets of adjustable sheaves. First set shall be installed for initial start-up and shall be based on scheduled data. The second set shall be installed after the balance is complete and shall be based on actual field conditions, and selected at mid-range of the sheave.
- D. Set pitch diameters of fixed pitch and adjustable or variable pitch sheaves when adjusted as specified, at not less than that recommended by NEMA Standard MG1-14.42.
- E. For companion sheaves for adjustable or variable pitch drives, furnish wide groove spacing to match driving sheaves.
- F. For all variable frequency controller (VFC) operated fans, contractor shall provide and install one set of fixed sheaves sized to allow full utilization of fan motor horsepower provided, with VFC at 100 percent of fan motor RPM.

2.5 V-BELT FAN DRIVES

- A. Fan Drives: Multiple V-belt style with adjustable pitch driver sheaves for fans up to 2 inches of total static pressure and fixed pitch driver sheaves for fans at or above 2 inches of total static pressure and up. Sheaves shall have split, taper style bushings. Drives shall be selected for a 150 percent service factor and shall provide for adjustment of both belt tension and alignment.

B. Manufacturers:

1. Emerson Power Transmission; Browning.
2. Rockwell Automation; Dodge.
3. T.B. Wood's Incorporated.

2.6 FAN DRIVE, SHAFT, AND COUPLING GUARDS

- A. Safety Provisions: Include guards and screens for power transmission equipment, but do not negate vibration isolation provision.
- B. Furnish ANSI and OSHA compliant mechanical power transmission apparatus guards except where superseded by other governing codes, and except as modified and supplemented. Requirements specified apply to all types of fans.
- C. Fabricate mechanical power transmission device guards such that the completed structure is capable of withstanding a load of at least 200 pounds applied in any direction.
- D. Furnish a guard enclosure for each V-belt drive, coupling, shaft, and rotating component. Secure guards in place, easily removable for maintenance. Guard fasteners used for maintenance access shall be "captive type." Locate holes on each guard for tachometer readings on both the motor and fan shafts. Fabricate guard of minimum 16 gage sheet metal with hemmed edges at openings for shafts. Weld four mounting lugs or feet of 10 gage material to the guard. Fabricate guards for couplings five inches in diameter and larger of 12 gage sheet metal. Furnish holes in mounting feet sized for suitable machine screws.
- E. Centrifugal exhaust fans shall be provided with shaft seals.

2.7 BELT DRIVE GUARDS

- A. Belt Guards: ANSI and OSHA compliant with provision for readily viewing belt tension and measuring shaft speeds. Guards shall be installed with quick release pins, so that removal of three to five clip pins, will allow the guard to be removed from fan housing.
- B. Fabricate guards which completely enclose moving parts of the particular drive. Design and construct guards of such rigidity as to contain a belt which breaks during operation. Minimum material thickness, 16 gage sheet metal. Where ventilation is required, perforated metal shall be used for the sides. Fabricate top of solid sheet metal.

2.8 V-BELTS

- A. Notched or cogged style, endless type, of Dacron reinforced elastomer construction, with cross-section to suit sheave grooves. Determine the number of V-belts from the motor horsepower to which apply the service factor to obtain the design horsepower. Determine the corrected horsepower per belt by multiplying the nominal horsepower per belt by an arc of contact factor not greater than 0.85. Divide the design horsepower by the corrected horsepower per belt to obtain the number of belts required. In any case, furnish not less than two belts for each drive.

- B. Furnish belts that have been factory or factory-authorized distributor matched and measured on a belt-matching machine. Selection by "code numbers," "sag numbers" or "match numbers" is not acceptable. Bind each belt set with wire and tag with equipment identification.
- C. Manufacturers:
 - 1. Emerson Power Transmission; Browning; AX, BX, and CX Series and 3VX and 5VX Series.
 - 2. Rockwell Automation; Dodge; Classic Cog and Narrow Cog V-Belts.
 - 3. T.B. Wood's Incorporated; Classical Cog and Narrow Cog V-Belts.

2.9 V-BELT DRIVE MOTOR BASES

- A. Furnish fan motors with slide or adjustable pivoted bases wherever equipment configuration permits proper installation.
- B. Provide for adjustment of both belt tension and alignment.

2.10 AIR HANDLING SYSTEM BALANCING PROVISIONS

- A. Provide extra sheaves, sized as recommended by the Balancing Agent, for the adjustment of fan speed for each air handling system during air quantity balancing operations. Furnish sheaves as specified in this Section.

2.11 FLEXIBLE COUPLINGS (DIRECT DRIVE)

- A. Fan shaft shall be connected to the motor shaft through a flexible coupling. The flexible member shall be a tire shape, in shear, or a solid mass serrated edge disc shape, made of chloroprene materials and retained by fixed flanges. Flexible coupling shall act as a dielectric connector and shall not transmit sound, vibration or end thrust.
- B. Manufacturer:
 - 1. Falk Corporation (The).

2.12 MOTOR REQUIREMENTS

- A. Furnish motors in accordance with Division 20 Section "Motors."

2.13 FAN BEARINGS

- A. Bearings: Anti-friction ball or roller type with provision for self-alignment and thrust load. Made in U.S.A. with ABMA L₁₀ minimum life of 200,000 hours. Use cast iron housings and dust-tight seals suitable for lubricant pressures.
 - 1. Lubrication Provisions - Use surface ball check type supply fittings. Provide extension tubes to allow safe maintenance while equipment is operating. Provide manual or automatic pressure relief

- fittings to prevent overheating or seal blow-out due to excess lubricant or pressure. Arrange relief fittings opposite supply but visible for normal maintenance observation.
2. Bearings on Equipment with less than 1/2 horsepower rating or on shafts smaller than 1-3/4 inch in diameter: Permanently sealed, pre-lubricated anti-friction bearings per specified materials and ABMA L₁₀ life requirements.

2.14 IDENTIFICATION

- A. Nameplate: Affix metallic, corrosion-resistant data plate for each fan in a conspicuous location. Include selection point capacity conditions.

2.15 ACCESSORIES

- A. Bird Screens: Of material to match adjacent contact construction, 1/2 inch mesh or equal expanded metal. Use on inlet or outlet of each nonducted fan.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Field Rigging: Do not negate balancing. Do not bend shaft. Use lifting eyes.
- B. Install sheaves where recommended by Testing, Adjusting, and Balancing agency.
- C. Refer to individual Division 23 HVAC equipment Sections for additional requirements.

END OF SECTION 23 0500

SECTION 23 0523 - GENERAL-DUTY VALVES FOR HVAC

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical Identification" for valve tags and charts.
 - 2. Division 21 fire-suppression piping and fire pump Sections for fire-protection valves.
 - 3. Division 22 Section "General-Duty Valves for Plumbing" for plumbing valves.
 - 4. Division 23 Section "Temperature Controls" for control valves and actuators.

1.2 SUMMARY

- A. This Section includes valves for general HVAC applications. Refer to piping Sections for specialty valve applications.

1.3 DEFINITIONS

- A. The following are standard abbreviations for valves:
 - 1. CWP: Cold working pressure.

2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. NRS: Nonrising stem.
4. OS&Y: Outside screw and yoke.
5. SWP: Steam working pressure.
6. TFE: Tetrafluoroethylene plastic.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.5 QUALITY ASSURANCE

- A. ASME Compliance: ASME B31.9 for building services piping valves.
- B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

1.6 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 ball valves open to minimize exposure of functional surfaces.
 4. Set butterfly valves closed or slightly open.
 5. Block 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 VALVES, GENERAL

- A. Isolation valves are scheduled on the Drawings. For other general HVAC valve applications, use the following:
 1. Shutoff Service: Ball, butterfly valves.

2. Throttling Service: Ball, butterfly valves.
 3. Pump Discharge: Spring-loaded, lift-disc check valves; and bronze lift check valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- D. For valves not indicated in the Application Schedules, select valves with the following end connections:
1. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends, except provide valves with threaded ends for condenser water, heating hot water, steam, and steam condensate services.
 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged, solder-joint, or threaded ends.
 3. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends.
 4. For Steel Piping, NPS 5 and Larger: Flanged ends.
 5. For Grooved-End Systems: Valve ends may be grooved. Do not use for steam or steam condensate piping.
- 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 Sizes: Same as upstream pipe, unless otherwise indicated.
- G. Valve Actuators:
1. Handwheel: For valves other than quarter-turn types.
 2. Lever Handle: For quarter-turn valves NPS 6 and smaller.
- H. Extended Valve Stems: On insulated valves.
- I. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
- J. Valve Grooved Ends: AWWA C606.
- K. Solder Joint: With sockets according to ASME B16.18.
1. Caution: Disassemble valves when soldering, as recommended by the manufacturer, to prevent damage to internal parts.
- L. Threaded: With threads according to ASME B1.20.1.
- M. Valve Bypass and Drain Connections: MSS SP-45.
- 2.2 BRONZE BALL VALVES
- A. Bronze Ball Valves, General: MSS SP-110 and have bronze body complying with ASTM B 584, except for Class 250 which shall comply with ASTM B 61, full-depth ASME B1.20.1 threaded or solder ends, and blowout-proof stems.

- B. Two-Piece, Regular Port Bronze Ball Valves with Stainless-Steel Trim: Type 316 stainless-steel ball and stem, reinforced TFE seats, blow-out-proof stem, with adjustable stem packing, soldered or threaded ends; and 150 psig SWP and 600-psig CWP ratings.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; by Conbraco Industries, Inc.; Series 70-140.
 - b. Crane Co.; Crane Valves.
 - c. Hammond Valve.
 - d. Kitz Corporation; Kitz Valves.
 - e. Milwaukee Valve Company; Model BA100S.
 - f. NIBCO INC.; Models S-580-70-66 or T-580-70-66.
 - g. Watts Water Technologies, Inc.

2.3 GENERAL SERVICE BUTTERFLY VALVES

- A. General: MSS SP-67, for bubble-tight shutoff, extended-neck for insulation, disc and lining suitable for potable water, unless otherwise indicated, and with the following features:
1. Full lug, and grooved valves shall be suitable for bi-directional dead end service at full rated pressure without the use or need of a downstream flange.
 2. Valve sizes NPS 2 through NPS 6 shall have lever lock operator; valve sizes NPS 8 and larger shall have weatherproof gear operator.
- B. Lug-Style (Single-Flange) Size NPS 2-1/2 through NPS 12, 200-psig CWP Rating, Aluminum-Bronze Disc, EPDM Seat, Ferrous-Alloy Butterfly Valves: Full-lug type with ductile-iron body, Type 416 stainless-steel stem, copper bushing, aluminum-bronze disc, and molded-in EPDM seat (liner).
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; by Conbraco Industries, Inc.; Series 143 and Series LD 145.
 - b. Bray International, Inc.
 - c. DeZurik.
 - d. Emerson Automation Solutions; Keystone.
 - e. Forum Energy Technologies; ABZ Valve.
 - f. Hammond Valve.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.; LD-2000-3/5.
 - i. Tyco Flow Control; Grinnell Flow Control.
 - j. Watts Water Technologies.
- C. Grooved-End Butterfly Valves with EPDM-Encapsulated, or Electroless Nickel Coated Ductile-Iron Disc: Ductile-iron body with grooved or shouldered ends and polyamide coating inside and outside; Type 416 stainless-steel stem, PTFE bronze sintered on steel bushing, and 300-psig CWP Rating for Valves NPS 2 through NPS 8, 200 psig CWP Rating for Valves NPS 10 through NPS 12. Valve design shall provide bi-directional, bubble tight seal from full vacuum to 300 psig.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. ASC Engineered Solutions.
- b. NIBCO INC.; Model GD-4765-3/5.
- c. Victaulic Co. of America.

2.4 BRONZE CHECK VALVES

- A. Bronze Check Valves, General: MSS SP-80.
- B. Class 150, Bronze, Swing Check Valves with Bronze Disc: ASTM B-62 bronze body and seat with regrinding-type bronze disc, Y-pattern design, soldered or threaded end connections, and having 300 psig CWP rating.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; by Conbraco Industries, Inc.
 - b. Crane Co.; Crane Valves.
 - c. Crane Co.; Stockham Div.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company; Model 515.
 - f. NIBCO INC.; Models S-433-B or T-433-B.
 - g. Watts Water Technologies.

2.5 DRAIN VALVES

- A. Ball-Valve-Type, Hose-End Drain Valves:
 - 1. Bronze ball valve as specified in this Section.
 - 2. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. 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.
- C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- D. Examine threads on valve and mating pipe for form and cleanliness.

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

3.2 VALVE INSTALLATION

- A. Piping installation requirements are specified in other Division 20 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above center of pipe. Butterfly valves shall be installed with stem horizontal to allow support for the disc and the cleaning action of the disc.
- E. Install valves in position to allow full stem movement.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Lift Check Valves: With stem upright and plumb.

3.3 JOINT CONSTRUCTION

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

3.4 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.

END OF SECTION 23 0523

SECTION 23 0593 - TESTING, ADJUSTING, AND BALANCING

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 23 Section "Common Work Results for HVAC."

1.2 SUMMARY

- A. This Section includes testing, adjusting, and balancing to produce design objectives for the following:
 - 1. Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.
 - 2. Hydronic Piping Systems:
 - a. Variable-flow systems.
 - b. Primary-secondary systems.
 - 3. HVAC equipment quantitative-performance settings.
 - 4. Verifying that automatic control devices are functioning properly.
 - 5. Reporting results of activities and procedures specified in this Section.
- B. Include rebalancing of air systems, or system portions affected by recommended sheave changes.

1.3 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. AHJ: Authority having jurisdiction.
- C. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.
- D. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.
- E. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- F. NC: Noise criteria.
- G. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- H. RC: Room criteria.
- I. Report Forms: Test data sheets for recording test data in logical order.
- J. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- K. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

- L. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- M. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- N. TAB: Testing, adjusting, and balancing.
- O. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- P. Test: A procedure to determine quantitative performance of systems or equipment.
- Q. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days from Contractor's Notice to Proceed, submit 2 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days from Contractor's Notice to Proceed, submit 2 copies of the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 30 days from Contractor's Notice to Proceed, submit 2 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.
- D. Sample Report Forms: Submit two sets of sample TAB report forms.

1.5 CLOSEOUT SUBMITTALS

- A. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- B. Warranties specified in this Section.

1.6 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.
- B. Approved Balancing Agencies.
 - 1. The TAB firm selected shall be from the following list:
 - a. Absolut Balance Company, Inc.; South Lyon, MI.
 - b. Airflow Testing Inc.; Lincoln Park, MI.

- c. Barmatic Inspecting Co., Inc.; Lincoln Park, MI.
 - d. Ener-Tech Testing; Holly, MI.
 - e. Enviro-Aire/Total Balance Co.; St. Clair Shores, MI.
 - f. International Test & Balance Inc.; Southfield, MI.
 - C. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.
 - 1. Agenda Items: Include at least the following:
 - a. Submittal distribution requirements.
 - b. The Contract Documents examination report.
 - c. TAB plan.
 - d. Work schedule and Project-site access requirements.
 - e. Coordination and cooperation of trades and subcontractors.
 - f. Coordination of documentation and communication flow.
 - D. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.
 - E. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems." TAB firm's forms approved by Architect.
 - F. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
 - G. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
 - 1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.
- 1.7 PROJECT 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.

1.8 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Notice: Provide seven days advance notice for each test. Include scheduled test dates and times.
- C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.9 WARRANTY

- A. National Project Performance Guarantee: If AABC standards are used, provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.
- B. Special Guarantee: If NEBB standards are used, provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- B. Examine system and equipment test reports.
- C. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- D. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

- E. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.
- F. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- G. Examine strainers for clean screens and proper perforations.
- H. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- I. Examine system pumps to ensure absence of entrained air in the suction piping.
- J. Examine equipment for installation and for properly operating safety interlocks and controls.
- K. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 - 4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
 - 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 6. Sensors are located to sense only the intended conditions.
 - 7. Sequence of operation for control modes is according to the Contract Documents.
 - 8. Controller set points are set at indicated values.
 - 9. Interlocked systems are operating.
 - 10. Changeover from heating to cooling mode occurs according to indicated values.
- L. 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.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:
 - 1. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
 - 2. Maximum Allowable Leakage: Leakage rates are scheduled on the Drawings.
- C. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - 1. Permanent electrical power wiring is complete.

2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Isolating and balancing valves are open and control valves are operational.
6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
7. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
- B. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.
- C. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts, or use reduced scale contract documents with notations.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- E. Cut insulation, and drill ducts for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes with neat patches, neoprene plugs, threaded plugs, or threaded twist-on metal caps, and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.
- F. Check air flow within intake plenums and mixing boxes of air handling units for uneven flow and temperature stratification and prepare a report with profile elevations (temperature and velocity) on each coil or filter face for Architect.
- G. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- H. Verify that motor starters are equipped with properly sized thermal protection.
- I. Check dampers for proper position to achieve desired airflow path.

- J. Check for airflow blockages.
- K. Check condensate drains for proper connections and functioning.
- L. Check for proper sealing of air-handling unit components.
- M. Check for proper sealing of air duct system.

3.5 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 fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 - 3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
 - 4. Select required sheave sizes and advise installing contractor to change drive sheaves accordingly. Refer to Division 23 Section "Common Work Results for HVAC" for additional requirements.
 - 5. Do not recommend 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 will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
 - 1. Measure airflow at a point downstream from the balancing damper and adjust volume dampers until the proper airflow is achieved.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure terminal outlets and inlets without making adjustments.
 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
 1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.
 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 3. Measure total system airflow. Adjust to within indicated airflow.
 4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
 6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
 7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
 8. Record the final fan performance data.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts, or use reduced scale contract documents with notations.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 - 1. Open all manual valves for maximum flow.
 - 2. Check expansion tank liquid level.
 - 3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
 - 4. Check flow-control valves for specified sequence of operation and set at indicated flow.
 - 5. Set system controls so automatic valves are wide open to heat exchangers.
 - 6. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
 - 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.

3.8 PROCEDURES FOR HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:
 - 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 - 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 - 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 - 4. Report flow rates that are not within plus or minus 5 percent of design.
- B. Set calibrated balancing valves, if installed, at calculated presettings.
- C. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 - 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- E. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:

1. Determine the balancing station with the highest percentage over indicated flow.
 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 3. Record settings and mark balancing devices.
- F. Equipment installed with pressure independent characterized control valves (PICCV) or auto-flow devices shall not require hydronic system balancing unless multiple coils are served from a single PICCV or auto-flow device (Example: AHU coil banks with multiple coils). Measure flow through each PICCV and auto-flow device and compare measured value to scheduled value to verify proper valve/device was installed and valve is functional. Verify flow for 100 percent of PICCV and auto-flow devices. Report discrepancies.
- G. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- H. Measure the differential-pressure control valve settings existing at the conclusions of balancing, and record in report.

3.9 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance variable-flow hydronic systems by following the "Proportional Balancing Procedure" in accordance with NEBB.
- B. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.10 PROCEDURES FOR PRIMARY-SECONDARY-FLOW HYDRONIC SYSTEMS

- A. Balance the primary system crossover flow first, then balance the secondary system.

3.11 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
1. Manufacturer, model, and serial numbers.
 2. Motor horsepower rating.
 3. Motor rpm.
 4. Efficiency rating.
 5. Power factor.
 6. Nameplate and measured voltage, each phase.
 7. Nameplate and measured amperage, each phase.
 8. Starter size.
 9. Starter thermal-protection-element rating.
 10. Fuse number and size.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.12 PROCEDURES FOR CHILLERS

- A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
 - 1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
 - 2. If water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
 - 3. Evaporator and condenser refrigerant temperatures and pressures.
 - 4. Power factor if factory-installed instrumentation is furnished for measuring kilowatt.
 - 5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatt.
 - 6. Capacity: Calculate in tons of cooling.
 - 7. If air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.13 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.14 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Water Coils: Measure the following data for each coil:
 - 1. Entering- and leaving-water temperature.
 - 2. Water flow rate.
 - 3. Water pressure drop.
 - 4. Dry-bulb temperature of entering and leaving air.
 - 5. Wet-bulb temperature of entering and leaving air for cooling coils.
 - 6. Airflow.
 - 7. Air pressure drop.
- B. Refrigerant Coils: Measure the following data for each coil:
 - 1. Dry-bulb temperature of entering and leaving air.
 - 2. Wet-bulb temperature of entering and leaving air.
 - 3. Airflow.
 - 4. Air pressure drop.
 - 5. Refrigerant suction pressure and temperature.

3.15 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 - 1. Air handling equipment and outlets: Plus or minus 5 percent.
 - a. Where terminal units serve 6 or more outlets within a common room, individual outlets may vary up to plus or minus 10 percent of design flow rates if overall room supply is within plus or minus 5 percent.
 - 2. Heating-Water Flow Rate: 0 to minus 10 percent.
 - 3. Cooling-Water Flow Rate: 0 to plus 5 percent.

3.16 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: As Work progresses, prepare 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.

3.17 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 - 1. Include a list of instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to certified field report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.
 - 5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
 - 1. Title page.

2. Name and address of TAB firm.
 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 firm 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. Notes to explain why certain final data in the body of reports varies from indicated values.
 14. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outside-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- E. 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 outside, supply, return, and exhaust airflows.
 2. Water flow rates.
 3. Terminal units.
 4. Balancing stations.
- F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data: Include the following:
 - 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. Sheave dimensions, center-to-center, and amount of adjustments in inches.

- j. Number of belts, make, and size.
- k. Number of filters, type, and size.

2. Motor Data:

- a. 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. Sheave dimensions, center-to-center, and amount of adjustments in inches.
- g. Power factor efficiency.

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. Preheat coil static-pressure differential in inches wg.
- g. Cooling coil static-pressure differential in inches wg.
- h. Heating coil static-pressure differential in inches wg.
- i. Outside airflow in cfm.
- j. Return airflow in cfm.
- k. Outside-air damper position.
- l. Return-air damper position.
- m. Vortex damper position.

G. 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. Outside-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.
- H. Gas- Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
- 1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Fuel type in input data.
 - g. Output capacity in Btuh.
 - h. Ignition type.
 - i. Burner-control types.
 - j. Motor horsepower and rpm.
 - k. Motor volts, phase, and hertz.
 - l. Motor full-load amperage and service factor.
 - m. Sheave make, size in inches, and bore.
 - n. Sheave dimensions, center-to-center, and amount of adjustments in inches.
 - 2. 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. Low-fire fuel input in Btuh.
 - i. High-fire fuel input in Btuh.
 - j. Manifold pressure in psig.
 - k. High-temperature-limit setting in deg F.
 - l. Operating set point in Btuh.
 - m. Motor voltage at each connection.
 - n. Motor amperage for each phase.
 - o. Heating value of fuel in Btuh.
- I. 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. Sheave dimensions, center-to-center, and amount of adjustments in inches.
 2. Motor Data:
 - a. 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. Sheave dimensions, center-to-center, and amount of adjustments in inches.
 - g. Number of belts, make, and size.
 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.
- J. Round 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.
- K. Air-Terminal-Device Reports:
1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.

- c. Test apparatus used.
 - d. Area served.
 - e. Air-terminal-device make.
 - f. Air-terminal-device number from system diagram.
 - g. Air-terminal-device type and model number.
 - h. Air-terminal-device size.
 - i. Air-terminal-device effective area in sq. ft..
 - 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.
- L. System-Coil Reports: For reheat coils and 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.
- M. Packaged Chiller Reports:
- 1. Unit Data:
 - a. Unit identification.
 - b. Make and model number.
 - c. Manufacturer's serial number.
 - d. Refrigerant type and capacity in gal..
 - e. Starter type and size.
 - f. Starter thermal protection size.
 - g. Compressor make and model number.
 - h. Compressor manufacturer's serial number.

2. Water-Cooled Condenser Test Data (Indicated and Actual Values):
 - a. Entering-water temperature in deg F.
 - b. Leaving-water temperature in deg F.
 - c. Entering-water pressure in feet of head or psig.
 - d. Water pressure differential in feet of head or psig.
 3. Air-Cooled Condenser Test Data (Indicated and Actual Values):
 - a. Entering- and leaving-air temperature in deg F.
 4. Evaporator Test Reports (Indicated and Actual Values):
 - a. Entering-water temperature in deg F.
 - b. Leaving-water temperature in deg F.
 - c. Entering-water pressure in feet of head or psig.
 - d. Water pressure differential in feet of head or psig.
 5. Compressor Test Data (Indicated and Actual Values):
 - a. Voltage at each connection.
 - b. Amperage for each phase.
 - c. Kilowatt input.
 - d. Crankcase heater kilowatt.
 - e. Chilled-water control set point in deg F.
 - f. Condenser-water control set point in deg F.
 6. Refrigerant Test Data (Indicated and Actual Values):
 - a. Oil level.
 - b. Refrigerant level.
- N. Condenser Test Reports: For cooling towers or condensers, include the following:
1. Unit Data:
 - a. Unit identification.
 - b. Make and type.
 - c. Model and serial numbers.
 - d. Nominal cooling capacity in tons.
 - e. Water-treatment chemical feeder and chemical.
 - f. Number and type of fans.
 - g. Fan motor make, frame size, rpm, and horsepower.
 - h. Fan motor voltage at each connection.
 - i. Sheave make, size in inches, and bore.
 - j. Sheave dimensions, center-to-center, and amount of adjustments in inches.
 - k. Number of belts, make, and size.
 2. Air Data (Indicated and Actual Values):

- a. Duct airflow rate in cfm.
 - b. Inlet-duct static pressure in inches wg.
 - c. Outlet-duct static pressure in inches wg.
 - d. Average entering-air, wet-bulb temperature in deg F.
 - e. Average leaving-air, wet-bulb temperature in deg F.
 - f. Ambient wet-bulb temperature in deg F.
- O. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
 - 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model and serial numbers.
 - f. Water flow rate in gpm.
 - g. Water pressure differential in feet of head or psig.
 - h. Required net positive suction head in feet of head or psig.
 - i. Pump rpm.
 - j. Impeller diameter in inches.
 - k. Motor make and frame size.
 - l. Motor horsepower and rpm.
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. Full-load amperage and service factor.
 - p. Seal type.
 - 2. Test Data (Indicated and Actual Values):
 - a. Static head in feet of head or psig.
 - b. Pump shutoff pressure in feet of head or psig.
 - c. Actual impeller size in inches.
 - d. Full-open flow rate in gpm.
 - e. Full-open pressure in feet of head or psig.
 - f. Final discharge pressure in feet of head or psig.
 - g. Final suction pressure in feet of head or psig.
 - h. Final total pressure in feet of head or psig.
 - i. Final water flow rate in gpm.
 - j. Voltage at each connection.
 - k. Amperage for each phase.
- P. Instrument Calibration Reports:
 - 1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.

- d. Dates of use.
- e. Dates of calibration.

3.18 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
2. Randomly check the following for each system:
 - a. Measure airflow of at least 10 percent of air outlets.
 - b. Measure water flow of at least 5 percent of terminals.
 - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - d. Measure sound levels at two locations.
 - e. Measure space pressure of at least 10 percent of locations.
 - f. Verify that balancing devices are marked with final balance position.
 - g. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:

1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Owner.
2. TAB firm test and balance engineer shall conduct the inspection in the presence of Owner.
3. Owner shall randomly select measurements documented in the final report to be rechecked. The 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.
4. If the 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."
5. 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.
6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

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3.19 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional testing and balancing 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 testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION 23 0593

SECTION 23 0933 - TEMPERATURE CONTROLS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 23 Section "Testing, Adjusting, and Balancing."

1.2 SUMMARY

- A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

1.3 DEFINITIONS

- A. BACnet: Communications open protocol for building automation system networks and control (developed by ASHRAE and documented per ANSI/ASHRAE Standard 135-2012).
- B. BAS: Building Automation System
- C. CAD: Computer Aided Design.
- D. DDC: Direct-digital controls.
- E. TC: Temperature Control.

1.4 SYSTEM DESCRIPTION

- A. Temperature control building automation system consisting of direct digital control system controllers, sensors, transducers, relays, switches, data communication network, etc. and all associated control wiring and raceway systems.
- B. BAS/DDC system programming, database generation. Graphic display generation on existing Tridium server supervisory software.
- C. Electric control valves, dampers, operators, control wiring, etc.
- D. Indicating devices, electric and electronic control accessories, and other control system devices.

1.5 SEQUENCE OF OPERATION

- A. Control sequences for HVAC systems, subsystems, and equipment are indicated on project drawings.

1.6 SUBMITTALS

- A. Submit under Division 20 and 23 provisions of respective project and as supplemented in this section.
- B. All control submittal requirements shall be submitted at one time with exception to control valves, automated dampers, and initial phases of work associated with fast-track projects (when required). Early submittals of control valves and automated dampers shall be incorporated with the complete temperature controls submittal.
- C. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
 - 1. Each control device labeled with setting or adjustable range of control
- D. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- E. Shop Drawings:
 - 1. Shop drawings shall be done on CAD. Minimum size 11" x 17".
 - 2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 - 3. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
 - 4. Details of control enclosure including panel faces and interior, including controls, instruments, terminations blocks and component labeling.
 - 5. Written sequence of operation for each controlled system.
 - 6. Schedule of dampers including size, leakage, and flow characteristics (Refer to Design Data).
 - 7. Schedule of valves including leakage and flow characteristics (Refer to Design Data).
 - 8. Complete bill of materials to identify and quantify all control components.
 - 9. Overall system schematic showing communication trunk cabling from Building Network Supervisory Controller(s) to BAS field level controllers including component locations and wire termination details.
 - 10. DDC controller layouts showing connected data points and LAN connections. DDC controller terminations including power supply and remote control component termination details shall be provided.
 - 11. Point list for each DDC controller including point descriptions and addresses. This information may be incorporated with DDC controller layouts.
- F. Design Data: Provide indicated component selection and sizing criteria for the following component categories:
 - 1. Control valves:
 - a. Component tag.
 - b. Equipment served/function.

- c. Media type.
- d. Design flow rate (GPM or lbs/hr).
- e. Design pressure drop (ft. head) or (psi), where applicable.
- f. Calculated valve Cv, where applicable.
- g. Selected valve Cv, where applicable.
- h. Resultant pressure drop (ft. head) or (psi) with selected valve.
- i. Valve size.
- j. Line size to valve connection (excluding reducers).
- k. Type (ball, butterfly, globe, etc.).
- l. Configuration (2-way, 3-way mixing, 3-way diverting).
- m. Normal position (normally open, normally closed, floating).
- n. Actuator spring range (where applicable).
- o. Actuator power requirement.
- p. Valve shut-off rating (ft. head) or (psi)
- q. Valve body pressure/temperature rating.
- r. Valve manufacturer/model number.
- s. Actuator manufacturer/model number.

2. Dampers:

- a. Component tag.
- b. Equipment served/function.
- c. Overall damper size (inch width x inch height).
- d. Quantity of damper sections with respective size(s):
- e. Material and gauge of thickness.
- f. Mounting orientation (horizontal or vertical).
- g. Blade configuration (parallel or opposed)
- h. Pressure drop (in. WG).
- i. Shut-off rating/differential pressure rating (in. wg).
- j. Leakage rating (CFM/sq.ft. at 4 in. wg).
- k. Normal position (normally open, normally closed, floating).
- l. Actuator spring range (where applicable).
- m. Actuator power requirement.
- n. Actuator torque requirement.
- o. Actuator quantity.
- p. Damper manufacturer/model number.
- q. Actuator manufacturer/model number.

3. Flow measuring probes - Air:

- a. Component tag.
- b. Equipment served/function.
- c. Duct dimension (inch width x inch height) if applicable.
- d. Fan inlet diameter (inch) if applicable)
- e. Probe quantity.
- f. Probe length (inch).
- g. Flow rate (CFM).
- h. Flow velocity (FPM).
- i. Probe manufacturer/model number.
- j. Transmitter manufacturer/model number.

- G. Wall mounted temperature sensor, thermostat and/or other temperature control device cover color shall be coordinated to match color of wall mounted electrical device components and cover plates – coordinate with electrical contractor. Provide samples of available temperature control device cover colors to Architect upon request or if available temperature control device colors do not match electrical device colors so a desired color selection may be determined. Provide sample of temperature sensor / thermostat guard upon request of Architect, Engineer or Owner.
- H. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- I. Submit field reports indicating operating conditions after detailed check out of systems at Date of Substantial Completion.
- J. Project Record Documents: Include the following:
 - 1. Revise Shop Drawings to reflect actual installation and operating sequences.
 - 2. Record actual locations of control components, including control units, thermostats, and sensors.
 - 3. Submit the electronic files for all as-built shop drawings in pdf format on USB Flash Drives (3 Total).
- K. Software and Firmware Operational Documentation: Include the following:
 - 1. DDC controller keypad operating instructions and DDC controller override features, where applicable.
 - 2. Device address list.
 - 3. Program Software Backup: On a magnetic media or compact disc, complete with data files.
- L. Maintenance Manuals: Include the following:
 - 1. Product data with installation details, maintenance instructions and lists of spare parts for each type of control device.
 - 2. Keypad illustrations and step-by-step procedures indexed for each operator function, where applicable.
 - 3. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
 - 4. Calibration records and list of set points.

1.7 REFERENCES

- A. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
- B. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- C. ASTM D1693 - Environmental Stress - Cracking of Ethylene Plastics.
- D. ASTM E1 - Specification for ASTM Thermometers.
- E. MMC – Michigan Mechanical Code, version applicable for project.
- F. NEMA DC 3 - Low-Voltage Room Thermostats.
- G. UL 1820 - Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics Only.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is an approved installer of the automatic control system manufacturer for both installation and maintenance of units required for this Project.
- B. Manufacturer Qualifications: A firm experienced in manufacturing automatic temperature-control systems similar to those indicated for this Project and with a record of successful in-service performance.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with all applicable code requirements for project.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated or optional to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

1.10 COORDINATION

- A. Coordinate work under Division 20 and 23 provisions and as supplemented in this section.
- B. Coordinate location of space temperature sensors, space humidity sensor, thermostats and other exposed control sensors with plans and room details before installation.
- C. Coordinate installation of system components with installation of mechanical systems and equipment to achieve compatibility.
- D. Ensure installation of components is complementary to installation of similar components in other systems.
- E. Coordinate control wiring requirements, including actual terminal block numbers, with mechanical equipment manufacturers or suppliers.
- F. Coordinate equipment with Division 28 Section "Fire Alarm" to achieve compatibility with equipment that interfaces with that system.
- G. Ensure control system installation is complete, checked, tested and functioning properly prior to system balancing and Owner/Engineer system checkout.
- H. Cooperate fully with the Test and Balance Contractor and provide labor to operate the temperature control system as required to meet the scope of work defined in Division 23 Section "Testing, Adjusting and Balancing."

1.11 WARRANTY

- A. Provide warranty per Division 20 Section "Mechanical General Requirements" and as supplemented in this section.

- B. Provide 24 hour per day emergency service during warranty period, with maximum response period of four (4) hours. Provide phone number(s) for quick assistance by a Service Engineer regarding hardware or software problems.
- C. Provide scheduled maintenance service during warranty period to inspect, calibrate, and adjust controls. Make a minimum of one eight hour service call every three months. Notify Owner prior to each scheduled inspection trip. Submit written reports upon completion of service.
- D. Provide any software or firmware revisions which are released by the DDC system manufacturer during the warranty period, at no additional cost to the Owner.

1.12 POSTED OPERATING INSTRUCTIONS

- A. Provide DDC controller related as-built documents in protective binder or clear plastic display envelope for each control enclosure panel. These instructions shall include such items as as-built control diagrams and sequence of operation, simplified narrative instructions and materials necessary to aid in the operation of the equipment at the local control panels.

1.13 SPECIAL TOOLS

- A. Deliver two sets of any special tools required for operation, adjustment, resetting or maintenance, excluding PC laptop.

1.14 PROTECTION OF PROPRIETARY INFORMATION

- A. Non-disclosure agreement(s) that may be subject to proprietary manuals and software shall be submitted by the proprietary equipment manufacturer to the Owner for approval and signature during the warranty period.

PART 2 - PRODUCTS

2.1 DESCRIPTION OF THE BUILDING AUTOMATION SYSTEM (BAS)

- A. The building automation system (BAS) shall be fully integrated, distributed data processing system incorporating direct digital control (DDC) for the control and monitoring of heating, ventilating and air conditioning (HVAC) equipment and other related systems. Microprocessor based BAS field level DDC controllers shall be directly connected to HVAC equipment sensors and actuators. A data communication network shall allow data exchange between the BAS field level DDC controllers and the Building Network Supervisory Controller. The Building Network Supervisory Controller shall be the primary operator BAS interface point for the building either through web-browser direct or through existing Tridium server supervisory application software.
- B. Approved Manufacturer – System / Approved Installer (Locations) as listed:
 - 1. Johnson Controls – Facility Explorer with FX Controllers / by:

- a. BASS Controls (Sterling Heights, MI).
 - b. Conti Corp Controls Group. (Sterling Heights, MI).
 - c. Green Building Automation, (Plymouth & Kalamazoo, MI).
 - d. Knight Watch/Vertex Integration (Hudsonville, MI).
 - e. Metro Controls, Inc. (Clinton Twp, MI).
 - f. SyEnergy Engineering Services, (Rochester Hills, MI).
 - g. W.J. O'Neil Controls Group. (Livonia, MI).
- C. Post Bid Interviews: Temperature Controls Contractor Bids shall be separately identified. The Owner and Project Design Team shall conduct one hour presentations with prospective TC Contractors that shall be a factor for selecting the TC Contractor for the project. Screen connection for Laptop presentation materials shall be made available. Bring your own Hot Spot for Web connectivity if needed for presenting graphical examples. TC Contractor presentation shall include but not be limited to the following:
1. Company information and short history.
 2. Company size and staff organization.
 3. Project resume.
 4. User Graphical Interface Examples.
 5. Training philosophy and offerings.
 6. Service Options.

2.2 BAS BUILDING NETWORK SUPERVISORY CONTROLLER (TRIDIUM N4 PLATFORM)

- A. The Building Network Supervisory Controller, utilizing the HTML5 platform, shall provide the interface between the Owner's Ethernet and the field control devices, and provide global supervisory control functions over the control devices connected to the NAC. It shall be capable of executing application control programs to provide:
1. Calendar functions
 2. Scheduling.
 3. Trending.
 4. Alarm monitoring and routing.
 5. Time synchronization.
 6. Integration of BACnet controller data.
 7. Network Management functions for all BACnet based devices.
- B. The Network Area Controller shall provide the following hardware and driver features as a minimum:
1. One RS-232 port
 2. One RS-485 port with BACnet MS/TP Driver.
 3. Battery Backup
 4. Flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity).
 5. Where the option for expanded memory is available, it must be supplied.
- C. Provide LonWorks or MODBUS driver(s) as required for system or equipment integration requirements for project.

- D. The network supervisory controller shall be sized appropriately per building to handle the required quantity of connected controllers and devices.
- E. Provide 5 year service agreement per network supervisory controller for updating firmware/software as available by manufacturer. Labor for updating the controllers shall be included.
- F. For Tridium based systems, provide Niagara 4 JACE-8000 series network supervisory controllers.
- G. Manufacturer:
 - 1. Manufacturers as listed for Building Automation System (based on N4 JACE-8000 platform).
 - 2. Vykon N4 JACE-8000 series is to be used in lieu of listed manufacturer's standard product per requirements of Owner's existing network or as indicated on the construction drawings.

2.3 DIRECT DIGITAL CONTROL (DDC) FIELD LEVEL CONTROLLERS

- A. Modular in design and consisting of stand-alone microprocessor board with ROM and fully custom programmable RAM, EPROM, and/or EEPROM memory, integral interface equipment and power surge protection. DDC controllers shall be connected directly to sensors, controlled devices and the communication network.
- B. Powerfail Restart and Battery Backup: Minimum of 72 battery backup hours for complete system RAM memory and clock, with automatic battery charger or 48 hour low voltage alarm warning. Upon full system power recovery, all clocks shall be automatically synchronized, and all controlled equipment shall be automatically re-started based on correct clock time and sequence of operation.
- C. Provide fully functional communication interface ports for communication between processor, other processors, portable programmer's terminal, portable operator's unit or the remote Operator Workstation when applicable for project.
- D. Panel enclosure for controller, associated power supply and other ancillary control components shall be finished steel or rigid plastic with hinged door and keyed lock. Electronics shall be removable for protection during mounting of panel.

2.4 DDC CONTROLLER SOFTWARE

- A. Operating system shall work in real time, provide prioritized task scheduling, control time programs, monitor DDC controller communications, scan inputs and outputs, and contain built-in diagnostics.
- B. Input/output point processing shall include the following:
 - 1. Continuous update of input and output values and/or conditions. All connected points are to be updated at least once per second.
 - 2. Assignment of proper engineering units and status condition identifiers to all points.
 - 3. In addition to physical or "hardware" points required, "software" points shall be provided where required for command access and meaningful displays, where required by the "execution" portion of this section or where required on the DDC input/output points lists. "Software" points shall appear identical to physical points in output displays and shall be assignable to text descriptors, logical

groups, reports, etc. in the same manner as physical points. "Software" points shall be assigned alarm limits in the same manner as physical points.

- C. Command control software shall manage the receipt of commands from control panels, portable programmer's terminal, portable operator's unit or the remote Operator Workstation when applicable for project.
 - 1. Command delay, programmable from 0 to 2 minutes, shall be provided to prevent simultaneous energizing of large loads. Command delays shall be honored throughout the BAS DDC network, not just within the DDC controller. Delays shall be assignable on an individual per point basis.
 - 2. Each command shall be assigned a command and residual priority to manage contentions created by multiple programs having access to the same command point. Only commands with a higher command priority than the existing residual priority shall be permitted to execute. Whenever a command is allowed to execute, its assigned residual priority shall replace the existing residual priority.
 - 3. A "fixed mode" option shall be supported to allow inputs to, and outputs from DDC control programs to be set to a fixed state or value. When in the "fixed mode," inputs and outputs shall be so noted in all reports.
 - 4. A "last user" record is to be maintained to positively identify which program or manual command is in control of a given point. The last user information shall be displayed and printed along with other point data of logical groups.
- D. Provide self-test procedure. Notify remote Operator Workstation (when applicable for project) for maintenance, performance, software, cable break, or data transmission problems. Identify variables as reliable or unreliable. Variables identified as unreliable shall use default in calculation.
- E. Alarm Processing
 - 1. High/Low Alarm: Analog input alarm comparison with the ability to assign two individual sets of high and low limits (warning and actual alarm) to an input. Each alarm shall be assigned a unique differential to prevent a point from oscillating into and out of alarm. Alarm comparisons are to be made each scan cycle.
 - 2. Floating Alarm: Where analog controlled values are automatically varied by software (such as hot water temperature reset), a single set of alarm limits shall be provided for those varying values. These alarm limits shall then "float" a user definable differential above and below the varying setpoint value.
 - 3. Abnormal Alarm: When a digital input is not in agreement with the commanded state of its associated output point, or when a digital input is not in its normal state, an abnormal alarm shall be generated. Abnormal "on" shall cause an alarm, as well as abnormal "off." Alarm time delay for digital inputs to prevent nuisance alarms shall be provided. Each digital input alarm time delay shall be adjustable from zero to two minutes in one-second increments.
 - 4. Alarm lockout shall be provided to positively lock out alarms when equipment is turned off or when a true alarm is dependent on the condition of an associated point. Lockout points and lockout initiators shall be operator programmable. On initial startup of air handler and other mechanical equipment, a "timed lockout" period shall be assigned to analog points to allow them to reach a stable condition before activating alarm comparison logic. Timed lockout period shall be programmable on a per point basis from 0 to 90 minutes in one-minute increments.
 - 5. The capability of automatically initiating commands upon the occurrence of an alarm.
- F. Totalization

1. Run time shall be accumulated based on the status of digital input points. It shall be possible to totalize either on time or off time up to 10,000 hours with one-minute resolution. Run time counts shall be resident in memory and have DDC controller resident run time limits assignable through portable programmer's terminal, portable operator's unit or the remote Operator Workstation when applicable for project.
2. A transition counter shall be provided to accumulate the number of times a device has been cycled on or off. Counter shall be capable of accumulating 600,000 switching cycles. Limits shall be assignable to counts to provide maintenance alarm printouts.
3. Analog totalization capability shall be provided to allow the totalization of electricity, air, water and steam flow, etc. These flows shall be totalized with respect to time and converted to the appropriate energy unit. It shall be possible to automatically set time intervals for totalization, adjustable from one second to 365 days. The totalization program shall keep track of the maximum and minimum instantaneous analog value measured during the period, including the date and time at which each occurred.

G. DDC Controller Programming / Configuration

1. All DDC controllers shall be fully programmable or configurable per required controller application type. DDC controllers which require remote or factory programming or configuration are not acceptable. DDC controllers with custom programs which may not be modified by the user are not acceptable. "Custom" programming shall mean allowing the alteration of actual control logic, and shall not be limited to allowing only the alteration of setpoints, gains, parameters, time constants, etc.
2. DDC controllers shall be provided to meet the control strategies as called for in the sequences of operation on the drawings. If a configurable application specific DDC controller cannot meet this requirement, a DDC fully programmable controller shall be provided.
3. All DDC controller setpoints, gains, parameters, time constants, etc., associated with DDC controller programs shall be available to the operator for display and modification via portable programmer's terminal, portable operator's unit or the remote Operator Workstation when applicable for project.
4. Each DDC controller shall have resident in its memory and available to the programs a full library of DDC algorithms, intrinsic control operators, and arithmetic, logic and relational operators for implementation of control sequences. Functions to be provided shall include, but not be limited to, the following:
 - a. Mathematical: Absolute value, calculate, square root, power, sign, average, totalize.
 - b. Logic: OR, AND, compare, negate.
 - c. Fixed Formula: High and low select, span, rate, ramp, enthalpy, wet bulb, dew point, relative humidity, humidity ratio, and filter.
 - d. Data Manipulation: Store, file and set.
 - e. Control Routines: Real-time based functions, proportional control, proportional-integral control, proportional-integral-derivative control, adaptive control (self-tuning), direct-acting, reverse acting, feedforward, fixed setpoint, calculated setpoint, adjustable setpoint, lead lag, hysteresis correction, event initiation/ software interlock.

2.5 DDC AIR TERMINAL UNIT CONTROLLERS

- A. Microprocessor based controllers capable of stand-alone operation for control of pressure independent air terminal units. Controllers shall be networked together and connected to the building's BAS/DDC network.

- B. Controllers shall have separate adjustable minimum and maximum airflow setpoints. Controllers shall work in conjunction with the air handling unit's DDC panel to provide the sequence of operation as indicated on the drawings. Setpoints shall be adjustable through the portable programmer terminal.
- C. Provide electronic type air terminal unit damper operators compatible with the controller and the air terminal units provided.
- D. Each controller shall have an internal differential pressure transducer capable of utilizing the total and static pressure signals from the air terminal unit's velocity sensor. Velocity sensor shall be furnished by air terminal unit manufacturer.
- E. Each controller shall have electronic outputs compatible with the electronically operated air terminal unit tempering coil control valve and perimeter radiation control valve where applicable
- F. TC contractor shall provide 24 VAC power requirements including transformers.
- G. If coordinated with mechanical contractor. Controllers and damper operators shall be furnished to the air terminal unit manufacturer for factory mounting by the air terminal unit manufacturer; otherwise, controls shall be field installed.
- H. Room temperature sensors for the DDC air terminal unit controllers:
 - 1. Sensing Element: Thermistor or resistance temperature detector (RTD) type. Accuracy shall be +/- 0.5 degrees F over the range of 55 degrees F to 95 degrees F, including calibration error, repeatability, hysteresis, and yearly drift.
 - 2. Cover: with tamper-proof fasteners.
 - 3. Provide with exposed setpoint adjustment dial and exposed temperature reading.
 - 4. Provide with exposed override switch to allow an occupant to reset the space to occupied control during the unoccupied cycle for a predetermined time period.
 - 5. Provide with portable operator unit plug-in port.

2.6 DDC INPUT/OUTPUT SENSORS

- A. Air Static/Differential Pressure Transmitters:
 - 1. Variable capacitance type with ranges not exceeding 150 percent of maximum expected input. Transmitter shall have zero and span adjustments.
 - 2. Safe overpressure rating shall be minimum 5 times the range.
 - 3. Temperature compensated with thermal error of not greater than 0.04 percent of full scale in temperature range of 40 to 100 deg F.
 - 4. Accuracy: +/- 0.5% of full scale including calibration error, repeatability, hysteresis, and yearly drift.
 - 5. Manufacturers:
 - a. Air Monitor.
 - b. Belimo.
 - c. Dwyer.
 - d. Modus
 - e. Setra.

B. Current Switches:

1. Split-core or donut type transformer for monitoring AC current, with digital output signal. Current switches used on motor side of variable frequency drives shall have low frequency detection capability.
2. Current switches with digital output shall have adjustable trip settings. Provide field adjustment of current switches to trip at approximately 90% of normal motor operating amperage.
3. Manufacturers:
 - a. Johnson Controls.
 - b. NK Technologies.
 - c. Senva.
 - d. Setra.
 - e. Veris Industries.

C. Differential Pressure Transmitters:

1. Transmitters used for measuring differential pressure only:
 - a. Each differential pressure transmitter shall be selected and calibrated for operations between 0 and 200% of the normal differential pressure. The calibration point shall be rounded upward to the nearest 10 inches of water column (for spans less than 200" W.C.) or to the nearest 5 psi for larger spans. Calibration date shall be included on an embossed tag attached to each transmitter.
 - b. The accuracy, including linearity, hysteresis and repeatability, of the transmitter for measuring differential pressure shall be better than 2% of the span stated above throughout a 4:1 turndown.
 - c. The transmitter shall not be damaged by pressures of up to 500 psig on either side of the transmitter and all wetted parts shall be essentially inert in the presence of up to a 40% concentration of ethylene or propylene glycol in water.
 - d. Provide a drain valve for each side of the pressure chamber. Furnish and install mounting brackets appropriate for the installation location.
 - e. Span and zero shall be individually adjustable.
 - f. With LCD Display.
 - g. Manufacturers:
 - 1) Belimo.
 - 2) Dwyer.
 - 3) Johnson Controls.
 - 4) Setra.
 - 5) Veris Industries.
2. Three Valve Manifold:
 - a. Provide a three-valve manifold for each transmitter. The manifold shall not be damaged by pressures of up to 500 psig and all wetted parts shall be essentially inert in the presence of up to a 40% concentration of ethylene glycol in water.
 - b. The manifold shall be designed for direct mounting on the transmitter it serves and utilize quarter-turn valves to provide zeroing, blocking and normal service modes.

D. Humidity Sensors:

1. Elements: Thin film or polymer capacitive type or bulk polymer resistance type with linear output, accurate within $\pm 2\%$ RH throughout the range of 10-95% RH and drift to be less than $\pm 0.25\%$.
2. Humidity sensors shall be resistant to chlorine and other cleaning agents.
3. Room Sensors: With locking cover matching space temperature sensors used.
4. Duct Sensors: With duct probe and mounting plate.
5. Manufacturers:
 - a. Specified BAS product where available that meets the requirements herein.
 - b. Belimo.
 - c. GE Industrial, Sensing (formerly General Eastern)
 - d. Rotronic.
 - e. Vaisala.
 - f. Veris – HD/HO Series.

E. Outside Air Temperature/Humidity Combination Transmitters:

1. Dual transmitters housed in a single hinged enclosure with integral probes configured for exterior wall mount application with PVC sun shield. Unit shall provide separate 4-20 mA signals for temperature and humidity measurement.
2. Temperature sensor: Refer to Temperature Sensors specifications. Range of operation shall be - 25 degrees F to 125 degrees F.
3. Humidity sensor: Refer to Humidity Sensors specifications. Range of operation shall be 0-100% RH.
4. Manufacturer:
 - a. Belimo.
 - b. Vaisala.
 - c. Veris.

F. Temperature Sensors:

1. Resistance temperature detectors (RTD) with 1000 ohm, thin-filmed platinum, nickel or balco element having 0.000385 temperature coefficient meeting the input requirements of the DDC controller.
2. Thermally sensitive resistors (thermistor) shall be 10k-type, epoxy or glass coated, having NTC characteristic, meeting the input requirements of the DDC controller.
3. Initial calibration accuracy shall be ± 0.5 deg F over the entire range. Range shall be as indicated below, or as appropriate to the application.
4. Additional error such as repeatability, stability, tolerance, linearity and hysteresis shall not exceed an additional ± 0.5 deg F additive (using RMS method) throughout the selected operating range for the application.
5. Temperature sensors shall be resistant to chlorine and other cleaning agents
6. Single point duct mounted sensors shall have 18" rigid probe and calibrated span of 20 - 120°F.
7. Averaging duct mounted sensors shall have 25' long averaging element and calibrated span of 20 - 120°F.
8. Liquid immersion sensors shall have welded stainless steel thermowells for ferrous pipe and brass thermowells for copper pipe. Length of sensor and thermowell shall be selected based on the diameter of the pipe to provide accurate, reliable and homogeneous sensing of the liquid

temperature. Thermowell pressure rating shall meet or exceed the system minimum pressure rating. Sensors for chilled water application shall have calibrated span of 20 - 120°F. Sensors for hot water applications shall have calibrated span of 40 - 240°F

9. Room sensors shall have locking cover and a minimum span of 40 - 90°F.
10. Outside air temperature (only) sensors shall have watertight inlet fitting and shall be shielded from direct rays of sun and wind.
11. Manufacturers:
 - a. Specified BAS product where available that meets the requirements herein.
 - b. ACI – except PT1000 averaging sensor.
 - c. BAPI – Basys Series.
 - d. Belimo.
 - e. MAMAC
 - f. Minco.
 - g. TCS.

2.7 DDC DATA COMMUNICATIONS NETWORK

- A. Data communication network shall be provided to allow data exchange between the BAS field level DDC controllers and the Building Network Supervisory Controller.
- B. The BAS/DDC system-wide communication network shall consist of a primary peer-to-peer network, and at the Contractor's option, secondary sub-networks linked to the primary network. The primary network shall support peer-to-peer communications between primary network BAS field level DDC controllers. The Building Network Supervisory Controller shall be connected to the primary network. Secondary sub-networks when used shall interface with the primary network through the primary network BAS field level DDC controllers. At least one DDC controller connected to the primary peer-to-peer network shall be provided in each mechanical room, or as indicated on the drawings.
- C. Data communications media shall be twisted pair wires.
- D. The communications network shall allow shared point and control information between BAS field level DDC controllers. All required repeaters, hubs, active links, gateways, etc. and associated power supplies shall be provided as required to provide shared point and control information between BAS field level DDC controllers.
- E. Failure of any individual BAS field level DDC controller shall not cause the loss of communications between peer BAS field level DDC controllers.
- F. All data transmitted must be positively acknowledged as received or negatively acknowledged as not received. Negative acknowledgments shall cause a retransmission of the data. Network connected devices must send a "functioning" message each network cycle. Lack of a "functioning" message after successive retries shall constitute a device failure and shall be recognized as such by the network.
- G. Error recovery and communication initialization routines shall be resident in each network connected device.

2.8 AIRFLOW MEASURING PROBES

- A. Duct airflow measuring probes shall be Thermal Dispersion type.
- B. Probes shall be constructed of extruded aluminum. Probes shall be provided with mounting plate, and gasket. Probe and mounting hardware shall facilitate easy removal and reinstallation of the probes.
- C. The number of sensors on each probe, and the quantity of probes provided at each location, shall comply with ASHRAE standards for duct traversing. Multiple probes provided at a single location shall be interconnected external to the duct to produce an average signal.
- D. For each airflow measurement location, the measured velocity pressure shall have accuracy within $\pm 2\%$ of the full scale throughout the velocity range of 0-4000 fpm.
- E. Associated transmitter at each airflow measurement location shall be provided with LCD readout to indicate airflow (in CFM) of the connected airflow measuring station.
- F. Manufacturers / Model:
 - 1. Ebtron / Gold Series.
 - 2. Air Monitor Corporation / ELECTRA-flo.

2.9 AIRFLOW MEASURING STATIONS – DUCT MTD THERMAL DISPERSION (INCLUDING OA FLOW)

- A. Airflow measuring station with thermal dispersion type technology utilizing perimeter chamber with array of inlet ports to produce an overall average airflow rate shall be a preassembled unit including casing with connecting flanges, fabricated to the duct size.
- B. Airflow measuring station shall have a galvanized steel casing (or stainless steel if manufacturer's standard) and the entire assembly shall be fabricated to withstand the maximum pressures and velocities for the application.
- C. Probe type units shall be constructed of extruded aluminum and the number of sensors on each probe, and the quantity of probes provided at each location, shall comply with ASHRAE standards for duct traversing. Multiple probes shall be interconnected external to the duct to produce an average signal.
- D. Perimeter chamber type units shall direct air through the mass airflow sensing probe.
- E. For each airflow measurement location, the measured airflow shall have accuracy within $\pm 2\%$ of the full scale throughout the velocity range of 0-4000 fpm.
- F. Associated transmitter at each airflow measurement location shall be provided with LCD readout to indicate airflow (in CFM) of the overall airflow measuring station.
- G. Manufacturer:
 - 1. NJK Precision Air Flow Measurement Products.

2.10 CONTROL AND INSTRUMENTATION TUBING

- A. Polyethylene Tubing: Black, UL 1820 flame and smoke retardant where exposed in an air plenum, virgin polyethylene, conforming to modified ASTM D1693 test. All non-metallic tubing shall be minimum 1/4" O.D.; micro-sleeve is not acceptable.
1. Fittings: UL approved rod or forged brass rated to 200 psig at 100 degrees F.
 2. Joints: Compression or barbed type.

2.11 CONTROL VALVES AND VALVE OPERATORS

- A. Pressure Independent Control Valves (2-way):
1. Characterized ball valve style with integral pressure compensating cartridge to maintain a constant pressure drop across valve seat or integral flow meter to maintain steady flow rate. Control valves shall provide equal percentage flow control. Ball valve construction shall include bronze or brass-nickel plated body with screwed ends, stainless steel or chrome plated brass ball, characterizing disc, stainless steel or brass stem, and resilient reinforced Teflon seats.
 2. Over 2 inches: Control valve construction shall include, iron body with flanged ends, stainless steel trim.
 3. Accuracy: Control valves shall accurately control flow from 0 to 100% of the full rated flow. Flow through the valve shall not vary more than +/- 5% due to system pressure fluctuations when the pressure drop across the valve is within the range of 5 psid to 35 psid.
 4. Manufacturers:
 - a. Belimo QPCIV for terminal equipment as noted on drawings.
 - b. Belimo EPIV for Primary equipment as noted on drawings.
- B. Pressure dependent Characterized Ball Valves (2-way) for HWH & CHW system bypass valves:
1. Up to 2 inches: Bronze body with screwed ends, stainless steel or chrome plated brass ball, characterizing disc, stainless steel or brass stem, and resilient reinforced Teflon seats.
 2. Manufacturers:
 - a. Belimo CCV.
- C. Electric Operators:
1. Operators shall be electronic type to accept signals from direct digital controller for proportional control.
 2. Valves shall spring return to normal position as indicated. Terminal unit tempering coil control valve operators are not required to be spring return.
 3. Select with sufficient shut-off power for system pressure and highest operating torque, and torque requirements of valves which may stick because of infrequent use.
 4. Select to provide smooth proportioning control under operating conditions normal to the system.
- D. Hydronic Systems:

1. Valve minimum pressure rating shall meet or exceed the system minimum pressure rating as noted for each system in Division 20 Section "Valves," and in Division 23 Section "Hydronic Piping."
2. Valve minimum temperature ratings shall be 250 deg F.
3. Two way valves shall have equal percentage characteristics. Size two way valve operators to close valves against pump shut off head.
4. Pressure independent control valves shall be used for 2-way applications unless otherwise indicated. Select to achieve scheduled flow rate of the associated heat transfer device. If the scheduled flow rate is too high to achieve with one valve, provide multiple valves sized at flow divided equally of the scheduled flow rate and control all valves in unison - coordinate control valve quantity and the need for parallel piping of control valves with mechanical contractor.
5. For pressure dependent control valves, select for flow and pressure drop as shown on the drawings.

2.12 DAMPERS - AUTOMATED

- A. Performance: Test in accordance with AMCA 500.
- B. Frames: Galvanized steel, minimum 16 gauge, minimum 2 inches in width, welded or riveted with corner reinforcement for 12 gage structural equivalence.
- C. Blades: Galvanized steel, minimum 14 gauge, maximum blade size 8 inches wide, 60 inches long, attached to minimum 1/2 inch shafts. Dampers which are required to have a static pressure rating over 4 inch W.G. shall have minimum 3/4 inch solid shafts.
- D. Blade Seals: Synthetic elastomeric or Neoprene, mechanically attached, field replaceable.
- E. Jackshafts (where required): Minimum 1/2 inch galvanized steel.
- F. Jamb Seals: Stainless steel.
- G. Bearings: Oil impregnated sintered bronze or lubricant free, solid stainless steel. Provide thrust washers at bearings for all dampers which are to be mounted with blades in the vertical position.
- H. Linkages: Accessible for maintenance. Linkages may be located in airstream. Linkages located in damper frame shall be external to the duct, accessible for maintenance. Linkages located in the airstream shall be zinc-plated.
- I. Leakage: Less than 8 CFM per square foot based on 4 inches W.G. pressure differential.
- J. Static Pressure Rating: As scheduled on the drawings, or if not scheduled, minimum 4" W.G.
- K. Maximum Velocity: As scheduled on the drawings, or design for maximum velocity to be encountered in location where installed.
- L. Temperature Limits: -40 to 200 deg F.
- M. Manufacturers:
 1. Johnson Controls.
 2. Greenheck.

3. Ruskin.
4. Tamco.
5. Vent Products.

2.13 DAMPERS, INSULATED OUTDOOR AIR / RELIEF AIR / EXHAUST AIR - AUTOMATED

- A. Performance: AMCA certified for Air Performance and Air Leakage.
- B. Frames: Extruded aluminum, .080-inch thickness minimum, 4 inches deep minimum, thermally broken, and insulated with polystyrene or polyurethane foam insulation.
- C. Blades: Extruded aluminum, internally insulated, and thermally broken. Maximum blade size 8 inches wide, 60 inches long.
- D. Shafts: Minimum 7/16 inch hexagonal or square corrosion resistant zinc plated steel.
- E. Blade Seals: Extruded EPDM, silicone, or synthetic elastomeric, mechanically attached.
- F. Jamb Seals: Silicone, or synthetic elastomeric, mechanically attached.
- G. Bearings: Dual bearing assembly of durable synthetic polymer resulting in no metal-to-metal contact. Provide thrust washers at bearings for all dampers which are to be mounted with blades in the vertical position.
- H. Linkage: Linkage shall be installed in the frame side and shall be constructed of aluminum and/or corrosion resistant zinc plated steel.
- I. Leakage: Less than 3 CFM per square foot at 1 inch W.G. pressure differential at minus 40 deg F.
- J. Static Pressure Rating: As scheduled on the drawings, or if not scheduled, minimum 4 inches W.G.
- K. Maximum Velocity: As scheduled on the drawings, or design for maximum velocity to be encountered in location where installed.
- L. Temperature Limits: Minus 40 to 155 deg F.
- M. Manufacturers:
 1. Greenheck ICD-45.
 2. Ruskin TED50 Series.
 3. Tamco Series 9000 BF.

2.14 DAMPER OPERATORS - ELECTRIC

- A. Electric damper motor shall be 24 or 120 volt two-position or modulating as required with spring return type and sized to operate the damper with sufficient reserve power for smooth operation from full close to full open and tight shut-off. Damper motor shall have "O ring" gaskets for weatherproof operation.

- B. Number: Sufficient to achieve unrestricted movement throughout damper range. Provide sufficient number of operators such that one operator does not operate more than the maximum square footage of damper area as recommended in standard catalog of manufacturer.
- C. Manufacturers:
 - 1. Belimo.
 - 2. Johnson Controls.

2.15 DIFFERENTIAL PRESSURE SWITCHES

- A. Shall provide electrical switching action upon a sensed pressure differential increase between two points. Sensitivity shall be suitable for the application. Setpoint shall be adjustable over the full range of the device. Switching action shall open or close two independent single pole double throw switches. Electrical switch rating shall be 10 amps at 120 VAC.
- B. Pressure rating of switch and connecting tubing:
 - 1. Fan - Rated for 12 inches W.C.

2.16 ELECTRICAL REQUIREMENTS FOR CONTROLS WORK

- A. Electrical accessories such as relays, switches, contactors and control transformers shall meet the requirements of the Division 26 Specifications of respective project.
- B. Electrical wiring and conduit shall meet the requirements of the Division 26 Specifications.
- C. All control wiring in mechanical rooms and any other exposed areas shall be run in conduit. Low voltage temperature control wiring in concealed accessible locations (i.e. above lay-in ceilings), as well as low voltage temperature control wiring within partitions, may be run using plenum rated cable, neatly tie-wrapped and fastened to the building structure (not to ceiling or ceiling support wires).
- D. Conduits carrying control wiring shall be sized for a maximum fill of 40% of capacity.
- E. Where raceway is required, two separate raceway systems shall be provided; one for A.C. wiring and the other for D.C. wiring.
- F. Data transmission cabling and equipment grounding procedures shall meet the latest FCC guidelines for electromagnetic field generation.
- G. All control wiring sizes and types shall meet or exceed the equipment manufacturer's recommendations.

2.17 EMERGENCY POWER-OFF (EPO) PUSH-BUTTON

- A. ADA compliant, push-button switch with clear cover to prevent inadvertent closure. Push-to-activate push-button, and providing two SPDT contacts rated 10 Amps at 120 VAC.
- B. Manufacturers:

1. Safety Technology International – model SS-2212PO
2. Alarm Controls Corporation – model ADC-100.

2.18 LIMIT SWITCHES

- A. Oil tight type with operator as required providing required function. Limit switches used on dampers should be set at approximately 75% of full stroke.
- B. Manufacturers:
 1. Allen-Bradley.
 2. General Electric.
 3. Square D.
 4. Westinghouse.
 5. Micro-switch.

2.19 LOCAL AND AUXILIARY CONTROL COMPONENT ENCLOSURE PANELS

- A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, pushbuttons and switches flush on cabinet panel face, or as detailed on drawings. Provide panel with locking door.
- B. ANSI/NEMA 250, general purpose utility enclosures with enameled finished face panel, or as indicated on the drawings.
- C. Panels shall be sized for a maximum fill of 50% capacity, and shall not be smaller than 24" X 24".

2.20 REFERENCE PROBE - DUCT STATIC PRESSURE

- A. Duct static pressure probe shall be capable of static pressure measurement with bi-directional flow in a duct, plenum or air handling unit. Probe shall have minimum 4" insertion depth, shall compensate for total pressure error, and shall provide an accurate, repeatable and stable static pressure value with a maximum flow of 4000 fpm.
- B. Probe shall be constructed of aluminum, with mounting flange suitable for round or flat duct surfaces. Probe shall have static pressure signal fitting.
- C. Manufacturers:
 1. MAMAC # A-520.
 2. Dwyer # A-305.
 3. Tek-Air # T-SPP 7100/7200.

2.21 REFERENCE PROBE - INDOOR STATIC PRESSURE

- A. Indoor pressure reference probe shall be a shielded static pressure sensor suitable for flush mounting in the ceiling, complete with multiple sensing ports, pressure impulse suppression chamber, airflow shielding,

control tubing take-off fitting, and brush finish on exposed surface. Probe shall be capable of sensing the static pressure in the proximity of the sensor to within 1% of the actual pressure value while being subjected to a maximum airflow of 1000 fpm from a radial source.

B. Manufacturers:

1. Air Monitor Corporation.
2. Tek-Air.

2.22 THERMOSTATS – ELECTRONIC & ELECTRIC

- A. Electric Low Limit Duct Thermostat (freezestat): Snap acting which trips if temperature sensed across any 12 inches of bulb length is equal to or below setpoint, fixed 5 deg F differential, range 30 deg F to 60 deg F, requiring minimum 20 feet length of bulb. Manual-reset unless indicated on drawings to be auto-reset type. Provide one thermostat for every 20 sq ft of coil surface. Switch shall be UL listed and rated for 10 amps at 120 VAC. Provide additional switch or contacts for connection to monitoring system.
- B. Electric High Limit Duct Thermostat: Snap acting, manual reset switch.
- C. Manufacturers for listed Thermostat Types:
1. Honeywell International, Inc.
 2. Johnson Controls, Inc.
 3. Schneider Electric USA, Inc.
 4. Siemens Industry, Inc.; Building Technologies Division.
 5. White-Rodgers Div.; Emerson Electric Co.

PART 3 - EXECUTION

3.1 INSTALLATION - CONTROL SYSTEMS

- A. Install in accordance with manufacturer's instructions.
- B. Check and verify location of temperature sensors, thermostats and other exposed control sensors with plans and room details before installation. Locate room temperature sensors at height noted on drawings.
- C. The location of all control-related items to be mounted on the exterior of the building must be approved by the Architect prior to installation. Indicate proposed locations on the shop drawings.
- D. Caulk both sides of damper frames to duct walls to prevent leakage between damper frame and duct.
- E. Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. Sensors used for closed loop control must be connected to the same DDC controller as the associated output signal.
- F. Provide conduit and electrical wiring where required.

- G. All wiring in altered and unaltered areas shall be run concealed. "Wiremold" in finished areas shall be allowed when wiring cannot be run concealed in walls or partitions. Minimize "wiremold" routing.
- H. Splicing of DDC sensor cabling at junction boxes shall not be acceptable.
- I. All equipment which has moving parts and is remotely started by the control system shall be provided with warning labels no less than 2 inches in height, and in bright warning color, stating that the equipment is remotely started by automatic controls. Such labels shall be posted clearly in the area of any moving parts, such as belts, fans, pumps, etc.
- J. Coil and conceal excess capillary on remote element instruments.
- K. Locate all control components and accessories such that they are easily accessible for adjustment, service and replacement.
- L. Locate, size and support sensing elements in airstreams so that they properly sense the representative condition. Controlling, transmitting and indicating elements shall be located to sense the average condition. Safety elements shall be located to sense the extreme condition.
- M. Locate and size sensing elements in liquid lines so that they are in moving liquid and not in stagnant or turbulent locations. Wells shall not obstruct the flow of the liquid being measured. Pipes one inch and smaller shall be increased at least one pipe size at the point of insertion.
- N. Locate pressure sensing taps in liquid lines in straight runs of pipe with at least 10 pipe diameters of straight pipe both upstream and downstream of pressure tap. Provide a shut-off cock in sensing line at each pressure tap.
- O. Install pressure sensing elements in ducts and casings with clean, sharp taps to accurately read true static pressure, avoiding velocity influence and turbulence.
- P. Locate, support and install all control components and accessories so that they will not be subject to vibration, excessive temperatures, dirt, moisture or other harmful conditions beyond their rated limitations.
- Q. Where insulation is penetrated due to the installation of sensing elements or tubing, reseal the openings air and vapor tight. Provide brackets for devices to be located on insulated surfaces so as to clear the finished surface of the insulation and to avoid puncturing the vapor seal.
- R. Provide all necessary relays, switches, linkages, control devices, accessories and connections as required for a complete and operational control system as specified herein and shown.
- S. All electric valve and damper operators shall be capable of moving from full closed to full open, or vice versa, within 120 seconds.

3.2 IDENTIFICATION AND MARKING

- A. All sensors, relays, switches, etc. shall be marked with the same identification number as used on the as-built shop drawings. Use Brother P-touch label maker or similar with black text on clear or white super adhesive tape. If label applied in wet environment, spray label with clear enamel for waterproofing.

- B. Wire shall be color coded according to functional use. Identify color coding format on record drawings.
- C. Identify each wire as to ID number at each controller termination, field device termination or on the field device.
- D. All control panels and auxiliary enclosures shall be supplied with engraved phenolic nameplate permanently attached on the front exterior with panel identification to match details of temperature control submittals and include system(s) served and area(s) served on the labeling. Include labeling near 120VAC terminations within panel identifying power source panel ID and specific circuit breaker used.

3.3 GRAPHIC DISPLAY GENERATION

- A. Provide the following graphic displays as a minimum at the operator interface, arranged in logical penetration paths:
 - 1. Overall campus layout which shows all of the buildings on the Owner's campus.
 - 2. Individual building layout or isometric for each building connected to the system.
 - 3. Floor plans for each floor within each building, with display of present values of space conditions sensed by connected space sensors, display of the name of the air handler associated with each space sensor, display of the room number in which the sensor is located and color coding to indicate whether the sensed space condition is within the acceptable range, is too high, or is too low. TC Contractor shall confirm Owner desired room names prior to graphics generation which may differ from the room names indicated on construction documents.
 - 4. Schematic diagram for each HVAC system. Each system schematic display shall include at least the following:
 - a. Schematic arrangement of ductwork, fans, dampers, coils, valves, piping, pumps, equipment etc.
 - b. System name.
 - c. Area served.
 - d. Present value or status of all inputs, along with present setpoint.
 - e. Present percent open for each damper, valve, etc. based on commanded position.
 - f. Reset schedule parameters for all points, where applicable.
 - g. Present occupancy mode.
 - h. Present economizer mode, where applicable.
 - i. Present outside air temperature.
 - j. Associated space conditions and setpoints, where applicable.
 - k. Status of application programs (e.g., warm-up, night cycle, duty cycle, etc.).
 - l. Color coding to indicate normal and abnormal values, alarms, etc.
 - 5. Manual override capability for each on/off or open/closed controlled digital output (for fans, pumps, 2-position dampers and valves, etc.) and each modulating analog output (for dampers, valves, VFD speed modulation type points, etc) shall be provided. Graphic display of output point auto or manual override status shall be provided.
 - 6. Sequence of operation in written (text) format for each HVAC system.
 - 7. Overall BAS system schematic.
 - 8. System management graphic for each network device and/or DDC controller.

3.4 OWNER INSTRUCTION AND TRAINING

- A. Provide a minimum of twenty four (24) hours] of combined on-site and classroom instruction and training to the Owner on the operation of the control systems for the initial installation.
- B. Instruction and training shall be performed by a competent Contractor representative familiar with the control systems operation, maintenance and calibration.
- C. Training shall take place after check, test, start-up of temperature controls system at a time mutually agreed upon by the Owner and Contractor.
- D. Provide computer training & tutorial material on USB Flash Drives 5 total describing operator's BAS graphical interface capabilities and functions.
- E. Provide 5 sets of literature pertaining to the operation and maintenance of the DDC system components provided.

3.5 CALIBRATION AND START-UP

- A. After installation and connection of control components, test, adjust and re-adjust as required all control components in terms of function, design, systems balance and performance. Make systems ready for environmental equipment acceptance tests.
- B. After environmental equipment has been accepted and after the systems have operated in normal service for two weeks, check the adjustment on control components and recalibrate where required. Components not in calibration shall be recalibrated to function as required, or shall be replaced. Control devices, linkages, and other control components shall be calibrated and adjusted for stable and accurate operation in accordance with the design intent and to obtain optimum performance from the equipment controlled. Cause every device to automatically operate as intended to ensure its proper functionality.

3.6 ACCEPTANCE PROCEDURE

- A. Upon successful completion of start-up and recalibration as indicated in this section, the Architect shall be requested in writing to inspect the satisfactory operation of the control systems.
- B. Demonstrate operation of all control systems, including each individual component, to the Owner and Architect.
- C. After correcting all items appearing on the punch list, make a second written request to the Owner and Architect for inspection and approval.
- D. After all items on the punch list are corrected and formal approval of the control systems is provided by the Architect, the Contractor shall indicate to the Owner in writing the commencement of the warranty period.

END OF SECTION 23 0933

PARTNERS 21-130
TEMPERATURE CONTROLS
23 0933 - 26

SECTION 23 2113 - HYDRONIC PIPING

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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.
- B. Related Sections include the following:
 - 1. Division 07 Section "Penetration Firestopping" for materials and methods for sealing pipe penetrations through fire and smoke barriers.
 - 2. Division 07 Section "Joint Sealants" for materials and methods for sealing pipe penetrations through exterior walls.
 - 3. Division 20 Section "Mechanical General Requirements."
 - 4. Division 20 Section "Basic Mechanical Materials and Methods" for general piping materials and installation requirements.
 - 5. Division 20 Section "Hangers and Supports" for pipe supports, product descriptions, and installation requirements. Hanger and support spacing is specified in this Section.
 - 6. Division 20 Section "Pipe Flexible Connectors, Expansion Fittings and Loops."

7. Division 20 Section "Meters and Gages" for thermometers, flow meters, flow measuring devices, and pressure gages.
8. Division 20 Section "Mechanical Identification" for labeling and identifying hydronic piping.
9. Division 23 Section "General-Duty Valves for HVAC" for general-duty gate, globe, ball, butterfly, and check valves.
10. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.
11. Division 23 Section "Temperature Controls" for temperature-control valves and sensors.
12. Division 23 Section "Piping Systems Flushing and Chemical Cleaning."
13. Division 23 HVAC water treatment sections.

1.2 PERFORMANCE REQUIREMENTS

- A. Where not indicated on the Drawings, hydronic piping components and installation shall be capable of withstanding the following minimum working pressures and temperatures:

1.3 SYSTEMS DESCRIPTIONS

- A. Hydronic piping system materials are scheduled on the Drawings.
- B. Refer to Application Schedule on the Drawings for valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 1. Hot-Water-Piping, Balancing Duty: Calibrated balancing valves.
 2. Drain Duty: Hose-end drain valves.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 1. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
 2. Air control devices.
 3. Hydronic specialties.

1.5 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp

air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

- B. Installer Qualifications:
- C. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be as recommended by the manufacturer of the grooved components.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. Wrought-Copper Socket Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Grooved Mechanical-Joint Fittings and Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ASC Engineered Solutions; Gruvlok; CTS Copper System.
 - b. Victaulic Company; Style 606 and Style 607.
 - 2. Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting.
 - 3. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, EPDM gasket rated for minimum 230 deg F for use with housing, and steel bolts and nuts.

2.2 STEEL PIPE AND FITTINGS

- A. Schedule 40 Steel Pipe: ASTM A 53/A 53M or ASTM A 106, Type E or S, Grade A or B. Include ends matching joining method.
 - 1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
 - 2. Malleable-Iron Unions: ASME B16.39, Class 150, hexagonal-stock body, with ball-and-socket, metal-to-metal, bronze seating surface and female threaded ends.
 - 3. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, standard pattern.
 - 4. Cast-Iron Flanges: ASME B16.1, Class 125.
 - 5. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125.
 - 6. Fittings: ASTM A234 ANSI B16.9, steel butt weld to match pipe wall thickness, Class 300.
 - 7. Flanges: Class 300 forged steel welding neck to match pipe wall thickness and valve flanges, ANSI B16.5. Orifice plate flanges shall be raised face welding neck type with ring joint gaskets and flange taps. Coordinate orifice plate flanges with orifice plate flow elements.
- B. Grooved Mechanical-Joint Fittings and Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ASC Engineered Solutions; Gruvlok; Model 7401 Rigid, Model 74 SlideLOK, and Fig. 7400 Rigidlite.
 - b. Victaulic Company; Style 107 QuickVic Rigid Coupling and W07 AGS Rigid Coupling.
2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 234, Grade WPB steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
3. Gaskets: Synthetic rubber gasket of central cavity pressure-responsive design suitable for temperatures from minus 30 deg F to 230 deg F.
4. Couplings: Ductile-iron housing with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
 - a. Rigid Type: To provide rigidity and system support and hanging in accordance with ANSI B31.1 and B31.9.

2.3 JOINING MATERIALS

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods."

2.4 VALVES

- A. General Service Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC."

2.5 SPECIALTY VALVES

- A. Balance Valves:
- B. Combination, Balancing Valves and Flow Measuring Devices NPS 2 and Smaller:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Griswold Controls.
 - b. Hydronic Components, Inc. (HCi); a Jomar Group Company.
 - c. IMI Flow Design; IMI Hydronic Engineering Inc.
 - d. Jomar Hydronics.
 - e. Macon Balancing; Tunstall Corporation.
 - f. Nexus Valve.
 - g. PRO Hydronic Specialties, LLC.
 2. Manufacturers: Subject to compliance with requirements, use products by one of the following:
 - a. Tour & Andersson; TA Hydronics Series available through Victaulic Company of America.
 - b. ASC Engineered Solutions; Gruvlok; Model CBV.

3. Body: Brass or bronze, ball or plug type with calibrated orifice or venturi.
4. Ball: Plated brass, or stainless steel.
5. Plug: Resin.
6. Seat: PTFE.
7. End Connections: Threaded or socket.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Lever, with memory stop to retain set position.
10. WOG Rating: Minimum 400 psig.
11. Maximum Operating Temperature: 250 deg F.

C. Combination, Balancing Valves and Flow Measuring Devices NPS 2-1/2 through NSP 4:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Griswold Controls.
 - b. Hydronic Components, Inc. (HCi); a Jomar Group Company.
 - c. IMI Flow Design; IMI Hydronic Engineering Inc.
 - d. Jomar Hydronics.
 - e. Macon Balancing; Tunstall Corporation.
 - f. Nexus Valve.
 - g. PRO Hydronic Specialties, LLC.
2. Manufacturers: Subject to compliance with requirements, use products by one of the following:
 - a. Tour & Andersson; TA Hydronics Series available through Victaulic Company of America.
 - b. ASC Engineered Solutions; Gruvlok; MBV Series, CSV Series.
3. Body: Cast-iron or steel body, ball, plug, butterfly, or globe pattern with calibrated orifice or venturi.
4. Stem Seals: EPDM O-rings.
5. Disc: Glass and carbon-filled PTFE.
6. Seat: PTFE.
7. End Connections: Flanged or grooved.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Lever, with memory stop to retain set position.
10. WOG Rating: Minimum 200 psig.
11. Maximum Operating Temperature: 225 deg F.

D. Contractor Option for Combination, Balancing Valves and Flow Measuring Devices NPS 2 and Smaller:
Preassembled coil hook up kits may be used.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Griswold Controls.
 - b. Hydronic Components, Inc. (HCi); a Jomar Group Company.
 - c. IMI Flow Design; IMI Hydronic Engineering Inc.
 - d. Jomar Hydronics.
 - e. Macon Balancing; Tunstall Corporation.
 - f. Nexus Valve.
 - g. PRO Hydronic Specialties, LLC.

2. Manufacturers: Subject to compliance with requirements, use products by one of the following:
 - a. Tour & Andersson; TA Hydronics Series available through Victaulic Company of America.
 - b. ASC Engineered Solutions; Gruvlok.

2.6 CONTROL VALVES

- A. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Temperature Controls."
- B. Calibrated orifice balancing valves shall not be required on devices where pressure independent characterized control valves (PICCV's) are installed.

2.7 AIR CONTROL DEVICES

- A. Manual Air Vents: Use ball-valve-type hose-end drain valves, refer to Division 23 Section "General-Duty Valves for HVAC."
- B. Automatic 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; Xylem Inc.
 - d. Spirotherm, Inc.
 - e. Taco, Inc.
 2. Body: Bronze or cast iron.
 3. Internal Parts: Nonferrous.
 4. Operator: Noncorrosive metal float.
 5. Inlet Connection: NPS 1/2.
 6. Discharge Connection: NPS 1/4.
 7. Maximum Operating Pressure: 150 psig.
 8. Maximum Operating Temperature: 240 deg F.
- C. Expansion Tanks:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett; Xylem Inc.
 - d. Taco, Inc.
 - e. Wessels Co.
 2. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature, with taps in bottom of tank for tank fitting and taps in end of tank for gage glass. Tanks

shall be factory tested with taps fabricated and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

3. Air-Control Tank Fitting: Cast-iron body, copper-plated tube, brass vent tube plug, and stainless-steel ball check, 100-gal. unit only; sized for compression-tank diameter. Provide tank fittings for 125-psig working pressure and 250 deg F maximum operating temperature.
4. Tank Drain Fitting: Brass body, nonferrous internal parts; 125-psig working pressure and 240 deg F maximum operating temperature; constructed to admit air to compression tank, drain water, and close off system.
5. Gage Glass: Full height with dual manual shutoff valves, 3/4-inch diameter gage glass, and slotted-metal glass guard.

D. Bladder-Type Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett; Xylem Inc.
 - d. Taco, Inc.
 - e. Wessels Co.
2. Tank: Welded steel, rated for 125-psig working pressure and 240 deg F maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
3. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
4. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

E. Combination Air and Dirt Separators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Spirotherm, Inc.; VDN Series.
2. Body: Fabricated steel; constructed for 150-psig maximum working pressure and 250 deg F maximum operating temperature. Separator shall have body extended below pipe connections for dirt separation and include removable lower head.
3. Air and Dirt Separation Mechanism: Internal copper core tube with continuous wound copper medium permanently attached followed by continuous wound copper wire permanently affixed.
4. Venting Chamber: With integral full port, float actuated brass venting mechanism. Include valved side tap to flush floating dirt or liquids and for quick bleeding of air during system fill.
5. Inlet and Outlet Connections: Threaded for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger.
6. Blowdown Connection: Threaded.
7. Size: Match system flow capacity.

2.8 HYDRONIC PIPING SPECIALTIES

- A. Diverting Fittings: 125-psig working pressure; 250 deg F maximum operating temperature; cast-iron body with threaded ends, or wrought copper with soldered ends. Indicate flow direction on fitting.
- B. Flexible connectors and expansion fittings are specified in Division 20 Section "Pipe Flexible Connectors, Expansion Fittings and Loops."
- C. Waterless Condensate Trap:
 - 1. Meet standard building code requirements.
 - 2. Predesigned to prevent:
 - a. Possibility of frozen or broken pipes.
 - b. Standing water within trap.
 - c. Sludge buildup in trap.
 - d. Geyser effect or blowout.
 - 3. Manufacturers:
 - a. Des Champs Technologies; HVAC Air Trap; P-Series, N-Series, and RLC Series.

2.9 HYDRONIC PIPING STRAINERS

- A. Manufacturers:
 - 1. Apollo Valves; Conbraco Industries, Inc.
 - 2. Griswold Controls.
 - 3. Keckley Company.
 - 4. Metraflex Company.
 - 5. Mueller Steam Specialty; a Watts Brand.
 - 6. NIBCO, Inc.
 - 7. Sure Flow Equipment Inc.
 - 8. Titan Flow Control, Inc.
 - 9. Watts.
 - 10. Yarway; Emerson Automation Solutions.
 - 11. ASC Engineered Solutions; Gruvlok Manufacturing (for grooved piping).
 - 12. Victaulic Company (for grooved piping).
- B. Y-Pattern Strainers, Bronze:
 - 1. CWP: 200 psig minimum, unless otherwise indicated.
 - 2. SWP: 125 psig minimum, unless otherwise indicated.
 - 3. Body: Bronze for NPS 2 and smaller.
 - 4. End Connections: Threaded or soldered.
 - 5. Strainer Screen: Stainless steel, 40-mesh unless otherwise noted or scheduled.
 - 6. Drain:
 - a. Pipe plug for sizes NPS 2 and smaller.

- b. Factory-installed, hose-end drain valve for sizes NPS 2-1/2 and larger.
- C. Y-Pattern Strainers, Cast and Ductile Iron:
 - 1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
 - 2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger; grooved ends may be used on grooved piping.
 - 3. Strainer Screen: Stainless steel, 40-mesh unless otherwise noted or scheduled.
 - 4. CWP: 200 psig minimum, unless otherwise indicated.
 - 5. SWP: 125 psig minimum, unless otherwise indicated.
 - 6. Drain:
 - a. Pipe plug for sizes NPS 2 and smaller.
 - b. Factory-installed, hose-end drain valve for sizes NPS 2-1/2 and larger.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such 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 indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- 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, other than drain 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 using tee fittings in main pipe, 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 Division 23 Section "General-Duty Valves for HVAC."
- Q. Install shutoff duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, unless only one piece of equipment is connected in the branch line. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.
- R. Install calibrated balancing valves in the return water line of each heating or cooling element and elsewhere as required to facilitate system balancing.
- S. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- T. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- U. Install flanges or grooved mechanical couplings in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- V. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and where indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.
- W. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 20 Section "Pipe Flexible Connectors, Expansion Fittings and Loops."
- X. Identify piping as specified in Division 20 Section "Mechanical Identification."

3.2 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Division 20 Section "Hangers and Supports." 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. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. 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; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
8. NPS 18: Maximum span, 28 feet; minimum rod size, 1-1/4 inches.
9. NPS 20: Maximum span, 30 feet; minimum rod size, 1-1/4 inches.

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 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
7. NPS 4 to NPS 5: Maximum span, 10 feet minimum rod size, 1/2-inch.

E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.3 PIPE JOINT CONSTRUCTION

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

3.4 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.
- B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.
- C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- D. Install combination air/dirt separator in pump suction. Install blowdown piping with ball valve; extend full size to nearest floor drain.
- E. Install expansion tanks as indicated in piping diagrams. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.
 1. Install tank fittings that are shipped loose.
 2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.

3. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

3.5 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.
- C. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 20 Section "Meters and Gages."

3.6 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 "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 5. After hydrostatic test pressure has been applied for at least 2 hours, 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 pumps for proper rotation.
3. Remove disposal fine-mesh strainers in pump suction diffusers.
4. Set makeup pressure-reducing valves for required system pressure.
5. 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).
6. Set temperature controls so all coils are calling for full flow.
7. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
8. Verify lubrication of motors and bearings.

END OF SECTION 23 2113

PARTNERS 21-130
HYDRONIC PIPING
23 2113 - 14

SECTION 23 2123 - HYDRONIC PUMPS

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."

1.2 DEFINITIONS

- A. Buna-N: Nitrile rubber.
- B. EPT: Ethylene propylene terpolymer.
- C. PEI: Pump Energy Index as defined by the Department of Energy.
- D. PEI_{CL}: Pump Energy Index – Constant Load, as defined by the Department of Energy.

- E. PEI_{VL}: Pump Energy Index – Variable Load, as defined by the Department of Energy.

1.3 ACTION SUBMITTALS

- A. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.

1.4 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.

- 1. Wiring Diagrams: Power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For all pumps and accessories to include in Operation and Maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.
- B. Department of Energy Requirements: Pumps supplied that are regulated by the Department of Energy pump standards shall bear the acceptable PEI index.
 - 1. Constant load pumps supplied shall bear the acceptable PEI_{CL} index.
 - 2. Variable load pumps supplied with variable speed controls shall bear the acceptable PEI_{VL} index.
 - 3. Submittals for approval shall clearly identify the applicable PEI index and affirm that that index meets the DOE pump standards.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- D. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.
- B. Store pumps in dry location.
- C. Retain protective covers for flanges and protective coatings during storage.

- D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.
- E. Comply with pump manufacturer's written rigging instructions.

1.8 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 GENERAL PUMP REQUIREMENTS

- A. Pump Units: Factory assembled and tested.
- B. Motors: Comply with requirements in Division 20 Section "Motors".
- C. Selection:
 - 1. Base non-overloading characteristics for pumps upon nameplate horsepower, at any point on performance curve.
 - 2. Shaft first critical speed shall not be less than 25 percent greater than operating speed.
 - 3. Maximum impeller diameter shall not be greater than 90 percent of "cut water" diameter for a given casing and no smaller than the smallest published diameter for casing. Do not base acceptable maximum diameter calculation on percentage of impeller diameter range for a given casing.
 - 4. Pump speed shall be limited to 1800 RPM except as scheduled.
 - 5. Select at the point of maximum efficiency for a given impeller-casing combination. Deviations shall be within 3 percent of maximum efficiency on the increasing capacity side of the maximum efficiency point and 7 percent on the decreasing capacity side of the maximum efficiency point.
 - 6. Select pump at a point no greater than 85 percent of end of curve flow.
 - 7. Maximum pump suction velocity:
 - a. In-line: 12 fps.
 - b. End suction: 13 fps.

2.2 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.3 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS (SMALL)

- A. Manufacturers:

1. Armstrong Pumps Inc.
 2. Bell & Gossett; Xylem Inc.; Series PL.
 3. Grundfos Pumps Corporation.
 4. Taco, Inc.
- B. Description: Factory-assembled and –tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; and designed for installation with pump and motor shafts mounted horizontally.
1. Pump Construction: Bronze fitted.
 - a. Casing: Radially split, cast iron, with threaded companion-flange connections.
 - b. Impeller: Glass-reinforced corrosion-resistant material; keyed to shaft.
 - c. Shaft: High-strength alloy steel.
 - d. Seal: Mechanical, carbon/silicon carbide seal.
 - e. Bearings: Permanently oil-lubricated type.
 2. Motor-Single speed, with oil-lubricated bearings, unless otherwise indicated; and directly mounted to pump casing. Comply with requirements in Division 20 Section “Motors.”
- C. Capacities and Characteristics: Refer to Schedule on Drawings.

2.4 FLEXIBLY COUPLED, BASE-MOUNTED, END-SUCTION CENTRIFUGAL PUMPS

- A. Manufacturers:
1. Armstrong Pumps Inc.; Series 4030.
 2. Aurora Pump; Division of Pentair Pump Group; Series 3340.
 3. Bell & Gossett; Xylem Inc.; Series e-1510.
 4. Grundfos Pumps Corporation/PACO.
 5. Taco, Inc.; Series FI.
- B. Description: Factory-assembled and tested, centrifugal, overhung-impeller, separately coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal. Rate pump for 175-psig minimum working pressure and a continuous water temperature of 225 deg F.
- C. Pump Construction:
1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and flanged connections. Provide integral mount on volute to support the casing, and attached piping to allow removal and replacement of impeller without disconnecting piping or requiring the realignment of pump and motor shaft true back pullout. Provide replaceable bronze wear rings for all pumps with pump shaft L/D ratios greater than 6.0.
 2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
 3. Pump Shaft: Steel, with copper-alloy shaft sleeve or stainless steel.

4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N seal for all glycol systems and all water systems 225 deg F and below; EPT seals for water systems above 225 deg F. Include water slinger on shaft between motor and seal.
 5. Pump Bearings: Permanently or grease-lubricated ball bearings contained in cast-iron housing with grease fittings.
- D. Flexible Shaft Coupling: Molded rubber insert and interlocking spider capable of absorbing vibration. Couplings shall be center drop-out type to allow disassembly and removal without removing pump shaft or motor. Provide EPDM coupling sleeve for all motors 40 HP and below and all variable-speed applications.
- E. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.
- F. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.
- G. Motor: Single speed, with permanently lubricated or grease-lubricated ball bearings, unless otherwise indicated; secured to mounting frame, with adjustable alignment. Comply with requirements in Division 20 Section "Motors".
- H. Capacities and Characteristics: Refer to Schedule on Drawings.

2.5 PUMP SPECIALTY FITTINGS

- A. Suction Diffuser: Angle pattern, minimum 175-psig pressure rating, cast-iron body and end cap for NPT or flanged connections or ductile iron body and end cap for grooved connections, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers; bronze or stainless-steel straightening vanes; drain plug; and integral locating boss for field-fabricated support.
1. Manufacturers:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett; Xylem Inc.
 - c. Grundfos Pumps Corporation/PACO.
 - d. Mueller Steam Specialty Company.
 - e. Taco; Fabricated Products Division.
 - f. Anvil International, Inc. (grooved only).
 - g. Victaulic Co. of America (grooved only).
- B. Contractor Option for Pump Suction and Discharge Connections NPS 3 through NPS 12: Preassembled vibration isolation pump drop kits may be used.
1. Manufacturers:
 - a. Victaulic Company; Suction Series 381/382, and Discharge Series 383 with TA Hydronics Series balance valve and 716H/779 check valve.
 2. Description:

- a. Suction: Class 150, factory assembled grooved-end vibration pump suction drop consisting of suction diffuser, flexible couplings, pipe spool with thermometer and pressure ports, and butterfly isolation valve.
- b. Discharge: Class 150, factory assembled grooved-end vibration pump discharge drop consisting of straight line with concentric reducer for vertical pump connections, flexible couplings, pipe spool with thermometer and pressure ports, spring check valve, balance valve, and butterfly isolation valve.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
- C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- D. Support in-line centrifugal pumps greater than 1/2 HP independent of piping. Use continuous-thread hanger rods and hangers of sufficient size to support pump weight. Do not support pump from motor housing plate.
- E. Refer to Division 20 Section "Mechanical Vibration Controls" for vibration isolation devices.
- F. Refer to Division 20 Section "Hangers and Supports" for hanger and support materials.
- G. Set base-mounted pumps on concrete bases. Disconnect flexible coupling before setting. Do not reconnect flexible couplings until alignment procedure is complete.
 - 1. Support pump baseplate on rectangular stainless steel blocks and shims, or on wedges with small taper, at points near foundation bolts to provide a gap of 3/4 to 1-1/2 inches between pump base and foundation for grouting.
 - 2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.

3. Install pumps on inertia bases where required. Refer to Division 20 Section "Mechanical Vibration Controls" for vibration isolation devices.

- H. Automatic (Cooling Coil) Condensate Pump Units: Install units for collecting condensate and extend to open drain.

3.3 ALIGNMENT

- A. Align pump and motor shafts and piping connections after setting on foundation, grout has been set and foundation bolts have been tightened, and piping connections have been made.
- B. Comply with pump and coupling manufacturers' written instructions.
- C. Adjust pump and motor shafts for angular and offset alignment by methods specified in HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation." Laser align to a tolerance of 0.0005 inches maximum.
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly.
- E. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- D. Install check valve and throttling valve on discharge side of pumps. Triple-duty valves are not allowed.
- E. Install Y-type strainer or suction diffuser and shutoff valve on suction side of pumps as indicated on drawings.
- F. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.
- G. Install pressure gages on pump suction and discharge or at integral pressure-gageappings, or install single gage with multiple-input selector valve.
- H. Install check valve and gate or ball valve on each condensate pump unit discharge.
- I. Install electrical connections for power, controls, and devices.
- J. Ground equipment according to Division 26 Section "Grounding and Bonding."
- K. Connect wiring according to Division 26 Section "Conductors and Cables."

3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service for each pump supplied. Written report of the start-up shall be provided to the Owner and Engineer upon completion of services.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Check piping connections for tightness.
 - 3. Clean strainers on suction piping.
 - 4. Perform the following startup checks for each pump before starting:
 - a. Verify bearing lubrication.
 - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - c. Verify that pump is rotating in the correct direction.
 - 5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
 - 6. Start motor.
 - 7. Open discharge valve slowly.

3.6 DEMONSTRATION

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

END OF SECTION 23 2123

SECTION 23 2300 - REFRIGERANT PIPING

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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.
- B. Related Sections include the following:
 1. Division 07 Section "Roof Accessories" for roof curbs, piping supports, and roof penetration boots.
 2. Division 07 Section "Penetration Firestopping" for materials and methods for sealing pipe penetrations through fire and smoke barriers.
 3. Division 07 Section "Joint Sealants" for materials and methods for sealing pipe penetrations through exterior walls.
 4. Division 20 Section "Mechanical General Requirements."
 5. Division 20 Section "Basic Mechanical Materials and Methods."
 6. Division 20 Section "Hangers and Supports" for pipe supports and installation requirements.
 7. Division 20 Section "Mechanical Identification" for labeling and identifying refrigerant piping.
 8. Division 20 Section "Meters and Gages" for thermometers and pressure gages.
 9. Division 23 Section "Temperature Controls" for thermostats, controllers, automatic-control valves, and sensors.

1.2 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerants: 535 psig.

1.3 SYSTEMS DESCRIPTIONS

- A. Suction Lines NPS 4 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.
- B. Hot-Gas and Liquid Lines NPS 4 and Smaller: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.
- C. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:
 - 1. Strainers.

1.5 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
- B. Delegated Design: Design refrigerant piping system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
 - 1. Shop Drawing Scale: Minimum 1/4 inch equals 1 foot.
 - 2. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

1.6 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."
- C. UL Standard: Provide products complying with UL 207, "Refrigerant-Containing Components and Accessories, Nonelectrical"; or UL 429, "Electrically Operated Valves."

1.8 PRODUCT STORAGE AND HANDLING

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.9 COORDINATION

- A. Coordinate layout and installation of refrigerant piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate pipe sleeve installations for foundation wall penetrations.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."
- D. Coordinate pipe sleeve installations for penetrations in exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 07 Section "Through-Penetration Firestop Systems" for materials and methods for sealing pipe penetrations through fire and smoke barriers.
- E. Coordinate pipe fitting pressure classes with products specified in related Sections.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 280, Type ACR.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.

2.2 VALVES AND SPECIALTIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Danfoss Electronics, Inc.

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2. Emerson Electric Company; Alco Controls Div.
3. Henry Valve Company.
4. Parker-Hannifin; Sporlan Division.

B. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig.

C. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.

1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat Disc: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Working Pressure Rating: 400 psig.
6. Maximum Operating Temperature: 240 deg F.

D. Straight-Type Strainers:

1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig.
5. Maximum Operating Temperature: 275 deg F.

E. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in ppm.
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 240 deg F.

PART 3 - EXECUTION

3.1 PIPING SYSTEM INSTALLATION

- A. Install refrigerant piping according to ASHRAE 15.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping adjacent to machines to allow service and maintenance.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Select system components with pressure rating equal to or greater than system operating pressure.
- I. Refer to Division 23 Section "Temperature Controls" and Sequence of Operation on the Drawings for solenoid valve controllers, control wiring, and sequence of operation.
- J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- L. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- M. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps and double risers to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- N. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- O. Install pipe sleeves at penetrations in exterior walls and floor assemblies.
- P. Seal penetrations through fire and smoke barriers according to Division 07 Section "Through-Penetration Firestop Systems."
- Q. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- R. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
- S. Seal pipe penetrations through exterior walls according to Division 07 Section "Joint Sealants" for materials and methods.
- T. Identify refrigerant piping and valves according to Division 20 Section "Mechanical Identification."

3.2 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube." Brazing filler metals are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- D. Purge pipe and fittings with nitrogen, during brazing to prevent scale formation.
- E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 VALVE AND SPECIALTY INSTALLATION

- A. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.
- B. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- C. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- D. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
 - 1. Solenoid valves.
 - 2. Thermostatic expansion valves.
 - 3. Hot-gas bypass valves.
 - 4. Compressor.
- E. Install flexible connectors at compressors. Flexible connectors must be installed in horizontal piping. Installation in vertical piping is prohibited.

3.4 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor products are specified in Division 20 Section "Hangers and Supports."
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
 - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- B. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 3/4, and soft copper tubing: Continuous support v-shaped plastic pipe channel, maximum hanger spacing 8 feet.
2. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
3. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
4. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
5. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
6. NPS 2-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
7. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
8. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 1. Comply with ASME B31.5, Chapter VI.
 2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.6 SYSTEM CHARGING

- A. Charge system using the following procedures:
 1. Install core in filter dryers after leak test but before evacuation.
 2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
 3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
 4. Charge system with a new filter-dryer core in charging line.

3.7 ADJUSTING

- A. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- B. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- C. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
 - 1. Open shutoff valves in condenser water circuit.
 - 2. Verify that compressor oil level is correct.
 - 3. Open compressor suction and discharge valves.
 - 4. Open refrigerant valves except bypass valves that are used for other purposes.
 - 5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

END OF SECTION 23 2300

SECTION 23 2510 - PIPING SYSTEMS FLUSHING AND CHEMICAL CLEANING

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 22 Section "Domestic Water Piping," for disinfection of potable water piping.
 - 4. Division 23 Section "Hydronic Piping."
 - 5. Division 23 water treatment sections.

1.2 SUMMARY

- A. This Section includes chemical cleaning for the following piping systems:
 - 1. Heating hot water.
 - 2. Chilled water.

1.3 DEFINITIONS

- A. Cleaning: Recirculating water containing chemical cleaning and passivation compounds.
- B. Flushing: Using approved water on a once through basis.

1.4 PERFORMANCE REQUIREMENTS

- A. Furnish the services of a firm specializing in piping system chemical cleaning and water treatment work.
 - 1. For chemical cleaning: This firm shall select the required type and quantity, based on system volume, of cleaning compound, and method of application.

1.5 ACTION SUBMITTALS

- A. Product Data:
 - 1. Proposed cleaning chemicals and quantities.

1.6 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Reduced scale plans indicating locations of velocity measurements.
- B. Other Informational Submittals:
 - 1. Proposed, step-by-step, chemical cleaning procedure.
 - 2. Circulation pump suction and discharge pressure at start and completion of chemical cleaning operations.

1.7 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.

1.8 QUALITY ASSURANCE

- A. Service Provider Qualifications: An experienced piping systems cleaning service provider capable of applying cleaning compounds as specified in this Section.
- B. Conduct safety meetings with Owner's Representative and personnel involved in the cleaning process.
- C. Assume responsibility for damage, necessary subsequent cleaning, flushing, and inspection of Work under the Contract which results from improper flushing and cleaning operations including failure to flush all dead-ends.

1.9 COORDINATION

- A. Schedule flushing and chemical cleaning activities immediately after piping system pressure testing and immediately prior to piping system chemical treatment work to minimize internal oxidization or flash corrosion of piping systems.
- B. Coordinate chemical cleaning work with other work to avoid accidental chemical discharge, spillage, or spray out, and electrolytically originated system damage resulting from concurrent chemical cleaning and arc welding.
- C. Coordinate with work performed under other Sections to provide in-place temporary strainers, spool pieces, flushing hose connections, cross-over piping, and isolation and drain valves.
- D. Chillers shall not be cleaned with any chloride component.
- E. Boilers shall be flushed and cleaned to remove rust and oil deposits.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. System Cleaning Chemicals: Subject to compliance with requirements, provide products by one of the following:
 - 1. PVS-Nolwood Chemicals, Inc.; PVS CHILL CLP Cleaner.
 - 2. NALCO Water, an Ecolab Company.
 - 3. DuBois Chemicals.
 - 4. H-O-H Chemicals, Inc.
 - 5. SUEZ Water Technologies & Solutions
 - 6. Enerco Corporation.

2.2 MATERIALS

- A. Cleaning chemicals shall be as recommended by manufacturer and compatible with piping system components and connected equipment.
- B. Cleaning and passivation chemical shall consist of an inorganic phosphate, yellow metal corrosion inhibitor (Tolytriazole), dispersant, and oil emulsifier.
- C. Provide additional temporary and permanent piping, equipment, and materials required for chemical cleaning work.
- D. Use potable water for flushing and cleaning operations, unless directed otherwise by the Architect.

PART 3 - EXECUTION

3.1 ACCEPTABLE SERVICE PROVIDER

- A. Subject to compliance with requirements, provide chemical cleaning service by one of the following:
 - 1. Eldon Water (Patrick Racine, Christa Blades, or Pierre Beausoleil, 888-712-4000).]
 - 2. Enerco Corporation (Doug White 517-627-8444 or 800-292-5908).
 - 3. GE Power & Water; Water & Process Technologies.
 - 4. Mitco Custom Water Treatment Gordon Chapin, 800-516-2175).
 - 5. Nalco, an Ecolab Company (Brian Irwin or Tony Mackovski, 248-344-7564).
 - 6. H-O-H Chemicals, Inc. David Burton/H.V. Burton Co, 734-261-4220.

3.2 PREPARATION

- A. Prior to flushing and cleaning activities, drain the system of all water used for hydrostatic testing.
- B. Temporarily connect dead-end supply and return piping as necessary to result in recirculating system in which no lines are left static for purposes of flushing and cleaning. Refer to System Piping Diagrams on the Drawings for suggested locations of temporary connections for flushing and cleaning purposes.
- C. Select three locations for monitoring flow rates.

3.3 INITIAL FLUSHING

- A. Remove loose dirt, mill scale, metal chips, weld beads, rust and other deleterious substances without damage to system components.
- B. Bypass factory cleaned equipment, unless acceptable means of protection are provided and subsequent inspection of water boxes and other "hide-out" areas takes place.
- C. Isolate or protect clean system components including pumps and pressure vessels and remove components which may be damaged.
- D. Open valves, drains, vents and strainers at all system levels.
- E. Remove plugs, caps, spool pieces and components to facilitate early discharge from system.
- F. Sectionalize system if possible to obtain debris carrying velocity of 6 FPS.
- G. Connect dead-end supply and return headers as necessary or provide terminal drains in end caps.
- H. Install temporary strainers where necessary to protect down-stream equipment.
- I. Supply and remove flushing water and drainage by fire hoses, garden hoses, temporary and permanent piping and Contractor's booster pumps.
- J. Flush for not less than one hour.

- K. Inspect system including basins to determine if debris accumulation requires dewatering and cleaning prior to next phase work.

3.4 FLUSHING AND CHEMICAL CLEANING PROCEDURES

- A. Remove without chemical or mechanical damage to system components adherent dirt (organic soil), oil and grease (hydrocarbons), welding and soldering flux, mill varnish, pipe compounds, rust (iron oxide), and other deleterious substances not removed by initial flushing. Removal of tightly adherent mill scale is not required.
- B. Fill system with fresh water and add manufacturer's recommended volume of system cleaner to remove grease and petroleum products from piping. Circulate solution for 48 hours at a minimum velocity of 6 fps.
 - 1. Utilize defoamers to preclude damage to existing work and adjacent electrical equipment.
 - 2. Utilize heat to maximize effectiveness of compounds or use live steam injection where practical and safe. Do not raise cleaning water temperature in excess of controlled limits.
- C. Monitor flow rates and clean strainers as required to maintain minimum specified velocity during the entire circulation and chemical cleaning period.
- D. Cleaning of new piping systems shall be completed prior to connection of systems to existing services.
- E. Install temporary strainer screens between pipe flange faces where necessary to protect primary system from branch connections during chemical cleaning procedures.
- F. Following chemical cleaning:
 - 1. Remove, clean, and reinstall strainer baskets.
 - 2. Blow down and clean low points, dirt legs, and traps.
- G. Drain systems:
 - 1. Check with local authorities concerning discharge requirements and submit copies of letters or reports.
 - 2. If acceptable, drain system to sanitary drainage system.
 - 3. Do not under any circumstances drain to storm drainage system or open drainage ditch.
 - 4. If discharge requirements do not allow discharge to sanitary sewer, secure the services of a licensed disposal Contractor.
 - 5. Disposal Contractors:
 - a. Dynecol.
 - b. SQS Environmental.
- H. Perform final flush to remove any remaining debris and chemical from the system:
 - 1. Flush dead ends and isolated pre-cleaned equipment.
 - 2. Operate valves to dislodge debris in valve body.
 - 3. Flush for not less than 1 hour.

3.5 PLACING INTO OPERATION

- A. Clean strainers.
- B. Dewater and clean new sumps, basins, storage vessels and pressure vessels.
- C. Disassemble, inspect, clean, repair, replace and reassemble any critical component or questionable item. Bellows style, and hose and braid flexible connectors left in place shall be removed and cleaned.
- D. Preliminarily adjust control valves.
- E. Install clean primary filter elements, if necessary, as determined by both pressure differential across filter and visual inspection of filter elements.
- F. Close-up and fill system as soon as possible to minimize corrosion of untreated surfaces.
- G. Vent air from system and adjust fill valve.
- H. Immediately after completion of flushing and chemical cleaning, fill systems with potable water and make ready for chemical treatment as specified in Division 23 Section "HVAC Water Treatment."

3.6 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Withdraw, inspect, and test samples of water from each system after flushing and chemical cleaning is completed, to ensure system is free of contaminants.
 - 2. If loose debris or contaminants are still present, repeat final flushing procedures until test samples and strainers remain free of debris and contaminants.

END OF SECTION 23 2510

SECTION 23 2513 - WATER TREATMENT FOR CLOSED-LOOP HYDRONIC SYSTEMS

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 23 Section "Piping Systems Flushing and Chemical Cleaning."

1.2 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene monomer.
- B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

- C. TDS: Total dissolved solids.
- D. TSS: Total suspended solids are solid materials, including organic and inorganic, that are suspended in the water. These solids may include silt, plankton, and industrial wastes.

1.3 PERFORMANCE REQUIREMENTS

- A. Furnish the services of a firm specializing in hydronic piping system water treatment work.
 - 1. This firm shall furnish and administer glycol for systems using glycol/water mix.
- B. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment.
- C. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.
- D. Base chemical quantities on estimated system size.
- E. Closed hydronic systems, including hot-water heating with non-aluminum boilers and chilled water shall have the following water qualities:
 - 1. pH: Maintain a value within 9.0 to 10.5.
 - 2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
 - 3. Boron: Maintain a value within 100 to 200 ppm.
 - 4. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
 - 5. Soluble Copper: Maintain a maximum value of 0.20 ppm.
 - 6. TDS: Maintain a maximum value of 5000 mmhos.
 - 7. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.
 - 8. Scale Control: Provide sufficient scale inhibitors to prevent formation of scale and maintain all scale-forming material in solution.
 - 9. Microbiological Limits:
 - a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/ml.
 - b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/ml.
 - c. Ammonia: Maintain a maximum value of 20 ppm.
 - d. Nitrate Reducers: Maintain a maximum value of 100 organisms/ml.
 - e. Sulfate Reducers: Maintain a maximum value of 0 organisms/ml.
 - f. Iron Bacteria: Maintain a maximum value of 0 organisms/ml.
 - g. Total Hardness: Maintain a value less than ?? ppm.

1.4 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following products:
 - 1. Bypass feeders.

2. Water meters.

1.5 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to HVAC systems. Include plans, elevations, sections, details, and attachments to other work.
 1. Wiring Diagrams: Power and control wiring.
- B. Other Informational Submittals:
 1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in the "Performance Requirements" Article above.
 2. An analytical review of make-up water characteristics for each treated system operating conditions, including such items as Langelier/Ryzner Indexes. Based on this review, provide a definitive description of treatment system developed to achieve specified objectives and include generic terms to describe product formulation content and function. Detailed proprietary formulation data is not required. However, manufacturer's standard published literature is not usually acceptable.
 3. A step-by-step procedure to be followed by the Contractor during flushing, purging, disinfecting, draining, disposal, pretreatment and treatment operations. The intent of the step-by-step procedure is two-fold.
 - a. To assure that all essential permanent provisions to accomplish the above work are included during the course of construction.
 - b. To allow the Owner to accomplish the source procedures as subsequent maintenance operations.
- C. Provide OSHA equivalent materials form for hazardous substances.

1.6 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports including final water quality test reports:
 1. Boiler water samples taken at one-week intervals after boiler startup for a period of five weeks, and test report advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article for each required characteristic. Boiler water taken at six -week intervals following the testing noted above to show that heating systems are maintaining water quality within performance requirements specified in this Section.
 2. Samples taken at six -week intervals following Substantial Completion, on hydronic systems to show that systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article.

1.7 QUALITY ASSURANCE

- A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- C. Regulatory Requirements: Conform to applicable codes for addition of non-potable chemicals to building mechanical systems, and for delivery to public sewage systems.

1.8 OWNER'S INSTRUCTIONS

- A. Provide a coordinated water treatment training program oriented to the needs common to operating personnel and maintenance personnel and to the needs of maintenance personnel only, sufficiently prior to acceptance of the work, upon mutually satisfactory arrangement with the Architect.
- B. Provide a total of not less than eight "field" hours encompassing mechanical, electrical, chemical, pollution and safety aspects, sufficient for personnel to operate and maintain systems and consistently achieve specified objectives, with subsequently scheduled guidance by the water treatment laboratory.
- C. Water treatment laboratory chemical engineer, complemented by instrument engineer, supplemented by Contractor's staff, shall comprise the training staff.
- D. Training materials shall include "survey," limits control program, shop drawings, operating and maintenance manuals, safe handling of chemicals, chemical testing, use of log sheets and demonstrations of installed and functioning systems.
- E. On completion of the installation of the entire purified water system, conduct a thorough check and test of all components in the system. During this period, instruct the Owner's personnel in the theory, operation, and maintenance of the system. When this work is finished, start up the system and operate it for as long as necessary to complete two consecutive days of operation at the specified performance levels. During this period, continue to instruct the Owner's personnel.

1.9 MAINTENANCE SERVICE

- A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion, scale formation, and biological growth for cooling, chilled-water piping heating, hot-water piping and equipment. Services and chemicals shall be provided for a period of one year from date of Substantial Completion, and shall include the following:
 - 1. Provide piping/plumbing recommendation to optimize chemical program results.
 - 2. Initial water analysis and HVAC water-treatment recommendations.
 - 3. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
 - 4. Quarterly field service and consultation.
 - 5. Customer report charts and log sheets.

6. Laboratory technical analysis.
7. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers/Suppliers: Unless otherwise specified, and subject to compliance with requirements, provide products by one of the following:
1. Ashland Specialty Chemical Company; Drew Industrial Div.
 2. Eldon Water Inc.; a brand within the Water Treatment Solutions division of DuBois Chemicals, Inc.
 3. Enerco Corporation.
 4. SUEZ Water Technologies & Solutions
 5. DuBois Chemicals.
 6. NALCO Water, an Ecolab Company.
 7. H-O-H Chemicals, Inc.

2.2 MANUAL CHEMICAL-FEED EQUIPMENT

- A. Bypass Feeders: Steel, with corrosion-resistant exterior coating, minimum 3-1/2-inch fill opening in the top, and NPS 3/4 bottom inlet and top side outlet. Quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.
1. Capacity: 5 gal.
 2. Minimum Working Pressure: 125 psig.

2.3 MAKE-UP WATER METERS

- A. Water Meter:
1. AWWA C700, oscillating-piston, magnetic-drive, totalization meter.
 2. Body: Bronze.
 3. Minimum Working-Pressure Rating: 150 psig.
 4. Maximum Pressure Loss at Design Flow: 3 psig.
 5. Registration: Gallons or cubic feet.
 6. End Connections: Threaded.
 7. Controls: Flow-control switch with normally open contacts; rated for maximum 10 A, 250-V ac; and that will close at adjustable increments of total flow.

2.4 CHEMICAL FEED PIPE AND FITTINGS

- A. CPVC Piping:
1. CPVC Schedule 80 Pipe: ASTM F 441/ F 441M.

2. CPVC Schedule 80 Fittings: ASTM F 439, socket type or ASTM F 437, threaded type.
3. Isolation Valves: Three-piece true union style ball valve constructed of CPVC with TFE seats, and FPM or EPDM o-ring seals.

B. Stainless-Steel Pipes And Fittings:

1. Stainless-Steel Tubing: Comply with ASTM A 269, Type 316.
2. Stainless-Steel Fittings: Complying with ASTM A 815/A 815M, Type 316, Grade WP-S.
3. Two-Piece, Full-Port, Stainless-Steel Ball Valves: ASTM A 351, Type 316 stainless-steel body; ASTM A 276, Type 316 stainless-steel stem and vented ball, carbon-filled TFE seats, threaded body design with adjustable stem packing, threaded ends, and 250-psig SWP and 600-psig CWP ratings.
4. Three-Piece, Full-Port, Stainless-Steel Ball Valves: ASTM A 351, Type 316 stainless-steel body; ASTM A 276, Type 316 stainless-steel stem and vented ball, threaded body design with adjustable stem packing, threaded ends, and 150-psig SWP and 600-psig CWP rating.

2.5 CHEMICAL TREATMENT TEST EQUIPMENT

- A. Test Kit: Manufacturer-recommended equipment and chemicals in a wall-mounting cabinet for testing pH, TDS, inhibitor, chloride, alkalinity, and hardness; sulfite and testable polymer tests for high-pressure boilers, and oxidizing biocide test for open cooling systems.
- B. Corrosion Test-Coupon Assembly (Corrosion Racks): Constructed of corrosive-resistant material, complete with piping, valves, and mild steel and copper coupons. Locate copper coupon downstream from mild steel coupon in the test-coupon assembly.
 1. Two-station rack for closed-loop systems.
 2. Include 1-inch diameter, chemical resistant acrylic flowmeter suitable for 1 to 20 gpm at exit of coupon rack.

2.6 CHEMICALS

- A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment, and that can attain water quality specified in Part 1 "Performance Requirements" Article.

PART 3 - EXECUTION

3.1 WATER ANALYSIS

- A. Perform an analysis of supply water to determine quality of water available at Project site.

3.2 INSTALLATION

- A. Install chemical application equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.

- B. Install water testing equipment on wall near water chemical application equipment.
- C. Install meters and equipment requiring service at a maximum 60 inches above finished floor.
- D. Install interconnecting control wiring for chemical treatment controls and sensors.
- E. Mount sensors and injectors in piping circuits.
- F. Bypass Feeders: Install in closed hydronic systems, including heating hot water and chilled water and equipped with the following:
 - 1. Install bypass feeder in a bypass circuit on main header having pressure differential greater than or equal to 20 psig, unless otherwise indicated on Drawings.
 - 2. Install water meter in makeup water supply.
 - 3. Install test-coupon assembly in bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
 - 4. Install a gate or full-port ball isolation valves on inlet, outlet, and drain below feeder inlet.
 - 5. Install a swing check on inlet after the isolation valve.

3.3 CHEMICAL INSTALLATION

- A. Utilize softened or reverse osmosis water for initial system fill
- B. Add specified chemicals to meet performance requirement specified in Part 1 of this Section.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Dielectric fittings are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- D. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Division 20 Section "Valves."
- E. Confirm applicable electrical requirements in Division 26 Sections for connecting electrical equipment.
- F. Ground equipment according to Division 26 Section "Grounding and Bonding."
- G. Connect wiring according to Division 26 Section "Conductors and Cables."

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.

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.

B. Tests and Inspections:

1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC systems' startup procedures.
4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
7. 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 test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
8. Repair leaks and defects with new materials and retest piping until no leaks exist.

C. Equipment will be considered defective if it does not pass tests and inspections.

D. Remove and replace malfunctioning units and retest as specified above.

E. At eight -week intervals following Substantial Completion, perform separate water analyses on hydronic systems to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article.

F. Comply with ASTM D 3370 and with the following standards:

1. Silica: ASTM D 859.
2. Steam System: ASTM D 1066.
3. Acidity and Alkalinity: ASTM D 1067.
4. Iron: ASTM D 1068.
5. Water Hardness: ASTM D 1126.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment.

END OF SECTION 23 2513

SECTION 23 3113 - METAL DUCTS

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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.
- B. Related Sections include the following:
 1. Division 20 Section "Mechanical General Requirements."
 2. Division 23 Section "Nonmetal Ducts" for fabric ducts, fibrous-glass ducts, thermoset FRP ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
 3. Division 23 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.

4. Division 23 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 SUMMARY

- A. This Section includes metal ducts for supply, return, outside, relief air, and exhaust air-distribution systems.

1.3 DEFINITIONS

- A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.
- B. Low Pressure: Up to and including 2 inch WG and velocities less than 1,500 fpm.
- C. Medium Pressure: Greater than 2 inch WG to 6 inch WG and velocities greater than 1,500 fpm and less than 2,500 fpm.

1.4 SYSTEM DESCRIPTION

- A. Duct system design, as indicated, has been used to select size and type of air-moving and -distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

1.5 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 Application Schedule" Article.

1.6 ACTION SUBMITTALS

- A. Shop Drawings: Drawn to scale. Show fabrication and installation details for metal ducts. Shop drawings shall be reviewed and approved by the Architect prior to any fabrication.
 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 2. Duct layout indicating sizes and pressure classes.
 3. Elevations of top and bottom of ducts.
 4. Dimensions of main duct runs from building grid lines.
 5. Fittings.
 6. Reinforcement and spacing.
 7. Seam and joint construction.
 8. Penetrations through fire-rated and other partitions.
 9. Equipment installation based on equipment being used on Project.
 10. Duct accessories, including access doors and panels.

11. Hangers and supports, including methods for duct and building attachment, vibration isolation.

1.7 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, 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. Ceiling suspension assembly members.
 2. Other systems installed in same space as ducts.
 3. Ceiling- and wall-mounting access doors and panels required to provide access to dampers and other operating devices.
 4. Ceiling-mounting items, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

1.8 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.

1.9 QUALITY ASSURANCE

- A. NFPA Compliance:
 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Duct Liner Maximum Temperature Limits: Based on ASTM C 411 test procedures.

1.10 COORDINATION

- A. Sheet metal trades shall cooperate fully with the Test and Balance Contractor and provide all miscellaneous caps and any other materials required for structural integrity and leakage testing of the complete duct system in whole or in part. Refer to Division 23 Section "Testing, Adjusting and Balancing."
 1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
- B. Sheet metal trades shall participate in the above ceiling coordination program. Refer to Division 01 requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

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

2.2 SHEET METAL MATERIALS

- A. 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: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation.
- C. Stainless Steel: ASTM A 480/A 480M, Type 316, and having a No. 2D finish for concealed ducts and No. 4 for exposed ducts.
- D. Aluminum Sheets: ASTM B 209, alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Reinforcement Shapes and Plates:
 1. Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.
 2. Compatible materials for aluminum and stainless-steel ducts.
- F. Tie Rods:
 1. Galvanized Steel Duct: Galvanized steel, 3/8-inch minimum diameter.
 2. Ducts in Humid or Corrosive Atmospheres: Stainless steel, 1/4-inch diameter for lengths 36 inches or less; 3/8-inch diameter for lengths longer than 36 inches .

2.3 DUCT LINER

- A. Fibrous-Glass Liner: Comply with NFPA 90A or NFPA 90B and with NAIMA AH124.
 1. Manufacturers:
 - a. CertainTeed Corp.; Insulation Group.
 - b. Johns Manville International, Inc.
 - c. Knauf Fiber Glass GmbH.
 2. Materials: ASTM C 1071, Type I, flexible; surfaces exposed to airstream shall be coated to prevent erosion of glass fibers.
 - a. Thickness: 1 inch.
 - b. Density: 1-1/2 pounds per cubic foot.
 - c. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
 - d. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
 - e. Maximum Operating Temperature: 250 deg F when tested according to ASTM C 411.
 - f. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

- g. Mechanical Fasteners: Galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in duct.
 - 1) Tensile Strength: Indefinitely sustain a 50-lb- tensile, dead-load test perpendicular to duct wall.
 - 2) Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8 inch into airstream.
 - 3) Adhesive for Attaching Mechanical Fasteners: Comply with fire-hazard classification of duct liner system.
- 3. Noise reduction coefficient (NRC): Sound absorption coefficients shall not be less than those in the table below as tested by ASTM C423 using an ASTM E795 Type A mounting.

		Sound absorption coefficients at octave band center frequencies, Hz						NRC
Thickness Inches (mm)		125	250	500	1000	2000	4000	
1	(25)	.08	.31	.59	.84	.91	.90	.70

2.4 SEALANTS 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. Elastomeric Sealant Tape: 3 inches wide; modified butyl adhesive backed.
 - 1. Manufacturers:
 - a. Hardcast; Foil-Grip 1402 and Foil-Grip 1402-181BFX.
 - 2. Manufacturers:
 - a. Design Polymerics; DP1010 Water Based Duct Sealant.
 - b. Hardcast; Flex-Grip 550 and Versa-Grip 181.
 - c. Polymer Adhesives; No. 11.
 - d. United McGill.
 - 3. Application Method: Brush on.
 - 4. Solids Content: Minimum 63 percent.
 - 5. Shore A Hardness: Minimum 20.
 - 6. Water resistant.
 - 7. Mold and mildew resistant.
 - 8. VOC: Maximum 75 g/L (less water).
 - 9. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 - 10. Service: Indoor or outdoor.
 - 11. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Solvent-Based Joint and Seam Sealant:

1. Manufacturers:
 - a. Hardcast; Sure-Grip 404.
 - b. United McGill.
2. Application Method: Brush on.
3. Base: Synthetic rubber resin.
4. Solvent: Toluene and heptane.
5. Solids Content: Minimum 60 percent.
6. Shore A Hardness: Minimum 60.
7. Water resistant.
8. Mold and mildew resistant.
9. VOC: Maximum 395 g/L.
10. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
11. Service: Indoor or outdoor.
12. Substrate: Compatible with galvanized sheet steel, stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

E. Gaskets: Chloroprene elastomer, 40 durometer, 1/8 inch thick, full face, one piece vulcanized or dovetailed at joints.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

B. Hanger Materials: Galvanized sheet steel or threaded steel rod.

1. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."

3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials. Attachments for stainless steel and PVC-coated duct shall be stainless steel.
- D. Load Rated Cable Suspension System for Noncorrosive Environments: Tested to five times the Safe Working Loads and verified by the SMACNA Testing and Research Institute.
1. Cable: Aircraft quality 7 x 7 and 7 x 19 wire rope.
 - a. Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
 - b. Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
 2. Fastener: One-piece, die-cast zinc housing with Type 302 S26 stainless steel hardened and tempered springs, and oil impregnated, sintered, hardened and tempered steel locking wedges.
 3. End Fixings: Loop, stud or toggle; or plain end suitable for wire rope beam clamp.
 4. Manufacturers:
 - a. B-Line by Eaton; KwikWire.
 - b. Ductmate Industries, Inc.; Clutcher and EZ-Lock.
 - c. Duro Dyne Corp.; Dyna-Tite System.
 - d. Gripple Inc.; Hang-Fast System.
- E. Stainless Steel Load Rated Cable Suspension System for Corrosive Environments: Tested to five times the Safe Working Loads and verified by the SMACNA Testing and Research Institute.
1. Cable: Aircraft quality stainless steel 7 x 7 and 7 x 19 wire rope.
 - a. Stainless steel complying with ASTM A 492.
 2. Fastener: One-piece, stainless steel housing with Type 302 S26 stainless steel hardened and tempered springs, and ceramic locking wedges.
 3. End Fixings:
 - a. Loop End: Type 316L/A4 stainless steel.
 - b. Stud or Toggle End: Type 304L/A2 stainless steel.
 - c. Plain end suitable for stainless steel wire rope beam clamp.
 4. Manufacturers:
 - a. B-Line by Eaton; KwikWire.
 - b. Ductmate Industries, Inc.; Clutcher and EZ-Lock.
 - c. Duro Dyne Corp.; Dyna-Tite System.
 - d. Gripple Inc.; Hang-Fast System.

2.6 RECTANGULAR DUCT FABRICATION

- A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
 - 1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
 - 2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
 - 3. Internal Tie Rods: As allowed by SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's and SMACNA guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
 - 1. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Nexus Inc.
 - c. Ward Industries, Inc.
- C. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of nonbraced panel area unless ducts are lined.

2.7 APPLICATION OF LINER IN RECTANGULAR DUCTS

- A. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
- B. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
- C. Butt transverse joints without gaps and coat joint with adhesive.
- D. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
- E. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.
- F. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
- G. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - 1. Fan discharges.
 - 2. Intervals of lined duct preceding unlined duct.
 - 3. Upstream edges of transverse joints in ducts where air velocities are greater than 2500 fpm or where indicated.

2.8 ROUND DUCT AND FITTING FABRICATION

- A. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.
- B. Round, Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" or SMACNA "Industrial Duct Construction Standards" as required based on pressure class.
 - 1. Round fittings shall be factory fabricated welded design. Use of field fabricated fittings (welded design) shall only be permitted when factory fabricated fittings are unavailable.
- C. Duct Joints:
 - 1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
 - 2. Ducts 21 to 72 Inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
 - 3. Bolts and fasteners for galvanized steel duct shall be carbon steel, zinc coated per ASTM A153. Bolts and fasteners for stainless steel and polyvinyl chloride coated steel duct shall be stainless steel.
 - 4. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
- D. Low Pressure Ductwork (plus or minus 2 inches W.G. Static Pressure Class)
 - 1. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible provide single thickness turning vanes.
 - 2. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.
- E. Medium Pressure Ductwork (For Static Pressure Class Greater than plus or minus 2 inches W.G.)
 - 1. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible provide single thickness turning vanes.
 - 2. Transform duct sizes gradually, not exceeding 15 degrees divergence and 30 degrees convergence.
 - 3. Fabricate continuously welded medium and high pressure round and oval duct fittings two gauges heavier than duct gauges indicated in SMACNA Standard. Joints shall be minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.
 - 4. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.
- F. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.
- G. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.

- H. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
1. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
 2. Round Elbows 8 Inches and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
 3. Round Elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
 4. Round Elbows Larger Than 14 Inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
 5. Die-Formed Elbows for Sizes through 8 Inches in Diameter and All Pressures 0.040 inch thick with 2-piece welded construction.
 6. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
 7. Pleated Elbows for Sizes through 14 Inches in Diameter and Pressures through 10-Inch wg: 0.022 inch.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
- B. Install round ducts in lengths not less than 12 feet unless interrupted by fittings.
- C. Install ducts with fewest possible joints.
- D. Install fabricated fittings for changes in directions, size, and shape and for connections.
- E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.
- F. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.
- 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. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.

- J. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
- K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
- L. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.
- N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, and sleeves. Fire and smoke dampers are specified in Division 23 Section "Duct Accessories."
 - 1. Where ducts not having fire dampers, smoke dampers, or combination fire and smoke dampers pass through fire-rated partitions, maintain indicated fire rating. Seal penetrations with firestop materials. Refer to Division 07 Specification Sections for materials and UL classified firestop systems.
- O. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.
- P. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
 - 1. Intermediate level

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 duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated. Ducts must be properly cleaned and sealed in strict accordance with sealant manufacturer's instructions.

1. Seal Class: Refer to Application Schedule on the Drawings.
2. Seal ducts before external insulation is applied.
3. After pressure testing, remake leaking joints until leakage is equal to or less than maximum allowable. Refer to Application Schedule on the Drawings for allowable leakage rates.

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," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- C. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- D. Support ductwork from building structure, not from roof deck, floor slab, pipe, other ducts, or equipment.
- E. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.
- F. Install roof mounted duct supports in accordance with manufacturer's instructions. Provide additional membrane layer or walkpads under support bases as required.
- G. Use load rated cable suspension system for round duct in exposed locations.

3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors according to Division 23 Section "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 Division 09 painting Sections.

3.7 FIELD QUALITY CONTROL

- A. Duct System Cleanliness Tests:
 - 1. Visually inspect duct system to ensure that no visible contaminants are present.
- B. Duct system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.8 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing."

END OF SECTION 23 3113

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METAL DUCTS
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SECTION 23 3119 - HVAC CASINGS

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."

1.2 SUMMARY

- A. Section Includes:
 - 1. Factory or shop-fabricated, field-assembled, double-wall casings for HVAC equipment.

1.3 DEFINITIONS

- A. Thermal Conductivity and Apparent Thermal Conductivity (k-Value): As defined in ASTM C 168. In this Section, these values are the result of the formula Btu x in./h x sq. ft. x deg F at temperature differences specified. Values are expressed as Btu.

1. Example: Apparent Thermal Conductivity (k-Value): 0.26.

1.4 PERFORMANCE REQUIREMENTS

A. Static-Pressure Classes:

1. Upstream from Fan(s): 2-inch wg.
2. Downstream from Fan(s): 4-inch wg.

B. Acoustical Performance:

1. NRC: 0.94 according to ASTM C 423.
2. STC: 40 according to ASTM E 90.

C. Structural Performance:

1. Casings shall be fabricated to withstand 133 percent of the indicated static pressure without structural failure. Wall and roof deflection at the indicated static pressure shall not exceed 1/8 inch per foot of width.
 - a. Fabricate outdoor casings to withstand wind load of 15 lbf/sq. ft. and snow load of 30 lbf/sq. ft.

1.5 ACTION SUBMITTALS

- ##### A. Product Data: For factory-fabricated casings, sealant materials, and acoustic liner materials.

1.6 INFORMATIONAL SUBMITTALS

- ##### A. Product Certificates: For factory-fabricated casings, signed by product manufacturer.

1. Show sound-absorption coefficients in each octave band lower than those scheduled when tested according to ASTM C 423.
2. Show airborne sound transmission losses lower than those scheduled when tested according to ASTM E 90.

1.7 QUALITY ASSURANCE

1.8 COORDINATION

- ##### A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- ##### B. Coordinate sizes and locations of steel supports. Supports are specified in Division 05 Section "Metal Fabrications."

- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SHEET METAL MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Exterior Surface Galvanized Coating Designation: G90.
 - 2. Interior Surface Galvanized Coating Designation:
 - a. Sections Not Exposed to Moisture: G90.
 - b. Sections Housing and Downstream from Cooling Coil and Humidifiers: G90.
- B. Stainless Steel: ASTM A 480/A 480M, Type 304, and having a No. 2D finish.
- C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet steel casings.
- D. Miscellaneous Materials and Products: Types and sizes required to comply with HVAC casing system requirements, including proper connection of ducts and equipment.

2.3 SEALANT MATERIALS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Water-Based Joint and Seam Sealant:
 - 1. Manufacturers:
 - a. Design Polymerics; DP1010 Water Based Duct Sealant.
 - b. Hardcast; Flex-Grip 550 and Versa-Grip 181.
 - c. Polymer Adhesives; No. 11.
 - d. United McGill.
 - 2. Application Method: Brush on.

3. Solids Content: Minimum 65 percent.
4. Shore A Hardness: Minimum 20.
5. Water resistant.
6. Mold and mildew resistant.
7. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel or stainless steel.

C. Solvent-Based Joint and Seam Sealant:

1. Manufacturers:
 - a. Hardcast; Sure-Grip 404.
 - b. United McGill.
2. Application Method: Brush on.
3. Base: Synthetic rubber resin.
4. Solvent: Toluene and heptane.
5. Solids Content: Minimum 60 percent.
6. Shore A Hardness: Minimum 60.
7. Water resistant.
8. Mold and mildew resistant.
9. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
10. Service: Indoor or outdoor.
11. Substrate: Compatible with galvanized sheet steel or stainless steel.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single component, acid curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

E. Gaskets: Chloroprene elastomer, 40 durometer, 1/8 inch thick, full face, one piece vulcanized or dovetailed at joints.

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.4 GENERAL CASING FABRICATION REQUIREMENTS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 9, "Equipment and Casings," for acceptable materials, material thicknesses, and casing construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

1. Fabricate casings with more than 3-inch wg negative static pressure according to SMACNA's "Rectangular Industrial Duct Construction Standards."

2. Casings with more than 2-inch wg positive static pressure may be fabricated according to SMACNA's "Rectangular Industrial Duct Construction Standards."
- B. Factory- or Shop-Applied Antimicrobial Coating:
1. Apply to the interior sheet metal surfaces of casing in contact with the airstream. Apply untreated clear coating to the exterior surface.
 2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
 3. Coating containing the antimicrobial compound shall have a hardness of 2H minimum when tested according to ASTM D 3363.
 4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 according to UL 723; certified by an NRTL.
 5. Applied Coating Color: Standard.
- C. Sealing Requirement: SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Seal Class A. Seal all seams, joints, connections, and abutments to building.
- D. Penetrations: Seal all penetrations airtight. Cover with escutcheons and gaskets, or fill with suitable compound so there is no exposed insulation. Comply with requirements for escutcheons specified in Division 20 Section "Basic Mechanical Materials and Methods." Provide shaft seals where fan shafts penetrate casing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine steel supports for compliance with requirements for conditions affecting installation and performance of HVAC casings.
- B. Examine casing insulation materials and liners before installation. Reject casings that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install casings according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Comply with recommended spacing of sheet metal screws and with requirements for casing sealing and trim positioning.
- B. Support casings on floor or foundation system. Secure and seal to base.
- C. Field-cut openings for pipe and conduit penetrations; insulate and seal according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- D. Support components rigidly with ties, braces, brackets, and anchors of types that will maintain housing shape and prevent buckling.

- E. Align casings accurately at connections, with 1/8-inch misalignment tolerance and with smooth interior surfaces.
- F. Maintain duct seal class integrity throughout casings.

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:
 - 1. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
 - 2. Determine leakage from entire system or section of system by relating leakage to surface area of test section. Comply with requirements for leakage classification of ducts connected to casings.
 - 3. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

3.4 CLEANING

- A. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
 - 1. Intermediate level.

END OF SECTION 23 3119

SECTION 23 3300 - DUCT ACCESSORIES

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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.
- B. Related Sections include the following:
 1. Division 20 Section "Mechanical General Requirements."
 2. Division 23 Section "Testing, Adjusting, and Balancing" for duct test holes.
 3. Division 23 Section "Temperature Controls" for motorized control dampers.
 4. Division 28 Section "Fire Alarm" for duct-mounting fire and smoke detectors.

1.2 DEFINITIONS

- A. Low Pressure: Up to 2 inch WG and velocities less than 1,500 fpm. Construct for 2 inch WG positive or negative static pressure.
- B. Medium Pressure: Greater than 2 inch WG to 6 inch WG and velocities greater than 1,500 fpm and less than 2,500 fpm. Construct for 6 inch WG positive or negative static pressure.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For turning vanes, include data for pressure loss generated sound power levels.
 - 2. For duct silencers, include pressure drop and dynamic insertion loss data.

1.4 INFORMATIONAL SUBMITTALS

- A. 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, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
 - e. Wiring Diagrams: Power, signal, and control wiring.
- B. Coordination Drawings: Reflected ceiling plans, drawn to scale and coordinating penetrations and ceiling-mounting items. Show ceiling-mounting access panels and access doors required for access to duct accessories.
- C. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation.
- C. Stainless Steel: ASTM A 480/A 480M, Types 304 and 316 as indicated.
- D. Extruded Aluminum: ASTM B 221, alloy 6063, temper T6.
- E. Bird Screens: No. 2 mesh, 0.063 inch diameter galvanized wire screen with open area of not less than 72 percent. Conceal sharp edges by adding metal edging consisting of rod, flat or angle iron, or 16 gage galvanized sheet steel turned over at least 3/4 inch on both sides.

2.3 LOW PRESSURE MANUAL VOLUME DAMPERS

- A. Manufacturers:
 - 1. American Warming and Ventilating; Mestek, Inc.
 - 2. Arrow United Industries; Mestek, Inc.
 - 3. Greenheck Fan Corporation.
 - 4. Krueger-HVAC; Air Distribution Technologies, Inc.; a JCI Company.
 - 5. Louvers and Dampers, Inc.; Mestek, Inc.
 - 6. Nailor Industries Inc.
 - 7. Ruskin Company.
 - 8. Vent Products Co., Inc.
 - 9. Young Regulator Co.
- B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
 - 1. Except for dampers in round ductwork sized 12 inches and smaller, provide end bearings.
- C. Rectangular Volume Dampers: Multiple-opposed-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.

- D. Round Volume Dampers 16-inch Diameter and Smaller: Single-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.
- E. Round Volume Dampers Larger than 16-inch Diameter: Multiple-opposed-blade design AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.
- F. Damper Materials:
 - 1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
 - 2. Roll-Formed Steel Blades: 0.064-inch- thick, galvanized sheet steel.
 - 3. Blade Axles: Galvanized steel.
 - 4. Bearings: Oil-impregnated bronze, molded synthetic, or stainless-steel sleeve type.
 - 5. Tie Bars and Brackets: Galvanized steel.
- G. Jackshaft: 1-inch- diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 - 1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.
- H. Damper Hardware: 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. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.4 MOTORIZED CONTROL DAMPERS

- A. Refer to Division 23 Section "Temperature Controls."

2.5 FIRE DAMPERS (CURTAIN STYLE)

- A. Manufacturers:
 - 1. Air Balance, Inc.; Mestek, Inc
 - 2. Greenheck Fan Corporation.
 - 3. NCA; a brand of Metal Industries Inc.
 - 4. Nailor Industries Inc.
 - 5. Ruskin Company.
- B. Dynamic fire dampers with curtain style blades, and labeled according to UL 555, maximum velocity 2000 fpm, maximum static pressure 4 inches w.g.
- C. Fire Rating:
 - 1. 1-1/2 hours for 2 hour rated walls.
 - 2. 3 hours for 4 hour rated walls.

- D. Frame: Type B or Type C Curtain type with blades outside airstream; fabricated with roll-formed, galvanized steel in gages required by manufacturer's UL listing; with mitered and interlocking corners.
- E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
 - 1. Thickness: Equal to or thicker than the duct connected to it, and of length to suit application.
 - 2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.
- F. Mounting Orientation: Vertical or horizontal as indicated.
- G. 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.
- H. Fusible Links: Replaceable, 212 deg F rated.

2.6 FIRE DAMPERS (MULTIPLE BLADE TYPE)

- A. Manufacturers:
 - 1. Greenheck Fan Corporation.
 - 2. NCA; a brand of Metal Industries Inc.
 - 3. Nailor Industries Inc.
 - 4. Ruskin Company.
- B. Dynamic fire dampers with multiple blades, and labeled according to UL 555, maximum velocity of 2000 fpm, maximum static pressure 4 inches w.g.
- C. Fire Rating:
 - 1. 1-1/2 hours for 2 hour rated walls.
 - 2. 3 hours for 4 hour rated walls.
- D. Frame: Fabricated with roll-formed, galvanized steel in gages required by manufacturer's UL listing; with mitered and interlocking corners.
- E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
 - 1. Thickness: Equal to or thicker than the duct connected to it, and of length to suit application.
 - 2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.
- F. Mounting Orientation: Vertical or horizontal as indicated.
- G. Blades: Parallel operation, single-piece airfoil type construction with 0.078 inch equivalent thickness, or 0.064 inch thick, roll-formed, triple v-groove.
- H. Axles: 1/2 inch plated steel hex.

- I. Bearings: Stainless steel, or oil-impregnated bronze sleeve type, pressed into frame.
- J. Linkage: Concealed in frame.
- K. Fusible Links: Replaceable, 212 deg F rated.

2.7 SMOKE DAMPERS

- A. Manufacturers:
 - 1. Air Balance, Inc.; Mestek, Inc
 - 2. Greenheck Fan Corporation.
 - 3. NCA; a brand of Metal Industries Inc.
 - 4. Nailor Industries Inc.
 - 5. Ruskin Company.
- B. General Description: Smoke dampers with airfoil blades, labeled according to UL 555S, with minimum Class II leakage rating.
- C. Frame and Blades: 16 gage, galvanized sheet steel.
- D. Mounting Sleeve: Factory-installed, galvanized sheet steel.
 - 1. Thickness: Equal to or thicker than the duct connected to it, and of length to suit application.
- E. Rated pressure and velocity to exceed design airflow conditions.
- F. Damper Actuators: Electric modulating or two-position action as required.
 - 1. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 - 2. Size for torque required for damper seal at load conditions.
 - 3. Overload Protection: Microprocessor or an electronic based motor controller providing burnout protection if stalled before full rotation is reached. The actuator shall be electronically cut off at full open to eliminate noise generation with the holding noise level to be inaudible.
 - 4. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
 - 5. Power Requirements (Two-Position Spring Return): 24 or 120 V ac (coordinate with Controls contractor).
 - 6. Power Requirements (Proportional): Maximum (running) 12 VA at 24-V ac or 8 W at 24-V dc. Maximum (holding) 5VA at 24-V ac or 3 W at 24-V dc holding.
 - 7. Proportional Actuators (24V ac/dc): Control signal shall be 0-10vdc, 2-10vdc or 4-20mA as required to operate with associated controller. Include position feedback signal for 0-10vdc, 2-10vdc or 4-20mA as required to be monitored by associated controller.
 - 8. Actuator timing shall meet 15 sec.
 - 9. Temperature Rating: Actuator shall have a UL555S listing by the damper manufacturer for 250 deg F
- G. Damper Actuators: Pneumatic modulating or two-position action.

1. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing.
 2. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
 3. Actuator Degradation Temperature: Not to exceed 250 deg F .
- H. Damper blade position end switches: Factory installed damper position switch package for both full open and full closed indication (equivalent to Ruskin SP100 switch package).
- I. Test Switch: Damper mounted momentary "test" push-button switch rated for 24V or 120V as required to allow testing and/or maintenance of motorized dampers.
1. For pneumatic actuators, include factory installed electric/pneumatic (EP) switch for testing function.
 2. Include damper mounted "open" and "closed" indication lights on switch plate for connection to factory installed damper blade position end switches.

2.8 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers:
1. Air Balance, Inc.; Mestek, Inc
 2. Greenheck Fan Corporation.
 3. NCA; a brand of Metal Industries Inc.
 4. Nailor Industries Inc.
 5. Ruskin Company.
- B. General Description: Combination fire and smoke dampers shall be labeled according to UL 555 and UL 555S. Leakage shall not exceed 10 cfm per square foot at 1 inch WG differential pressure (Leakage Class II).
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.
- D. Fire Rating:
1. 1-1/2 hours for 2 hour rated walls.
- E. Frame and Blades: 0.064-inch- thick, galvanized sheet steel.
- F. Mounting Sleeve: Factory-installed, galvanized sheet steel.
1. Thickness: Equal to or thicker than the duct connected to it, and of length to suit application.
- G. Rated pressure and velocity to exceed design airflow conditions.
- H. Damper Actuators: Electric modulating or two-position action as required.
1. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 2. Size for torque required for damper seal at load conditions.

3. Overload Protection: Microprocessor or an electronic based motor controller providing burnout protection if stalled before full rotation is reached. The actuator shall be electronically cut off at full open to eliminate noise generation with the holding noise level to be inaudible.
 4. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
 5. Power Requirements (Two-Position Spring Return): 24 or 120 V ac (coordinate with Controls contractor).
 6. Power Requirements (Proportional): Maximum (running) 12 VA at 24-V ac or 8 W at 24-V dc. Maximum (holding) 5VA at 24-V ac or 3 W at 24-V dc holding.
 7. Proportional Actuators (24V ac/dc): Control signal shall be 0-10vdc, 2-10vdc or 4-20mA as required to operate with associated controller. Include position feedback signal for 0-10vdc, 2-10vdc or 4-20mA as required to be monitored by associated controller.
 8. Actuator timing shall meet 15 sec.
 9. Temperature Rating: Actuator shall have a UL555S listing by the damper manufacturer for 250 deg F.
- I. Manual Heat Responsive Fuse Link with Reset and Damper Blade Position End Switches: Factory installed manual heat responsive fuse link with reset switch / damper position switch package for both full open and full closed indication (equivalent to Ruskin TS150 switch package).
- J. Test Switch: Damper mounted momentary "test" push-button switch rated for 24V or 120V as required to allow testing and/or maintenance of motorized dampers.
1. Include damper mounted "open" and "closed" indication lights on switch plate for connection to factory installed damper blade position end switches.
- 2.9 DUCT SILENCERS (FIBERGLASS FILL)
- A. Manufacturers:
1. IAC Acoustics; a Division of Sound Seal.
 2. Price Industries.
 3. Ruskin Company.
 4. VAW Systems Ltd.
 5. Vibro-Acoustics; A Swegon Group Company.
- 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.
- C. Rectangular Units: Unless otherwise scheduled on the Drawings, fabricate casings with a minimum of 20 gage, solid galvanized sheet metal for outer casing and 22 gage, ASTM A 653/A 653M, G90, perforated galvanized sheet metal for inner casing.
- D. Round Units: Unless otherwise scheduled on the Drawings:

1. Outer Casings:
 - a. ASTM A 653/A 653M, G90, galvanized sheet steel.
 - b. Up to 8 Inches in Diameter: 24 gage.
 - c. 9 through 22 Inches in Diameter: 22 gage.
 - d. 24 through 36 Inches in Diameter: 20 gage.
 - e. 38 through 50 Inches in Diameter: 18 gage.
 - f. 52 through 60 Inches in Diameter: 16 gage.
 - g. Casings fabricated of spiral lock-seam duct may be one gage thinner than that indicated.
 2. Interior Casing, Partitions, and Baffles:
 - a. ASTM A 653/A 653M, G90, galvanized sheet steel.
 - b. At least 24 gage thick and designed for minimum aerodynamic losses.
- E. Sheet Metal Perforations: 1/8-inch diameter for inner casing and baffle sheet metal.
- F. Fill Material: Inert and vermin-proof fibrous glass material, packed under not less than 5 percent compression.
- G. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations.
1. Do not use nuts, bolts, or sheet metal screws for unit assemblies.
 2. Lock form and seal or continuously weld joints.
 3. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
 4. Reinforcement: Cross or trapeze angles for rigid suspension.
- H. Source Quality Control:
1. Acoustic Performance: Test according to ASTM E 477.
 - a. Tests performed in NVLAP accredited laboratory.
 - b. Include accreditation certificate with submittals.
 - c. Submittals from non-NVLAP accredited facilities will not be accepted.
 2. Record acoustic ratings, including dynamic insertion loss and self-noise power levels with an airflow of at least 2000-fpm face velocity.
 3. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg static pressure, whichever is greater.
- 2.10 TURNING VANES
- A. Manufactured Turning Vanes:
1. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.

2. Double-vane or airfoil-shaped, curved blades of galvanized sheet steel set into vane runners suitable for duct mounting.
3. Generated sound power level shall not exceed 54 decibels in octave band 4 at 2000 fpm in a 24-inch by 24-inch duct.
4. Manufacturers:
 - a. Aero-Dyne Sound Control; H-E-P Turning Vanes & Rail.
 - b. Ductmate Industries, Inc.
 - c. Duro Dyne Corporation.
 - d. Ward Industries, Inc.; a JCI Company.

B. Manufactured Acoustic Turning Vanes:

1. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.
2. Double-vane curved blades of galvanized sheet steel with perforated faces and fibrous-glass fill set into vane runners suitable for duct mounting.
3. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Ward Industries, Inc.; a JCI Company.

2.11 DUCT-MOUNTING ACCESS DOORS

- A. General Description: Fabricate doors airtight and suitable for duct pressure class. Doors may be field fabricated in accordance with SMACNA Standards, or commercially produced.
- B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.
 1. Manufacturers:
 - a. Air Balance, Inc.; Mestek, Inc.
 - b. Greenheck Gan Corporation.
 - c. Nailor Industries Inc.
 - d. Ruskin Company.
 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 3. Provide number of hinges and locks as follows:
 - a. Less Than 12 Inches Square: Secure with two sash locks.
 - b. Up to 18 Inches Square: Two hinges and two compression locks.
 - c. Up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
 - d. Sizes 24 by 48 Inches and Larger: One additional hinge.
- C. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

- D. Insulation: 1-inch-thick, fibrous-glass or polystyrene-foam board.

2.12 FLEXIBLE CONNECTORS

A. Manufacturers:

1. ADSCO Manufacturing LLC.
2. Duro Dyne Corp.
3. Senior Flexonics Pathway.
4. Ventfabrics, Inc.

- B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

- C. Metal-Edged Connectors: Factory fabricated with a fabric strip minimum 3-1/2 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. Select metal compatible with ducts.

- D. 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 20 to plus 200 deg F.

- E. 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.

2.13 FLEXIBLE DUCTS, LOW AND MEDIUM PRESSURE

A. Manufacturers:

1. Flexmaster U.S.A.; a Masterduct Company; Type 1M Acoustical.
2. Hart & Cooley.
3. Thermaflex; part of the Flexible Technologies Group.

- B. Flexible Ducts: Interlocking spiral of galvanized steel or aluminum construction or fabric supported by helically wound spring steel wire or flat steel bands; rated to 6 inches WG positive and 4 inches WG negative for low and medium pressure ducts.

- C. Insulated Flexible Ducts: UL 181, Class 1, flexible duct wrapped with flexible glass fiber insulation, enclosed by a fire retardant polyethylene vapor barrier jacket; maximum 0.23 K value at 75 deg F .

- D. Acoustical performance tested in accordance with the Air Diffusion Council's *Flexible Air Duct Test Code FD 72-R1, Section 3.0, Sound Properties* shall be as follows:

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DUCT ACCESSORIES
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The insertion loss (dB) of a 10 foot length of straight duct when tested in accordance with ASTM E477, at a velocity of 2500 feet per minute, shall be minimum:

Octave Band Hz.	2	3	4	5	6	7
6" diameter	8	32	38	35	39	25
8" diameter	13	32	36	35	36	21
12" diameter	15	29	28	33	26	14

The radiated noise reduction (dB) of a 10 foot length of straight duct when tested in accordance with ASTM E477, at a velocity of 2500 feet per minute, shall be minimum:

Octave Band Hz.	2	3	4	5	6	7
6" diameter	6	8	7	8	9	13
8" diameter	9	6	6	7	8	10
12" diameter	9	7	6	6	8	11

The self-generated sound power levels (LW) dB are 10-12 Watt of a 10 foot length of straight duct for an empty sheet metal duct when tested in accordance with ASTM E477, at a velocity of 1000 feet per minute, shall not exceed:

Octave Band Hz.	2	3	4	5	6	7
6" diameter	42	31	23	18	17	21
8" diameter	41	34	27	19	18	21
12" diameter	53	44	36	27	21	22

- E. Flexible Duct Fittings: Galvanized steel, twist-in design with damper. Size as indicated.
- F. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 through 18 inches to suit duct size.

2.14 FLEXIBLE DUCT ELBOW SUPPORTS

- A. Manufacturer:
 1. Titus; Air Distribution Technologies, Inc.; a JCI Company; FlexRight.
 2. Thermaflex; part of the Flexible Technologies Group; FlexFlow Elbow.
 3. Hart and Cooley, Inc.; Smart Flow Elbow.
- B. Elbow supports shall be constructed of durable composite material and be fully adjustable to support flexible duct diameters 6 inches through 16 inches.
- C. Elbow supports shall be UL listed for use in return air plenum spaces.

2.15 DUCT ACCESSORY HARDWARE

- A. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.16 FINISHES

- A. Chemical Resistant Coating: P-403 manufactured by Heresite Chemical Company.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards-Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts and PVC coated 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 fire dampers, smoke dampers, and combination fire and smoke dampers according to UL listing.
- G. Install duct silencers rigidly to ducts.
- H. Install duct access doors on ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On upstream side of duct coils.
 - 2. Upstream from duct filters.
 - 3. At outdoor-air intakes and mixed-air plenums.
 - 4. At drain pans.
 - 5. Downstream from control dampers, backdraft dampers, and duct mounted equipment.
 - 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links.
 - 7. Control devices requiring inspection, including airflow measuring devices. Size access doors appropriately to facilitate service of each device.
 - 8. Elsewhere as indicated.
- I. Install access doors with swing against duct static pressure.
- J. Install duct-mounting, rectangular access doors with long dimension at right angles to direction of airflow and of largest standard size which can be accommodated in duct. Maximum size: 21 by 14 inches.

- K. Label access doors according to Division 20 Section "Mechanical Identification."
- L. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.
- M. For fans developing static pressures of 5-inch wg and higher, 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 flexible ducts to metal ducts with plenum-rated draw bands.
- P. Install flexible duct elbow supports at each diffuser, grille, or register, and elsewhere as indicated.
- Q. Install turning vanes in rectangular duct elbows in excess of 45 degrees, and where indicated:
 - 1. Use manufactured double-vane turning vanes unless otherwise specified.
 - 2. Seat outboard-most vane in heel of duct elbow.
 - 3. Provide vanes for all runner punchings. Practice of eliminating every other vane is prohibited.
 - 4. Use single-vane turning vanes in low pressure square elbows.

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, smoke, and combination fire and smoke 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.
 - 5. Operate remote damper operators to verify full range of movement of operator and damper.

3.3 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Adjust fire dampers, combination fire and smoke dampers, and smoke dampers for proper action.
- C. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing."

END OF SECTION 23 3300

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 23 Section "Common Work Results for HVAC" for common mechanical drive requirements for fans and air moving equipment.
 - 4. Division 23 Section "Power Ventilators" for axial roof ventilators.

1.2 PERFORMANCE REQUIREMENTS

- A. AMCA Compliance:
 - 1. Operating Limits: Classify according to AMCA 99.

1.3 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.
6. Fan speed controllers.

1.4 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 1. Wiring Diagrams: Power, signal, and control wiring.
 2. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
 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.
- B. Coordination Drawings: Show fan room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

1.5 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Operation and Maintenance Data: For axial fans to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Disassemble and reassemble units, as required for moving to final locations, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

1.8 COORDINATION

- A. Coordinate size and location of structural-steel support members.

PART 2 - PRODUCTS

2.1 MIXED-FLOW FANS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Aerovent; a division of Twin City Fan Companies, Ltd.; QSL.
 2. American Fan; Flakt Woods Inc.; MX
 3. Greenheck; QEI.
 4. Loren Cook Company; QMX.
 5. PennBarry; a unit of Tomkins PLC; ESI.
- B. Description: Fan wheel and housing, factory-mounted motor and accessories.
- C. Housings: Welded, heavy-gage steel.
1. Inlet and Outlet Connections: Outer mounting frame and companion flanges.
 2. Guide Vane Section: Integral guide vanes downstream from fan wheel designed to straighten airflow.
- D. Wheel Assemblies: Cast aluminum with airfoil-shaped blades mounted on cast-iron wheel plate keyed to shaft with solid-steel key.
- E. Accessories:
1. Mounting Clips: Horizontal ceiling clips welded to fan housing, of same material as housing.
 2. Inlet Cones: Round-to-round transition of same material as housing.
 3. Outlet Cones: Round-to-round transition of same material as housing.
- F. Motors: Comply with requirements in Division 20 Section "Motors."
1. Direct-Driven Units: Encase motor in housing outside of airstream, factory wired to disconnect switch located on outside of fan housing.
- G. Factory Finishes:
1. Sheet Metal Parts: Prime coat before final assembly.
 2. Exterior Surfaces: Baked-enamel finish coat after assembly.
- H. Capacities and Characteristics: Refer to schedule(s) on Drawings.
- I. Sound Power and Level Ratings:
1. Ducted Fans: Rated in accordance with AMCA 301 when tested in accordance with AMCA 300.
 2. Non-Ducted Fans: Rated in accordance with AMCA 301 in zones at 5 feet from acoustic center of fan, tested in accordance with AMCA 300 and converted in accordance with AMCA 302.

- J. Vibration Isolators: Spring isolators having a static deflection of 1 inch. Refer to Division 20 Section "Mechanical Vibration Controls" for additional requirements.

2.2 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install axial fans level and plumb.
- B. Support suspended units from structure using threaded steel rods and spring hangers. Vibration-control devices are specified in Division 20 Section "Mechanical Vibration Controls."
- C. Install units with clearances for service and maintenance.
- D. Label fans according to requirements specified in Division 20 Section "Mechanical Identification."

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Duct Accessories."
- B. Ground equipment according to Division 26 Section "Grounding and Bonding."
- C. Connect wiring according to Division 26 Section "Conductors and Cables."

3.3 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 field tests and inspections and prepare test reports:
1. Verify that shipping, blocking, and bracing are removed.
 2. Verify unit is secure on mountings and supporting devices and connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 3. Verify that cleaning and adjusting are complete.
 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 5. Adjust belt tension.
 6. Adjust damper linkages for proper damper operation.
 7. Verify lubrication for bearings and other moving parts.
 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 9. Disable automatic temperature-control operators, energize motor and confirm proper motor rotation and unit operation, adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 10. Shut unit down and reconnect automatic temperature-control operators.
 11. Remove and replace malfunctioning units and retest as specified above.
- C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Lubricate bearings.

END OF SECTION 23 3413

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AXIAL FANS
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SECTION 23 3417 – FAN ARRAYS

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Motors."
 - 3. Division 23 Section "Common Work Results for HVAC" for common mechanical drive requirements for fans and air moving equipment.

1.2 PERFORMANCE REQUIREMENTS

- A. AMCA Compliance:
 - 1. Operating Limits: Classify according to AMCA 99.

1.3 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.

2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness.
5. Dampers, including housings, linkages, and operators.

1.4 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 1. Wiring Diagrams: Power, signal, and control wiring.
 2. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
 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.

1.5 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Operation and Maintenance Data: For fan arrays to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

PART 2 - PRODUCTS

2.1 FAN ARRAY (HAVC-1,HVAC-2, HVAC-3)

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

1. AHU manufacturer's typical OEM fan supplier.
- B. Description: Fan array, shall consist of multiple, direct driven, Arrangement 4 plenum fans constructed in accordance with AMCA requirements for Class III). All fans shall be selected to deliver design air flow at the specified operating Total Static Pressure (TSP) at the specified motor speed and as scheduled. Fan array shall be selected to operate at a system TSP that does not exceed 90 percent of the specified fan's peak static pressure producing capability at the specified fan speed.
- C. Construction: Each fan/motor cartridge shall consist of an 11 gage galvanized steel intake wall, 14 gage spun aluminum inlet funnel, and an 11 gage galvanized steel motor support plate and structure.
- D. Each fan array and assembly shall be dynamically balanced to meet AMCA Standard 204-96, Category BV-3.
- E. Fan Array: Unless remote mounted each fan motor shall be factory wired to a motor control panel containing motor overloads and VFC(s) specified elsewhere. Each motor shall have an overload protector with a switch to shut down a fan for service. Each control panel shall have a single point electrical power connection. Therefore, units with supply and return fan arrays would have two separate power connections.
 1. Single VFC without bypass.
- F. Wire sizing shall be determined, and installed, in accordance with applicable NEC standards. Each fan array and assembly shall be statically and dynamically balanced at the factory as a single rotating assembly to a quality level of G=2.5 in accordance with DIN ISO 1940-1.
- G. Each fan/motor cartridge shall be removable through a 30-inch wide free area, access door located in the same air handling unit compartment as the fan/motor cartridge.
- H. Accessories:
 1. Coplaner Silencer: Fan array shall be provided with acoustical silencers that reduce bare fan discharge sound power levels by a minimum of 15 db re 10^{-12} watts throughout the eight octave bands with center frequencies of 125, 250, 500, 1000, 2000, 4000, and 8000 Hz when compared to the same unit without silencers. Silencers shall not increase fan total static pressure, or increase airway tunnel length of the Air Handling Unit when compared to same fan wall unit without silencer array.
 2. Backdraft Damper: Each individual cube or cell in the multiple fan arrays shall be provided with an integral back flow prevention device that prohibits recirculation of air in the event a fan or multiple fans become disabled. All fans in the multiple fan arrays shall be provided with a back flow prevention means that produces near no static pressure drop and/or system effect when that fan is enabled. The system effects for the back flow prevention device(s) shall be included in the criteria for TSP determination for fan selection purposes, and shall be indicated as a separate line item SP loss in the submittals.
- I. Motors: Premium efficiency, inverter duty, comply with requirements in Division 20 Section "Motors."
 1. Enclosure Type: Totally enclosed, fan cooled (TEFC) or totally enclosed, air over (TEAO).
 2. Motors shall include permanently sealed bearings (L10/500,000 hour) and shaft grounding to protect the motor bearings from electrical discharge machining due to stray shaft currents.

- J. Capacities and Characteristics: Refer to schedules on the Drawings.

2.2 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210/ASHRAE 51, "Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fan arrays level and plumb within associated air handling equipment.
- B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.
 - 1. After field assembly, test and confirm balance and vibration levels. Rebalance as required to meet specified levels.
- C. Lift and support units with manufacturer's designated lifting or supporting points.
- D. Install units with clearances for service and maintenance.
- E. Label fans according to requirements specified in Division 20 Section "Mechanical Identification."

3.2 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding."
- B. Connect wiring according to Division 26 Section "Conductors and Cables."

3.3 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 field tests and inspections and prepare test reports:
1. Verify that shipping, blocking, and bracing are removed.
 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 3. Verify that cleaning and adjusting are complete.
 4. Adjust damper linkages for proper damper operation.
 5. Verify lubrication for bearings and other moving parts.
 6. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.
 7. Remove and replace malfunctioning units and retest as specified above.
- C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fan arrays. Refer to Division 20 Section "Mechanical General Requirements."

END OF SECTION 23 3417

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FAN ARRAYS
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SECTION 23 3423 - POWER VENTILATORS

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Motors."
 - 3. Division 23 Section "Common Work Results for HVAC" for common mechanical drive requirements for fans and air moving equipment.

1.2 PERFORMANCE REQUIREMENTS

- A. Classify according to AMCA 99.

1.3 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness.
5. Dampers, including housings, linkages, and operators.
6. Roof curbs.
7. Fan speed controllers.

1.4 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 1. Wiring Diagrams: Power, signal, and control wiring.
- B. Coordination Drawings: 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. Roof framing and support members relative to duct penetrations.
 2. Ceiling suspension assembly members.
 3. Size and location of initial access modules for acoustical tile.
 4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

1.5 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Operation and Maintenance Data: For power ventilators to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- D. UL Standard: Power ventilators shall comply with UL 705.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.

- B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

1.8 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate delivery and placement of roof curbs, and equipment supports. Installation of roof curbs, equipment supports, and roof penetrations is specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 IN-LINE CENTRIFUGAL FANS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Acme Engineering & Manufacturing; Acme Fan Group.
 - 2. Aerovent; a Twin City Fan Company.
 - 3. Greenheck Fan Corporation; SQ/BSQ Series.
 - 4. Loren Cook Company.
 - 5. Moffitt Corporation.
 - 6. PennBarry; Division of Air System Components.
- B. Description: In-line, direct-drive centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.
- C. Casing: Rectangular or cylindrical, flanged.
- D. Throat and Mounting Assembly: One-piece spun aluminum or continuously welded assembly.
 - 1. Stiffeners: Continuously welded.
 - 2. Bolts, nuts, rivets, and washers: Cadmium plated.
 - 3. Nuts: Self-locking type, vibration proof.
- E. Direct-Driven Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.
- F. Fan Wheels: Aluminum, backward curved airfoil blades welded to aluminum hub.
- G. Accessories:
 - 1. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
 - 2. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
 - 3. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

- H. Capacities and Characteristics: Refer to schedule(s) on Drawings.
- I. Vibration Isolators: Refer to Division 20 Section "Mechanical Vibration Controls."
- J. Spark Arrestance Class: A.

2.2 CENTRIFUGAL ROOF VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Acme Engineering & Manufacturing; Acme Fan Group; Models PRN and PV.
 - 2. Aerovent; a Twin City Fan Company.
 - 3. Greenheck Fan Corporation; Models G and GB.
 - 4. Loren Cook Company; Models ACED and ACES.
 - 5. Moffitt Corporation.
 - 6. PennBarry; Division of Air System Components; Domex.
- B. Description: Direct- drive centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
- C. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
- D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- E. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
 - 1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 - 2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 - 3. Sheaves: Cast-iron, adjustable-pitch motor sheave.
 - 4. Fan and motor isolated from exhaust airstream.
 - 5. Refer to Division 23 Section "Common Work Results for HVAC" for additional requirements.
- F. Accessories:
 - 1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted **inside** fan housing, factory wired through an internal aluminum conduit.
 - 2. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
- G. Provide prefabricated roof curbs for each fan.
- H. Capacities and Characteristics: Refer to schedule(s) on Drawings.

2.3 ROOF CURBS AND ACCESSORIES

- A. Construction: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch chemically treated wood nailer. Size as required to suit roof opening and fan base.

1. Manufacturers: Roof curbs shall be provided by the fan manufacturer, or one of the following:
 - a. Creative Metals.
 - b. The Pate Company.
 - c. Roof Products & Systems.
 - d. Thybar Corporation.
 - e. Any of the approved roof mounted exhaust fan manufacturers.
 2. Configuration: Self-flashing without a cant strip, with mounting flange, and suitable for flat roofs with tapered insulation.
 3. Height: Curb shall extend a minimum 18 inches above top surface of roof insulation.
- B. Construction: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch chemically treated wood nailer. Size as required to suit roof opening and fan base.
1. Manufacturers: Roof curbs shall be provided by the fan manufacturer, or one of the following:
 - a. Creative Metals.
 - b. The Pate Company.
 - c. Roof Products & Systems.
 - d. Thybar Corporation.
 - e. Any of the approved roof mounted exhaust fan manufacturers.
 2. Configuration: Built-in raised cant with step dimension matching insulation thickness, with mounting flange, and suitable for sloped roofs with uniform insulation thickness.
 3. Height: Curb shall extend a minimum 18 inches above top surface of roof insulation.

2.4 MOTORS

- A. Comply with requirements in Division 20 Section "Motors."

2.5 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install power ventilators level and plumb.

- B. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.
- C. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 1 inch. Vibration-control devices are specified in Division 20 Section "Mechanical Vibration Controls."
- D. Install units with clearances for service and maintenance.
- E. Label units according to requirements specified in Division 20 Section "Mechanical Identification."

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding."
- D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Adjust belt tension.
 - 6. Adjust damper linkages for proper damper operation.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 - 9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 - 10. Shut unit down and reconnect automatic temperature-control operators.
 - 11. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.
- C. Replace fan and motor sheaves as required to achieve design airflow.
- D. Lubricate bearings.

END OF SECTION 23 3423

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POWER VENTILATORS
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SECTION 23 3600 - AIR TERMINAL UNITS

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 23 Section "Metal Ducts."
 - 3. Division 23 Section "Temperature Controls."

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, include rated capacities, furnished specialties, sound-power ratings, and accessories.
 - 1. Liners and adhesives.
 - 2. Sealants and gaskets.

1.3 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Detail equipment assemblies and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Include a schedule showing unique model designation, room location, model number, size, and accessories furnished.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
- B. Coordination Drawings: Reflected ceiling plans, 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. Ceiling suspension assembly members.
 - 2. Method of attaching hangers to building structure.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air terminal units to include in operation and maintenance manuals. Include the following:
 - 1. Instructions for resetting minimum and maximum air volumes.
 - 2. Instructions for adjusting software set points.

1.5 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of air terminal units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- C. NFPA Compliance: Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

1.6 COORDINATION

- A. Coordinate layout and installation of air terminal units 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 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SINGLE-DUCT AIR TERMINAL UNITS

- A. Manufacturers:
 - 1. Krueger-HVAC; Air Distribution Technologies, Inc.; a JCI Company.
 - 2. Nailor Industries, Inc.
 - 3. Price Industries.
 - 4. Titus; Air Distribution Technologies, Inc.; a JCI Company.
 - 5. Tuttle & Bailey; Air Distribution Technologies, Inc.; a JCI Company.
- B. Configuration: Variable and constant volume, medium pressure terminal units with casing, 100 percent tight shutoff volume regulator, velocity sensor, and sound attenuating thermal insulation.
- C. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
 - 1. Maximum Damper Leakage: AHRI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.
- D. Velocity Sensor: Multipoint averaging array. Sensor located in air inlet.
- E. Attenuator Section: 0.034-inch mill galvanized steel or 0.032-inch aluminum sheet metal.
 - 1. Lining: 1-inch- thick, coated, fibrous-glass duct liner complying with ASTM C 1071; secured with adhesive. Cover liner with nonporous foil.
- F. Hot-Water Heating Coil: Copper tube, mechanically expanded into aluminum-plate fins; leak tested underwater to 200 psig; and factory installed.
- A. DDC Controls: Single-package unitary controller and actuator specified in Division 23 Section "Temperature Controls."
- B. Control Sequence: Refer to Temperature Control Diagrams on Drawings.

2.3 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Steel Cables: Galvanized steel complying with ASTM A 603.

- C. 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.
- D. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

2.4 SOURCE QUALITY CONTROL

- A. Identification: Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and AHRI certification seal.
- B. Verification of Performance: Rate air terminal units according to AHRI 880.
- C. Acoustical Applications and Sound Evaluation: Based on AHRI Standard 885-98, "Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts or structural-steel fasteners appropriate for construction materials to which hangers are being attached. Refer to Division 20 Section "Hangers and Supports" for additional information.
 - 1. Where practical, install concrete inserts before placing concrete.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. 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.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Install piping adjacent to air terminal units to allow service and maintenance.
- C. Hot Water Piping: Unless otherwise indicated:
 - 1. Install union and isolation valve on supply-water connection.
 - 2. Install union and calibrated balancing valve or PICCV as indicated on the Drawings on return-water connection.
 - 3. Hydronic specialties are specified in Division 23 Section "Hydronic Piping."
- D. Connect ducts to air terminal units according to Division 23 Section "Metal Ducts."
- E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing
 - 2. Leak Test: After installation, fill water coils 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.
- B. Remove and replace malfunctioning units and retest as specified above.

3.5 STARTUP SERVICE

- A. Complete installation and startup checks according to manufacturer's written instructions and do the following:
 - 1. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
 - 2. Verify that controls and control enclosure are accessible.
 - 3. Verify that control connections are complete.
 - 4. Verify that nameplate and identification tag are visible.
 - 5. Verify that controls respond to inputs as specified.

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AIR TERMINAL UNITS
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3.6 DEMONSTRATION

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

END OF SECTION 23 3600

SECTION 23 3713 - DIFFUSERS, REGISTERS, AND GRILLES

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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.
- B. Related Sections include the following:
 - 1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
 - 2. Division 20 Section "Mechanical General Requirements."
 - 3. Division 23 Section "Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.2 ACTION SUBMITTALS

- A. Product Data: For each product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, 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. Ceiling suspension assembly members.
 - 2. Method of attaching hangers to building structure.

3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

PART 2 - PRODUCTS

2.1 AIR DIFFUSION DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 1. Krueger-HVAC; Air Distribution Technologies, Inc.; a JCI Company.
 2. Nailor Industries, Inc.
 3. Price Industries.
 4. Titus; Air Distribution Technologies, Inc.; a JCI Company.
 5. Tuttle & Bailey; Air Distribution Technologies, Inc.; a JCI Company.
- B. Terminal air diffusion devices have been chosen in terms of specific air distribution requirements, spacing, and sound characteristics.
- C. Provide plaster frames for units installed in plaster ceilings.
- D. Provide gaskets for supply terminal air devices mounted in finished surfaces.
- E. Finish:
 1. Device Face and Visible Trim: Standard off white baked enamel finish unless noted otherwise.
 2. Device Interior Surfaces, Including Blank-Offs and Boots: Black matte finish.
- F. Air pattern adjustments shall be made from the face of the device.
- G. Refer to drawings and schedules for quantities, types, and finishes.
- H. Coordinate frame types with Architectural Reflected Ceiling Plan.

2.2 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."
- B. Acoustical Applications and Sound Evaluation: Based on ARI Standard 885-98, "Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Wall-Mounted Supply Registers: Install 6 inches below finished ceiling unless otherwise indicated.
- D. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 3713

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DIFFUSERS, REGISTERS, AND GRILLES
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SECTION 23 3723 - AIR INTAKE AND RELIEF HOODS

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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.
- B. Related Sections include the following:
 - 1. Division 08 Section "Louvers and Vents" for ventilator assemblies provided as part of the general construction.
 - 2. Division 20 Section "Mechanical General Requirements."
 - 3. Division 23 Section "Power Ventilators" for roof-mounting exhaust fans.

1.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Intake and relief ventilators shall be capable of withstanding the effects of gravity loads, wind loads, and thermal movements without permanent deformation of components, noise or metal fatigue, or permanent damage to fasteners and anchors.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: For intake and relief ventilators. Include plans, elevations, sections, details, and ventilator attachments to curbs and curb attachments to roof structure.
- B. Coordination Drawings: Roof framing 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. Structural members to which roof curbs and ventilators will be attached.
 - 2. Sizes and locations of roof openings.
- C. Samples for Verification: For each type of exposed finish required for intake and relief ventilators.
- D. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain ventilators through one source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of intake and relief ventilators and are based on the specific equipment indicated. Refer to Division 01 Section "Product Requirements."
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- D. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.2, "Structural Welding Code--Aluminum."
 - 2. AWS D1.3, "Structural Welding Code--Sheet Steel."

1.6 COORDINATION

- A. Coordinate installation of roof curbs and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 MATERIALS

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5 or T-52.
- B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming or as otherwise recommended by metal producer for required finish.
- C. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 zinc coating, mill phosphatized.
- D. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel, unless otherwise indicated. Do not use metals that are incompatible with joined materials.
 - 1. Use types and sizes to suit unit installation conditions.
 - 2. Use Phillips flat, hex-head or Phillips pan-head screws for exposed fasteners, unless otherwise indicated.
- E. Post-Installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
- F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.3 FABRICATION, GENERAL

- A. Factory or shop fabricate intake and relief ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.
- B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.
- D. Fabricate supports, anchorages, and accessories required for complete assembly.
- E. Perform shop welding by AWS-certified procedures and personnel.

2.4 GRAVITY INTAKE AND RELIEF HOODS (RECTANGULAR)

- A. Manufacturers:
 - 1. Acme Engineering & Manufacturing.
 - 2. Greenheck Fan Corporation; Fabra-Hood.
 - 3. Loren Cook Company.
 - 4. Moffitt Corporation.
 - 5. PennBarry; Division of Air System Components.
- B. Factory or shop fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figures 5-6 and 5-7.
- C. Materials: Galvanized-steel sheet, minimum 0.064-inch- thick base and 0.040-inch- thick hood or Aluminum sheet, minimum 0.063-inch-thick base and 0.050-inch thick hood; suitably reinforced.
- D. Bird Screening: Galvanized-steel, 1/2-inch- square mesh, 0.041-inch wire, or Aluminum, 1/2-inch- square mesh, 0.063-inch wire
- E. Galvanized-Steel Sheet Finish:
 - 1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing according to ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.

2.5 ACCESSORIES

- A. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch chemically treated wood nailer. Size as required to suit roof opening and hood base.
 - 1. Manufacturers: Roof curbs shall be provided by the hood manufacturer, or one of the following:
 - a. Creative Metals.
 - b. Pate.
 - c. Roof Products & Systems.
 - d. ThyCurb.
 - e. Any of the listed hood manufacturers.
 - 2. Height: Curb shall extend a minimum 18 inches above top surface of roof insulation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install intake and relief hoods level, plumb, and at indicated alignment with adjacent work.

- B. Secure intake and relief hoods to roof curbs with cadmium-plated hardware. Use concealed anchorages where possible. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.
- C. Install intake and relief hoods with clearances for service and maintenance.
- D. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Division 07 Section "Joint Sealants" for sealants applied during installation.
- F. Label intake and relief hoods according to requirements specified in Division 20 Section "Mechanical Identification."
- G. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
- H. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories.

3.3 ADJUSTING

- A. Adjust damper linkages for proper damper operation.

END OF SECTION 23 3723

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AIR INTAKE AND RELIEF HOODS
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SECTION 23 4300 - ELECTRONIC AIR CLEANERS

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 23 Section "Particulate Air Filtration."

1.2 DEFINITIONS

- A. PM0.3: Particulate matter up to 0.3 microns.
- B. PM2.5: Particulate matter 2.5 microns and below.
- C. TVOC: Total volatile organic compounds.
- D. VOC; Volatile organic compound.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include dimensions; operating characteristics; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each model indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: For each electronic air cleaner.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Show filter assembly, dimensions, materials, and methods of assembly of components.
 - 3. Include setting drawings, templates, and requirements for installing anchor bolts and anchorages.
 - 4. Include diagrams for power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

- A. Field quality-control reports.
- B. Operation and Maintenance Data: For each type of filter and housing to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. ASHRAE Compliance:
 - 1. Comply with applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality"; Section 5 - "Systems and Equipment"; and Section 7 - "Construction and Startup."
- B. Comply with AHRI 850.
- C. Comply with UL 867.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- E. Laboratory Testing Performance. Each bi-polar ionization manufacturer shall have third party laboratory testing results proving contaminant reductions against MS2, Staph, E. Coli, Dust, Mold, and C. Difficile.
- F. Bipolar ionization system manufacturer shall produce five documented installation references including client contact information with the following criteria.
 - 1. Systems shall have operated continuously for a minimum of 3 years.
 - 2. Installations must be greater than 10,000 CFM serving office or healthcare spaces.
 - 3. Systems shall have a documented ability to reduce volatile organic compound (TVOC levels), particulate (PM) levels, and not increase ozone (O3) in both before and after installation results from air testing completed within the occupied space. Results must include real-time performance results on Particulate Matter 2.5 (PM2.5), Total Volatile Organic Compounds (TVOC), and ozone (O3).

1.7 WARRANTY

- A. Furnish a two-year manufacturer's warranty against manufacturing defects for all systems and components.
- B. Ionization tubes shall last for 18,000 hours at minimum 90 percent ion output.
- C. Warranty period shall begin at time of Final Acceptance by Owner.

PART 2 - PRODUCTS

2.1 BI-POLAR IONIZATION AIR PURIFIERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Base Bid Manufacturer:
 - a. AtmosAir Solutions; Clean Air Group, Inc.
 - 2. Voluntary Alternate Manufacturers:
 - a. Aerisa.
 - b. Global Plasma Solutions.
- B. Each bi-polar ionization air purifier shall be capable of effectively reducing or agglomerating microorganisms throughout the ductwork and interior occupied spaces served by the system (including mold, bacteria, vapors, viruses and other airborne particulates), controlling gas-phase contaminants including volatile organic compounds (VOC's) generated from human occupants, building structure and furnishings, and reducing static space charges.
- C. Each bi-polar ionization system shall have a dynamic ion switch allowing Owner the ability to increase or decrease bi-polar ionization levels.
- D. Bi-polar ionization shall utilize ionization tubes or bars as specified.
 - 1. Ionization Tubes: Constructed from durable, shatterproof material, and last for two years. Tubes constructed of glass are not acceptable.
 - 2. Tube Quantity: 21-inch bi-polar ionization tubes shall meet CFM requirements for different building types as follows:
 - a. One tube per 1,875 CFM of supply air in Residences, Airports, Office Spaces, Day Care Centers and Schools.
 - b. One tube per 938 CFM of supply air in Nursing Homes, Locker Rooms, Manufacturing, Food Processing, and Restaurants.
 - c. One tube per 625 CFM of supply air in Beauty Salons, Casinos, Waste Water Applications, Industrial Facilities, Garbage Rooms, Kennels.
 - 3. Alternating Current Ionization Bars:

- a. Bi-polar Ionization output shall include a minimum of eighteen carbon fiber cluster ion needles per foot of coil face width shall be provided.
 - b. Systems without ion needles at least 0.50-inch (12.5mm) apart shall not be acceptable.
 - c. Entire cooling coil width shall have equal distribution of ionization across the face.
 - d. Plasma electrode shall require no more than 1-inch (25mm) in the direction of airflow for mounting.
 - e. Hardware required for mounting shall be provided by the air purification manufacturer except self-tapping screws for the power supply.
- E. Relative humidity from zero percent to 99 percent shall not cause damage, deterioration or dangerous conditions within the purification system.
- F. Operation of the electrodes or bi-polar generator unit shall conform to ASHRAE Standard 62 and UL867 with respect to ozone generation.
- G. Generator unit shall provide minimum of 86 percent reduction of PM0.3 smaller particles. Independent testing performance criteria shall be provided within the submittal.
- H. System shall include real time IAQ monitors that measure at a minimum:
 - 1. CO2 levels.
 - 2. Temperature.
 - 3. Relative humidity.
 - 4. PM2.5.
 - 5. TVOC.
- I. Each unit shall include required number of composite tubes or bars sized to the scheduled capacity of the duct and/or air handling unit. The tube or bar shall be installed into a base with suitable bonding material and be hermetically sealed to prevent moisture penetration. Base shall include an external molded ring, which seals base to the socket which shall be water/moisture proof.
- J. Bi-polar ionization system shall operate in a manner such that equal amounts of positive and negative ions are produced. Uni-polar ion devices shall not be acceptable.
- K. Bi-polar ionization system shall be designed to increase ionization levels in areas served by air handlers, ducts or plenums where systems are installed. Acceptable ionization level increase in such areas shall be between 500 and 1,500 ions per cubic centimeter as measured by an Alpha Labs air ion counter model AIC 2.
- L. Operation of air purification system shall be through bi-polar ionization utilizing association/disassociation process. It shall operate in such a manner that agglomeration or precipitation of airborne particulates shall not be permitted to collect on occupants, walls or furnishings by virtue of its operation.
- M. Variations in the quantity of air exchange shall not be increased due to requirements of the bi-polar ionization air purifiers.
- N. Capacities: As scheduled on the drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine electronic air cleaners 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.

3.2 INSTALLATION

- A. Install bi-polar ionization air purifiers of capacity and sizes as indicated on the Construction Drawings, and in accordance with the manufacturer's recommendations based on the air flow rate of the air handling system and the size and characteristics of the space(s) being served.
- B. Install bi-polar ionization air purifiers with required clearance for service and maintenance.
- C. Provide access to the ionization tubes for inspection and cleaning.
- D. Install IAQ sensors in the occupied space in the 4-foot to 7-foot breathing zone to measure IAQ within the space.
- E. Seal penetrations of plenums and/or ducts with shaped flanges and with flexible gaskets or grommets.

3.3 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring between sensors and DDC system.
- C. Connect control wiring between controlled devices.
- D. Connect control wiring according to Division 26 Section "Control-Voltage Electrical Power 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.
 - 1. Provide third party ozone testing from 10 locations where technology is installed.
 - 2. Provide proof that there is no measurable increase in ozone levels within the space.
- B. System will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

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3.5 CLEANING

- A. Comply with Division 01 requirements for cleaning and protection of installed work.
- B. Upon completion of the installation, remove all protective materials.

3.6 PROTECTION

- A. Protect installed products and accessories from damage during construction.

END OF SECTION 23 4300

SECTION 23 6433 - MODULAR WATER CHILLERS

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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.
- B. Related Sections:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 20 Section "Hangers and Supports."
 - 4. Division 23 Section "Hydronic Piping" for chilled water piping and accessories.
 - 5. Division 23 Section "General Duty Valves for HVAC" for chilled water isolation valves.
 - 6. Division 28 Section "Refrigerant Monitoring System" for refrigerant monitors, alarms, supplemental breathing apparatus, and ventilation equipment interlocks.

1.2 DEFINITIONS

- A. COP: Coefficient of performance. The ratio of the rate of heat removal to the rate of energy input using consistent units for any given set of rating conditions.
- B. EER: Energy-efficiency ratio. The ratio of the cooling capacity given in terms of Btu/h to the total power input given in terms of watts at any given set of rating conditions.

- C. IPLV: Integrated part-load value. A single number part-load efficiency figure of merit calculated per the method defined by AHRI 550/590 and referenced to AHRI standard rating conditions.
- D. kW/Ton: The ratio of total power input of the chiller in kilowatts to the net refrigerating capacity in tons at any given set of rating conditions.
- E. NPLV: Nonstandard part-load value. A single number part-load efficiency figure of merit calculated per the method defined by AHRI 550/590 and intended for operating conditions other than the AHRI standard rating conditions.
- F. SCCR: Short circuit current rating.

1.3 ACTION SUBMITTALS

- A. Product Data: Include refrigerant, rated capacities, operating characteristics, furnished specialties, and accessories.
 - 1. Performance at AHRI standard conditions and at conditions indicated.
 - 2. Performance at AHRI standard unloading conditions.
 - 3. Minimum evaporator flow rate.
 - 4. Refrigerant capacity of water chiller.
 - 5. Oil capacity of water chiller.
 - 6. Fluid capacity of evaporator.
 - 7. Characteristics of safety relief valves.
 - 8. Minimum entering condenser-air temperature
 - 9. Performance at varying capacity with constant design entering condenser-air temperature. Repeat performance at varying capacity for different entering condenser-air temperatures from design to minimum in 10 deg F increments.

1.4 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Complete set of manufacturer's prints of water chiller assemblies, control panels, sections and elevations, and unit isolation. Include the following:
 - 1. Assembled unit dimensions.
 - 2. Weight and load distribution.
 - 3. Required clearances for maintenance and operation.
 - 4. Size and location of piping and wiring connections.
 - 5. Wiring Diagrams: For power, signal, and control wiring.
- B. Coordination Drawings: Floor 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. Structural supports.
 - 2. Piping roughing-in requirements.
 - 3. Wiring roughing-in requirements, including spaces reserved for electrical equipment.
 - 4. Access requirements, including working clearances for mechanical controls and electrical equipment, and tube pull and service clearances.

- C. Certificates: For certification required in "Quality Assurance" Article.
- D. Source quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

- A. Startup service reports.
- B. Operation and Maintenance Data: For each water chiller to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. AHRI Certification: Certify chiller according to AHRI 590 certification program.
- B. AHRI Rating: Rate water chiller performance according to requirements in AHRI 550/590, "Water Chilling Packages Using the Vapor Compression Cycle."
- C. ASHRAE Compliance:
 - 1. ASHRAE 15 for safety code for mechanical refrigeration.
 - 2. ASHRAE Guideline 3 for refrigerant leaks, recovery, and handling and storage requirements.
- D. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- E. ASME Compliance: Fabricate and stamp water chiller heat exchangers to comply with ASME Boiler and Pressure Vessel Code.
- F. Comply with NFPA 70.
- G. Comply with requirements of UL and UL Canada, and include label by an NRTL showing compliance.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Ship water chillers from the factory fully charged with refrigerant and filled with oil.

1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 MODULAR AIR-COOLED WATER CHILLERS

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

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MODULAR WATER CHILLERS
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1. Base Bid Manufacturer:
 - a. Carrier, a United Technologies Company.
 2. Voluntary Alternate Manufacturers:
 - a. Trane, a Trane Technologies Brand.
 - b. Multistack LLC; Airstack Series.
 - c. Tandem Chillers Incorporated.
 - d. Aermec North America.
- B. General:
1. Chiller Modules: ETL listed in accordance with UL Standard 1995/CSA C22.2 No.236.
 2. Modules shall ship wired, and charged with refrigerant.
 3. Modules factory run-tested prior to shipment.
 4. Compressors, heat exchangers, condenser fans, piping, and controls mounted on heavy-gage steel frame.
 5. Electrical controls, contactors, and relays for each module mounted within that module.
 6. Module provided within steel enclosure suitable for outdoor installation.
 7. Exposed steel surfaces provided with powder coat finish in manufacturer's standard color.
- C. Chilled Water Mains:
1. Each module shall include supply and return mains with grooved end connections.
 2. Each inlet water header shall incorporate a built-in, 30-mesh, in-line strainer to prevent heat exchanger fouling.
- D. Scroll Compressors:
1. Description: Positive-displacement direct drive with hermetically sealed casing.
 2. Each compressor provided with suction and discharge service valves, crankcase oil heater, and suction strainer.
 3. Operating Speed: Nominal 3600 rpm for 60-Hz applications.
 4. Capacity Control: On-off compressor cycling, plus hot-gas bypass on at least one circuit.
 5. Oil Lubrication System: Automatic pump with strainer, sight glass, filling connection, filter with magnetic plug, and initial oil charge.
 6. Vibration Isolation: Mount individual compressors on rubber-in-shear vibration isolators.
- E. Compressor Motors:
1. Hermetically sealed and cooled by refrigerant suction gas.
 2. High-torque, two-pole induction type with inherent thermal-overload protection on each phase.
- F. Compressor Motor Controllers:
1. Across the Line: NEMA ICS 2, Class A, full voltage, nonreversing.
- G. Refrigeration:

1. Refrigerant: R-410A.
2. Refrigerant Compatibility: Parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.
3. Refrigerant Circuit: Each circuit shall include a thermal-expansion valve or electronic-expansion valve, refrigerant charging connections, a hot-gas muffler, compressor suction and discharge shutoff valves, a liquid-line shutoff valve, a replaceable-core filter-dryer, a sight glass with moisture indicator, a liquid-line solenoid valve, and an insulated suction line.
4. Refrigerant Isolation: Factory install positive shutoff isolation valves in the compressor discharge line and the refrigerant liquid-line to allow the isolation and storage of the refrigerant charge in the chiller condenser.
5. Minimum Ambient Start and Operation: 20 deg F.
6. Maximum Ambient Operation: 105 deg F.

H. Evaporator:

1. Direct-expansion, single-pass, brazed-plate design.
2. Type 316 stainless-steel construction.
3. Code Compliance: Tested and stamped according to ASME Boiler and Pressure Vessel Code.
4. Fluid Nozzles: Terminate with mechanical-coupling end connections for connection to field piping.

I. Air-Cooled Condenser:

1. Plate-fin coil with integral subcooling on each circuit, rated at 450 psig.
 - a. Construct coils of copper tubes mechanically bonded to aluminum fins.
2. Fans: Direct-drive multi-blade vane-axial type with statically and dynamically balanced fan blades, arranged for vertical air discharge.
3. Fan Motors: Totally enclosed non-ventilated (TENV) or totally enclosed air over (TEAO) enclosure, with permanently lubricated bearings, and having built-in overcurrent- and thermal-overload protection.
4. Low Sound Fan option shall be provided.
5. High Interrupt option shall be provided.
6. Fan Guards: Steel safety guards with corrosion-resistant coating.

J. Electrical:

1. Factory installed and wired, and functionally tested at factory before shipment.
2. House in a unit-mounted, NEMA 250, Type 3R enclosure with hinged access door with lock and key or padlock and key.
3. Wiring shall be numbered and color-coded to match wiring diagram.
4. Factory wiring located outside of an enclosure shall be installed in a raceway. Terminal connections shall be made with not more than a 24-inch length of liquidtight or flexible metallic conduit.
5. Field power interface shall be to NEMA KS 1, heavy-duty, nonfused disconnect switch.
6. Minimum SCCR according to UL 508 shall be as indicated on the Drawings.
7. Each motor shall have branch power circuit and controls with one of the following disconnecting means having SCCR to match main disconnecting means:
 - a. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.

- b. NEMA KS 1, heavy-duty, nonfusible switch.
 - c. UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
- 8. Each motor shall have overcurrent protection.
- 9. Overload relay sized according to UL 1995, or an integral component of water chiller control microprocessor.
- 10. Phase-Failure and Undervoltage: Solid-state sensing with adjustable settings.
- 11. Controls Transformer: Unit-mounted transformer with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.
- 12. Control Relays: Auxiliary and adjustable time-delay relays, or an integral to water chiller microprocessor.
- 13. Service Receptacle:
 - a. Unit-mounted, 120-V GFI duplex receptacle.
 - b. Power receptacle from chiller internal electrical power wiring.
- 14. Indicate the following for water chiller electrical power supply:
 - a. Current, phase to phase, for all three phases.
 - b. Voltage, phase to phase and phase to neutral for all three phases.
 - c. Three-phase real power (kilowatts).
 - d. Three-phase reactive power (kilovolt amperes reactive).
 - e. Power factor.
 - f. Running log of total power versus time (kilowatt hours).
 - g. Fault log, with time and date of each.

K. Control System:

- 1. Factory installed and wired, and functionally tested at factory before shipment.
- 2. Stand-alone, microprocessor based.
- 3. Enclosure: Share enclosure with electrical power devices or provide a separate enclosure of matching construction.
- 4. Controller shall be a scrolling marquee display with BACnet Communication option.
- 5. Scheduling of compressors performed by Master Controller. New lead compressor selected every 24 hours. Master controller shall monitor and report the following on each refrigeration system:
 - a. Discharge Pressure Fault:
 - 1) Suction pressure fault.
 - 2) Compressor winding temperature fault.
 - 3) Suction temperature.
 - 4) Evaporator leaving chilled water temperature.
- 6. Master controller shall monitor and report the following system parameters:
 - a. Chilled water entering and leaving temperature.
 - 1) Discharge refrigerant temperature.
 - 2) Chilled water flow fault.

7. Out-of-tolerance indication from controls or sensors shall cause fault indication at master controller and shutdown of associated compressor with transfer of load requirements to next available compressor. In the event of a system fault, the entire chiller will be shut down.
8. Master controller shall record conditions at time of the fault and store data for recall.
9. Information shall be capable of being recalled through the keypad of the master controller and displayed on master controller's LCD.
10. History of faults shall be maintained, including date and time-of-day of each fault (up to last 20 occurrences).
11. Individual monitoring of leaving chilled water temperatures from each refrigeration system shall be programmed to protect against freeze-up.
12. Control system shall monitor entering and leaving chilled water temperatures to determine system load, and select number of compressor circuits required to operate. Response times and set points shall be adjustable.
13. Building Automation System Interface: Factory-installed hardware and software to enable building automation system to monitor, control, and display water chiller status and alarms.
 - a. Hardwired Points:
 - 1) Monitoring: On/off status, common trouble alarm.
 - 2) Control: On/off operation, chilled-water discharge temperature set-point adjustment.
 - b. ASHRAE 135 (BACnet) and Industry-accepted open-protocol translator or gateway with building management system shall enable building management system operator to remotely control and monitor the water chiller from an operator workstation. Control features and monitoring points displayed locally at water chiller control panel shall be available through building management system.

L. Accessories and Options:

1. Pump Module: Interconnect through the common chiller header system. Include dual in-line centrifugal pumps in primary/standby pumping arrangement. Pump starters and controls shall enable manual selection of lead pump. In the event of a loss-of-flow failure pump module controls shall disable lead pump and automatically start standby pump. Module factory assembled and tested prior to shipping.
2. Water Manifold Sound Enclosure.
3. High Interrupt and Hot Gas Bypass.
4. High Tank Module: Factory assembled and including insulated chilled water tank. Pressure rated at 150 psig minimum. Modules shall interconnect through common chiller header system and become an integral part of the chiller system. Include drain and fill valves.
5. Sound-reduction package consisting of the following:
 - a. High temperature acoustic covers around compressors.
 - b. Oversized condenser coils and VFC controlled fans with acoustically optimized fan blades.
 - c. Free cooling modules with VFC controlled condenser fan motors.
 - d. Designed to reduce sound level without affecting performance.
6. Equipment Stands for Outdoor Units:

- a. Constructed of heavy gage, high grade steel with thermally fused polyester powder coat finish meeting ASTM D3451 standards. Furnish complete with galvanized mounting hardware that meets ASCE 7 overturning safety requirements. Refer to Division 20 Section "Hangers and Supports" for additional requirements. Supports shall be provided with height adjustment kit.

M. Capacities and Characteristics:

1. Refer to schedule on Drawings.

2.2 SOURCE QUALITY CONTROL

- A. Factory test and inspect evaporator according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1. Stamp with ASME label.
- B. Factory test and inspect water-cooled condenser according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1. Stamp with ASME label.
- C. For water chillers located indoors, rate sound power level according to AHRI 575 procedure.
- D. Allow Owner access to place where water chillers are being tested. Notify Architect 14 days in advance of testing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Before water chiller installation, examine roughing-in for equipment support, anchor-bolt sizes and locations, piping, and electrical connections to verify actual locations, sizes, and other conditions affecting water chiller performance, maintenance, and operations.
 1. Water chiller locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 MODULAR WATER CHILLER INSTALLATION

- A. Equipment Mounting: Install water chiller on concrete bases. Concrete bases shall comply with requirements in Division 03. Vibration isolation devices and minimum deflection are specified in Division 20 Section "Mechanical Vibration Controls."
 1. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 2. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 3. Install anchor bolts to elevations required for proper attachment to supported equipment.

- B. Equipment Mounting: Install water chiller using vibration isolation devices specified in Division 20 Section "Mechanical Vibration Controls."
 - 1. Minimum Deflection: Refer to Division 20 Section "Mechanical Vibration Controls."
- C. Maintain manufacturer's recommended clearances for service and maintenance.
- D. Charge water chiller with refrigerant if not factory charged and fill with oil if not factory installed.
- E. Install and wire separate devices furnished by manufacturer and not factory installed.

3.3 CONNECTIONS

- A. Comply with requirements in Division 23 Section "Hydronic Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to chiller to allow service and maintenance.
- C. Evaporator Fluid Connections: Connect to evaporator inlet with isolation valve, strainer, flexible connector, thermometer, and plugged tee with pressure gage. Connect to evaporator outlet with shutoff valve, balancing valve, flexible connector, flow switch, thermometer, plugged tee with pressure gage, flow meter, and drain connection with valve. Make connections to water chiller with a mechanical coupling.
- D. Connect each drain connection with a union and drain pipe and extend pipe, full size of connection, to floor drain. Provide a shutoff valve at each connection if required.

3.4 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.
- C. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
 - 1. Verify that refrigerant charge is sufficient and water chiller has been leak tested.
 - 2. Verify that pumps are installed and functional.
 - 3. Verify that thermometers and gages are installed.
 - 4. Operate water chiller for run-in period.
 - 5. Check bearing lubrication and oil levels.
 - 6. Verify that refrigerant pressure relief device for chillers installed indoors is vented outside.
 - 7. Verify proper motor rotation.
 - 8. Verify static deflection of vibration isolators, including deflection during water chiller startup and shutdown.
 - 9. Verify and record performance of chilled-water flow and low-temperature interlocks.
 - 10. Verify and record performance of water chiller protection devices.
 - 11. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

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- D. Prepare a written startup report that records results of tests and inspections.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water chillers. Video record the training sessions.

END OF SECTION 23 6423

SECTION 23 7413 - MODULAR AND SEMI-CUSTOM CENTRAL-STATION AIR-HANDLING UNITS

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 23 Section "Common Work Results for HVAC" for common mechanical drive requirements for fans and air handling equipment.

1.2 SUMMARY

- A. This Section includes indoor central-station air-handling units HVAC-1, HVAC-2 with the following components and accessories as scheduled on the Drawings:
 - 1. Chilled water cooling coils.
 - 2. Hot water heating coils.
 - 3. Supply fan.

1.3 DEFINITIONS

- A. DDC: Direct-digital controls.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Casing panels shall be self-supporting and capable of withstanding 125 percent of internal static pressures indicated, without panel joints exceeding a deflection of L/240 where "L" is the unsupported span length within completed casings.

1.5 ACTION SUBMITTALS

- A. Product Data: Include manufacturer's technical data for each air handling unit, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

1.6 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.

1.7 CLOSEOUT SUBMITTALS

- A. Field quality control test reports.
- B. Operation and Maintenance Data: For air handling units to include in operation and maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of central station air-handling units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- B. AHRI Certification: Indoor air-handling units and their components shall be factory tested according to AHRI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by AHRI.

- C. AHRI Compliance:
 - 1. Comply with AHRI 210/240 and AHRI 340/360 for testing and rating energy efficiencies for air handling units.
 - 2. Comply with AHRI 270 for testing and rating sound performance for outdoor units.
- D. ASHRAE Compliance:
 - 1. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
 - 2. Comply with ASHRAE/IESNA 90.1 for minimum efficiency of heating and cooling.
- E. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.
- F. UL Compliance: Comply with UL 1995.
- G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

1.9 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (HVAC-1, HVAC-2, HVAC-3)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Base Bid Manufacturer:
 - a. Trane; a Trane technologies Brand; Performance Climate Changer.
 - 2. Voluntary Alternates Manufacturers:
 - a. AAON, Inc.
 - b. Buffalo Air Handling; Model J and Outdoor Model J.
 - c. Carrier; Div. of United Technologies Corp.; 39 Series.
 - d. Daikin Applied; a member of Daikin Industries, Ltd.
 - e. JCI/YORK International Corporation.
 - f. Nortek Air Solutions; Ventrol, Venmar, and Temtrol Divisions.
 - g. VTS America, Inc.; American Ventus.

2.2 CASING

- A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.

Casing panels shall be solid double-wall construction of pre-painted galvanized steel inner and outer panels and foam insulation. Casing deflection shall not exceed a 1 to 200 ratio when subject to an internal pressure of plus or minus 5-inch wg and shall exhibit no permanent deformation at plus or minus 9-inch wg.

- B. Exterior Casing Material: Galvanized steel, knockouts with grommet seals for electrical and piping connections, and lifting lugs.
- C. Inner Casing Fabrication Requirements:
 - 1. Fan sections shall have acoustic interior sheet uniformly perforated with 1/16 or 3/32 inch holes to produce approximately 20 percent open area.
 - a. A Mylar or Tedlar lining shall be installed between the insulation and interior sheet.
 - 2. Floor Plate: Galvanized steel, 0.1382 inch thick.
- D. Access Requirements: Removable panels or hinged access doors with neoprene gaskets for inspection and access to internal components.
- E. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
 - 1. Materials: Foam panels, ASTM C 1071.
 - 2. Thickness: 2 inches.
 - 3. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
 - 4. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50, when tested according to ASTM C 411.
 - 5. Location and Application: Encased between outside and inside casing.
- F. Condensate Drain Pans: Formed sections of stainless-steel sheet, a minimum of 2 inches deep, and complying with ASHRAE 62.
 - 1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
 - 2. Drain Connections: Threaded coupling or nipple.
- G. Casing Finish:
 - 1. External surface of unit casing prepared and coated with a minimum 1.5 mil enamel finish or equal.
 - 2. Manufacturer's standard color.

2.3 FAN ARRAYS

- A. Refer to Division 23 Section "Fan Arrays."

2.4 COILS

- A. Water Coils:
 - 1. Performance Ratings: Tested and rated according to AHRI 410 and ASHRAE 33.
 - 2. Minimum Working-Pressure/Temperature Ratings: 200 psig, 325 deg F.

3. Source Quality Control: Factory tested to 300 psig.
4. Tubes: ASTM B 743 copper, minimum 0.020 inch wall thickness, and minimum 0.50 inch diameter.
5. Fins: Aluminum, minimum 0.010 inch thick.
6. Headers: Cast iron with cleaning plugs, and drain and air vent tappings or seamless copper tube with brazed joints, prime coated.
7. Frames, Hot Water Coils: Galvanized-steel channel frame, minimum 0.0625 inch thick.
8. Frames, Chilled Water Coils: ASTM A 666, Type 304 stainless steel, minimum 0.0625 inch thick.

2.5 FILTER SECTION

- A. Filter Section: Provide filter holding frames arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side.
- B. Filters: Size, type, and rating as scheduled on the Drawings. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
 1. Air Filter Manufacturers:
 - a. AAF International.
 - b. Camfil Farr Co.
 - c. ECO Air.
 - d. Filtration Group, Inc.
 - e. Flanders Filters, Inc.

2.6 DAMPERS

- A. Outdoor-Air Damper: Provided by Temperature Control Contractor.

2.7 ELECTRICAL REQUIREMENTS

- A. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to air handling unit.
 1. House in NEMA 250, Type 1 or 3R enclosure.
 2. Wiring shall be numbered and color-coded to match wiring diagram.
 3. Install wiring outside of an enclosure in a metal raceway.
 4. Field power interface shall be to NEMA KS 1, heavy-duty, nonfused disconnect switch.
 5. Minimum SCCR according to UL 508 shall be as indicated on the Drawings.
 6. Each motor shall have branch power circuit and controls with one of the following disconnecting means having SCCR to match main disconnecting means:
 - a. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
 - b. NEMA KS 1, heavy-duty, nonfusible switch.
 - c. UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

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2.8 CONTROLS

- A. Control equipment is specified in Division 23 Section "Temperature Controls," and sequence of operation is indicated on the Drawings.

2.9 ACCESSORIES

- A. Lighting: Vapor-proof, marine-type, 100-watt service lights in segments indicated on Drawings. Lights shall be wired to single on/off toggle switch which brings all lights on at once. Lights shall be operable even if the main disconnect is open.
- B. Filter Differential Pressure Switch: With sensor tubing on either side of filter. Set for final filter pressure loss.

2.10 CAPACITIES AND CHARACTERISTICS

- A. Refer to Schedule on Drawings.

2.11 SOURCE QUALITY CONTROL

- A. Factory test fan performance for flow rate, pressure, power, air density, rotation speed, and efficiency. Establish ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of air handling units.
- B. Examine roughing-in for air handling units to verify actual locations of piping and duct connections before equipment installation.
- C. Examine roofs for suitable conditions where air handling units will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION (INDOOR UNITS)

- A. Concrete Bases: Install floor mounting units on 4-inch- high concrete bases. See Division 20 Section "Basic Mechanical Materials and Methods" for concrete base materials and fabrication requirements.
- B. Hoist, transport, and rig units or their shipping sections into position following procedures recommended by manufacturer.

- C. Install indoor air-handling units with the following vibration -control devices. Vibration -control devices are specified in Division 20 Section "Mechanical Vibration Controls."
 - 1. Units with Internally Isolated Fans:
 - a. Floor-Mounted Units: Support on concrete bases using neoprene pads. Secure units to anchor bolts installed in concrete bases.
- D. Arrange installation of units to provide access space around indoor air-handling units for service and maintenance.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20 and 23 Sections.
- B. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.
- C. Install piping adjacent to air handling units to allow service and maintenance.
- D. Duct installation requirements are specified in other Division 23 Sections. The following are specific connection requirements:
 - 1. Install ducts to termination at top of roof curb.
 - 2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
 - 3. Connect supply ducts to air handling units with flexible duct connectors specified in Division 23 Section "Duct Accessories."
 - 4. Install return-air duct continuously through roof structure.

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. Report results in writing.
 - 1. After installing air handling units and after electrical circuitry has been energized, test units for compliance with requirements.
 - 2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 - 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.
- B. Remove and replace malfunctioning units and retest as specified above.

3.5 STARTUP SERVICE

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

- B. Complete installation and startup checks according to manufacturer's written instructions and do the following:
1. Inspect for visible damage to unit casing.
 2. Inspect for visible damage to coils and fans.
 3. Inspect internal insulation.
 4. Verify that labels are clearly visible.
 5. Verify that clearances have been provided for servicing.
 6. Verify that controls are connected and operable.
 7. Verify that filters are installed.
 8. Connect and purge gas line.
 9. Remove packing from vibration isolators.
 10. Verify lubrication on fan and motor bearings.
 11. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
 12. Adjust fan belts to proper alignment and tension.
 13. Start unit according to manufacturer's written instructions.
 - a. Complete startup sheets and attach copy with Contractor's startup report.
 14. Inspect and record performance of interlocks and protective devices; verify sequences.
 15. Operate unit for an initial period as recommended or required by manufacturer.
 16. Calibrate thermostats.
 17. Adjust and inspect high-temperature limits.
 18. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
 19. Cooling System: Measure and record the following when ambient is a minimum of 15 deg F above return-air temperature:
 - a. Coil leaving-air, dry- and wet-bulb temperatures.
 - b. Coil entering-air, dry- and wet-bulb temperatures.
 - c. Outdoor-air, dry-bulb temperature.
 - d. Outdoor-air-coil, discharge-air, dry-bulb temperature.
 20. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
 21. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
 - a. Supply-air volume.
 - b. Return-air volume.
 - c. Relief-air volume.
 - d. Outdoor-air intake volume.
 22. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:
 - a. High-temperature limit on gas-fired heat exchanger.
 - b. Low-temperature safety operation.
 - c. Filter high-pressure differential alarm.
 - d. Economizer to minimum outdoor-air changeover.
 - e. Relief-air fan operation.
 - f. Smoke and firestat alarms.

23. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.6 CLEANING AND ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site during other-than-normal occupancy hours for this purpose.
- B. After completing system installation and testing, adjusting, and balancing air handling units and air-distribution systems, clean filter housings and install new filters.

3.7 DEMONSTRATION

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

END OF SECTION 23 7413

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SECTION 23 8120 - UNITARY ROOFTOP AIR CONDITIONERS

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 20 Section "Mechanical Vibration Controls."
 - 4. Division 23 Section "Common Work Results for HVAC" for common mechanical drive requirements for fans and air handling equipment.

1.2 SUMMARY

- A. This Section includes outdoor-mounted unitary air conditioning units smaller than 20 tons.
- B. Products supplied but not installed under this Section:
 - 1. Roof curbs and equipment rails.

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1.3 DEFINITIONS

- A. DDC: Direct-digital controls.
- B. BAS: Building Automation System.

1.4 ACTION SUBMITTALS

- A. Product Data: Include manufacturer's technical data for each model indicated, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

1.5 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1.6 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Operation and Maintenance Data: For rooftop air conditioners to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. AHRI Compliance:
 - 1. Comply with AHRI 210/240 and AHRI 340/360 for testing and rating energy efficiencies for RTUs.
 - 2. Comply with AHRI 270 for testing and rating sound performance for RTUs.
- B. ASHRAE Compliance:
 - 1. Comply with ASHRAE 15 for refrigeration system safety.
 - 2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
- C. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.
- D. UL Compliance: Comply with UL 1995.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.8 COORDINATION

- A. Coordinate size and locations of roof curbs, equipment supports, and roof penetrations. Framing, flashing, and attachment to roof structure are specified under Division 07.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 UNITARY ROOFTOP AIR CONDITIONERS 7-1/2 TO 20 TONS (RTU-11, RTU-12)

- A. Base Bid Manufacturer:

1. Trane; a Trane Technologies Brand; Precedent Light Commercial.

- B. Voluntary Alternate Manufacturer:

1. AAON, Inc.; RN Series.
2. Carrier Corp.; United Technologies Corporation.
3. Johnson Controls Incorporated/YORK; Engineered Systems Group; Series 10 and Series 20.
4. Daikin Applied; a member of Daikin Industries, Ltd.

- C. Description: Factory Single zone variable air volume, assembled and tested; designed for exterior installation; consisting of compressor, condenser coil, direct expansion cooling coil, supply-air fan, condenser coil fan, refrigeration controls, filters, dampers, and temperature controls or interface specified for unit controls.

- D. Maximum Temperature Distribution Across Supply Air Outlet:

1. 10 deg F Heating.
2. 5 deg F Cooling.

- E. Casing: Galvanized-steel single-wall construction with enamel paint finish, hinged access doors with neoprene gaskets for inspection and access to internal parts, minimum 1/2-inch- thick thermal insulation, knockouts for electrical and piping connections, exterior condensate drain connection, and lifting lugs.

- F. Condensate Drain Pans: Formed sections of plastic or stainless-steel sheet, a minimum of 2 inches deep.

1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
2. Drain Connections: Threaded nipple both sides of drain pan.
3. Pan-Top Surface Coating: Corrosion-resistant compound.

- G. Supply-Air Fan: Variable speed, direct-driven, fan and motor shall be provided.

- H. Condenser Coil Fan: Propeller type, directly driven by permanently lubricated motor.

- I. Direct Expansion Cooling Coils: Aluminum-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.

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- J. Compressor(s): Number as scheduled. Hermetic reciprocating or scroll compressors with integral vibration isolators, internal overcurrent and overtemperature protection, internal pressure relief, and crankcase heater(s).
- K. Refrigeration System:
1. Compressor(s).
 2. Condenser coil and fan.
 3. Direct expansion cooling coil and supply-air fan.
 4. Expansion valves with replaceable thermostatic elements.
 5. Check valves.
 6. Refrigerant dryers.
 7. High-pressure switches.
 8. Low-pressure switches.
 9. Thermostats for coil freeze-up protection during low-ambient temperature operation or loss of air.
 10. Low ambient switch.
 11. Brass service valves installed in discharge and liquid lines.
 12. Independent refrigerant circuits.
 13. Refrigerant: R-407C or R-410A.
 14. Compressor Motor Overload Protection: Manual reset.
 15. Anti-recycling Timing Device: Prevents compressor restart for five minutes after shutdown.
 16. Oil-Pressure Switch: Designed to shut down compressors on low oil pressure.
- L. Filters: 2-inch- thick, MERV 13 fiberglass, pleated, throwaway filters in filter rack.
- M. Outside-Air Damper: Linked damper blades with fully modulating, spring-return damper motor and hood.
- N. Economizer: Return- and outside-air dampers with neoprene seals, bird screen, and hood.
1. Damper Motor: Fully modulating spring return with adjustable minimum position.
 2. Control: Electronic-control system uses return-air and outside-air temperature to adjust mixing dampers.
 3. Relief Damper: Gravity actuated with bird screen and hood.
- O. Electrical:
1. Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection.
 2. House in a unit-mounted, NEMA 250, Type 3R enclosure with hinged access door with lock and key or padlock and key.
 3. Wiring shall be numbered and color-coded to match wiring diagram.
 4. Field power interface shall be to NEMA KS 1, heavy-duty, nonfused disconnect switch.
 5. Minimum SCCR according to UL 508 shall be as indicated on the Drawings.
 6. Each motor shall have branch power circuit and controls with one of the following disconnecting means having SCCR to match main disconnecting means:
 - a. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
 - b. NEMA KS 1, heavy-duty, nonfusible switch.

- c. UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
- 7. Each motor shall have overcurrent protection.
- P. Unit Controls: Solid-state control board and components contain at least the following features:
 - 1. Supply-air fan control relay.
 - 2. Default control to ensure proper operation after power interruption.
 - 3. Field-adjustable control parameters.
 - 4. Economizer control.
 - 5. Electric heat staging.
 - 6. Gas valve delay between first- and second-stage firing.
 - 7. Night setback mode (outside air damper lockout).
 - 8. Low-refrigerant pressure control.
 - 9. Control interface for BAS communication link.
- Q. BAS Communication Link (with or without manufacturer provided thermostat): Install stand-alone control module providing link between unit controls and BAS. Control module shall be compatible with temperature-control system specified in Division 23 Section "Temperature Controls." Interface shall communicate the following:
 - 1. Occupied (continuous) mode control.
 - 2. Unoccupied cycle mode control.
 - 3. Economizer mode activated.
 - 4. Supply-air fan status.
 - 5. Relief/Exhaust fan status.
 - 6. Dirty filter alarm.
 - 7. Specific unit alarms system diagnostics.
 - 8. Occupied space heating and cooling setpoints.
 - 9. Unoccupied space heating and cooling setpoints
 - 10. Unit monitored temperatures.
 - 11. Control signal feedback (on/off or modulating signals).
- R. Accessories:
 - 1. Cold-Weather Kit: Electric heater maintains temperature in gas burner compartment.
 - 2. Service Outlets: 115-V, ground-fault, circuit-interrupter type, field wired such that outlet remains energized even if the unit main disconnect is open.
 - 3. Dirty-filter switch.
 - 4. Hail guards of steel, painted to match casing.
- S. Roof Curb Extensions and Adapters:
 - 1. Manufacturers: Roof curbs shall be provided by the fan manufacturer, or one of the following:
 - a. Creative Metals.
 - b. The Pate Company.
 - c. Roof Products & Systems.
 - d. Thybar Corporation.

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2. Curb Extensions: Constructed of minimum 18 ga. galvanized steel.
 - a. 12-inch high construction with damper shelf; and removable panel, or access door (minimum required for motorized damper).
3. Curb Adapters: Constructed of minimum 18 ga. galvanized steel and designed to adapt or reduce curb cap dimensions to match new rooftop units to existing roof curbs.

2.3 MOTORS

- A. Comply with requirements in Division 20 Section "Motors."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Hoist, transport, and rig air conditioning units or their shipping sections into position following procedures recommended by the manufacturer.
- B. Install units level and plumb, maintaining manufacturer's recommended clearances. Install according to AHRI Guideline B.
- C. Deliver roof curbs and equipment supports to site for installation under Division 07. Install rooftop air conditioners on equipment curbs and supports specified and as scheduled. Secure units to curb support with anchor bolts.
- D. Unit Support: Install unit level on structural curbs. Coordinate wall penetrations and flashing with wall construction. Secure units to structural support with anchor bolts.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20 and 23 Sections.
- B. Install piping adjacent to machine to allow service and maintenance.
 1. Gas Piping: Comply with applicable requirements in Division 23 Section "Fuel Gas Piping." Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.
- C. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
 1. Install ducts to termination in roof curb.
 2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
 3. Connect supply and return ducts to rooftop unit with flexible duct connectors specified in Division 23 Section "Duct Accessories."

- D. Electrical System Connections: Comply with applicable requirements in Division 26 Sections for power wiring, switches, and motor controls.
- E. Ground equipment according to Division 26 Section "Grounding and Bonding."
- F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.
- B. Perform the following field quality-control tests and inspections and prepare test reports:
 - 1. After installing rooftop air conditioners and after electrical circuitry has been energized, test units for compliance with requirements.
 - 2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 - 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. Repair malfunctioning units and retest as specified above; or remove malfunctioning units, replace with new units and retest as specified.

3.4 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions and do the following:
 - 1. Inspect for visible damage to unit casing.
 - 2. Inspect for visible damage to furnace combustion chamber.
 - 3. Inspect for visible damage to compressor, air-cooled outside coil, and fans.
 - 4. Inspect internal insulation.
 - 5. Verify that labels are clearly visible.
 - 6. Verify that clearances have been provided for servicing.
 - 7. Verify that controls are connected and operable.
 - 8. Verify that filters are installed.
 - 9. Clean outside coil and inspect for construction debris.
 - 10. Clean furnace flue and inspect for construction debris.
 - 11. Connect and purge gas line.
 - 12. Adjust vibration isolators.
 - 13. Inspect operation of barometric dampers.
 - 14. Lubricate bearings on fan.
 - 15. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
 - 16. Adjust fan belts to proper alignment and tension.

17. Start unit according to manufacturer's written instructions.
 - a. Start refrigeration system in summer only.
 - b. Complete startup sheets and attach copy with Contractor's startup report.
18. Inspect and record performance of interlocks and protective devices; verify sequences.
19. Operate unit for an initial period as recommended or required by manufacturer.
20. Perform the following operations for both minimum and maximum firing and adjust burner for peak efficiency. Adjust pilot to stable flame.
 - a. Measure gas pressure on manifold.
 - b. Measure combustion-air temperature at inlet to combustion chamber.
 - c. Measure flue-gas temperature at furnace discharge.
 - d. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
 - e. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
21. Check control interface wiring.
22. Adjust and inspect high-temperature limits.
23. Inspect outside-air dampers for proper stroke and interlock with return-air dampers.
24. Start refrigeration system and measure and record the following:
 - a. Coil leaving-air, dry- and wet-bulb temperatures.
 - b. Coil entering-air, dry- and wet-bulb temperatures.
 - c. Outside-air, dry-bulb temperature.
 - d. Outside-air-coil, discharge-air, dry-bulb temperature.
25. Inspect and verify operation of controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
26. Measure and record the following minimum and maximum airflows.
 - a. Supply-air volume.
 - b. Return-air volume.
 - c. Relief-air volume.
 - d. Outside-air intake volume.
27. Simulate maximum cooling demand and inspect the following:
 - a. Compressor refrigerant suction and hot-gas pressures.
 - b. Short circuiting of air through outside coil or from outside coil to outside-air intake.
28. Record all final adjustment and control settings.
29. After startup and performance testing, change filters, vacuum heat exchanger and cooling and outside coils, lubricate bearings, adjust belt tension, and inspect operation of power vents.

3.5 ADJUSTING

- A. Adjust initial temperature set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- C. 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 site outside normal occupancy hours for this purpose, without additional cost.

3.6 DEMONSTRATION

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

END OF SECTION 23 8120

PARTNERS 21-130
UNITARY ROOFTOP AIR CONDITIONERS
23 8120 - 10

SECTION 23 8121 - COMMERCIAL ROOFTOP AIR CONDITIONERS

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 20 Section "Mechanical Vibration Controls."
 - 4. Division 23 Section "Temperature Controls."

1.2 SUMMARY

- A. This Section includes outdoor-mounted air conditioning units 20 tons and larger.
- B. Products supplied but not installed under this Section:
 - 1. Roof curbs and equipment rails.

1.3 DEFINITIONS

- A. DDC: Direct-digital controls.
- B. BAS: Building Automation System.
- C. Modulating: As applied to gas-fired heat exchangers, infinite or finely stepped regulation of burner output within a specified range.

1.4 ACTION SUBMITTALS

- A. Product Data: Include manufacturer's technical data for each model indicated, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

1.5 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Operation and Maintenance Data: For rooftop air conditioners to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. AHRI Compliance:
 - 1. Comply with AHRI 210/240 and AHRI 340/360 for testing and rating energy efficiencies for RTUs.
 - 2. Comply with AHRI 270 for testing and rating sound performance for RTUs.
- B. ASHRAE Compliance:
 - 1. Comply with ASHRAE 15 for refrigeration system safety.
 - 2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
- C. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.
- D. UL Compliance: Comply with UL 1995.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

1.7 COORDINATION

- A. Coordinate size and locations of roof curbs, equipment supports, and roof penetrations. Framing, flashing, and attachment to roof structure are specified under Division 07.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 COMMERCIAL ROOFTOP AIR CONDITIONERS LARGER THAN 20 TONS (RTU-10)

- A. Manufacturers:

1. Base Bid Manufacturer:
 - a. Trane; a Trane Technologies Brand; IntelliPak.
2. Voluntary Alternate Manufacturers:
 - a. AAON, Inc.; RL Series.
 - b. Carrier; a United Technologies Company; WeatherMaster P Series.
 - c. Daikin Applied; a member of Daikin Industries, Ltd.; RoofPak RPS and RDT.
 - d. Johnson Controls Incorporated/YORK; Engineered Systems Group; Series 40 and Eco 2.

- B. Description: Multi-zone variable air volume (VAV), factory assembled and tested; designed for exterior installation; consisting of compressor, condenser coils, direct expansion refrigerant coils, supply-air fan, relief or exhaust fan, condenser coil fan, refrigeration controls, filters, dampers, and temperature controls or interface specified for unit controls.

- C. Maximum Temperature Distribution Across Supply Air Outlet:

1. 10 deg F Heating.
2. 5 deg F Cooling.

- D. Casing: Double-wall galvanized sheet metal construction with exterior enamel paint finish. Units having single-wall casing construction are not acceptable.

1. Finish able to withstand minimum 500-hour salt spray test in accordance with ASTM B117.
2. Hinged access doors with neoprene gaskets for inspection and access to internal parts.
3. Minimum 1-inch- thick thermal insulation.
4. Perforated-metal liner on supply-air fan discharge section.
5. Knockouts for electrical and piping connections.
6. Exterior condensate drain connection.
7. Lifting lugs.

- E. Supply-Air Fan:

1. Fan Arrays: Refer to Division 23 Section "Fan Arrays."

- F. Relief or Exhaust Fan: Fan type and quantity as scheduled.
 - 1. Single, direct drive plenum fans, single width, single inlet, 5-blade backward incline, high efficiency aluminum impeller that is dynamically balanced. Motor shall be electrically commutated motor (ECM) Mount fan and motor assembly on base with elastomeric isolator pads.
- G. Condenser Coil Fans: Propeller type, directly driven by permanently lubricated motor.
- H. Condenser Coils: Heavy duty aluminum fins mechanically bonded to seamless copper tubes, tested to 450 psig and leak tested to 300 psig with air under water. Provide subcooling circuit(s) integral with condenser coils to maximize efficiency and prevent premature flashing of liquid refrigerant, to a gaseous state, ahead of the expansion valve. Condenser coils shall not exceed 14 fins per inch density in order to permit routine cleaning, and prevent excessive air pressure drop across the condenser coil.
- I. Direct Expansion Cooling Coils: Aluminum-plate fin and seamless copper tube in stainless-steel casing inter-circuited to assure complete coil face activity, with equalizing-type vertical distributor and thermal expansion valve; tested to 450 psig and leak tested to 300 psig with air under water.
- J. Drain Pan: Under cooling coils. Formed of stainless-steel sheet and complying with requirements in ASHRAE 62.1. Fabricate pans with slopes in two planes to collect condensate from cooling coils (including coil piping connections and return bends) and when units are operating at maximum design face velocity across the coils.
 - 1. Drain Connections: Both ends of pan.
 - 2. Units with stacked coils shall have an intermediate stainless steel drain pan or drain trough to collect condensate from top coil.
- K. Compressor(s): Number as scheduled. Variable speed compressors shall be capable of modulation from 25Hz to 100 Hz. The minimum unit capacity shall be 15% of full load or less. Each compressor shall be matched with a specifically designed variable frequency drive which modulates the compressor motor and provides several compressor protections functions. The compressor shall be provided with integral vibration isolators, internal overcurrent and overtemperature protection, internal pressure relief, and crankcase heater(s).
- L. Refrigeration System:
 - 1. Compressor(s).
 - 2. Condenser coils and fans.
 - 3. Direct expansion cooling coil and supply-air fan.
 - 4. Check valves.
 - 5. Expansion valves with replaceable thermostatic elements.
 - 6. Refrigerant dryers.
 - 7. High-pressure switches.
 - 8. Low-pressure switches.
 - 9. Thermostats for coil freeze-up protection during low-ambient temperature operation or loss of air.
 - 10. Independent refrigerant circuits.
 - 11. Brass service valves installed in discharge and liquid lines.
 - 12. Refrigerant: R-407C or R-410A.
 - 13. Refrigerant Circuits: Interlaced refrigerant-coil circuiting with circuit for each compressor.

14. Capacity Control: Number of stages as scheduled on the Drawings, and hot-gas bypass valve and piping.
 15. Compressor Motor Overload Protection: Manual reset.
 16. Anti-recycling Timing Device: Prevents compressor restart for five minutes after shutdown.
 17. Oil-Pressure Switch: Designed to shut down compressors on low oil pressure.
- M. Filters: Size, type, and rating as scheduled on the Drawings, in filter racks or galvanized-steel frames as required by filter type.
1. Air Filter and Filter-Holding System Manufacturers:
 - a. AAF | Flanders.
 - b. AAF International.
 - c. Camfil.
- N. Outside-Air Damper: Linked damper blades with fully modulating, spring-return damper motor and hood. Refer to Division 23 Section "Temperature Controls" for additional requirements.
- O. Economizer: Return- and outside-air dampers with neoprene seals, bird screen, and hood.
1. Damper Motor: Fully modulating spring return with adjustable minimum position.
 2. Control: Electronic-control system uses outside-air and return-air enthalpy to adjust mixing dampers.
 3. Relief Damper: Motorized actuated with bird screen and hood.
 4. Leakage: Maximum leakage 2.5 percent at nominal airflow of 400 cfm per ton with 1-inch wg pressure differential.
 5. Refer to Division 23 Section "Temperature Controls" for additional damper and operator requirements.
- P. Electrical:
1. Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection.
 2. House in a unit-mounted, NEMA 250, Type 3R enclosure with hinged access door with lock and key or padlock and key.
 3. Wiring shall be numbered and color-coded to match wiring diagram.
 4. Field power interface shall be to NEMA KS 1, heavy-duty, nonfused disconnect switch.
 5. Minimum SCCR according to UL 508 shall be as indicated on the Drawings.
 6. Each motor shall have branch power circuit and controls with one of the following disconnecting means having SCCR to match main disconnecting means:
 - a. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
 - b. NEMA KS 1, heavy-duty, nonfusible switch.
 - c. UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
 7. Each motor shall have overcurrent protection.
- Q. Unit Controls: Provide an application specific programmable controller that is factory installed and designed to meet the Temperature Control Specifications and drawings. The controller shall be provided with the

following features: automated controller backup and optional features, remote connectivity, and custom programming with expandable I/O.

- R. BAS Communication Link (with or without unit manufacturer provided Programmable DDC): Stand-alone control module providing link between unit controls and DDC temperature-control system. Control module shall be compatible with temperature-control system specified in Division 23 Section "Temperature Controls" and as indicated on the Temperature Control Drawings.
- S. Accessories:
 - 1. Cold-Weather Kit: Electric heater maintains temperature in gas burner compartment.
 - 2. Service Outlets: 115-V, ground-fault, circuit-interrupter type, factory wired such that outlet shall remain energized even if the unit main disconnect is open.
 - 3. Vapor-proof, marine-type, 100-watt service lights in fan sections factory wired such that lighting circuit remains energized even if the unit main disconnect is open, and wired to single on/off toggle switch which brings on all lights at once.
 - 4. Dirty-filter switch.
 - 5. Hail guards of minimum 20 gage galvanized steel, painted to match casing.
- T. Roof Curb: Existing roof curb shall be reused, provide an extension and adapter as required.
- U. Extensions and Adapters:
 - 1. Manufacturers: Roof curbs shall be provided by the fan manufacturer, or one of the following:
 - a. Creative Metals.
 - b. The Pate Company.
 - c. Roof Products & Systems.
 - d. Thybar Corporation.
 - 2. Curb Extensions: Constructed of minimum 18 ga. galvanized steel.
 - a. 12-inch high construction with damper shelf; and removable panel, or access door (minimum required for motorized damper).
 - 3. Curb Adapters: Constructed of minimum 18 ga. galvanized steel and designed to adapt or reduce curb cap dimensions to match new rooftop units to existing roof curbs.

2.3 MOTORS

- A. Comply with requirements in Division 20 Section "Motors."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Hoist, transport, and rig air conditioning units or their shipping sections into position following procedures recommended by the manufacturer.

- B. Install units level and plumb, maintaining manufacturer's recommended clearances. Install according to AHRI Guideline B.
- C. Deliver roof curbs and equipment supports to site for installation under Division 07. Install rooftop air conditioners on equipment curbs and supports specified. Secure units to curb support with anchor bolts.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20 and 23 Sections.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
 - 1. Connect supply and return ducts to rooftop unit with flexible duct connectors specified in Division 23 Section "Duct Accessories."
- D. Electrical System Connections: Comply with applicable requirements in Division 26 Sections for power wiring, switches, and motor controls.
- E. Ground equipment according to Division 26 Section "Grounding and Bonding."
- F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.
- B. Perform the following field quality-control tests and inspections and prepare test reports:
 - 1. After installing rooftop air conditioners and after electrical circuitry has been energized, test units for compliance with requirements.
 - 2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 - 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. Repair malfunctioning units and retest as specified above; or remove malfunctioning units, replace with new units and retest as specified.

3.4 STARTUP SERVICE

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

- B. Complete installation and startup checks according to manufacturer's written instructions and do the following:
1. Inspect for visible damage to unit casing.
 2. Inspect for visible damage to furnace combustion chamber.
 3. Inspect for visible damage to compressor, air-cooled outside coil, and fans.
 4. Inspect internal insulation.
 5. Verify that labels are clearly visible.
 6. Verify that clearances have been provided for servicing.
 7. Verify that controls are connected and operable.
 8. Verify that filters are installed.
 9. Clean outside coil and inspect for construction debris.
 10. Connect and purge gas line.
 11. Adjust vibration isolators.
 12. Inspect operation of barometric dampers.
 13. Lubricate bearings on fan.
 14. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
 15. Adjust fan belts to proper alignment and tension.
 16. Start unit according to manufacturer's written instructions.
 - a. Start refrigeration system in summer only.
 - b. Complete startup sheets and attach copy with Contractor's startup report.
 17. Inspect and record performance of interlocks and protective devices; verify sequences.
 18. Operate unit for an initial period as recommended or required by manufacturer.
 19. Check control interface wiring.
 20. Adjust and inspect high-temperature limits.
 21. Inspect outside-air dampers for proper stroke and interlock with return-air dampers.
 22. Start refrigeration system and measure and record the following:
 - a. Coil leaving-air, dry- and wet-bulb temperatures.
 - b. Coil entering-air, dry- and wet-bulb temperatures.
 - c. Outside-air, dry-bulb temperature.
 - d. Outside-air-coil, discharge-air, dry-bulb temperature.
 23. Inspect and verify operation of controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
 24. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
 - a. Supply-air volume.
 - b. Return-air volume.
 - c. Relief-air volume.
 - d. Outside-air intake volume.
 25. Simulate maximum cooling demand and inspect the following:
 - a. Compressor refrigerant suction and hot-gas pressures.
 - b. Short circuiting of air through outside coil or from outside coil to outside-air intake.
 26. Record all final adjustments and control settings.

27. After startup and performance testing, change filters, vacuum heat exchanger and cooling and outside coils, lubricate bearings, adjust belt tension, and inspect operation of power vents.

3.5 ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- C. 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 site outside normal occupancy hours for this purpose, without additional cost.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain rooftop air conditioners. Refer to Division 20 Section "Mechanical General Requirements."

END OF SECTION 23 8121

PARTNERS 21-130
COMMERCIAL ROOFTOP AIR CONDITIONERS
23 8121 - 10

SECTION 23 8126 - SPLIT-SYSTEM AIR-CONDITIONING UNITS

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."

1.2 SUMMARY

- A. This Section includes ductless split-system air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components.
- B. Products supplied but not installed under this Section:
 - 1. Roof curbs and equipment rails.

PARTNERS 21-130
SPLIT-SYSTEM AIR-CONDITIONING UNITS
23 8126 - 2

1.3 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

1.4 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Diagram power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Operation and Maintenance Data: For split-system air-conditioning units to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- C. ASHRAE Compliance:
 - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.
- E. Seasonal Energy-Efficiency Ratio (SEER): Minimum 13.

1.7 COORDINATION

- A. Coordinate delivery and placement of roof curbs, and equipment supports. Installation of roof curbs, equipment supports, and roof penetrations is specified in Division 07 Section "Roof Accessories." Pipe Roof Penetration Enclosures are specified in Division 20 Section "Basic Mechanical Materials and Methods."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Single-Zone Split-System Air-Conditioning Units:
 - a. Airedale North America, Inc.
 - b. Carrier Corp.; United Technologies Corporation.
 - c. Daikin Applied; a member of Daikin Industries, Ltd.; Daikin AC.
 - d. Johnson Controls-Hitachi.
 - e. LG Electronics, HVAC Division.
 - f. Mitsubishi Electric & Electronics America, Inc.; HVAC Advanced Products Division.
 - g. Samsung Electronics.
2. Roof Curbs and Equipment Rails:
 - a. Pate Company (The).
 - b. Roof Products and Systems Corp.
 - c. ThyCurb; a division of THYBAR Corporation.

2.2 SINGLE-ZONE DUCTLESS SPLIT SYSTEM AIR CONDITIONER

- A. Complete packaged air conditioning unit factory fabricated and tested.
- B. Indoor Evaporator Section: Complete with fan section, motor, washable filter, condensate drain pan, field installed condensate pump, and direct expansion evaporator section. Include factory-installed float switch to detect high condensate water level and disable fan operation.
- C. Air Cooled Condensing Section: Completely factory piped for single point connection of refrigerant lines. Condensing unit with propeller fan shall be matched to evaporator section to provide cooling capacity as scheduled on drawings.
- D. Controls: Unit furnished with factory installed microprocessor controls. Provide wireless remote or unit mounted control or wall thermostat, which shall provide selection of all functions and control of room temperature set points. Furnish and install one mounting bracket for each wireless remote control.
- E. Provide complete refrigerant piping circuit (including all piping specialties) sized in accordance with manufacturer's requirements to interconnect evaporator and condenser sections.
- F. Wall-Mounting, Evaporator-Fan Components:
 1. Cabinet: With removable panels for servicing, and discharge drain pans with drain connection.
 2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with thermal-expansion valve.
 3. Fan: Direct drive, centrifugal fan.
 4. Fan Motors: Comply with requirements in Division 20 Section "Motors."
 - a. Special Motor Features: Multitapped, multispeed with internal thermal protection and permanent lubrication.
 5. Filters: Disposable, with ASHRAE 52.2 MERV rating of 6 or higher.

G. Ceiling-Mounting, Evaporator-Fan Components:

1. Cabinet: Enameled steel chassis with removable panels on front and ends, and discharge drain pans with drain connection.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with thermal-expansion valve.
3. Fan: Direct drive, centrifugal fan, with outside air intake, and integral factory or field installed condensate pump.
4. Fan Motors: Comply with requirements in Division 20 Section "Motors."
 - a. Special Motor Features: Multitapped, multispeed with internal thermal protection and permanent lubrication.
5. Filters: Disposable, with ASHRAE 52.2 MERV rating of 6 or higher.

H. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
 2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - a. Compressor Type: Reciprocating or Scroll.
 - b. Include refrigerant charge.
 - c. Refrigerant: R-410A.
 3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with AHRI 210/240, and with liquid subcooler.
 4. Fan: Aluminum-propeller type, directly connected to motor.
 5. Motor: Permanently lubricated, with integral thermal-overload protection.
 6. Low Ambient Kit: Permits operation down to (-10 deg F).
- I. Control equipment is specified in Division 23 Section "Temperature Controls," and sequence of operation is indicated on the Drawings.
- J. Thermostat: Wall-mounted low voltage type to control compressor and evaporator fan.
- K. Automatic-reset timer to prevent rapid/short cycling of compressor.

2.3 ACCESSORIES

- A. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized with nitrogen, and sealed; factory-insulated suction line with flared fittings at both ends.
- B. Roof Curbs and Equipment Rails:
1. Minimum 18 gage welded galvanized steel construction.

2. Integral base flange or plate.
3. Built-in fully mitered raised cant with step matching insulation thickness.
4. Factory installed insect and decay resistant wood nailer.
5. Top of curb or equipment support shall be level and extend a minimum of 8 inches above the top of the roof insulation.

C. Automatic Condensate Pump Units (Field Installed)

1. Manufacturers:
 - a. Little Giant Pump Co.; Subsidiary of Tecumseh Products Co.
 - b. Beckett Corporation.
 - c. Hartell Pumps Div.; Milton Roy Co.
 - d. Hydromatic Pump Company; Division of Pentair Pump Group.
2. Description: Packaged units with corrosion-resistant pump, plastic tank with cover, and automatic controls.

D. Automatic Condensate Pump Units (Field Installed Above Ceiling Applications)

1. Manufacturers:
 - a. Hartell Pumps Div.; Milton Roy Co.; Model A2-X-1965.
2. Description: Packaged units with corrosion-resistant pump, dual-voltage thermally protected motor, cast aluminum tank with cover, and automatic controls. Include auxiliary safety switch; junction box wire connections, with 3/4-inch knock out for conduit; and factory- or field-installed check valve.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Deliver roof curbs and equipment support to site for installation under Division 07. Install roof-mounting compressor-condenser components on equipment supports specified. Anchor units to supports with removable, cadmium-plated fasteners. Install wind baffle according to manufacturer's installation instructions.
- D. Install and connect refrigerant tubing to components. Install tubing to allow access to unit. Evacuate and charge with refrigerant in accordance with manufacturers instructions.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20 and 23 Sections.

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- B. Install piping adjacent to unit to allow service and maintenance.
- C. Electrical Connections: Comply with requirements in Division 26 Sections for power wiring, switches, and motor controls.

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.

3.4 DEMONSTRATION

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

END OF SECTION 23 8126

SECTION 23 8216 - HEATING AND COOLING COILS

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 23 Sections for coils that are integral to air-handling units.

1.2 SUMMARY

- A. This Section includes duct-mounted heating and cooling coils, and heating and cooling coils that are an integral part of air-handling units.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each coil. Include rated capacity and pressure drop for each coil.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which coil location and ceiling-mounted access panels are shown and coordinated with each other.

1.5 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Operation and Maintenance Data: For air coils to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASHRAE Compliance:
 - 1. Comply with ASHRAE 15 for refrigeration system safety.
 - 2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.

PART 2 - PRODUCTS

2.1 WATER COILS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Aerofin Corporation.
 - 2. Carrier; a United Technologies Company.
 - 3. Daikin Applied; a member of Daikin Industries, Ltd.
 - 4. JCI/York International.
 - 5. Luvata/Heatcraft Commercial/Industrial Products.
 - 6. Nortek Air Solutions; Ventrol.
 - 7. Precision Coils; a business of Unison Comfort Technologies.
 - 8. Trane; a Trane Technologies Brand.
- B. Performance Ratings: Tested and rated according to AHRI 410 and ASHRAE 33.
- C. Minimum Working-Pressure/Temperature Ratings: 200 psig, 325 deg F.
- D. Source Quality Control: Factory tested to 300 psig.
- E. Tubes: ASTM B 743 copper, minimum 0.020 inch wall thickness, and minimum 0.50 inch diameter.
- F. Fins: Aluminum, minimum 0.010 inch thick.

- G. Headers: Cast iron with cleaning plugs, and drain and air vent tappings or seamless copper tube with brazed joints, prime coated.
- H. Frames, Hot Water Coils: Galvanized-steel channel frame, minimum 0.0625 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine ducts, plenums, and casings to receive air coils for compliance with requirements for installation tolerances and other conditions affecting coil performance.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before coil installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install coils level and plumb.
- B. Install coils in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."
- C. Install minimum 22 gage, Type 304 stainless-steel drain pan under each cooling coil.
 - 1. Construct drain pans with connection for drain; insulated.
 - 2. Construct drain pans to extend beyond coil length and width and to connect to condensate trap and drainage.
 - 3. Extend drain pan upstream and downstream from coil face.
 - 4. Extend drain pan under coil headers and exposed supply piping.
- D. Install moisture eliminators for cooling coils. Extend drain pan under moisture eliminator.
- E. Straighten bent fins on air coils.
- F. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to coils to allow service and maintenance.

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- C. Connect water piping with unions and shutoff valves to allow coils to be disconnected without draining piping. Control valves are specified in Division 23 Section "Temperature Controls," and other piping specialties are specified in Division 23 Section "Hydronic Piping."

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, operate electric coils to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION 23 8216

SECTION 23 8229 - HYDRONIC RADIANT HEATING UNITS

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."

1.2 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, specialties, and accessories for each product indicated.

1.3 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Detail equipment assemblies and suspension and attachment. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- B. Coordination Drawings: Reflected ceiling plan(s) 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 heaters and suspension systems will be attached.

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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.
5. Perimeter moldings.

1.4 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Operation and Maintenance Data: For electric radiant heaters and panels to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a NRTL acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

- A. Coordinate layout and installation of radiant heaters and panels and suspension system components 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 HYDRONIC HEATING PANELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Aero Tech Manufacturing Inc.
 2. AIRTEX Radiant Systems; a division of Engineered Air Ltd.
 3. Rittling; a Zehnder Group Company.
 4. Armstrong Ceiling & Wall Solutions; Metalworks Airtite Radiant Ceiling Systems.
 5. Sterling Hydronics; a Mestek Company.
 6. Twa Panel Systems Inc.
- B. Description: Linear metal panel with serpentine water piping, suitable for installation flush with T-bar ceiling grid.
 1. Panels: Fluted, extruded aluminum sheet.

2. Backing Insulation: Minimum 1-inch- thick, mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB with factory-applied jacket.
3. Piping Inlet and Outlet: NPS 1/2.
4. Exposed-Side Panel Finish: Baked-enamel finish in manufacturer's standard paint color as selected by Architect.
5. Factory Piping: ASTM B 88, Type L copper tube with ASME B16.22 wrought-copper fittings and brazed joints. Piping shall be mechanically bonded to panel.
6. Accessories:
 - a. Male bullnose panels.
 - b. Female bullnose panels.
 - c. Male corner panels.
 - d. Female corner panels.
 - e. Inside corner panel.
 - f. Filler panels.

C. Capacities and Characteristics: Refer to Schedules on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive radiant heating and cooling units for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for hydronic piping connections to verify actual locations before radiant heating and cooling unit installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install radiant heating units level and plumb.
- B. The linear radiant and matching non-radiant panels shall be installed by manufacturer's authorized Radiant Ceiling Contractor. Contractor shall install all panels in accordance with the manufacturer's recommendations.
 1. Contractor shall provide all necessary wall channels, angles and required support for radiant panel. Contractor shall provide tee sections between adjacent panels and at panel ends. Contractor shall verify ceiling openings are large enough to accommodate thermal expansion and contraction of ceiling panels. The ceiling contractor shall provide and install the tee between the acoustical ceiling and the radiant panel along the length of the panel.
- C. Radiant ceiling panel suspension shall be independent of the ceiling system.
- D. Hangers shall be installed as recommended by the manufacturer.

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- E. Contractor shall integrate and coordinate radiant ceiling panel installation with ceiling grid installation (by others).
- F. The Radiant Ceiling Sub-Contractor shall cooperate with other trades working in the ceiling to achieve a neat, well coordinated, and properly sequenced overall installation.
- G. Work of Radiant Ceiling Sub-contractor shall terminate within three feet of the supply and return point of each panel circuit.
- H. The Radiant Ceiling Sub-Contractor shall furnish and install all necessary piping and bends required for the interconnection of the panel sections. The panel interconnecting pipe and bends shall be furnished by the panel manufacturer and shall provide for necessary expansion and contraction as recommended by the manufacturer.
- I. All installation of linear panels, where made with mitered joints, shall be made so that the fluting on the abutting panel is aligned.
- J. Verify locations of thermostats with Drawings and room details before installation. Install devices 48 inches above finished floor.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in Division 23 Section "Hydronic Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to unit to allow service and maintenance.
- C. Water Piping: Unless otherwise indicated:
 - 1. Install union and isolation valve on supply-water connection.
 - 2. Install union and calibrated balancing valve or PICCV as indicated on the Drawings on return-water connection.
 - 3. Hydronic specialties are specified in Division 23 Section "Hydronic Piping."

3.4 FIELD QUALITY CONTROL

- A. Testing: Perform the following field tests and inspections and prepare test reports:
- B. Remove and replace malfunctioning units and retest as specified above.
- C. After installing panels, inspect unit cabinet for damage to finish. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

3.5 DEMONSTRATION

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

END OF SECTION 23 8229

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SECTION 23 8241 - PROPELLER FAN UNIT HEATERS – HOT WATER

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3.5 DEMONSTRATION	5

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section “Mechanical General Requirements.”
 - 2. Division 20 Section “Basic Mechanical Materials and Methods.”

1.2 SUMMARY

- A. This Section includes propeller fan unit heaters with hot-water coils.

1.3 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each unit type and configuration.

1.4 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Submit the following for each unit type and configuration:
 - 1. Plans, elevations, sections, and details.
 - 2. Details of anchorages and attachments to structure and to supported equipment.
 - 3. Wiring Diagrams: Power, signal, and control wiring.
 - 4. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Coordination Drawings: Plan(s) 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 unit heaters will be attached.
 - 3. Other items, including the following:
 - a. Lighting fixtures.
 - b. Sprinklers.
 - c. Ductwork.

1.5 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Operation and Maintenance Data: For propeller unit heaters to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hot-Water Unit Heaters:

- a. Daikin Applied; a member of Daikin Industries, Ltd.
- b. Dunham-Bush, Inc.
- c. Hydro-Air Components; Zehnder Rittling.
- d. Modine Manufacturing Company.
- e. Sterling Radiator, a Mestek Company.
- f. Trane Inc.; a Trane Technologies Brand.
- g. Vulcan Radiator, a Mestek Company.

2.2 UNIT HEATERS

- A. Description: An assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers.

2.3 CASING

- A. Cabinet: Removable panels for maintenance access to controls.
- B. Cabinet Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heater before shipping.
- C. Discharge Louver: Four-way adjustable louvers for horizontal units and adjustable pattern diffuser for projection units.

2.4 COILS

- A. Hot-Water Coil: Copper tube, minimum 0.025-inch wall thickness, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 325 deg F, with manual air vent. Test for leaks to 350 psig underwater.

2.5 FAN

- A. Propeller type, aluminum wheel directly mounted on motor shaft in the fan venturi.

2.6 FAN MOTORS

- A. Comply with requirements in Division 20 Section "Motors."
- B. Motor Type: Permanently lubricated, multispeed.

2.7 CAPACITIES AND CHARACTERISTICS

- A. Refer to Schedule on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive propeller unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for piping and electrical connections to verify actual locations before propeller unit-heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install propeller unit heaters level and plumb.
- B. Install propeller unit heaters to comply with NFPA 90A.
- C. Suspend propeller unit heaters from structure with all-thread hanger rods and spring hangers.
 - 1. Hanger rods and attachments to structure are specified in Division 20 Section "Hangers and Supports."
 - 2. Vibration hangers are specified in Division 20 Section "Mechanical Vibration Controls."

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Hot Water Piping: Unless otherwise indicated:
 - 1. Install union and isolation valve on supply-water connection.
 - 2. Install union and calibrated balancing valve or PICCV as indicated on the Drawings on return-water connection.
 - 3. Hydronic specialties are specified in Division 23 Section "Hydronic Piping."
- D. Ground equipment according to Division 26 Section "Grounding and Bonding."
- E. Connect wiring according to Division 26 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing and report results in writing:
 - 1. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Test and adjust controls and safeties.
- B. Remove and replace malfunctioning units and retest as specified above.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain propeller fan unit heaters. Refer to Division 20 Section "Mechanical General Requirements."

END OF SECTION 23 8241

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PROPELLER FAN UNIT HEATERS - STEAM, HOT WATER, ELECTRIC
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SECTION 23 8413 - HUMIDIFIERS

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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.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 23 Section "Steam and Condensate Piping."

1.2 DEFINITION

- A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.3 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Detail fabrication and installation of humidifiers. Include piping details, plans, elevations, sections, details of components, manifolds, and attachments to other work.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- B. Coordination Drawings: Detail humidifiers and adjacent equipment. Show support locations, type of support, weight on each support, required clearances, 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. Structural members to which humidifiers will be attached.
 - 2. Size and location of initial access modules for acoustical tile.

1.5 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Operation and Maintenance Data: For humidifiers to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with ARI 640, "Commercial and Industrial Humidifiers."

1.7 COORDINATION

- A. Coordinate location and installation of humidifiers with manifolds in ducts and air-handling units or occupied space. Revise locations and elevations to suit field conditions and to ensure proper humidifier operation.

PART 2 - PRODUCTS

2.1 SELF-CONTAINED HUMIDIFIERS (ELECTRODE CYLINDER TYPE)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Armstrong International, Inc.
 - 2. Carel USA, LLC.
 - 3. Carnes Co., Inc.
 - 4. Condair Inc.
 - 5. Trion IAQ; Hermidifier.
- B. Electrode Cylinder: Replaceable plastic assembly. Comply with UL 499.

- C. Electrode Cylinder: Plastic assembly with disposable ionic bed inserts. Comply with UL 499.
- D. Manifold: ASTM A 666, Type 304 stainless-steel tube extending across entire width of duct or plenum and equipped with mounting brackets on ends.
- E. Cabinet: Sheet metal enclosure for housing heater cylinder, electrical wiring, components, controls, and control panel. Enclosure shall include baked-enamel finish, hinged or removable access door, and threaded outlet in bottom of cabinet for drain piping.
- F. Control Panel:
 - 1. Liquid-crystal display.
 - 2. Programmable keyboard.
 - 3. Set-point adjustment.
 - 4. Low-voltage control circuit.
 - 5. Diagnostic, maintenance, alarm, and status features.
 - 6. High-water sensor or float to prevent overfilling.
- G. Controls:
 - 1. Microprocessor-based control system for modulating or cycling control, and start/stop and status monitoring for interface to central HVAC instrumentation and controls.
 - 2. Solenoid-fill and automatic drain valves to maintain water level and temper hot drain water.
 - 3. Field-adjustable timer to control drain cycle for flush duration and interval.
 - 4. Controls shall drain tanks if no demand for humidification for more than 72 hours.
 - 5. Conductivity-type level controls.
- H. Accessories:
 - 1. Humidistat: Wall-mounting, solid-state, electronic-sensor controller capable of full modulation or cycling control.
 - 2. Duct-mounting, high-limit humidistat.
 - 3. Airflow switch for preventing humidifier operation without airflow.
- I. Capacities and Characteristics: Refer to Schedule on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine ducts, air-handling units, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before humidifier installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install humidifiers with required clearance for service and maintenance
- B. Seal humidifier manifold duct or plenum penetrations with flange.
- C. Install humidifier manifolds in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."
- D. Install manifold supply piping pitched to drain condensate back to humidifier.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20, 22 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
 - 1. Install piping adjacent to humidifiers to allow service and maintenance.
 - 2. Install shutoff valve, strainer, backflow preventer, and union in humidifier makeup line.
- B. Install electrical devices and piping specialties furnished by manufacturer but not factory mounted.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding."
- D. Connect wiring according to Division 26 Section "Conductors and Cables."

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. Report results in writing.
- B. Perform tests and inspections and prepare test reports.
 - 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. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Remove and replace malfunctioning units and retest as specified above.

3.5 DEMONSTRATION

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

END OF SECTION 23 8413

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HUMIDIFIERS
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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 work of this section.

1.2 SUMMARY

- A. This Section includes electrical general administrative and procedural requirements. The following requirements are included in this Section to supplement the requirements specified in Division 1 Specification Sections.

1.3 REFERENCES

- A. All materials shall be new. The electrical and physical properties of all materials, and the design, performance characteristics, and methods of construction of all items of equipment, shall be in accordance with the latest issue of the various, applicable Standard Specifications of the following recognized authorities:
 - 1. ANSI - American National Standards Institute; www.ansi.org.
 - 2. ASTM - ASTM International; www.astm.org.
 - 3. CSI - Construction Specifications Institute (The); www.csiresources.org.
 - 4. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
 - 5. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
 - 6. NEC - National Electrical Code
 - 7. NECA - National Electrical Contractors Association; www.necanet.org.
 - a. NECA 1-2000, "Practices for Good Workmanship in Electrical Contracting (ANSI)."
 - 8. NEMA - National Electrical Manufacturers Association; www.nema.org.
 - 9. NETA - InterNational Electrical Testing Association; www.netaworld.org.
 - 10. UL - Underwriters Laboratories Inc.; www.ul.com.

1.4 QUALITY ASSURANCE

- A. Scope of Work: Furnish all labor, material, equipment, technical supervision, and incidental services required to complete, test and leave ready for operation the electrical systems as specified in the Division 26 Sections and as indicated on Drawings.
 - 1. Contract Documents are complimentary, and what is required by one shall be as binding as if required by all. In the event of inconsistencies or disagreements within the Construction Documents bids shall be based on the most expensive combination of quality and quantity of the work indicated.
 - 2. The Contractor understands that the work herein described shall be complete in every detail.
- B. Ordinances and Codes: Perform all Work in accordance with applicable Federal, State and local ordinances and regulations, the Rules and Regulations of NFPA, NECA, and UL, unless otherwise indicated.
 - 1. Notify the Architect/Engineer before submitting a proposal should any changes in Drawings or Specifications be required to conform to the above codes, rules or regulations. After entering into Contract, make all changes required to conform to above ordinances, rules and regulations without additional expense to the Owner.
- C. Source Limitations: All equipment of the same or similar systems shall be by the same manufacturer.

- D. Tests and Inspections: Perform all tests required by state, city, county and/or other agencies having jurisdiction. Provide all materials, equipment, etc., and labor required for tests.
- E. Performance Requirements: Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the trades involved.
- F. Sequence and Schedule: Work so as to avoid interference with the work of other trades. Be responsible for removing and relocating any work which in the opinion of the Owner's Representatives causes interference.

1.5 CODES, PERMITS AND FEES

- A. Unless otherwise indicated, all required permits, licenses, inspections, approvals and fees for electrical work shall be secured and paid for by the Contractor. All work shall conform to all applicable codes, rules and regulations.
- B. Rules of local utility companies shall be complied with. Coordinate with the utility company supplying service to the installation and determine all devices including, but not limited to, all current and potential transformers, meter boxes, C.T. cabinets and meters which will be required and include the cost of all such items and all utilities costs in proposal.
- C. All work shall be executed in accordance with the rules and regulations set forth in local and state codes. Prepare any detailed Drawings or diagrams which may be required by the governing authorities. Where the Drawings and/or Specifications indicate materials or construction in excess of code requirements, the Drawings and/or Specifications shall govern.

1.6 DRAWINGS

- A. The Drawings show the location and general arrangement of equipment, electrical systems and related items. They shall be followed as closely as elements of the construction will permit.
- B. Examine the Drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly, providing such fittings, conduit, junction boxes and accessories as may be required to meet such conditions.
- C. Deviations from the Drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer.
- D. The architectural and structural Drawings take precedence in all matters pertaining to the building structure, mechanical Drawings in all matters pertaining to mechanical trades and electrical Drawings in all matters pertaining to electrical trades. Where there are conflicts or differences between the Drawings for the various trades, report such conflicts or differences to the Architect/Engineer for resolution.
- E. Drawings are not intended to be scaled for rough-in or to serve as shop drawings. Take all field measurements required to complete the Work.

1.7 MATERIAL AND EQUIPMENT MANUFACTURERS

- A. All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new and shall be standard products of manufacturers regularly engaged in the production of electrical equipment and shall be of the manufacturer's latest design.
- B. If an approved manufacturer is other than the manufacturer used as the basis for design, the equipment or product provided shall be equal in size, quality, durability, appearance, capacity, and efficiency through all ranges of operation, shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified, shall be compatible with the other components of the system and shall comply with the requirements for Items Requiring Prior Approval specified in this section of the Specifications. All costs to make these items of equipment comply with these requirements including, but not limited to, electrical work, and building alterations shall be included in the original Bid. Similar equipment shall be by one manufacturer.
- C. Where existing equipment is modified to include new switches, circuit breakers, metering or other components, the new components shall be by the original equipment manufacturer and shall be listed for installation in the existing equipment. Where original equipment manufacturer components are not available, third party aftermarket components shall be listed for the application and submitted to the engineer for approval. Reconditioned or salvaged components shall not be used unless specifically indicated on the drawings.

1.8 INSPECTION OF SITE

- A. Visit the site, examine and verify the conditions under which the Work must be conducted before submitting Proposal. The submitting of a Proposal implies that the Contractor has visited the site and understands the conditions under which the Work must be conducted. No additional charges will be allowed because of failure to make this examination or to include all materials and labor to complete the Work.

1.9 ITEMS REQUIRING PRIOR APPROVAL

- A. Bids shall be based upon manufactured equipment specified. All items that the Contractor proposes to use in the Work that are not specifically named in the Contract Documents must be submitted for review prior to bids. Such items must be submitted in compliance with Division 1 specifications. Requests for prior approval must be accompanied by complete catalog information, including but not limited to, model, size, accessories, complete electrical information and performance data in the form given in the equipment schedule on the drawings at stated design conditions. Where items are referred to by symbolic designations on the drawings, all requests for prior approval shall bear the same designations.
 - 1. Equipment to be considered for prior approval shall be equal in quality, durability, appearance, capacity and efficiency through all ranges of operation, shall fulfill the requirements of equipment arrangement and space limitations of the equipment shown on the plans and/or specified and shall be compatible with the other components of the system.
 - 2. All costs incurred to make equipment comply with other requirements, including providing maintenance, clearance, electrical, replacement of other components, and building alterations shall be included in the original bid.

- B. Voluntary alternates may be submitted for consideration, with listed addition or deduction to the bid.

1.10 SHOP DRAWINGS/SUBMITTALS

- A. Submit project-specific submittals for review in compliance with Division 1.
- B. All shop Drawings shall be submitted in groupings of similar and/or related items (lighting fixtures, switchgear, etc.). Incomplete submittal groupings will be returned unchecked.
- C. If deviations (not substitutions) from Contract Documents are deemed necessary by the Contractor, details of such deviations, including changes in related portions of the project and the reasons therefore, shall be submitted with the submittal for approval.
- E. Submit for approval shop drawings for electrical systems or equipment indicated in other sections of electrical specs. Where items are referred to by symbolic designation on the Drawings and Specifications, all submittals shall bear the same designation (light fixtures).

1.11 COORDINATION DRAWINGS

- A. Submit project specific coordination drawings for review in compliance with Division 1 Specification Sections.

1.12 OPERATION AND MAINTENANCE INSTRUCTIONAL MANUALS

- A. Submit project specific Operation and Maintenance Instructional Manuals for review in compliance with Division 01 Specification Sections.
- B. Provide complete operation and maintenance instructional manuals covering all electrical equipment herein specified, together with parts lists. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. Manual shall be provided on electronic media. All literature shall be combined in one document and shall be properly bookmarked with all applicable sections. Maintenance and operating instructional manuals shall be provided when construction is approximately 75% complete.
- C. The operating and maintenance instructions shall include a brief, general description for all electrical systems including, but not limited to:
 - 1. Routine maintenance procedures.
 - 2. Trouble-shooting procedures.
 - 3. Contractor's telephone numbers for warranty repair service.
 - 4. Submittals.
 - 5. Recommended spare parts list.
 - 6. Names and telephone numbers of major material suppliers and subcontractors.
 - 7. System schematic drawings on 8-1/2" x 11" sheets.

1.13 RECORD DRAWINGS

- A. Submit record drawings in compliance with Division 01.
- B. Contractor shall submit to the Architect/Engineer, record drawings on electronic media which have been neatly marked to represent as-built conditions for all new electrical work. Modifications to original drawings shall be clearly marked with a contrasting color so the marks are readily apparent.
- C. The Contractor shall keep accurate note of all deviations from the construction documents and discrepancies in the underground concealed conditions and other items of construction on field drawings as they occur. The marked up field documents shall be available for review by the Architect, Engineer and Owner at their request during the course of construction.

1.14 INSTRUCTION OF OWNER PERSONNEL

- A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of electrical equipment and systems at agreed upon times. A minimum of 8 hours of formal instruction to Owner's personnel shall be provided for each building. Additional hours are specified in individual specification sections.
- B. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- C. In addition to individual equipment training provide overview of each electrical system. Utilize the as-built documents for this overview.
- D. Prepare and insert additional data in operation and maintenance manual when need for such data becomes apparent during instruction, or as requested by Owner.

1.15 WARRANTY

- A. Warranty: Comply with the requirements in Division 01 Specification Sections. Contractor shall warranty that the electrical installation is free from defects and agrees to replace or repair, to the Owner's satisfaction, any part of this electrical installation which becomes defective within a period of one year (unless specified otherwise in other Division 26 sections) from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship or failure to follow the contract documents.
- B. Contractor shall be responsible for any temporary services including equipment and installation required to maintain operation as a result of any equipment failure or defect during warranty period.
- C. File with the Owner any and all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

1.16 USE OF EQUIPMENT

- A. The use of any equipment, or any part thereof for purposes other than testing even with the Owner's consent, shall not be construed to be an acceptance of the work on the part of the Owner, nor be construed to obligate the Owner in any way to accept improper work or defective materials.
- B. Do not use Owner's lamps for temporary lighting except as allowed and directed by the Owner. Equip lighting fixtures with new lamps when the project is turned over to the Owner.

1.17 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. To ensure that connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions; and to maintain the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 8 Section "Access Doors and Frames."
- D. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

- E. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 DEMOLITION WORK

- A. All demolition of existing electrical equipment and materials will be done by this Contractor unless otherwise indicated. Include all items such as, but not limited to, electrical equipment, devices, lighting fixtures, conduit, and wiring called out on the Drawings and as necessary whether such items are actually indicated on the Drawings or not in order to accomplish the installation of the specified new work.
- B. In general, demolition work is indicated on the Drawings. However, the Contractor shall visit the job site to determine the full extent and character of this work.
- C. Unless specifically noted to the contrary, removed materials shall not be reused in the work. Salvaged materials that are to be reused shall be stored safe against damage and turned over to the appropriate trade for reuse. Salvaged materials of value that are not to be reused shall remain the property of the Owner unless such ownership is waived. Items on which the Owner waives ownership shall become the property of the Contractor, who shall remove and legally dispose of same, away from the premises.
- D. Where equipment or fixtures are removed, outlets shall be properly blanked off, and conduits capped. After alterations are done, the entire installation shall present a "finished" look, as approved by the Architect/Engineer. The original function of the present electrical work to be modified shall not be changed unless required by the specific revisions to the system as specified or as indicated.
- E. Reroute signal wires, lighting and power wiring as required to maintain service. Where walls and ceilings are to be removed as shown on the Drawings, the conduit is to be cut off by the Electrical Trades so that the abandoned conduit in these walls and ceilings may be removed with the walls and ceilings by the Architectural Trades. All dead-end conduit runs shall be plugged at the remaining line outlet boxes or at the panels.
- F. Where new walls and/or floors are installed which interfere with existing outlets, devices, etc., the Electrical Trades shall adjust, extend and reconnect such items as required to maintain continuity of same.
- G. All electrical work in altered and unaltered areas shall be run concealed wherever possible. Use of surface raceway or exposed conduits will be permitted only where approved by the Architect/Engineer.
- H. Existing lighting shall be reused where indicated on plans. Reused fixtures shall be detergent cleaned, relamped and reconditioned suitable for satisfactory operation and appearance.

3.3 INSTALLATION OF EQUIPMENT

- A. Install all equipment in strict accordance with all directions and recommendations furnished by the manufacturer. Where such directions are in conflict with the Drawings and Specifications, report such conflicts to the Architect/Engineer for resolution.
- B. Device Location:

1. Allow for relocation prior to installation of wiring devices and other control devices, for example, receptacles, switches, fire alarm devices, and access control devices, within a 10-foot radius of indicated location without additional cost.

3.4 WORK IN EXISTING BUILDINGS

- A. The Owner will provide access to existing buildings as required. Access requirements to occupied buildings shall be identified on the project schedule. The Contractor, once Work is started in the existing building, shall complete same without interruption so as to return work areas as soon as possible to Owner.
- B. Adequately protect and preserve all existing and newly installed Work. Promptly repair any damage to same at Contractor's expense.
- C. Consult with the Owner's Representative as to the methods of carrying on the Work so as not to interfere with the Owner's operation any more than absolutely necessary. Accordingly, all service lines shall be kept in operation as long as possible and the services shall only be interrupted at such time as will be designated by the Owner's Representative.
- D. Prior to starting work in any area, obtain approval for doing so from a qualified representative of the Owner who is designated and authorized by the Owner to perform testing and abatement of all hazardous materials including but not limited to, asbestos. The Contractor shall not perform any inspection, testing, containment, removal or other work that is related in any way whatsoever to hazardous materials under the Contract.

3.5 TEMPORARY SERVICES

- A. Provide and remove upon completion of the project, in accordance with the general conditions and as described in Division 01, a complete temporary electrical and telephone service during construction.

3.6 DISPOSAL

- A. Fluorescent Lamps
 1. Fluorescent lamps are known to contain mercury and are classified as hazardous material. All fluorescent lamps shall be assumed to contain mercury unless tested and confirmed otherwise with a toxicity characteristic leaching procedure (TCLP).
 2. Hazardous materials (fluorescent lamps), shall be sent to a lamp recycling facility. The materials shall be properly packaged with labels that meet the Department of Transportation Regulations and stored in a secure location prior to transportation.
 3. The Contractor shall identify the costs of the lamp disposal process including, but not limited to, the lamp packaging, storage, transportation, disposal, and any profile fees.
 4. At the completion of the project, provide documentation to verify that the lamps have been properly disposed of in accordance with all local, state and federal guidelines.
- B. Ballasts

1. Lighting ballasts manufactured prior to 1979 have been known to contain polychlorinated biphenyls (PCBs). Unless specifically noted on the ballast as containing "No PCBs," the ballast shall be assumed to contain components with PCB materials.
2. Hazardous materials (ballasts with PCBs), shall be disposed of at a hazardous waste incineration facility, or at a recycling facility in accordance with the Code of Federal Regulations as administered by the EPA in regards to this issue. The ballasts shall be packaged/stored in fifty-five gallon steel drums with labels that meet the Department of Transportation Regulations.
3. The Contractor shall identify the costs of the ballast disposal process including, but not limited to, the packaging, storage, transportation, disposal, and any profile fees.
4. Provide at completion of the project documentation (manifests) to verify that the ballasts have properly been disposed of in accordance with all local, state and federal guidelines.

3.7 CHASES AND RECESSES

- A. Provided by the architectural trades, but the Contractor shall be responsible for their accurate location and size.

3.8 CUTTING, PATCHING AND DAMAGE TO OTHER WORK

- A. Refer to General Conditions for requirements.
- B. All cutting, patching and repair work shall be performed by the Contractor through approved, qualified subcontractors. Contractor shall include full cost of same in bid.

3.9 EXCAVATION AND BACKFILLING

- A. Provide all excavation, trenching, tunneling, dewatering and backfilling required for the electrical work. Coordinate the work with other excavating and backfilling in the same area.
- B. Where conduit is installed less than 2'6" below the surface of pavement, provide concrete encasement, 4" minimum coverage, all around or as shown on the electrical Drawings.
- C. Backfill all excavations with well-tamped granular material. Backfill all excavations under wall footings with lean mix concrete up to underside of footings and extend concrete within excavation a minimum of four (4) feet each side of footing. Granular backfill shall be placed in layers not more than 8 inches in thickness, 95 percent compaction throughout with approved compaction equipment. Tamp, roll as required. Excavated material shall not be used.
- D. Backfill all excavations inside building, under drives and parking areas with well-tamped granular material. Granular backfill shall be placed in layers not more than 8 inches in thickness, 95 percent compaction throughout with approved compaction equipment. Tamp, roll as required. Excavated material shall not be used.
- E. Backfill outside building with granular material to a height 12 inches over top of pipe compacted to 95 percent compaction as specified above. Backfill remainder of excavation with unfrozen, excavated material in such a way to prevent settling.

3.10 EQUIPMENT CONNECTIONS

- A. Make connections to equipment and other items included in the work in accordance with the approved shop Drawings and rough-in measurements furnished by the manufacturers of the particular equipment furnished. All additional connections not shown on the Drawings, but called out by the equipment manufacturer's shop Drawings shall be provided.

3.11 CLEANING

- A. All debris shall be removed daily as required to maintain the work area in a neat, orderly condition.
- B. Final cleanup shall include, but not be limited to, washing of fixture lenses or louvers, switchboards, substations, motor control centers, panels, etc. Fixture reflectors and lenses or louvers shall be left with no water marks or cleaning streaks.

3.12 PROTECTION AND HANDLING OF EQUIPMENT AND MATERIALS

- A. Equipment and materials shall be protected from theft, injury or damage.
- B. Protect conduit openings with temporary plugs or caps.
- C. Provide adequate storage for all equipment and materials delivered to the job site. Location of the space will be designated by the Owner's representative or Architect/Engineer. Equipment set in place in unprotected areas must be provided with temporary protection.

3.13 EXTRA WORK

- A. For any extra electrical work which may be proposed, this Contractor shall furnish to the General Contractor, an itemized breakdown of the estimated cost of the materials and labor required to complete this work. The Contractor shall proceed only after receiving a written order from the General Contractor establishing the agreed price and describing the work to be done. Prior to any extra work which may be proposed, the Electrical Contractor shall submit unit prices (same prices for increase/decrease of work) for the following items: 1/2", 3/4", 1", 1-1/2" conduit; #12, #10, #8, #6, #2 wire; receptacle, I.G. receptacle, data box, V4000 wiremold, fire alarm combination visual/audible notification appliance, fire alarm visual notification appliance, clock, or other devices which may be required for any proposed extra work.

3.14 DRAWINGS AND MEASUREMENTS

- A. The Drawings are not intended to be scaled for rough-in measurements nor to serve as Shop Drawings. Field measurements necessary for ordering materials and fitting the installation to the building construction and arrangement are the Contractor's responsibility. The Contractor shall check latest Architectural Drawings and locate light switches from same where door swings are different from Electrical Drawings.

END OF SECTION 26 0010

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ELECTRICAL GENERAL REQUIREMENTS
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SECTION 26 0519 - CONDUCTORS AND CABLES

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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. Building wires and cables rated 600V and less.
- 2. Connectors, splices, and terminations rated 600 V and less.

1.3 SUBMITTALS

A. Field Quality-Control Test Reports

- B. Submit letter of compliance (intent) for general building wire and cable. Provide product data for the following:

- 1. Metal-Clad Cable, Type MC

2. Armored Cable, Type AC
3. Power Cable for Variable Frequency Controlled Motors

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Standards:
 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- D. Conductor Insulation:
 1. Type THHN/THWN-2: Comply with UL 83.
 2. Type THW/THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
 3. Type XHHW-2: Comply with UL 44.

2.2 ALUMINUM BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn aluminum current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
 1. Allowed only for conductors used in feeders 100A and larger.
- B. Manufacturers:
 1. General Cable
 2. Southwire
- C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Conductors: Aluminum, complying with ASTM B 800 and ASTM B 801.
- E. Conductor Insulation:
1. Type XHHW-2: Comply with UL 44.

2.3 POWER CABLE FOR VARIABLE FREQUENCY CONTROLLED MOTORS

- A. Description: A factory assembly of three conductor cable with three symmetrical ground conductors, a continuous shield, an overall PVC jacket and a product specific connector and termination kit.
- B. Manufacturers:
1. Service Wire Co.
- C. Standards:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 2. Comply with UL 1277
 3. Comply with ICEA S-95-658/NEMA WC 70 for Type TC-ER Power Cable (for VFD application)
 4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Circuits:
1. Single circuit feeder.
- E. Phase Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- F. Ground Conductor: Bare copper.
- G. Phase Conductor Insulation: Moisture resistant, flame retardant, cross linked polyethylene (2KV RHW-2) suitable for 90degC conductor temperature operation in dry, damp and wet locations
- H. Shield: Helically applied minimum 5 mils thick bare copper with minimum 50% overlap.
- I. Armor: Steel or Aluminum, interlocked.
- J. Jacket: Oil resistant PVC
- K. Connector: Water-tight and UL listed for installation on supplied TC cable (tray cable) assembly.
1. Body material: nickel clad aluminum

2. Connector shall provide a 360-degree electrical bonding of the copper tape shield to the connector body.
 3. Connection of the copper tape shield to the connector body shall be accomplished by an integral and self-retaining grounding collar that automatically provides a 360-degree connection as the connector is tightened.
 4. The connector assembly shall be designed to ensure against loosening of threads due to vibration.
 5. A UL listed chrome plated grounding and bonding locknut with a 360-degree knurled teeth connection shall be provided with each connector to secure and bond the connector to the inverter cabinet / motor termination box.
 6. Tinned copper braids (minimum $\frac{3}{4}$ inches wide) with installation hardware to connect the copper tape shield to the inverter enclosure / back-panel and to the motor frame shall be provided as part of the cable system.
- L. Termination Kit: Tinned copper braids (minimum $\frac{3}{4}$ inches wide) with installation hardware to connect the copper tape shield to cable core, to the inverter enclosure/back-panel, and to the motor frame shall be provided as part of the cable system.
1. Braid width shall be determined by cable core diameter size and shall be placed at a separation of 180 degrees.

2.4 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Refer to application schedule on the drawings
- B. If providing aluminum feeders, contractor is responsible for providing correct feeder, equipment ground and conduit size based on voltage drop and any de-rating required.
- C. Feeders and Branch Circuits: Solid or stranded for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.
- D. Each feeder shall be of the same conductor and insulation material (phase, neutral, and parallel).
- E. Use conductor not smaller than 14 AWG for control circuits,
- F. Where equipment is listed for use with copper conductors only, use copper conductors for the entire length of feeder.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Refer to application schedule on the drawings
- B. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel wire-mesh strain relief device at terminations to suit application.
- C. Fire Alarm Circuits: Match existing.
- D. Class 1 Control Circuits: Type THHN/THWN-2, in raceway.
- E. Class 2 Control Circuits: Type THHN/THWN-2, in raceway.
- F. Connection between Variable Frequency Controllers and Motors: Use power cable for variable frequency-controlled motors. Install and terminate according to cable manufacturer's recommendations.

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 26 0533 "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 Division 26 Section "Hangers and Supports for Electrical Systems."
- G. Complete cable tray systems installation according to Section 26 0536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.
- H. Support communication cables above accessible ceiling, using spring metal clips or plastic cable ties to support cables from structure. Do not rest cable on ceiling panels.
- I. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- J. Provide a separate neutral conductor for each circuit unless multi-wire branch circuits are specifically indicated on the drawings.
- K. Electrical Contractor shall be responsible for de-rating of conductors as required by N.E.C. when more than three current carrying conductors are installed in a single raceway or cable. Neutral conductors shall be considered current carrying conductors.

- L. Type MC cable shall be supported and secured at intervals not exceeding 4'-0" in new construction
- M. AC/MC cable shall not be used for home runs to receptacle or distribution panels.
- N. Where AC/MC cable is permitted by the specifications, AC/MC cable shall not be bundled.
- O. Between support, hangers and termination no more than 3" deflection from the bottom of the cable to a horizontal line between the support/hanger or termination.
- P. Do not route conductors across roof without prior approval from engineer.
- Q. Install and terminate power cable for variable frequency- controlled motors according to cable manufacturer's recommendations.

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.
 - 1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
 - 2. Use compression type terminations for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.
- D. Clean conductor surfaces before installing lugs and connectors.
- E. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- F. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and larger.
- G. Use piercing connector with insulating covers for conductor splices and taps, 8 AWG and larger only for taps to existing feeders. Do not use piercing connectors in new construction.
- H. Use Sta-Kon connectors to terminate stranded conductors #10 AWG and smaller to screw terminals.
- I. Use insulated spring wire connectors with plastic caps (wire nuts) for copper conductor splices and taps, 10 AWG and smaller. Push-in style connectors are not permitted.
- J. Provide lugs suitable for bussing and conductor material used.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 26 0553 "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 26 0533 "Raceways and Boxes."

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 Division 07 Section "Penetration Firestopping".

3.8 FIELD QUALITY CONTROL

- A. Perform the following field quality control tests in accordance with Division 26 section "Electrical Testing"
 - 1. Description: Test all feeders rated 100 A and above.
 - 2. Visual and Mechanical Inspection
 - a. Inspect cables for physical damage and proper connection in accordance with the one line diagram.
 - b. Test cable mechanical connections with an infrared survey.
 - c. Check cable color-coding against project Specifications and N.E.C. requirements.
 - 3. Electrical Tests
 - a. Perform insulation resistance test on each conductor with respect to ground and adjacent conductors. Applied potential to be 1000 volts dc for 1 minute.
 - b. Perform continuity test to insure proper cable connection.
 - 4. Test Values
 - a. Minimum insulation resistance values shall be not less than fifty mega-ohms.
- B. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION 26 0519

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CONDUCTORS AND CABLES
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SECTION 26 0526 - GROUNDING AND BONDING

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.
- B. Related Sections include the following:
1. Division 26 Section "Electrical General Requirements".
 2. Division 26 Section "Conductors and Cables".

1.3 REFERENCES

- A. ASTM B 3: Specification for Soft or Annealed Copper Wire.
- B. ASTM B 8: Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft.
- C. ASTM B 33: Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes.

- D. ASTM B 187: Specification for Copper, Bus Bar, Rod, and Shapes and General Purpose Rod, Bar, and Shapes.
- E. IEEE 81: Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.
- F. IEEE 142: Grounding of Industrial and Commercial Power Systems.
- G. IEEE 837: Qualifying Permanent Connections Used in Substation Grounding.
- H. IEEE 1100 – 1992: Recommended Practice for Powering and Grounding Sensitive Electronic Equipment.
- I. IEEE C2: National Electrical Safety Code.
- J. NETA MTS – 2001: Maintenance Testing Specifications.
- K. NFPA 70: National Electrical Code.
- L. NFPA 70B: Recommended Practice for Electrical Equipment Maintenance.
- M. TIA/EIA 607: Commercial Building Grounding and Bonding Requirements Standard.
- N. UL 467: Grounding and Bonding Equipment.
- O. UL 486 A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.
- P. UL 486B: Wire Connectors for Use with Aluminum Conductors.

1.4 SUBMITTALS

- A. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- B. Field Test Reports: Submit written test reports to include the following:
 - 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.
 - 4. Indicate overall system resistance to ground.
 - 5. Indicate overall Telecommunications system resistance to ground.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 26 "Electrical General Requirements".
- B. Accurately record actual locations of grounding electrodes and connections to building steel.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Refer to specification section "Electrical Testing."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 1. Comply with UL 467.
- C. Comply with ANSI/TIA/EIA-607 "Standard for Commercial Building Grounding and Bonding Requirements for Telecommunications".
- D. Comply with ANSI/IEEE 1100 -1992 "Powering and Grounding Sensitive Electronic Equipment".

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Grounding Conductors and Cables:
 - a. Refer to Division 26 Section "Conductors and Cables".
 - 2. Mechanical Connectors:
 - a. American Electric-Blackburn.
 - b. Burndy.
 - c. Chance/Hubbell.
 - 3. Exothermic Connections:
 - a. Cadweld.
 - 4. Compression-type Connectors:
 - a. Burndy HyGround
 - b. Blackburn EZ Ground.
 - c. Panduit.

2.2 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Division 26 Section "Conductors and Cables."
- B. Material: Aluminum, copper-clad aluminum, and copper.
- C. Equipment Grounding Conductors: Insulated with green-colored insulation.

- D. Grounding Electrode Conductors: Stranded cable.
- E. Underground Conductors: Bare, stranded, copper unless otherwise indicated.
- F. Bare Copper Conductors: Comply with the following:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Assembly of Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
- G. Copper Bonding Conductors: As follows:
 - 1. Bonding Conductor: Stranded copper conductor; size per the NEC.
 - 2. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; size per the NEC.
- H. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.
- I. Telecommunications Main Grounding Busbar (TMGB)
 - 1. 48" (min) x 4" x 1/4" tin plated, copper busbar with three rows of 1/4 x 20 tapped holes 3" on center.
- J. Telecommunications Grounding Busbar (TGB)
 - 1. 12" (min) x 2" x 1/4" tin plated, copper busbar with two rows of 1/4 x 20 tapped holes 3" on center.
- K. Telecommunications Bonding Backbone (TBB)
 - 1. Minimum No. 2 AWG insulated stranded copper.
- L. Telecommunications Bonding Conductors
 - 1. Minimum No. 6 AWG insulated stranded copper.

2.3 CONNECTOR PRODUCTS

- A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.
- C. Welded Connectors: Exothermic-welded type, in kit form, and selected for the specific application per manufacturer's written instructions.
- D. Compression-Type Connectors: Pure, wrought copper, per ASTM B187.

PART 3 - EXECUTION

3.1 EQUIPMENT GROUNDING

- A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
- B. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
- C. Underground Grounding Conductors: No. 2/0 AWG minimum. Bury at least 24 inches below grade or bury 12 inches above duct bank when installed as part of the duct bank.
- D. In raceways, use insulated equipment grounding conductors.
- E. Install equipment grounding conductors in all feeders and circuits. Terminate each end on suitable lugs, bus or bushing.
- F. Computer Outlet Circuits: Install insulated equipment grounding conductor in branch-circuit runs from computer-area power panels or power-distribution units.
- G. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
- H. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.
- I. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components.
- J. Verify specific equipment grounding requirements with the manufacturer's recommendations.

3.2 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 - 4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
 - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

- B. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells. Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. Equipment Grounding Conductor Terminations
 - 1. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and larger.
 - 2. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- E. Tighten screws and bolts for grounding and bonding 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 or UL 486B as applicable.
- F. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Connections shall be non-reversible. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- G. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage. Install in conduit where routed above grade.
 - 1. Aluminum and copper-clad aluminum conductors shall not be used in direct contact with masonry, within 18 inches of the earth, or where subject to corrosive conditions.
- B. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors or non-reversing compression-type connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
- C. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.
- D. Bond interior metal piping systems, including any portions of metal piping systems separated by non-metal piping, and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.

E. Grounding Bus:

1. Install grounding bus in the locations listed below and elsewhere as indicated:
 - a. Telephone equipment rooms.
2. Use insulated spacer; space 1 inch from wall and support from wall 6 inches above finished floor, unless otherwise indicated.

F. Equipment Grounding: Provide a permanent and continuous bonding of conductor enclosures, equipment frames, power distribution equipment ground busses, cable trays, metallic raceways, and other non-current carrying metallic parts of the electrical system.

3.4 TELECOMMUNICATIONS GROUNDING

A. Telecommunications Grounding System: The telecommunications grounding system shall consist of:

1. Telecommunications Main Grounding Busbar (TMGB) located in the main telecommunications room near the telecommunications service entrance. Bond to the main building electrical grounding electrode system via a No. 3/0 AWG copper ground conductor.
2. A Telecommunications Grounding Busbar (TGB) in each telecommunications room, cabinets, etc.
3. A Telecommunications Bonding Backbone (TBB) tying together the TMGB and each TGB.
4. Bonding of all equipment racks, raceways, non-current carrying metallic equipment and surge protection devices within the telecommunications room to the TGB's or TMGB using approved bonding conductors. Each piece of equipment shall be bonded individually directly to the ground bus.

B. All bonding connections shall be installed at an accessible location for inspection and maintenance.

C. All telecommunications bonding connections shall be of an approved mechanical type connection. Do not use exothermic welds unless specifically indicated on the Drawings.

D. The physical routing shall, in general, follow the same path as the backbone cable system.

E. Bond each TGB directly to the building steel with a No. 6 AWG conductor.

F. Do not use TGB's as a power system ground connection unless specifically noted on the Drawings.

G. All bonding connectors and conductors shall be UL listed for the purpose intended.

H. Mount TMGB and TGB bus to backboard or wall using 2" standoff insulators.

I. Individually bond each piece of non-current carrying metallic equipment in the Telecommunications Room to the TGB.

J. Install continuous cable from the TMGB to the furthest TGB. Bond all TGB's to TBB with bare No. 3/0 AWG copper ground conductor and T-tap grounding hardware.

3.5 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality control tests in accordance with Division 26 section "Electrical Testing"
1. Inspect grounding and bonding system conductors and connections for tightness and proper installation and for compliance with the Drawings and Specifications.
 2. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
 - a. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal.
 - b. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - c. Perform tests, by the fall-of-potential method according to IEEE 81. Instrumentation utilized shall be as defined in Section 12 of IEEE 81 and shall be specifically designed for ground impedance testing. Provide sufficient spacing so that curves flatten in the 62% area of the distance between the item under test and the current electrode.
 - d. Equipment Grounds: Utilize two-point method of IEEE 81. Measure between equipment ground being testing and known low-impedance grounding electrode or system.
 3. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 0526

SECTION 26 0529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 QUALITY ASSURANCE

- A. Comply with NFPA 70.

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 Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit; a part of Atkore International..
 - b. B-Line, by Eaton..
 - c. GS Metals Corp.
 - d. Pentair Electrical & Fastening Solutions.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; a part of Atkore International.
 - g. Wesanco, Inc.
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 4. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored 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 malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) B-Line by Eaton.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
 - 2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 - 3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 - 4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 - 5. Toggle Bolts: All-steel springhead type.
 - 6. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

2.3 ROOF MOUNTED CONDUIT AND EQUIPMENT SUPPORTS

- A. General: Shop- or field- fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted conduit and equipment.

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. B-Line by Eaton; Dura-Blok.
 - 2. MIRO Industries.
 - 3. Pentair Electrical & Fastening Solutions; Caddy Pyramid.
 - 4. Pipe Pier Support Systems; Pipe Piers.
- C. Adjustable Compact Stand: Recycled rubber base unit with integral threaded coupling capable of accepting 3/8-16 threaded rod, or 1-5/8 inch by 1-5/8 inch metal strut and various supporting elements.
- D. Multiple-Conduit and Equipment Stand: Assembly of bases, vertical and horizontal members, and conduit supports, for roof installation without membrane penetration.
 - 1. Bases: One or more adjustable compact stand bases.
 - 2. Vertical Members: Two or more protective-coated-steel channels.
 - 3. Horizontal Member: Protective-coated-steel channel.
 - 4. Supports: Standard strut clamps, hangers, and accessories.

2.4 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels specified in Division 6 Section "Rough Carpentry." Plywood sheets shall be free of all voids. Plywood shall have a minimum of two coats of fire-resistant, non-conducting paint applied to all sides of all sheets. Provide flush hardware and supports to mount plywood to wall. The provided hardware shall have sufficient strength to carry all anticipated loads including, but not limited to cabling, cable management and equipment racks.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - a. Two-bolt conduit clamps
 - b. Single-bolt conduit clamps
 - c. Single-bolt conduit clamps using spring friction action for retention in support channel.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. 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.
- C. 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. To Steel:
 - a. Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
 - b. Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69
 - c. Spring-tension clamps.
 - 6. To Light Steel: Sheet metal screws.
 - 7. 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 support systems attached to substrate.
- D. Slotted support systems applications:
 - 1. Indoor dry and damp Locations: Painted Steel
 - 2. Outdoors and interior wet locations: Galvanized Steel
 - 3. Corrosive Environments, including pool equipment rooms: Nonmetallic
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.
- F. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.
- G. Obtain permission from Architect/Engineer before using powder-actuated anchors.
- H. Obtain permission from Architect/Engineer before drilling or cutting structural members.
- I. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
- J. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- K. In wet and damp locations use steel channel supports to stand cabinets and panelboards one inch off wall.

- L. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
- M. The Contractor shall replace all supports and channels that sag, twist, and/or show signs of not providing proper structural support, to the equipment, it is intended for, as determined by the Owner and Architect/Engineer. All costs associated with replacing supports and steel channels shall be incurred by the Contractor.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "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 INSTALLATION OF ROOF MOUNTED SUPPORTS

- A. Install in accordance with manufacturer's instructions.
- B. If gravel top roof, gravel must be removed around and under support.
- C. Consult roofing manufacturer for roof membrane compression capacities. If required, a compatible sheet of roofing material (rubber pad) may be required under rooftop support to disperse concentrated loads and add further membrane protection.
- D. Utilize properly sized clamps and accessories to suit conduit sizes.
- E. Provide vertical steel channel members as required for elevated conduit supports where required for clearances, coordination with other roof mounted systems or derating.

3.5 BACKBOARDS

- A. A minimum of two walls (or as indicated on drawings) shall be covered with plywood backboards to a minimum 8'-6" above finished floor in all Telecommunication Rooms and similar spaces and as indicated on Drawings.
- B. Securely fasten backboard to wall using appropriate hardware and mount at all four corners, minimum. Securely fasten backboard to wall-framing members (studs).
- C. Provide adequate backboard space to allow a clean and workable arrangement for telephone and data connections.

3.6 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 0529

PARTNERS 21-130
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
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SECTION 26 0533 - RACEWAYS AND BOXES

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
 - 1. Division 07 Section, "Penetration Firestopping" for firestopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.

2. Division 26 Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings, and for access floor boxes and service poles.
3. Division 26 "Hangers and Supports for Electrical Systems" for concrete bases.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. FMC: Flexible metal conduit.
- D. IMC: Intermediate metal conduit.
- E. LFMC: Liquidtight flexible metal conduit.
- F. LFNC: Liquidtight flexible nonmetallic conduit.
- G. RNC: Rigid nonmetallic conduit.
- H. PVC: Polyvinyl Chloride.
- I. HDPE: High Density Polyethylene.
- J. RTRC: Reinforced Thermosetting Resin Conduit

1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFC Cable Systems, Inc.
 2. Alflex Inc.
 3. Allied Tube Triangle Century.
 4. Anamet Electrical, Inc.; Anaconda Metal Hose.
 5. International Metal Hose.
 6. Electri-Flex Co
 7. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
 8. LTV Steel Tubular Products Company – Manhattan/CDT/Cole-Flex.
 9. Maverick.
 10. O-Z Gedney; unit of General Signal.
 11. Wheatland.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. IMC: ANSI C80.6.
- D. EMT: ANSI C80.3.
- E. FMC: Zinc-coated steel or Aluminum.
- F. LFMC: Flexible steel conduit with PVC jacket.
- G. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
 2. Fittings for EMT: Steel, set-screw or compression type.
 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.

2.2 FIRE ALARM EMT

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Allied Tube Triangle Century.
- B. EMT conduit with bright red topcoat; Fire Alarm EMT.
- C. EMT and Fittings: ANSI C80.3.

2.3 NONMETALLIC CONDUIT AND TUBING

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

1. American International.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco Corp.
4. Cantex Inc.
5. Certainteed Corp.; Pipe and Plastics Group.
6. Condux International.
7. ElecSys, Inc.
8. Electri-Flex Co.
9. Integral.
10. Kor-Kap.
11. Lamson and Sessions: Carlon Electrical Products.
12. Manhattan/CDT/Cole-Flex.
13. RACO; Division of Hubbell, Inc.
14. Scepter.
15. Spiraldut, Inc./AFC Cable Systems, Inc.
16. Thomas & Betts Corporation.

B. ENT: NEMA TC 13.

C. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.

D. ENT and RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.

E. LFNC: UL 1660.

F. HDPE: UL 651, ASTM D 3350, ASTM D 1248 Schedule 40.

G. RTRC: Comply with UL 2515A and NEMA TC 14.

2.4 METAL WIREWAYS

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

1. Hoffman.
2. Square D.

B. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 1.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

E. Wireway Covers: Screw-cover type.

- F. Finish: Manufacturer's standard enamel finish.

2.5 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Airey-Thompson Sentinel Lighting: Wiremold Company (The).
 - b. Thomas & Betts Corporation.
 - c. Walker Systems, Inc.; Wiremold Company (The).
 - d. Wiremold Company (The); Electrical Sales Division.
 - e. Mono-Systems, Inc.
- B. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

2.6 BOXES, ENCLOSURES, AND CABINETS

- A. Sheet Metal Outlet and Device Boxes: NEMA OS 1. Shall be used within walls or ceiling.
- B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover. Shall be used in all exposed, non-recessed, locations.
- C. Nonmetallic Outlet and Device Boxes: NEMA OS 2. Shall be used in corrosive areas.
- D. Floor Boxes: Cast metal, fully adjustable, rectangular.
- E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- F. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover. Shall be used in areas exposed to water.
- G. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
- H. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

2.7 SLEEVES FOR RACEWAYS

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."

2.8 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex Co.
 - 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
 - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 2. Pressure Plates: Plastic. Include two for each sealing element.
 - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.9 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Provide raceways in interior and exterior locations in accordance with the "Raceway Application Matrix" included on the drawings.
- B. Boxes and Enclosures, Exterior Aboveground: NEMA 250, Type 3R.
- C. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.
- D. Minimum Raceway Size: 3/4-inch trade size.

- E. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
 - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.
 - 3. EMT: Use setscrew or compression, steel or cast-metal 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.
- F. Do not install aluminum conduits in contact with concrete.
- G. Install surface raceways only where indicated on Drawings.
- H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F

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. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Install temporary closures to prevent foreign matter from entering raceways.
- F. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.
- G. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.
- H. 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.
- I. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
 - 1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.
- J. Support conduit within 12 inches of enclosures to which attached.
- K. Raceways Embedded in Slabs:

1. Raceways embedded in slabs shall be limited to above grade concrete decks. Embedded conduit shall be limited to servicing floor boxes and equipment located in open spaces away from accessible walls.
 2. Install in middle 1/3 of slab thickness where practical and leave at least 2 inches of concrete cover.
 3. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
 4. Space raceways laterally to prevent voids in concrete.
 5. Run conduit larger than 1-inch trade size (DN 27) parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 6. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 7. Conduits shall run flat. Do not allow conduits to cross.
 8. Change from non-metallic raceway to rigid steel before turning up out of the concrete and rising above the floor.
- L. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
1. Run parallel or banked raceways together on common supports.
 2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
- M. 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. 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.
- S. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.
- T. 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.

- U. Communications and Signal Cabling Systems Raceways: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.
1. Electrical conduit (LB's) are not permitted.
 2. Conduits shall have no more than two 90 degree bends between pull points or pull boxes.
 3. Conduits shall contain no continuous sections longer than 150 ft. without a pull point/box.
 4. Conduit for fiber cabling shall have a bend radius of at least 10 times the internal diameter.
 5. Conduit for copper cabling less than 2" shall have a bend radius of at least 6 times the internal diameter. Conduit for copper cabling 2" and larger shall have a bend radius of at least 10 times the internal diameter.
 6. All conduit ends shall have an insulated bushing.
- V. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-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 at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where conduits route through, to, or from a hazardous classified space (Class I or II), provide proper seal offs when exiting or entering the hazardous classified space.
 3. Where conduits pass between spaces that are maintained at two different vapor pressures.
 4. Where otherwise required by NFPA 70.
- W. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.
- X. 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.
 - d. Attics: 135 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.
- Y. Flexible Conduit Connections: Comply with NEMA RV3. Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.
- Z. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals. Provide cover clips to cover space between connecting pieces.
- AA. 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.
- BB. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- CC. Locate boxes so that cover or plate will not span different building finishes.
- DD. 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.
- EE. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- FF. Set floor boxes level and flush with finished floor surface. Trim non-metallic boxes after installation to fit flush with finished floor surface.
- GG. Install hinged-cover enclosures and cabinets plumb. Support at each corner.
- HH. Do not route feeders across roof unless approved in writing by Engineer.
- II. Provide a pull box (a handhole for outdoor applications) for each conduit run that exceeds 250 feet. Provide two pull boxes (handholes for outdoor applications) for runs that exceed 500 feet.
- JJ. Outlet boxes within hazardous locations shall be of the proper class and division as noted in the N.E.C.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
 1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 2 Section "Earthwork" for pipe less than 6 inches in nominal diameter.
 2. Install backfill as specified in Division 2 Section "Earthwork."
 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make

final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 2 Section "Earthwork."

4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
 - b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
5. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits, placing them 24 inches o.c. Align planks along the width and along the centerline of conduit.

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install handholes and boxes with bottom below the frost line, 42" below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.
- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL AND COMMUNICATIONS PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Through-Penetration Firestop Systems."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both surfaces of walls.
- G. Extend sleeves installed in floors 2 inches above finished floor level.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 7 Section "Through-Penetration Firestop Systems."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using 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.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground, exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Through-Penetration Firestop Systems."

3.8 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.9 CLEANING

- A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION 26 0533

PARTNERS 21-130
RACEWAYS AND BOXES
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SECTION 26 0553 - ELECTRICAL IDENTIFICATION

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Identification for raceway and metal-clad cable.
 - 2. Identification for conductors and communication and control cable.
 - 3. Warning labels and signs.
 - 4. Equipment identification labels.
 - 5. Miscellaneous identification products.

1.3 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with 29 CFR 1910.145.

1.4 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and

Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Color for Printed Legend:
 - 1. Power Circuits: Black letters on an orange field.
 - 2. Legend: Indicate system or service and voltage, if applicable.
- C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.2 CONDUCTOR, COMMUNICATION AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.3 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
- C. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.4 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. Black letters on a white background. Minimum letter height shall be 3/8 inch.
- B. Outdoor Equipment Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.5 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength: 50 lb, minimum.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black, except where used for color-coding.
- B. Paint: Paint materials and application requirements are specified in Division 9 painting Sections.
- C. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service and Feeders More Than 400 A: Identify with orange self-adhesive vinyl label.
- B. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands:
 - 1. Fire Alarm System: Red.
 - 2. Security System: Blue and yellow.
 - 3. Telecommunication System: Green and yellow.
 - 4. Control Wiring: Green and red.
- C. Power-Circuit Conductor Identification: For conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape and marker tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.
- D. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use marker tape. Identify each ungrounded conductor according to source and circuit number as indicated on Drawings. Identify control circuits by control wire number as indicated on shop drawings.

- E. Branch-Circuit Conductor Identification: Mark junction box covers in indelible ink with the panel and breaker numbers of other circuits contained within.
- F. Conductor Identification: Locate at each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection or termination point.
- G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.
- H. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
 - 1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
 - 2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
- I. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
 - 1. Labeling Instructions:
 - a. Indoor Equipment: Engraved, laminated acrylic or melamine label mechanically secured.
 - b. Outdoor Equipment: Stenciled.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - 2. Equipment to Be Labeled: If included on project. All items may not be on project.
 - a. Panelboards, electrical cabinets, and enclosures.
 - b. Access doors and panels for concealed electrical items.
 - c. Emergency system boxes and enclosures.
 - d. Disconnect switches.
 - e. Enclosed circuit breakers.

- f. Motor starters.
- g. Push-button stations.
- h. Contactors.
- i. Remote-controlled switches, dimmer modules, and control devices.
- j. Fire-alarm control panel and annunciators.
- k. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
- l. Monitoring and control equipment.
- m. Breakers or switches at distribution panels.

3.2 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location:
 - 1. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
 - 2. Conduit Markers: Provide identification for each power conduit containing conductors rated 400A or greater.
- C. Apply identification devices to surfaces after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- F. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- G. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - 1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - d. Grounded Conductor (Neutral): White.
 - 3. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.

- b. Phase B: Orange.
 - c. Phase C: Yellow.
 - d. Ground Conductor (Neutral): Grey.
 - 4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- H. Label information arrangement for 3 lines of text.
- 1. Line one shall describe the panel or equipment. Line one example: "DP-XX," RP-XX," "T-XX," "EF-XX," etc.
 - 2. Line two shall describe the first disconnecting means feeding this panel or equipment. Line two example: "Fed from DP-XX," "Fed from RP-XX," etc.
 - 3. Line three indicates that location of the disconnecting means as identified in line two. Line three example: "First Floor Elect. Rm #XXX."
 - 4. Line four shall include "Via T-XX" when panel or equipment is fed from a transformer.
- I. Examples:
- | | | |
|---|---|---|
| RP-1A
FED FROM DP-1A
ELECTRICAL ROOM A100
VIA T-1A | EF-1
FED FROM MCC-1A
MECHANICAL ROOM F101 | LP-1A
LOCATED IN
ELECTRICAL ROOM A100 |
|---|---|---|
- J. Fusible Enclosed Switches and Distribution Equipment: Install self-adhesive vinyl label indicating fuse rating and type on the outside of door on each fused switch.
- K. Painted Identification: Prepare surface and apply paint according to Division 9 painting Sections.
- L. Degrease and clean surface to receive nameplates.
- M. Install nameplate and labels parallel to equipment lines.
- N. Secure nameplate to equipment front using screws.
- O. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.
- P. Identify conduit using field painting where required.
- Q. Paint red colored band on each fire alarm conduit and junction box.
- R. Paint bands 10 feet on center, and 4 inches minimum in width.

END OF SECTION 26 0553

SECTION 26 0573 - OVERCURRENT DEVICE COORDINATION STUDY/ARC FLASH HAZARD ANALYSIS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2 SCOPE

- A. The contractor shall furnish short-circuit and protective device coordination studies as prepared by the electrical equipment manufacturer.
- B. The contractor shall furnish an Arc Flash Hazard Analysis Study per the requirements set forth in NFPA 70E -Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2018, Annex D prepared by the electrical equipment manufacturer.
- C. The scope of the studies shall include all new distribution equipment supplied by the equipment Manufacturer under this contract.

1.3 REFERENCES

- A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis
4. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings
5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
6. IEEE 1584 -Guide for Performing Arc-Flash Hazard Calculations

B. American National Standards Institute (ANSI):

1. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
2. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
3. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.

C. The National Fire Protection Association (NFPA)

1. NFPA 70 -National Electrical Code, latest edition
2. NFPA 70E – Standard for Electrical Safety in the Workplace, latest edition.

1.4 SUBMITTALS FOR REVIEW/APPROVAL

- A. The short-circuit and protective device coordination studies shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.

1.5 SUBMITTALS FOR CONSTRUCTION

- A. The results of the short-circuit, protective device coordination, and arc flash hazard analysis studies shall be summarized in a final report. Report shall be provided on electronic media. All literature shall be combined in one document and shall be properly bookmarked with all applicable sections.

B. The report shall include the following sections:

1. Executive Summary.
2. Descriptions, purpose, basis and scope of the study.
3. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties.
4. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection.
5. Fault current calculations including a definition of terms and guide for interpretation of the computer printout.
6. Details of the incident energy and flash protection boundary calculations.

- 7. Recommendations for system improvements, where needed.
 - 8. One-line diagram.
- C. Arc flash labels shall be provided in hard copy and a copy of the computer analysis software viewer program is required to provide arc flash labels in electronic format.

1.6 QUALIFICATIONS

- A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.
- B. The Registered Professional Electrical Engineer shall be a full-time employee of the equipment manufacturer.
- C. The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies.
- D. The equipment manufacturer shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analysis it has performed in the past year.

1.7 COMPUTER SOFTWARE PROGRAMS

- A. Computer Software Programs: Subject to compliance with requirements, provide products by one of the following:
 - 1. EDSA Micro Corporation.
 - 2. SKM Systems Analysis, Inc.
 - 3. ESA Inc.
 - 4. CGI CYME.
 - 5. Operation Technology, Inc.

PART 2 - PRODUCTS

2.1 STUDIES

- A. Contractor to furnish short-circuit and protective device coordination studies as prepared by equipment manufacturer.
- B. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E -Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D prepared by the equipment manufacturer.

2.2 DATA COLLECTION

- A. Contractor shall furnish all data as required by the power system studies. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor

with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.

- B. Source combination may include present and future motors and generators.
- C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner.
- D. If applicable, include fault contribution of existing motors in the study. The Contractor shall obtain required existing equipment data to satisfy the study requirements.

2.3 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY

- A. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standard 141-1993.
- B. Transformer design impedances shall be used when test impedances are not available.
- C. Provide the following:
 - 1. Calculation methods and assumptions
 - 2. Selected base per unit quantities
 - 3. One-line diagram of the system being evaluated
 - 4. Source impedance data, including electric utility system and motor fault contribution characteristics
 - 5. Tabulations of calculated quantities
 - 6. Results, conclusions, and recommendations.
- D. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:
 - 1. Electric utility's supply termination point
 - 2. Incoming switchgear
 - 3. Unit substation primary and secondary terminals
 - 4. Low voltage switchgear
 - 5. Motor control centers
 - 6. Standby generators and automatic transfer switches
 - 7. Branch circuit panelboards
 - 8. Other significant locations throughout the system.
- E. For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.
- F. Protective Device Evaluation:
 - 1. Evaluate equipment and protective devices and compare to short circuit ratings
 - 2. Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses
 - 3. Notify design engineer in writing, of existing, circuit protective devices improperly rated for the calculated available fault current.

2.4 PROTECTIVE DEVICE COORDINATION STUDY

- A. Proposed protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.
- B. Include on each TCC graph, a complete title and one-line diagram with legend identifying the specific portion of the system covered.
- C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
- D. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
- E. Plot the following characteristics on the TCC graphs, where applicable:
 - 1. Electric utility's overcurrent protective device
 - 2. Medium voltage equipment overcurrent relays
 - 3. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands
 - 4. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands
 - 5. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves
 - 6. Conductor damage curves
 - 7. Ground fault protective devices, as applicable
 - 8. Pertinent motor starting characteristics and motor damage points, where applicable
 - 9. Pertinent generator short-circuit decrement curve and generator damage point
 - 10. The largest feeder circuit breaker in each motor control center and applicable panelboard.
- F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.
- G. For emergency and standby distribution paths, provide selective coordination tables to demonstrate tested upstream/downstream breaker pairs selectively coordinate at calculated fault current levels.

2.5 ARC FLASH HAZARD ANALYSIS

- A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2018, Annex D.
- B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.
- C. The Arc-Flash Hazard Analysis shall include all significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 125 kVA where work could be performed on energized parts.
- D. Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm².

- E. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations
- F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.
- G. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:
 - 1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
 - 2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).
- H. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.
- I. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.
- J. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
- K. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

2.6 REPORT SECTIONS

- A. Input data shall include, but not be limited to the following:
 - 1. Feeder input data including feeder type (cable or bus), size, length, number per phase, conduit type (magnetic or non-magnetic) and conductor material (copper or aluminum).
 - 2. Transformer input data, including winding connections, secondary neutral-ground connection, primary and secondary voltage ratings, kVA rating, impedance, % taps and phase shift.

3. Generation contribution data, (synchronous generators and Utility), including short-circuit reactance (X''_d), rated MVA, rated voltage, three-phase and single line-ground contribution (for Utility sources) and X/R ratio.
 4. Motor contribution data (induction motors and synchronous motors), including short-circuit reactance, rated horsepower or kVA, rated voltage, and X/R ratio.
- B. Short-Circuit Output Data shall include, but not be limited to the following reports:
1. Low Voltage Fault Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
 - a. Voltage
 - b. Calculated fault current magnitude and angle
 - c. Fault point X/R ratio
 - d. Equivalent impedance
 2. Momentary Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
 - a. Voltage
 - b. Calculated symmetrical fault current magnitude and angle
 - c. Fault point X/R ratio
 - d. Calculated asymmetrical fault currents
 - 1) Based on fault point X/R ratio
 - 2) Based on calculated symmetrical value multiplied by 1.6
 - 3) Based on calculated symmetrical value multiplied by 2.7
 - e. Equivalent impedance
 3. Interrupting Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
 - a. Voltage
 - b. Calculated symmetrical fault current magnitude and angle
 - c. Fault point X/R ratio
 - d. No AC Decrement (NACD) Ratio
 - e. Equivalent impedance
 - f. Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a symmetrical basis
 - g. Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a total basis
- C. Recommended Protective Device Settings:
1. Phase and Ground Relays:
 - a. Current transformer ratio
 - b. Current setting
 - c. Time setting
 - d. Instantaneous setting
 - e. Recommendations on improved relaying systems, if applicable.

2. Circuit Breakers:
 - a. Adjustable pickups and time delays (long time, short time, ground)
 - b. Adjustable time-current characteristic
 - c. Adjustable instantaneous pickup
 - d. Recommendations on improved trip systems, if applicable.

D. Incident energy and flash protection boundary calculations

1. Arcing fault magnitude
2. Protective device clearing time
3. Duration of arc
4. Arc flash boundary
5. Working distance
6. Incident energy
7. Hazard Risk Category
8. Recommendations for arc flash energy reduction

PART 3 - EXECUTION

3.1 FIELD ADJUSTMENT

- A. The contractor shall adjust relay and protective device settings according to the recommended settings table provided by the coordination study.
- B. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- C. Notify design engineer in writing of any required major equipment modifications.

3.2 ARC FLASH WARNING LABELS

- A. The contractor shall provide a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed.
- B. All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.
- C. The label for equipment where arc incident energy is calculated shall include the following, at a minimum:
 1. Location designation
 2. Nominal system voltage
 3. Arc flash boundary
 4. Incident energy
 5. Working distance
 6. Engineering report number, revision number and issue date.

- D. The label for equipment where arc incident energy is not calculated shall include the following, at a minimum:
1. Location designation
 2. Nominal system voltage
 3. Arc flash boundary from NFPA 70E 2018 Table 130.7(C) 15(a)
 4. Arc flash PPE category from NFPA 70E 2018 Table 130.7(C) 15(a)
 5. Engineering report number, revision number and issue date.
- E. Labels shall be machine printed, with no field markings.
- F. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.
1. For each 208 volt panelboard, one arc flash label shall be provided.
- G. Labels shall be field installed by the contractor.

END OF SECTION 26 0573

PARTNERS 21-130
OVERCURRENT DEVICE COORDINATION STUDY/ARC FLASH HAZARD ANALYSIS
26 0573 - 10

SECTION 26 0923 - LIGHTING CONTROL DEVICES

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PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- 1.2 SUMMARY
- A. This Section includes the following lighting control devices:
1. Occupancy sensors.
- B. Related Sections include the following:
1. Division 26 Section "Electrical General Requirements".
2. Division 26 Section "Wiring Devices" for wall-box dimmers and manual light switches.
- 1.3 REFERENCES
- A. IEEE C62.41: Guide for Surge Voltages in Low-Voltage AC Power Circuits.
- B. IEEE C136.10: Standard for Roadway Lighting Equipment Locking-Type Photocontrol Devices and Mating Receptacle Physical and Electrical Interchangeability and Testing.

- C. NFPA 70: National Electrical Code.
- D. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.
- E. UL 486B: Wire Connectors for Use with Aluminum Conductors.
- F. UL 1449: Surge Protective Devices.
- G. UL 1598: Luminaires.
- H. NECA 130-2010: Installing and Maintaining Wiring Devices.

1.4 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.
- C. ULTRASONIC: Active emission of at least 35 kHz sound waves, using Doppler reflectance to detect motion.
- D. MICROPHONIC: Passive reception to listen for continued occupancy, with circuitry to filter out white noise.
- E. MULTI-Tech: Using PIR and ultrasonic or microphonic technologies in one sensor.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated including physical data and electrical performance.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
 - 1. Lighting plan showing location, orientation, and coverage area of each sensor.
 - 2. Interconnection diagrams showing field-installed wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. Include the following:
 - 1. Description of operation and servicing procedures.
 - 2. List of major components.
 - 3. Recommended spare parts.
 - 4. Programming instructions and system operation procedures.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.7 COORDINATION

- 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, fire-suppression system, and partition assemblies.
- B. Coordinate interface of lighting control devices with temperature controls specified in Division 23.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the site under provisions of Division 26 Section "Electrical General Requirements".
- B. Store and protect products under provisions of Division 26 Section "Electrical General Requirements".

PART 2 - PRODUCTS

2.1 GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS

- A. Line-Voltage Surge Protection: An integral part of the devices for 120- and 277-V solid-state equipment. For devices without integral line-voltage surge protection, field-mounting surge protection shall comply with IEEE C62.41 and with UL 1449.OCCUPANCY SENSORS
- B. General
 - 1. Coordinate occupancy sensor locations, coverages and required quantities with manufacturer's recommendations. Coverage areas indicated on the Drawings are for minor motion (6 to 8 inches of hand movement). Provide additional occupancy sensors and control units as required to achieve complete minor motion coverage of the space indicated.
 - 2. Adjust occupancy sensors and test that complete minor motion coverage is obtained in accordance with Part 3. Provide written confirmation of testing to owner, architect and engineer.
 - 3. Provide occupancy sensors with a bypass switch to override the "ON" function in the event of sensor failure.
 - 4. Provide occupancy sensors with an LED indicator indicating when motion is being detected during testing and normal operation of the sensor.
 - 5. Provide occupancy sensors and occupancy sensor control units from single manufacturer.
- C. Wall Switch Passive Infrared Occupancy Sensor
 - 1. Manufacturers:
 - a. Perfect Sense – PS-PWS
 - b. Wattstopper PW-100.
 - c. Hubbell Building Automation SOM 101.
 - d. Greengate OSW-P-0451-W.
 - e. Sensorswitch WSD.
 - f. Philips LRS2210.
 - g. Leviton ODS10-IDW.

2. Description: Wall mounted, 180° coverage, passive infrared sensing occupancy sensor.
 - a. Electrical Characteristics: Capable of switching up to 800W fluorescent or incandescent lighting loads at 120V and 1200 watts fluorescent loads at 277V.
 - b. Functions: Automatic ON/Automatic OFF, or Manual ON/Automatic OFF operation, field selectable. Integral manual override pushbutton switch.
 - c. Adjustments: User adjustable sensitivity and time delay. Time delay shall be adjustable from 30 seconds to 30 minutes.
 - d. Device Body: White plastic with momentary on/off override pushbutton designed to mount in a standard switch box with "decora" style switch plate.
3. Dual Level Switching: Provide occupancy sensor capable of controlling two switch legs independently where dual level switching is indicated.
 - a. Manufacturers:
 - 1) Perfect Sense PWD.
 - 2) Wattstopper PW-200.
 - 3) Hubbell Building Automation SOM-102.
 - 4) Greengate OSW-P-0451-DMV.
 - 5) Sensorswitch WSD-2P.
 - 6) Philips LRS2215.
 - 7) Leviton ODSOD-IDW.

D. 360° Ceiling Mounted Dual Technology Occupancy Sensor

1. Manufacturers:
 - a. Perfect Sense CDS.
 - b. Wattstopper DT 300
 - c. Hubbell Building Automation "OMNI-DT" Series.
 - d. Greengate OMC-DT-2000-R.
 - e. Sensorswitch CM-PDT-R.
 - f. Philips LRM2255.
 - g. Leviton OSC10-M0W.
2. Description: Ceiling mounted, 360° coverage, multi-tech sensing occupancy sensor.
 - a. Housing: White, thermoplastic, tamper resistant ceiling mount.
 - b. Functions: Automatic ON must sense motion from both ultrasonic and infrared sensing elements. Either technology shall maintain ON, with adjustable time delays.
 - c. Adjustments: User adjustable sensitivity adjustment shall be provided for each sensing technology. Time delay shall be adjustable from 30 seconds to 30 minutes.
 - d. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.
 - e. Manual override function.

E. 110° Wall Mounted Dual Technology Occupancy Sensor

1. Manufacturers:

- a. Perfect Sense DTC.
 - a. Wattstopper DT-200
 - b. Hubbell Building Automation "LO-DT" Series.
 - c. Sensorswitch WV-PDT-R/WV-BR.
 - d. Philips LRM2265.
 - e. Leviton OSW12-M0W.
 2. Description: Wall mounted, 110° coverage, multi-tech occupancy sensor.
 - a. Housing: White, thermoplastic, tamper resistant with swivel bracket for wall or ceiling mounting.
 - b. Functions: Automatic ON must sense motion from both sensing elements. Either technology shall maintain ON, with adjustable time delays.
 - c. Adjustments: User adjustable sensitivity adjustment shall be provided for each sensing technology. Time delay shall be adjustable from 30 seconds to 15 minutes.
 - d. Sensor Orientation: Orient sensor in room such that sensor will not detect motion through open door which could cause false activation.
 - e. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.
 - f. Manual override function.
- F. 360° Ceiling Mounted Ultrasonic Occupancy Sensors
1. Manufacturers:
 - a. Perfect Sense WDS.
 - b. Wattstopper "WT" Series.
 - c. Hubbell Building Automation "OMNI-US" Series.
 - d. Greengate OPC-U-2000.
 - e. Sensorswitch CM MPT-10.
 - f. Philips LRM2255.
 - g. Leviton OSC20-U0W.
 2. Description: Ceiling mounted, 360° coverage, ultrasonic or microphonics sensing occupancy sensor.
 - a. Housing: White, thermoplastic, tamper resistant.
 - b. Adjustments: Adjustments: User adjustable sensitivity and time delay. Time delay shall be adjustable from 30 seconds to 15 minutes.
 - c. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.
 - d. Manual override function.
- G. 360° Ceiling Mounted Passive Infrared Occupancy Sensor.
1. Manufacturers:
 - a. Perfect Sense CPS.
 - a. Wattstopper CI-200.
 - b. Hubbell Building Automation OMNI-IR.

- c. Greengate OMC-P-04500-R.
 - d. Sensorswitch CM-9.
 - e. Philips LRM2250.
 - f. Leviton OSC04-IOW.
2. Description: Ceiling mounted, 360° coverage, infrared sensing occupancy sensor.
- a. Housing: White, thermoplastic, tamper resistant ceiling mount.
 - b. Adjustments: User adjustable sensitivity adjustment shall be provided for each sensing technology. Time delay shall be adjustable from 30 seconds to 30 minutes.
 - c. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.
 - d. Manual override function.

H. Occupancy Sensor Control Units:

1. Description: Transformer and relay combined in single unit to provide 24DC power to sensors and provide 20A contact(s) for control of lighting loads at 120 or 277V. Control unit input power shall be from unswitched leg of lighting circuit it is controlling.
- a. Control units shall be provided as required to power ceiling mounted occupancy sensors, control lighting loads and provide a minimum of one auxiliary contact.
 - b. Occupancy sensor control units shall mount external to 4" sq junction box in the ceiling space. Wiring between control unit and occupancy sensor shall be plenum rated.
 - c. Locate control unit in accessible location in gyp-board ceilings, adjacent to return air grilles, or provide access panel.
 - d. Additional auxiliary relay modules shall be provided as required to provide control of all lighting circuits and additional auxiliary contacts as required.
 - e. It is acceptable to provide controls and auxiliary contacts as required integral to the ceiling sensor, provided all required contacts are provided.
 - f. Maximum of 3 sensors per power pack. Verify exact quantities required with manufacturer.

PART 3 - EXECUTION

3.1 OCCUPANCY SENSOR INSTALLATION

- A. Install wall mounted occupancy sensors as noted on plan. Arrange occupancy sensors with adjacent switch devices so that device plates line-up and are equally spaced.
- B. Install ceiling mounted sensors at approximate locations as indicated on plan. Sensor manufacturer shall provide quantity of sensors as required to provide complete coverage for rooms.
- C. Locate sensors such that motion through open doors will not falsely activate sensors.
- D. Do not locate ultrasonic sensors within six feet of supply air diffusers.
- E. Locate infrared sensors to avoid obstructions.

- F. Provide the services of a manufacturer's representative for commissioning of occupancy sensor installation. This shall include consultation on layout and location prior to installing sensors, testing of each sensor for compliance with Contract Documents and field adjustment and fine tuning after installation is complete. Provide written confirmation of testing to the Owner, Architect and Engineer.
- G. Field adjustments shall take place in the presence of the owner and the engineer. This shall include owner training on adjustment techniques for the occupancy sensors.

3.2 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 26 Section "Conductors and Cables".
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. 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.
- E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Electrical Identification."

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
 - 2. Operational Test: Verify actuation of each sensor and adjust time delays.
- B. Remove and replace lighting control devices where test results indicate that they do not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

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3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose.

END OF SECTION 26 0923

SECTION 26 0943 - LIGHTING CONTROL SYSTEMS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the design and installation programmable automatic lighting controls with all input and control devices necessary to meet the performance indicated on the contract drawings and this specification
- B. Integrate new components into existing control systems as required.

C. Related Sections include the following:

1. Division 26 Section "Lighting Control Devices" for time switches, photoelectric switches, occupancy sensors, and multi-pole contactors.
2. Division 26 Section "LED Interior Lighting" for luminaire specifications and accessories.

1.3 DEFINITIONS

- A. BACnet: A networking communication protocol that complies with ASHRAE 135.
- B. Lon Works: A control network technology platform for designing and implementing interoperable control devices and networks.
- C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling and power-limited circuits.
- D. RS-485: A serial network protocol, like RS-232, complying with TIA/EIA-485-A.

1.4 SUBMITTALS

- A. Product Data: Indicating general device descriptions, dimensions, electrical specifications, wiring details, and nomenclature for all sensors, relays, dimming modules, control stations and other devices necessary for complete operation of the system
- B. Shop Drawings: Detail assemblies of standard components, custom assembled for specific application on this Project.
 1. Outline Drawings: Indicate dimensions, weights, arrangement of components, and clearance and access requirements for all system components requiring field installation.
 2. Riser Diagram: Show interconnection between all system components.
 - a. Identify complete data communication backbone and interconnection between sensors, relays, dimming modules control stations and other components.
 - b. Identify typical room/area type configurations.
 - c. Indicate interconnections with emergency egress lighting relays and transfer devices required.
 3. Information Technology (IT) connection: Provide information pertaining to interconnection with facility IT networking equipment and third-party systems.
 4. Other Diagrams and Operational Descriptions – as needed to indicate system operation or interaction with other system(s).
 5. Contractor startup and commissioning worksheet.
- C. Software and Firmware Operational Documentation:
 1. Software operating and upgrade manuals.
 2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
 3. Device address list.

4. Printout of software application and graphic screens.
- D. Submit qualifications of commissioning agent and draft functional test plans for review and approval.
- E. Field quality-control test reports and commissioning reports at project closeout.
- F. Software licenses and upgrades required by and installed for operation and programming of digital devices.
- G. Operation and Maintenance Data: For lighting controls to include in emergency, operation, and maintenance manuals. Include the following:
 1. Software manuals.
 2. Operation of adjustable zone controls.
 3. Description of operation and servicing procedures.
 4. List of major components and recommended parts.
 5. System operation and integration instructions.
- H. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain lighting control module and power distribution components through one source from a single manufacturer with total responsibility for compatibility of lighting control system components specified in this Section.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with 47 CFR, Subparts A and B, for Class A digital devices.
- D. Comply with NFPA 70.
- E. Listed as qualified under Design Lights Consortium (DLC) Networked Lighting Control System Specification V2.0.
- F. System luminaires and controls are certified by manufacturer to have been designed, manufactured and tested for interoperability.
- G. Comply with ASHRAE 90.1 - 2013

1.6 COORDINATION

- A. Coordinate lighting control components specified in this Section and with systems and components specified in other Sections to form an integrated interconnection of compatible components.
- B. Match components and interconnections for optimum performance of lighting control functions.

- C. Provide open protocol interface for interoperability with building automation system including status of each occupancy/vacancy sensor, control station, dimming module, relay, time schedule, display graphics and status of lighting controls by zone.
- D. Coordinate lighting controls with devices specified in Division 26 Section "Lighting Control Devices".

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of lighting controls that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

1.8 EXTRA MATERIALS

1.9 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning with Substantial Completion, provide software support for five years.
- B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revise licenses for use of the software.
 - 1. Provide 30-day notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment, if necessary.

1.10 SYSTEM COMMISSIONING

- A. Provide the services of a third party, independent agent to perform functional testing and verification of the lighting control system to comply with the requirements of ASHRAE 90.1 – 2013.
- B. Perform functional testing of all lighting control system operations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Acuity nLight Air
 - 2. Lutron Vive
 - 3. WaveLinx – Eaton

2.2 SYSTEM PERFORMANCE REQUIREMENTS

A. System Architecture

1. System shall have an architecture that is based upon three main concepts: (a) networkable intelligent lighting control devices, (b) standalone lighting control zones using distributed intelligence, (c) system backbone for remote, time based and global operation between control zones.
 - a. Intelligent lighting control devices shall have individually addressable network communication capability and consist of one or more basic lighting control components: occupancy sensor, photocell sensor, relay, dimming output, contact closure input, analog 0-10V input, and manual wall station capable of indicating switching, dimming, and/or scene control. Combining one or more of these components into a single device enclosure shall be permissible to minimize overall device count of system.
 - b. Lighting control zones consisting of one or more networked luminaires and intelligent lighting control devices and shall be capable of providing automatic control from sensors (occupancy and/or photocell) and manual control from local wall stations without requiring connection to a higher-level system backbone; this capability is referred to as "distributed intelligence."
 - c. System must be capable of interfacing directly with networked luminaires such that either low voltage network cabling or wireless RF communication is used to interconnect networked luminaires with control components such as sensors, switches and system backbone.
2. The system shall provide individually addressable switching and dimming control of the following: networked luminaires, control zones to include multiple switch legs or circuits, and relay and dimming outputs from centralized panels to provide design flexibility appropriate with sequence of operations required in each project area or typical space type. A single platform shall be used for both indoor and outdoor lighting controls.
3. Lighting control zones shall be networked with a higher-level system backbone to provide time-based control, remote control from inputs and/or systems external to the control zone, and remote configuration and monitoring through a software.
4. All system devices shall support remote firmware update, such that physical access to each device is not necessary, for purposes of upgrading functionality later.
5. System shall be capable of "out of box" sequence of operation for each control zone. Standard sequence is:
 - a. All switches control all fixtures in a zone
 - b. All occupancy sensors automatically control all fixtures in the control zone with a default timeout.

B. Wired Networked Control Zone Characteristics

1. All networked devices connected with low voltage network cable shall automatically form a functional lighting control zone without requiring any type of programming, regardless of the programming mechanism (e.g., software application, handheld remote, pushbutton). The "out of box" default sequence of operation is intended to provide typical sequence of operation to minimize the system startup and programming requirements and to also have functional lighting control operation prior to system startup and programming.
2. System shall be able to automatically discover all connected devices without requiring any provisioning of system or zone addresses.

3. The following types of wired networked control devices shall be provided for egress and/or emergency light fixtures:
 - a. Low-Voltage power sensing: These devices shall automatically provide 100% light level upon detection of loss of power sensed via the low voltage network cable connection.
 - b. UL924 Listed Line-Voltage power sensing: These devices shall be listed as emergency relays under the UL924 standard and shall automatically close the load control relay(s) and provide 100% light output upon detection of loss of power sensed via line voltage connections.
 - c. Emergency egress devices shall be provided, and UL labeled by the lighting control manufacturer.

C. System Integration Capabilities

1. The system shall be capable of interface with third party building management systems (BMS) to support two-way communication using the industry standard BACnet/IP or BACnet/MSTP protocols.
 - a. Systems utilizing a third-party converter or systems that require a dedicated server to achieve integration are not acceptable.

2.3 SYSTEM SOFTWARE INTERFACES

A. Management Interface

1. System shall provide a web-based management interface that provides remote system control, live status monitoring, and configuration capabilities of lighting control settings and schedules.
2. Management interface must be compatible with industry-standard web browser clients, including, but not limited to, Microsoft Internet Explorer®, Apple Safari®, Google Chrome®, Mozilla Firefox®.
3. All system software updates must be available for automatic download and installation via the internet.

B. Historical Database and Analytics Interface

1. System shall provide a browser-based trending and monitoring interface that stores historical data for all occupancy/daylight sensors and lighting loads. Additionally, the system shall optionally upload that data to a cloud-based server.

C. Visualization Interfaces

1. System shall provide an optional web-based visualization interface that displays a graphical floorplan. System data, to include status of occupancy sensors, daylight sensors and light output shall be overlaid to the floorplan to provide a graphical status page.

D. Portable Programming Interface for Standalone Control Zones

1. Portable handheld application interface for standalone control zones shall be provided for systems that allows configuration of lighting control settings.
2. Programming capabilities through the application shall include, but not be limited to, the following:
 - a. Switch, occupancy and photo sensor group configuration

- b. Manual/automatic on modes
- c. Turn-on dim level
- d. Occupancy sensor time delays
- e. Dual technology occupancy sensors sensitivity
- f. Photo-sensor calibration adjustment and auto-setpoint
- g. Trim level settings

2.4 SYSTEM BACKBONE AND SYSTEM INTEGRATION EQUIPMENT

A. System Controller

1. System Controller shall be a multi-tasking, real-time digital control processor consisting of modular hardware with plug-in enclosed processors, communication controllers, and power supplies.
2. System Controller shall perform the following functions:
 - a. Facilitation of global network communication between different areas and control zones.
 - b. Time-based control of downstream wired and wireless network devices.
 - c. Linking into an Ethernet network.
 - d. Integration with Building Management Systems (BMS) and Heating, Ventilation and Air Conditioning (HVAC) equipment.
 - e. Connection to various software interfaces, including management interface, historical database and analytics interface, visualization interface, and personal control applications.
3. System Controller shall not require a dedicated PC or a dedicated cloud connection.
4. Device shall automatically detect all networked devices connected to it, including those connected to wired and wireless communication bridges.
5. Device shall have a standard and astronomical internal time clock.
6. Shall be capable of connecting to the customers Local Area Network (LAN) via IEEE 802.11.x Wireless and IEEE 802.3 Wired connection.
7. System Controller shall support BACnet/IP and BACnet/MSTP protocols to directly interface with BMS and HVAC equipment without the need for additional protocol translation gateways.
 - a. BACnet/MSTP shall support a minimum of 50 additional BACnet MS/TP controllers in addition to the Expansion I/O modules.
 - b. BACnet/MSTP shall support 9600 to 115200 baud.
 - c. System Controller shall be BACnet Testing Laboratory (BTL listed) using Device Profile BACnet Building Controller (B-BC) with outlined enhanced features.
 - d. System controller must support BACnet/IP Broadcast Management Device (BBMD) and Foreign Device Registration (FDR).

2.5 WIRED NETWORKED DEVICES

A. Wired Networked Wall Switches, Dimmers, Scene Controllers

1. Wall switches & dimmers shall support the following device options:
 - a. Number of control zones: 1, 2 or 4. Gang multiple switches where more than 4 control zones are required in a single location under a single faceplate.

- b. Control Types Supported: On/Off or On/Off/Dimming
 - 2. Scene controllers shall support the following device options:
 - a. Number of scenes: 1, 2 or 4
 - b. Control Types Supported:
 - 1) On/Off or On/Off/Dimming
 - 2) Preset Level Scene Type
 - 3) Reprogramming of other devices within daisy-chained zone so as to implement user selected lighting scene
 - 4) Selecting a lighting profile to be run by the system's upstream controller to implement a selected lighting profile across multiple zones
 - 3. Match color specified in Division 26 Section "Wiring Devices."
 - 4. Integral green LED pilot light to indicate when circuit is on.
 - 5. Internal white LED locator light to illuminate when circuit is off.
 - 6. Networked switch stations shall have backlit buttons.
 - 7. Wall Plates:
 - a. Single and multi-gang plates as specified in Division 26 Section "Wiring Devices."
 - b. Where multiple switches and/or dimmers are adjacent to each other, install a single cover plate. Provide separate boxes or barriers as required for the application.
 - c. Provide cover plates that are identical in material and dimension to standard single and double gang switch plates.
 - d. Verify back box requirements for multiple control points with manufacturer.
 - 8. Legend: Engraved or permanently silk-screened on wall plate where indicated. Use designations indicated on Drawings.
- B. Wired Networked Graphic Wall Stations
- 1. Device shall have a full color touch screen.
 - 2. Device shall enable configuration of all switches, dimmers, and lighting preset scenes via password protected setup screens.
 - 3. Graphic wall stations shall support the following device options:
 - a. Number of control zones: Minimum of 16
 - b. Number of scenes: Minimum of 16
 - c. Optional password protection for setup screens.
- C. Wired Networked Auxiliary Input / Output (I/O) Devices
- 1. Auxiliary Input/output Devices shall be specified as an input or output device with the following options:
 - a. Contact closure input: Programmable to support maintained or momentary inputs that can activate local or global scenes and profiles, ramp light level up or down, or toggle lights on/off.
 - b. 0-10V analog input: Programmable to function as a daylight sensor.

- c. RS-232/RS-485 digital input: Supports activation of up to 4 local or global scenes and profiles, and on/off/dimming control of up to 16 local control zones.
- d. 0-10V dimming control output, capable of sinking a minimum of 20mA of current programmable to support all standard sequence of operations supported by system.

D. Wired Networked Occupancy and Photosensors

- 1. Sensors shall utilize passive infrared (PIR) or passive dual technology (PDT) to detect both major and minor motion as defined by NEMA WD-7 standard.
- 2. Sensing technologies that are acoustically passive, meaning they do not transmit sound waves of any frequency do not require additional commissioning. Ultrasonic or Microwave based sensing technologies may require commissioning due to the active nature of their technology, if factory required.
- 3. Sensor programming parameter shall be available and configurable remotely from the software and locally via the device.
- 4. Sensor mounting type shall match project design requirements as shown on plans.
 - a. Sensors shall have optional features for photosensor/daylight override, dimming control, and low temperature/high humidity operation.
- 5. The system shall support the following types of photocell-based control:
 - a. On/Off: The control zone is automatically turned off if the photocell reading exceeds the defined setpoint and automatically turned on if the photocell reading is below the defined setpoint. A time delay or adaptive setpoint adjustable behavior may be used to prevent the system from exhibiting nuisance on/off switching.
 - b. Continuous Dimming: The control zone automatically adjusts its dimming output in response to photocell readings, such that a minimum light level consisting of both electric light and daylight sources is maintained at the task. The photocell response shall be configurable to adjust the photocell setpoint and dimming rates.

E. Wired Networked Wall Switch Sensors

- 1. Wall switches sensors shall support the following device options:
 - a. User Input Control Types Supported: On/Off or On/Off/Dimming
 - b. Occupancy Sensing Technology: PIR only or Dual Tech
 - c. Daylight Sensing Option: Inhibit Photosensor

F. Wired Networked Embedded Sensors

- 1. Embedded sensors shall support the following device options:
 - a. Occupancy Sensing technology: PIR only or Dual Tech
 - b. Daylight Sensing Option: Occupancy only, Daylight only, or combination Occupancy/Daylight sensor

G. Distributed System Power, Switching and Dimming Controls

1. Devices shall incorporate one optional Class 1 relay, optional 0-10 VDC dimming output, and contribute low voltage Class 2 power to the rest of the system.
2. Device programming parameters shall be available and configurable remotely from the software and locally via the device push-button.
3. Device shall be plenum rated.
4. Devices shall be UL Listed for load and load type as specified on the plans.

H. Wired Networked Luminaires

1. Networked luminaire shall have a factory installed mechanically integrated control device and carry a UL Listing as required.
2. Networked LED luminaire shall provide low voltage power to other networked control devices.
3. System shall be able to maintain constant lumen output over the specified life of the LED luminaire (also called lumen compensation) by automatically varying the dimming control signal to account for lumen depreciation.
4. System shall be able to provide control of network luminaire intensity, in addition to correlated color temperature of specific LED luminaires.
5. Controls manufacturer is responsible for primary troubleshooting and tech support of complete fixture.

2.6 CONDUCTORS AND CABLES

- A. General: All conductors and cables shall comply with the requirements of Division 26 Section "Conductors and Cables." Where cable is permitted to be installed exposed in ceiling space, provide plenum rated cable.
- B. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG.
- C. Classes 2 and 3 Control Cables: Multi-conductor cable with copper conductors not smaller than No. 22 AWG.
- D. Class 1 Control Cables: Multi-conductor cable with copper conductors not smaller than No. 18 AWG.
- E. Digital and Multiplexed Signal Cables: As required by system manufacturer. Provide plenum rated cables where installed exposed in ceiling space.

PART 3 - EXECUTION

3.1 WIRING INSTALLATION

- A. The lighting control system shall be installed and connected as shown on the plans and as directed by the manufacturer.
- B. Comply with NECA 1.
- C. Wiring Method: Install wiring in raceways except where installed in accessible ceilings. Comply with Division 26 Sections "Conductors and Cables" and "Raceways and Boxes".

- D. Where cables are installed in finished areas with exposed construction, conceal cables from view. Route at top of structural systems and conceal on top of structural members where possible. Where cable is exposed to view, provide raceway. As an alternative to raceway, provide cable that is factory colored to match exposed ceiling. Submit sample to Architect for approval.
- E. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.
- F. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.
- G. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- H. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in terminal cabinets, equipment enclosures, and in junction, pull, and outlet boxes as per manufacturers' recommendations.
- I. Identify components and power and control wiring according to Division 26 Section "Electrical Identification."
- J. Label each relay with a unique designation.

3.2 FIELD QUALITY CONTROL

3.3 INSTALLATION REQUIREMENTS

- A. Review all required installation and pre-startup procedures with the manufacturer's representative through pre-construction meetings.
- B. Install and connect the networked lighting control system components according to the manufacturer's installation instructions, wiring diagrams, the project submittals, plans and specifications.
- C. Coordination with Owner's IT Network Infrastructure to secure all required network connections to the owner's IT network infrastructure. Provide the owner's representative with all network infrastructure requirements of the networked lighting control system. Provide the manufacturer's representative with all necessary contacts pertaining to the owner's IT infrastructure, to ensure that the system is properly connected and started up.
- D. Verify integration and interoperability scope with the Mechanical Contractor prior to submittal phase and provide all necessary schedules to the Lighting Control manufacturer.

3.4 SYSTEM STARTUP

- A. Upon completion of installation by the installer, including completion of all required verification and documentation required by the manufacturer, the system shall be started up and programmed by an authorized representative of the manufacturer.
 - 1. Low voltage network cable testing shall be performed prior to system startup at the discretion of the manufacturer.

- B. System start-up and programming shall include:
 - 1. Verifying operational communication to all system devices.
 - 2. Programming the network devices into functional control zones to meet the required sequence of operation.
 - 3. Programming and verifying all sequence of operations.
 - 4. Customization of owner's software interfaces and applications.
- C. Initial start-up and programming are to occur on-site. Additional programming may occur on-site or remotely over the Internet as necessary.

3.5 DOCUMENTATION

- A. Submit software database file with desired device labels and notes completed.
- B. Document the installed location of all networked devices, including networked luminaires. Provide as-built plan drawing showing device addresses corresponding to locations of installed equipment.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components and equipment installation, including connections and assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Test for circuit continuity.
 - 2. Verify that the control module features are operational.
 - 3. Check operation of local override controls.
 - 4. Test system diagnostics by simulating improper operation of several components selected by Architect.

3.7 SYSTEM COMMISSIONING

- A. Facilitate the functional testing and verification of the lighting control system by an independent, third party commissioning agent.
- B. Perform commissioning in the presence of the Owner's representative.
- C. Submit functional test plan checklist signed by the commissioning agent.

3.8 SOFTWARE INSTALLATION

- A. Install and program software with initial settings of adjustable values. Make backup copies of software and user-supplied values. Provide current licenses for software.

3.9 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting programming functions and other system parameters and to assist Owner's personnel in making program changes to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to program, adjust, operate, and maintain lighting controls.
- B. Demonstration shall be done only after initial system start-up setup has occurred and system is functioning properly.
- C. Demonstration shall consist of a four-hour minimum session.

3.11 MANUFACTURER SUPPORT

- A. Manufacturer telephone support shall be available at no cost to the Owner during the warranty period and shall include the following:
 - 1. Assistance in solving programming or other application issues pertaining to the control equipment.
 - 2. The manufacturer shall provide a toll-free number for direct technical support available 7 days a week, 24 hours a day.
 - 3. A factory authorized technician shall be located within a 100-mile radius of the project site.

END OF SECTION 26 0943

PARTNERS 21-130
LIGHTING CONTROL SYSTEMS
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SECTION 26 0999 - ELECTRICAL TESTING

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. Related Sections include the following:
 - 1. Division 26 Section "Electrical General Requirements."
 - 2. Division 26 Section "Conductors and Cables."
 - 3. Division 26 Section "Grounding and Bonding."
 - 4. Division 26 Section "Enclosed Switches."
 - 5. Division 26 Section "Enclosed Controllers."
 - 6. Division 26 Section "Surge Protective Devices"
 - 7. Division 26 Section "Panelboards."
 - 8. Division 26 Section "Fuses."

1.2 SECTION INCLUDES

- A. The Electrical Contractor shall engage the services of a recognized corporately independent N.E.T.A. certified testing firm for the purpose of performing inspections and tests as herein specified
- B. The testing firm shall provide all material, equipment, labor, and technical supervision to perform such tests and inspections.
- C. It is the intent of these tests to assure that all tested electrical equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with design Specifications.
- D. The test and inspections shall determine suitability for energization.

- E. Equipment to be tested and inspected shall be the equipment shown on the one line diagram and schedules as required by part three of each individual Specification Section. In addition, all equipment that is part of an emergency distribution system shall be tested.

1.3 REFERENCES

- A. All inspections and tests shall be in accordance with the latest version of the following codes and standards except as provided otherwise herein.
 - 1. National Electrical Manufacturer's Association - NEMA
 - 2. American Society for Testing and Materials - ASTM
 - 3. Institute of Electrical and Electronic Engineers - IEEE
 - 4. InterNational Electrical Testing Association - NETA Acceptance Testing Specifications - ATS-2017
 - 5. InterNational Electrical Testing Association - NETA Maintenance Testing Specifications-MTS-2015
 - 6. American National Standards Institute - ANSI C2: National Electrical Safety Code
 - 7. State and Local Codes and Ordinances
 - 8. Insulated Cable Engineers Association - ICEA
 - 9. Association of Edison Illuminating Companies - AEIC
 - 10. Occupational Safety and Health Administration
 - 11. National Fire Protection Association - NFPA
 - a. ANSI/NFPA 70: National Electrical Code
 - b. ANSI/NFPA 70B: Electrical Equipment Maintenance
 - c. NFPA 70E: Electrical Safety Requirements for Employee Workplaces
 - d. ANSI/NFPA 101: Life Safety Code

1.4 QUALIFICATIONS

- A. The testing firm shall be a corporately independent testing organization, which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems evaluated by the testing firm.
- B. The testing firm shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.
- C. The lead, on site, technical person and at least 50% of the on site crew shall be currently certified by the InterNational Electrical Testing Association (NETA) or National Institute for Certification in Engineering Technologies in Electrical Power Distribution System Testing.
- D. The testing firm shall only utilize technicians who are regularly employed by the firm on a full-time basis for testing services.
- E. The Contractor shall submit proof of the above qualifications with bid proposal.
- F. The terms used herewithin such as Test Agency, Test Contractor, Testing Laboratory, or Contractor Test Company, shall be construed to mean the testing organization.
- G. Acceptable Testing Firms:

1. Northern Electrical Testing; Phone (248) 689-8980.
2. Utilities Instrumentation Services; Phone (734) 424-1200.
3. High Voltage Maintenance Corporation; Phone (248) 305-5596.
4. Powertech Services, Inc.; Phone (810) 720-2280.
5. Power Plus Engineering, Inc.; Phone (800) 765-3120.
6. Premier Power Maintenance, Inc.; (517) 230-6629

1.5 PERFORMANCE REQUIREMENTS

- A. The Electrical Contractor shall supply a suitable and stable source of electrical power to each test site. The testing firm shall specify the power requirements.
- B. The Electrical Contractor shall notify the testing firm when equipment becomes available for acceptance tests. Work shall be coordinated to expedite project scheduling.
- C. The testing firm shall notify the Owner's Representative prior to commencement of any testing.
- D. Any system, material or workmanship, which is found defective on the basis of acceptance tests, shall be reported to the Engineer. The Electrical Contractor shall correct all defects.
- E. The testing organization shall maintain a written record of all tests and shall assemble and certify a final test report.
- F. Safety and Precautions
 1. Safety practices shall include, but are not limited to, the following requirements:
 - a. Occupational Safety and Health Act.
 - b. Accident Prevention Manual for Industrial Operations, National Safety Council.
 - c. Applicable state and local safety operating procedures.
 - d. NETA Safety/Accident Prevention Program.
 - e. Owner's safety practices.
 - f. National Fire Protection Association - NFPA 70E.
 - g. American National Standards for Personnel Protection.
 2. All tests shall be performed with apparatus de-energized except where otherwise specifically required.
 3. The testing organization shall have a designated safety representative on the project to supervise operations with respect to safety.

1.6 TEST INSTRUMENT CALIBRATION

- A. Test Instrument Calibration
 1. The testing firm shall have a calibration program, which assures that all applicable test instruments are maintained within rated accuracy.
 2. The accuracy shall be directly traceable to the National Institute of Standards and Technology.
 3. Instruments shall be calibrated in accordance with the following frequency schedule:

- a. Field instruments: Analog - 6 months maximum Digital - 12 months maximum
 - b. Laboratory instruments: 12 months
 - c. Leased specialty equipment: 12 months
(Where accuracy is guaranteed by Lessor)
 4. Dated calibration labels shall be visible on all test equipment.
 5. Records must be kept up-to-date which show date and results of instruments calibrated or tested.
 6. An up-to-date instrument calibration instruction and procedures shall be maintained for each test instrument.
 7. Calibrating standard shall be of higher accuracy than that of the instrument tested.
- B. Field Test Instrument Standards
1. All equipment used for testing and calibration procedures shall exhibit the following characteristics:
 - a. Maintained in good visual and mechanical condition.
 - b. Maintained in safe, operating condition.
- C. Suitability of Test Equipment
1. All test equipment shall be in good mechanical and electrical condition.
 2. Selection of metering equipment should be based on knowledge of the waveform of the variable being measured. Digital multi-meters may be average of RMS sensing and may include or exclude the dc component. When the variable contains harmonics of dc offset and, in general, any deviation from a pure sine wave, average sensing, average measuring RMS scaled meters may be misleading. Use of RMS measuring meters is recommended.
 3. Field test metering used to check power system meter calibration must have any accuracy higher than that of the instrument being checked.
 4. Accuracy of metering in test equipment shall be appropriate for the test being performed.
 5. Waveshape and frequency of test equipment output waveforms shall be appropriate for the test and tested equipment.

1.7 TEST REPORTS

- A. A test report shall be generated for each piece of major equipment or groups of equipment and shall include the following:
1. A list of visual and mechanical inspections required by Division 26 Specification Sections in a checklist or similar format.
 2. Test reports, including test values where applicable, for all required electrical tests. Clearly indicate where test values fall outside of the limits of recommended values.
 3. Summary and interpretation of test results detailing problems located and recommended corrective measures.
 4. Record of infrared scan and photos showing potential problem locations.
 5. Signed and dated by the testing firm field superintendent stating that all required tests have been completed.

- B. Test reports shall be furnished to the Architect/Engineer within 14 days of the completion each test on an ongoing basis. Original copies of the reports shall be furnished directly to the Architect/Engineer by the testing company prior to formal submittal via the Contractors.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.1 THERMOGRAPHIC SURVEY

- A. Visual and Mechanical Inspection
 - 1. Remove all necessary covers prior to scanning.
 - 2. Inspect for physical, electrical, and mechanical condition.
- B. Equipment to be Scanned
 - 1. All modified components of the distribution system including existing and new branch circuit panelboards. Return 3 months after equipment has been energized and loaded to do a final scan of all equipment.
- C. Provide report indicating the following:
 - 1. Problem area (location of "hot spot").
 - 2. Temperature rise between "hot spot" and normal or reference area.
 - 3. Cause of heat rise.
 - 4. Phase unbalance, if present.
 - 5. Areas scanned.
- D. Test Parameters
 - 1. Scanning distribution system with ability to detect 1°C between subject area and reference at 30°C.
 - 2. Equipment shall detect emitted radiation and convert detected radiation to visual signal.
 - 3. Infrared surveys should be performed during periods of maximum possible loading but not less than twenty percent (20%) of rated load of the electrical equipment being inspected.

E. Test Results

1. Interpretation of temperature gradients requires an experienced technician. Some general guidelines are:
 - a. Temperature gradients of 37°F to 44.6°F indicate possible deficiency and warrant investigation.
 - b. Temperature gradients of 44.6°F to 59°F indicate deficiency; repair as time permits.
 - c. Temperature gradients of 61°F and above indicate major deficiency; repair immediately.

END OF SECTION 26 0999

SECTION 26 2416 - PANELBOARDS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.

- D. AFCI: Arc-fault circuit interrupter.
- E. RFI: Radio-frequency interference.
- F. RMS: Root mean square.
- G. SPDT: Single pole, double throw.

1.4 SUBMITTALS

- A. Product Data: For each type of panelboard, overcurrent protective device, surge protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Related Submittals:
 - 1. Provide overcurrent device coordination study to demonstrate proper overcurrent device ratings, adjustments, and settings.
- C. Shop Drawings: For each panelboard and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Bus configuration, current, and voltage ratings.
 - c. Short-circuit current rating of panelboards and overcurrent protective devices.
 - d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
- D. Field quality-control test reports including the following:
 - 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.
- E. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- F. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1, 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.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of panelboards and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- D. 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.
- E. Comply with NEMA PB 1.
- F. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
 - 1. Ambient Temperature: Not exceeding 104 deg F.
 - 2. 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 seven days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Construction Manager's written permission.

1.7 COORDINATION

- 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, and encumbrances to workspace clearance requirements.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Keys: Six spares for each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
 - a. Eaton Corporation; Cutler-Hammer Products.
 - b. GE by ABB.
 - c. [Siemens Industries, Inc.](#)
 - d. Square D.

2.2 MANUFACTURED UNITS

- A. Enclosures: Mounting as noted on panel schedules. NEMA PB 1, Type 1.
 - 1. Rated for environmental conditions at installed location.
 - 2. Cabinet Front: Flush or surface cabinet as noted on the Drawings.
 - a. Eaton LTDD (Piano hinge trim)
 - b. GE – FGB (front hinge to box).
 - c. Square D – Continuous piano hinge trim.
 - d. Siemens – Figure 4 hinge to box w/piano hinge.
 - 3. Finishes:
 - a. Panels and Trim: 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: Galvanized steel.

4. Directory Card: With transparent protective cover, mounted in metal frame, inside panelboard door.
- B. Phase and Ground Buses:
 1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
- C. Conductor Connectors: Suitable for use with conductor material.
 1. Main and Neutral Lugs: Mechanical type.
 2. Ground Lugs and Bus Configured Terminators: Compression type.
- D. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.
- E. Surge Protective Devices: Where indicated, provide manufactured units with direct bus connected type as specified in Division 26 Section "Surge Protective Devices."
 1. Provide Surge Protective Device for all Distribution and Branch Circuit Panelboards that are part of the Emergency Distribution System.
 2. Provide Surge Protective Devices elsewhere where indicated on the drawings.

2.3 PANELBOARD SHORT-CIRCUIT RATING

- A. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Main bus bars, neutral and ground, shall be sized in accordance with U.L. Standards to limit temperature rise on any current carrying part to the maximums as indicated in UL67.
- B. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

2.5 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: NEMA AB 3, with interrupting capacity to meet available fault currents.
 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits.
 - a. Circuit Breakers 250A and Larger: Magnetic trip element with front-mounted, field-adjustable trip setting with restricted access cover.
 2. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
 3. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).

4. AFCI Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
- B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
1. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 4. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
 5. Shunt Trip: 120-V trip coil energized from separate circuit.
 6. Do not use tandem circuit breakers.
 7. Provide lock on devices for circuit breakers when called out on panel schedules with "LOD" designation.
 8. Provide type GFEP circuit breakers for all self-regulating heating (snow melting and heat trace) cables branch circuits and where noted on panel schedules with "GFEP" designation.
 9. Provide GFCI circuit breaker when called out on panel schedules with "GFCI" designation.
 10. Provide Arc-Fault Circuit Interrupters where indicated on panel schedule with "AFCI" designation.
 11. Provide shunt trip breakers when called out on panel schedules with "STB" designation.
 12. Provide smart controllable circuit breakers when called out on panel schedules with "SMT" designation.
 13. Provide permanent padlockable handle for circuit breakers when called out on panel schedules with "PL" designation.

2.6 ACCESSORY COMPONENTS AND FEATURES

- A. Furnish accessory set including tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Provide permanent provisions for padlocking all overcurrent devices in Distribution Panelboards. Provisions shall remain in place whether or not lock is installed.
- C. Provide permanent provisions for padlocking overcurrent devices in Branch Circuit Panelboards that serve equipment not provided with a local, lockable disconnecting means. Provisions shall remain in place whether or not lock is installed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Comply with mounting and anchoring requirements specified in Division 26 Section "Hangers and Supports for Electrical Systems."

- C. Mount top of trim 74 inches above finished floor, unless otherwise indicated.
- D. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
- E. Install overcurrent protective devices and controllers.
 - 1. Set field-adjustable switches and circuit-breaker trip ranges.
- F. Install filler plates in unused spaces.
- G. Stub four 1-inch empty conduits from recessed 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.
- H. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Electrical Identification."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads or created by retrofitting. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable. Coordinate final directory room names and numbers with Facility Engineer.
- C. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding."
- B. Connect wiring according to Division 26 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Testing: Perform the following field quality control tests in accordance with Division 26 section "Electrical Testing"

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters. Perform electrical tests on all breakers and switches 200A and above or that constitute a component of an emergency distribution system. Main circuit breakers in branch circuit panelboards 225A and below are not required to be tested.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
1. Measure as directed during period of normal system loading.
 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.
- D. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scanning of each panelboard. Remove panel fronts so joints and connections are accessible to portable scanner.
1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 2. Record of Infrared Scanning: Prepare a certified report that identifies panelboards checked and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 CLEANING

- A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 26 2416

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Single and duplex receptacles
 - 2. Receptacles with integral USB charger.
 - 3. Ground-fault circuit interrupter receptacles
 - 4. Single- and double-pole snap switches.
 - 5. Device wall plates.
 - 6. Floor service fittings

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.

- B. GFCI: Ground-fault circuit interrupter.
- C. AFCI: Arc-fault circuit interrupter.
- D. PVC: Polyvinyl chloride.
- E. RFI: Radio-frequency interference.
- F. SPD: Surge protective devices.
- G. UTP: Unshielded twisted pair.
- H. USB: Universal serial bus.

1.4 REFERENCES

- A. DSCC W-C-596G: Federal Specification Connector, Electrical, Power, General Specification.
- B. DSCC W-C-896F: Federal Specification Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification).
- C. IEC 309-1, Part 1: General Requirements: Plugs, Socket-Outlets and Couplers for Industrial Purposes
- D. NEMA WD 1: General Requirements for Wiring Devices.
- E. NEMA WD 6: Wiring Device – Dimensional Requirements.
- F. UL 20: General-Use Snap Switches.
- G. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.
- H. UL 486B: Wire Connectors for Use with Aluminum Conductors.
- I. UL 498: Electrical Attachment Plugs and Receptacles.
- J. UL 943: Ground Fault Circuit Interrupters.
- K. NECA 130-2010: Installing and Maintaining Wiring Devices.

1.5 SUBMITTALS

- A. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations for each type of product indicated.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and source.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.7 COORDINATION

PART 2 - PRODUCTS

2.1 GENERAL WIRING DEVICE REQUIREMENTS

- A. Comply with NFPA 70, NEMA WD 1, NEMA WD 6, and UL498.
- B. 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. Wall Switches: As selected by Architect, unless otherwise indicated.

2.2 STANDARD GRADE RECEPTACLES

- A. Duplex Receptacle, NEMA 5-20R:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Wire Device-Kellems: 5352
 - b. Eaton/Arrow Hart Wiring Devices: 5362
 - c. Leviton: 5362
 - d. Legrand, Pass & Seymour: 5362
- B. Tamper-Resistant Duplex Receptacle, NEMA 5-20R:
 - 1. Safety mechanism to energize contacts only when both openings are simultaneously engaged.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Wiring Device-Kellems: 5362TR
 - b. Eaton/Arrow Hart Wiring Devices: AHTR5362
 - c. Leviton: 5362-SG
 - d. Legrand, Pass & Seymour: TR5362

C. Weather-Resistant Duplex Receptacle, NEMA 5-20R:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Wire Device-Kellems: BR20WR
 - b. Eaton/Arrow Hart Wiring Devices: WRBR20
 - c. Leviton: WBR20
 - d. Legrand, Pass & Seymour: WR20TR

D. Weather- and Tamper-Resistant Duplex Receptacle, NEMA 5-20R:

1. Safety mechanism to energize contacts only when both openings are simultaneously engaged.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Wire Device-Kellems: BR20WRTR
 - b. Eaton/Arrow Hart Wiring Devices: TWRBR20
 - c. Leviton: TWR20
 - d. Legrand, Pass & Seymour: WR5352TR

2.3 GFCI RECEPTACLES

A. General:

1. Comply with UL 943

B. Duplex GFCI Receptacle, NEMA 5-20R:

1. Manufacturers: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell Wiring Device-Kellems: GFRST20
 - b. Eaton/Arrow Hart Wiring Devices: SGF20
 - c. Leviton: GFNT2
 - d. Legrand, Pass & Seymour: 2097

C. Tamper-Resistant Duplex GFCI Receptacle, NEMA 5-20R:

1. Safety mechanism to energize contacts only when both openings are simultaneously engaged.
2. Manufacturers: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell Wiring Device-Kellems: GFTRST20
 - b. Eaton/Arrow Hart Wiring Devices: TRSGF20
 - c. Leviton: GFTR2
 - d. Legrand, Pass & Seymour: 2097TR

D. Tamper- and Weather-Resistant Duplex GFCI Receptacle, NEMA 5-20R:

1. Safety mechanism to energize contacts only when both openings are simultaneously engaged.
2. Manufacturers: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell Wiring Device-Kellems: GFTWRST20

- b. Eaton/Arrow Hart Wiring Devices: TWRSGF20
- c. Leviton: GFWT2
- d. Legrand, Pass & Seymour: 2097TRWR

E. Weather-Resistant Duplex GFCI Receptacle, NEMA 5-20R:

- 1. Manufacturers: Subject to compliance with requirements, provide one of the following:
 - a. Eaton/Arrow Hart Wiring Devices WRS GF20
 - b. Leviton: GFWR2
 - c. Legrand, Pass & Seymour: 2097TRWR

A. Dead Front GFCI, 20A:

- 1. Manufacturers: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell Wiring Device-Kellems: GFBFST20
 - b. Eaton/Arrow Hart Wiring Devices: SGF20
 - c. Leviton: GFRBF
 - d. Legrand, Pass & Seymour: 2087

2.4 STRAIGHT BLADE AND TWIST-LOCK RECEPTACLES, OTHER THAN NEMA 5-20R

- A. Provide commercial specification grade straight blade and twist-lock receptacles with standard NEMA configurations in accordance with the "Special Receptacles" schedule included on the drawings.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hubbell Wiring Device-Kellems
 - 2. Eaton/Arrow Hart Wiring Devices
 - 3. Leviton
 - 4. Legrand, Pass & Seymour

2.5 WALL SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hubbell Wiring Device-Kellems: 2100 Series
 - 2. Eaton/Arrow Hart Wiring Devices: 7630
 - 3. Leviton: 5621 Series
 - 4. Legrand, Pass & Seymour: 2624
- B. Device body: Plastic handle.
- C. Single- and Double-Pole Switches: Comply with DSCC W-C-896F and UL 20.
- D. Snap Switches: Heavy Duty specification grade, quiet type; rated 20A., 120-277 V AC.
- E. Provide single-pole, two-pole, three-way and four-way switches as indicated.

- F. Provide pilot light where indicated. Switch shall be illuminated when the switch is on.
- G. Provide key type where indicated. Furnish four keys to Owner.
- H. Combination Switch and Receptacle: Both devices in a single gang unit with plaster ears and removable tab connector that permit separate or common feed connection.
 - 1. Switch: 20 A, 120/277-V ac.
 - 2. Receptacle: NEMA WD 6, Configuration 5-20R.

2.6 WALL PLATES

- A. Manufacturers:
 - 1. Provide wall plates and corresponding wiring devices from same manufacturer.
- B. Single and combination types to match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces:
 - a. 0.035-inch- thick, satin-finished stainless steel
 - 3. Material for Unfinished Spaces:
 - a. Galvanized steel
 - 4. Material for Wet Locations: Gasketed Cast aluminum with hinged cover and listed and labeled as Extra Duty Weatherproof While-In-Use.
 - a. Manufacturers:
 - 1) Hubbell: MX3200
 - 2) Red Dot Model: CKLSVU, Thomas & Betts
 - 3) Intermatic: WP3110MXD
 - 4) Leviton: IUM1V
 - 5. Material for Damp Locations: Gasketed Cast aluminum with hinged cover and listed and labeled as Weatherproof.
 - a. Manufacturers:
 - 1) Red Dot Model CCGV, ABB Installation Products
 - 2) Eaton/Arrow Hart WLRD1
 - 3) Legrand, Pass & Seymour
 - 4) Intermatic: WP3110MXD

2.7 FLOOR SERVICE FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hubbell Wiring Device-Kellems
 - 2. Legrand, Wiremold
 - 3. Steel City
- B. Refer to Floor Service Fitting Schedule on Plan.
- C. Compartments: Provide barrier separating power from telecommunications cabling. Provide recessed-type floor service fittings with independent compartments and feed through wiring capability.
- D. Provide a blank bracket for any unused gangs.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Prior to installation of devices, verify wall openings are neatly cut and will be completely covered by wall plates, clean debris from outlet boxes and provide extension rings to bring outlet boxes flush with finished surface.
- C. Install devices and assemblies level, plumb, and square with building lines.
- D. Arrangement of Devices:
 - 1. Coordinate locations of outlet boxes provided under Division 26 Section "Raceways and Boxes" to obtain mounting heights indicated on Drawings.
 - 2. Unless otherwise indicated, mount flush, with long dimension vertical, and with grounding terminal of receptacles on top.
 - 3. Where multiple switches, dimmers, and/or occupancy sensors are adjacent to each other, provide a single cover plate. Custom fabricate, if required, for all combinations. Provide separate boxes or barriers as required for the application.
 - 4. Install horizontally mounted receptacles with grounding pole on the left.
 - 5. Install GFCI receptacles so that the "Push To Test" and "Reset" designations can be read correctly. If printed in both directions, install with ground pole on top.
 - 6. Install switches with OFF position down.
- E. Install cover plates on switch, receptacle, and blank outlets in finished areas.
- F. Install weather-resistant type receptacles in all damp and wet locations.
- G. Install weatherproof cover plates on receptacles in damp locations.
- H. Install weatherproof While-In-Use cover plates on receptacles in wet locations.
- I. Install tamper-resistant type receptacles in all locations as required by the NEC (406.12) and as indicated on plan.

- J. Use oversized plates for outlets installed in masonry walls.
- K. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
- L. Remove wall plates and protect devices and assemblies during painting.
- M. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.
- N. Adjust devices and wall plates to be flush and level. Three corners of wall plates must be in contact with wall surfaces. Devices shall be solidly mounted against the box.

3.2 IDENTIFICATION

- A. Comply with Division 26 Section "Electrical Identification."
 - 1. Receptacles: Identify panelboard and circuit number from which served. Use adhesive label as specified in Division 26 Section "Electrical Identification" with black-filled lettering on back side of wall plate, and durable wire markers or tags inside outlet boxes.
 - 2. Wall Switches: Identify panelboard and circuit number from which served. Use adhesive label as specified in Division 26 Section "Electrical Identification" with black-filled lettering on back side of wall plate, and durable wire markers or tags inside outlet boxes.

3.3 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding." Connect wiring device grounding terminal to outlet box with bonding jumper. Use of quick ground strap or screw is not acceptable.
- B. Connect wiring according to Division 26 Section "Conductors and Cables." Connect wiring devices by wrapping conductor around screw terminal or by using back wiring and tightening the screw securely.
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Inspect each wiring device for defects.
 - 2. Operate each wall switch with circuit energized and verify proper operation.
 - 3. After installing wiring devices and after electrical circuitry has been energized, test each receptacle for proper polarity, ground continuity, and compliance with requirements.
 - 4. Test each GFCI receptacle for proper operation with both local and remote fault simulations according to manufacturer's written instructions.
- B. Remove malfunctioning units, replace with new units, and retest as specified above.

END OF SECTION 26 2726

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SECTION 26 2813 - FUSES

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Cartridge fuses rated 600 V and less for use in switches, existing panelboards, existing switchboards, and controllers.

1.3 SUBMITTALS

- A. Product Data: Include the following for each fuse type indicated:
 - 1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
- B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.
 - 1. Ambient temperature adjustment information.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with:
 - 1. NEMA FU 1 – Low Voltage Cartridge Fuses.
 - 2. NFPA 70 – National Electrical Code.
 - 3. UL 198C – High-Interrupting-Capacity Fuses, Current-Limiting Types.
 - 4. UL 198E – Class R Fuses.
 - 5. UL 512 – Fuseholders.

1.5 PROJECT 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.

1.6 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. [Cooper Bussmann, Inc.](#)
 - 2. [Eagle Electric Mfg. Co., Inc.](#); Cooper Industries, Inc.
 - 3. [Ferraz Shawmut, Inc.](#)
 - 4. Tracor, Inc.; [Littelfuse, Inc.](#) Subsidiary.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.
 - 1. Feeders: Class RK1, time delay.
 - 2. Motor Branch Circuits: Class RK5, time delay.
 - 3. Other Branch Circuits: Class RK1, time delay.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Fuses shall be shipped separately. Any fuses shipped installed in equipment, shall be replaced by the Electrical Contractor with new fuses as specified above prior to energization at no additional expense to Owner. All fuses shall be stored in moisture free packaging at job site and shall be installed immediately prior to energization of the circuit in which it is applied.
- B. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.3 IDENTIFICATION

- A. Install labels indicating fuse rating and type on outside of the door on each fused switch.

END OF SECTION 26 2813

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SECTION 26 2816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

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PART 1 - GENERAL

1.1 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. Related Sections include the following:
 - 1. Division 26 Section "Fuses".

1.2 SUMMARY

- A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Molded-case circuit breakers.
 - 4. Molded-case switches.
 - 5. Enclosures.
- B. Related Sections:

1. Division 26 "Hangers and Supports for Electrical Systems" for concrete bases.

1.3 DEFINITIONS

- A. GD: General duty.
- B. GFCI: Ground-fault circuit interrupter.
- C. HD: Heavy duty.
- D. RMS: Root mean square.
- E. SPDT: Single pole, double throw.

1.4 REFERENCES

- A. NECA 1: Practices for Good Workmanship in Electrical Contracting.
- B. NETA ATS: Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum).
- D. NEMA AB 1: Molded Case Circuit Breakers and Molded Case Switches.
- E. NEMA FU 1: Low Voltage Cartridge Fuses.
- F. NEMA KS 1: Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- G. NEMA PB1.1: General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
- H. NEMA PB2.1: General Instructions for Proper Installation, Operation, and Maintenance of Deadfront Switchboards Rated 600 Volts or Less.
- I. NFPA 70: National Electrical Code.

1.5 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
 1. Enclosure types and details for types other than NEMA 250, Type 1.
 2. Current and voltage ratings.
 3. Short-circuit current rating.
 4. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Qualification Data: For testing agency.
- D. Field quality-control test reports including the following:
 - 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.
- E. Manufacturer's field service report.
- F. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Sections "Closeout Procedures and Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 - 2. Time-current curves, including selectable ranges for each type of circuit breaker.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.
- 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.

1.7 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FUSIBLE AND NONFUSIBLE SWITCHES

A. Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Siemens Industries, Inc.
4. Square D/Group Schneider.

B. Fusible Switch: NEMA KS 1, quick make, quick-break load interrupter enclosed knife switch Type HD, with clips or bolt pads to accommodate specified fuses, externally operable lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Nonfusible Switch: NEMA KS 1, quick make, quick-break load interrupter enclosed knife switch Type HD, externally operable lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

D. Accessories:

1. Provide early break auxiliary contacts in motor disconnect switches for motors that are fed from variable frequency controllers.
2. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
3. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
4. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

2.3 TOGGLE DISCONNECT SWITCH

A. Manufacturers:

1. Double Pole:

- a. Hubbell 1372.
- b. Leviton 6808G-DAC.
- c. Pass & Seymour 7812.
- d. Bryant 30102.

2. Three Pole:

- a. Hubbell 1379.
- b. Leviton 7810GD.
- c. Pass & Seymour 7813.
- d. Bryant 30103.

B. Description: Heavy duty, 30A, 600 volt, double or three pole as required, single throw, motor rated switch without overload protection. Provide NEMA 1 enclosure and padlock attachment.

2.4 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

A. Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Siemens Industries, Inc.
4. Square D/Group Schneider.

B. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.

1. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
2. GFCI Circuit Breakers: Single- and two-pole configurations with 5 or 30-mA trip sensitivity as required.

C. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.

1. Lugs: Mechanical style suitable for number, size, trip ratings, and conductor material.
2. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
3. Enclosure: Provide handle capable of being locked in the open position with padlock.

D. Molded-Case Switches: Molded-case circuit breaker with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

E. Molded-Case Switch Accessories:

1. Lugs: Mechanical style suitable for number, size, trip ratings, and material of conductors.
2. Application Listing: Type HACR for heating, air-conditioning, and refrigerating equipment.

2.5 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.

1. Indoor Dry Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
4. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

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.

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

3.2 INSTALLATION

- A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.
- C. Install switches with off position down.
- D. Install NEMA KS 1 enclosed switch where indicated for motor loads $\frac{1}{2}$ HP and larger and equipment loads greater than 30A.
- E. Install toggle disconnect switch, surface mounted, where indicated for motor loads less than $\frac{1}{2}$ HP and equipment loads 30A. and less.
- F. Install fuses in fusible disconnect switches.
- G. Install flexible liquid tight conduit from toggle disconnect switch to portable equipment. Leave a 6'-0" whip.
- H. Install flexible liquid tight conduit from toggle disconnect switch to stationary equipment.
- I. Install control wiring from early break contacts in motor disconnect switch to variable frequency controllers to shut down controller when switch is open.
- J. Install equipment on exterior foundation walls at least one inch from wall to permit vertical flow of air behind breaker and switch enclosures.
- K. Support enclosures independent of connecting conduit or raceway system.
- L. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Electrical Identification."
- B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 26 Section "Electrical Identification."
- C. Provide adhesive label as specified in Division 26 Section "Electrical Identification" on inside door of each switch indicating UL fuse class and size for replacement.

3.4 FIELD QUALITY CONTROL

A. Prepare for acceptance testing as follows:

1. Inspect mechanical and electrical connections.
2. Verify switch and relay type and labeling verification.
3. Verify rating of installed fuses.

B. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches. Certify compliance with test parameters.
2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.6 for molded-case circuit breakers. Test all NEMA AB1, molded case circuit breakers with thermal magnetic trip or auxiliary, solid-state trip units 100A and larger. Certify compliance with test parameters.

a. Visual and Mechanical Inspection

- 1) Circuit breaker shall be checked for proper mounting and compare nameplate data to Drawings and Specifications.
- 2) Operate circuit breaker to ensure smooth operation.
- 3) Inspect case for cracks or other defects.
- 4) Check internals on unsealed units.

b. Electrical Tests

- 1) Perform a contact resistance test.
- 2) Perform an insulation resistance test at 1000 volts dc from pole-to-pole and from each pole-to-ground with breaker closed and across open contacts of each phase.
- 3) Perform long time delay time-current characteristic tests by passing three hundred percent (300%) rated current through each pole separately. Record trip time. Make external adjustments as required to meet time current curves.
- 4) Determine short time pickup and delay by primary current injection.
- 5) Determine ground fault pickup and time delay by primary current injection.
- 6) Determine instantaneous pickup current by primary injection using run-up or pulse method.
- 7) Perform adjustments for final settings in accordance with coordination study.

c. Test Values

- 1) Compare contact resistance or millivolt drop values to adjacent poles and similar breakers. Investigate deviations of more than fifty percent (50%). Investigate any value exceeding manufacturer's recommendations.
- 2) Insulation resistance shall not be less than 100 megohms.
- 3) Trip characteristic of breakers shall fall within manufacturer's published time-current characteristic tolerance band, including adjustment factors.
- 4) All trip times shall fall within N.E.T.A. Acceptance Testing Specifications, Table 10.7 Circuit breakers exceeding specified trip time at three hundred percent (300%) of pickup shall be tagged defective.

- 5) Instantaneous pickup values shall be within values shown on N.E.T.A. Acceptance Testing Specifications, Table 10.8 or manufacturer's recommendations.
3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.5 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip and time delay settings to values as determined by the protective device coordination study.

3.6 CLEANING

- A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.
- B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION 26 2816

SECTION 26 2913 - ENCLOSED CONTROLLERS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes ac, enclosed controllers rated 600 V and less, of the following types:
1. Across-the-line, manual and magnetic controllers.
 2. Reduced-voltage controllers.
 3. Multispeed controllers.

B. Related Sections include the following:

1. Division 20 Section "Variable Frequency Controllers" for general-purpose, ac, adjustable-frequency, pulse-width-modulated controllers for use on constant torque loads in ranges up to 200 hp.
2. Division 26 "Hangers and Supports for Electrical Systems" for concrete bases.

1.3 SUBMITTALS

- A. Product Data: For each type of enclosed controller. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each enclosed controller.
1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Each installed unit's type and details.
 - b. Nameplate legends.
 - c. Short-circuit current rating of integrated unit.
 - d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices in combination controllers.
 2. Wiring Diagrams: Power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Sections "Closeout Procedures" and "Operation and Maintenance Data," include the following:
1. Routine maintenance requirements for enclosed controllers and all installed components.
 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
- E. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

1.4 REFERENCES

- A. ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
- B. ANSI/UL 198C - High-Intensity Capacity Fuses; Current-Limiting Types.
- C. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service.
- D. FS W-F-870 - Fuseholders (For Plug and Enclosed Cartridge Fuses).
- E. FS W-S-865 - Switch, Box, (Enclosed), Surface-Mounted.

- F. NEMA AB 1 - Molded Case Circuit Breakers.
- G. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.
- H. NEMA KS 1 - Enclosed Switches.
- I. ANSI/NFPA 70 - National Electrical Code.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.
- B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- C. Source Limitations: Obtain enclosed controllers of a single type through one source from a single manufacturer.
- D. 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.
- E. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prior to beginning work on any system, verify all existing conditions that affect the work and coordinate with all other trade Contractors. Determine that the work can be installed as indicated or immediately report to the Architect/Engineer errors, inconsistencies or ambiguities.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle in accordance with manufacturer's written instructions. Lift large equipment only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure, and finish.
- D. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

1.7 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of each contactor and indicate circuits controlled. Submit under provisions of 26 0010.

1.8 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of electrical service.
 - 2. Indicate method of providing temporary utilities.
 - 3. Do not proceed with interruption of electrical service without Construction Manager's written permission.

1.9 COORDINATION

- A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."
- C. Coordinate features of enclosed controllers and accessory devices with pilot devices and control circuits to which they connect.
- D. Coordinate features, accessories, and functions of each enclosed controller with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. [ABB Power Distribution, Inc.](#); ABB Control, Inc. Subsidiary.
 - 2. [Danfoss Inc.](#); Danfoss Electronic Drives Div.
 - 3. [Eaton Corporation; Cutler-Hammer Products.](#)
 - 4. [General Electrical Company; GE Industrial Systems.](#)
 - 5. [Rockwell Automation; Allen-Bradley Co.; Industrial Control Group.](#)
 - 6. [Siemens/Furnas Controls.](#)
 - 7. [Square D.](#)

2.2 ACROSS-THE-LINE ENCLOSED CONTROLLERS

- A. Manual Controller: NEMA ICS 2, general purpose, Class A, with "quick-make, quick-break" toggle or pushbutton action, and marked to show whether unit is "OFF," "ON," or "TRIPPED."
 - 1. Overload Relay: Ambient-compensated type with inverse-time-current characteristics and NEMA ICS 2, Class 10 tripping characteristics. Relays shall have heaters and sensors in each phase, matched to nameplate, full-load current of specific motor to which they connect and shall have appropriate adjustment for duty cycle.
- B. Magnetic Controller: NEMA ICS 2, Class A, full voltage, nonreversing, across the line, unless otherwise indicated.
 - 1. Control Circuit: 120 V; obtained from integral control power transformer with sufficient capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.
 - 2. Adjustable Overload Relay: Dip switch selectable for motor running overload protection with NEMA ICS 2, Class 20 tripping characteristic, and selected to protect motor against voltage and current unbalance and single phasing. Provide relay with Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
- C. Combination Magnetic Controller: Factory-assembled combination controller and disconnect switch.
 - 1. Fusible Disconnecting Means: NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by an NRTL.
 - 2. Nonfusible Disconnecting Means: NEMA KS 1, heavy-duty, nonfusible switch.
 - 3. Circuit-Breaker Disconnecting Means: NEMA AB 1, motor-circuit protector with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

2.3 REDUCED-VOLTAGE ENCLOSED CONTROLLERS

- A. Star-Delta Controller: NEMA ICS 2, closed transition with adjustable time delay.
- B. Part-Winding Controller: NEMA ICS 2, closed transition with separate overload relays for starting and running sequences.
- C. Autotransformer Reduced-Voltage Controller: NEMA ICS 2, closed transition.
- D. Solid-State, Reduced-Voltage Controller: NEMA ICS 2, suitable for use with NEMA MG 1, Design B, polyphase, medium induction motors.
 - 1. Adjustable acceleration rate control utilizing voltage or current ramp, and adjustable starting torque control with up to 500 percent current limitation for 20 seconds.
 - 2. Surge suppressor in solid-state power circuits providing 3-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
 - 3. LED indicators showing motor and control status, including the following conditions:
 - a. Control power available.
 - b. Controller on.

- c. Overload trip.
 - d. Loss of phase.
 - e. Shorted silicon-controlled rectifier.
- 4. Motor running contactor operating automatically when full voltage is applied to motor.
 - 5. Coil operating voltage: 120 volts secondary, 60 hertz.

2.4 MULTISPEED ENCLOSED CONTROLLERS

- A. Multispeed Enclosed Controller: Match controller to motor type, application, and number of speeds; include the following accessories:
 - 1. Compelling relay to ensure that motor will start only at low speed.
 - 2. Accelerating relay to ensure properly timed acceleration through speeds lower than that selected.
 - 3. Decelerating relay to ensure automatically timed deceleration through each speed.

2.5 VARIABLE FREQUENCY CONTROLLERS

- A. Refer to Division 20 "Variable Frequency Controllers."
- B. Equipment furnished by mechanical trades and installed by electrical trades.

2.6 ENCLOSURES

- A. Description: Flush- or surface-mounting cabinets as indicated. NEMA 250, Type 1, unless otherwise indicated to comply with environmental conditions at installed location.
 - 1. Outdoor Locations: NEMA 250, Type 3R.
 - 2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2.7 ACCESSORIES

- A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.
- B. Push-Button Stations, Pilot Lights: NEMA ICS 2, heavy-duty type.
- C. Indicating Lights: Run (Red), off or ready (Green).
- D. Auxiliary Contacts: Provide two normally open (N.O.) and two normally closed (N.C.) contacts.
- E. Selector Switch: NEMA ISC 2, mounted in front cover to read "hand/off/auto," provide auxiliary contact for auto position monitoring.
- F. Control Relays: Auxiliary and adjustable time-delay relays.
- G. Manufacturer provided nameplate shall be provided on controller enclosure. Nameplate shall contain the following information:

1. Manufacturer's name or identification.
2. Voltage rating.
3. Current and/or horsepower rating.
4. Short-circuit current rating,

2.8 FACTORY FINISHES

- A. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1) and gray baked enamel paint, electrodeposited on cleaned, phosphatized galvanized steel (NEMA 250 Types 3R, 12).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive enclosed controllers for compliance with requirements, installation tolerances, and other conditions affecting performance.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Select features of each enclosed controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, controller, and load; and configuration of pilot device and control circuit affecting controller functions.
- B. Select horsepower rating of controllers to suit motor controlled.

3.3 INSTALLATION

- A. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- B. Enclosed Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 26 Section "Fuses."
- C. Install motor control equipment and contactors in accordance with manufacturer's instructions.
- D. Select and install heater elements in motor starters to match installed motor characteristics.
- E. Motor Data: Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

3.4 IDENTIFICATION

- A. Identify enclosed controller, components, and control wiring according to Division 26 Section "Electrical Identification."

3.5 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers according to Division 26 Section "Conductors and Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect hand-off-automatic switch and other automatic-control devices where applicable.
 - 1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
 - 2. Connect selector switches with enclosed controller circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.6 CONNECTIONS

- A. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding."

3.7 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each enclosed controller element, bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Testing: Perform the following field quality control tests in accordance with Division 26 section "Electrical Testing"
 - 1. Perform each electrical test and visual and mechanical inspection, except optional tests, stated in NETA ATS, "Motor Control - Motor Starters and Motor Control - Adjustable Speed Drive Systems." 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.

3.8 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers. Refer to Division 1 Section "Closeout Procedures" and "Demonstration and Training."

END OF SECTION 26 2913

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ENCLOSED CONTROLLERS
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SECTION 26 4113 - LIGHTNING PROTECTION

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Contractor sections, apply to work of this section.
- B. Related Sections include the following:
 - 1. Division 26 Section "Electrical General Requirements."

1.2 GENERAL REQUIREMENTS

- A. Provide additions to the existing lightning protection system including all labor, materials and installation as specified herein.
- B. The entire system shall be copper or aluminum as used previously (verify in field) and shall be installed as a semi -concealed system as required.
- C. Installers of system shall be registered with Underwriters' Laboratories and certified by the Lightning Protection Institute.
- D. The installed components system shall be installed in accordance with Underwriter's Laboratories Standard UL 96-A, NFPA-780, and LPI-175. Upon completion of installation deliver to the Architect/Engineer, for the Owner, the UL Master Label Certificate or LPI-IP Certificate.
- E. The installation of this system shall be subcontracted in its entirety, by the Electrical Contractor to a fully qualified Lightning Protection Contractor having no less than five years of continuous experience in this

area, and being able to certify his having made installations similar to this and of this size or larger and shall submit a list of similar buildings on which he has installed a Master Label Lightning Protection system that has been inspected and certified by U.L. or LPI-IP, within the past five years.

1.3 REFERENCES

- A. ANSI/NFPA 780 – Standard for the Installation of Lightning Protection Systems.
- B. ANSI/UL 96 - Lightning Protection Components.
- C. LPI-175 - Lightning Protection Institute.
- D. UL 96A - Installation Requirements for Lightning Protection Systems.

1.4 SUBMITTALS

- A. Submit shop Drawings and product data under provisions of Section 26 0100.
- B. Submit shop Drawings showing layout of air terminals, grounding electrodes, and bonding connections to structure and other metal objects. Include terminal, electrode, and conductor sizes, and connection and termination details.
- C. Submit product data showing dimensions and materials of each component, and include indication of listing in accordance with ANSI/UL 96.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit project record documents under provisions of Section 26 0100.
- B. Accurately record actual locations of air terminals, grounding electrodes, bonding connections, and routing of system conductors.

1.6 SEQUENCING AND SCHEDULING

- A. Coordinate the work of this Section with other building systems and components to insure a correct, neat and unobtrusive installation.
- B. Coordinate installation of through roof assemblies and air terminals fastened to roofing systems with roofing contractor.
- C. Final flashes of through roof assemblies, and all specialty roof products necessary for the preservation of manufacturer's warranty such as heat welds or slip sheets if required, shall be supplied and installed by the roofing contractor per roofing manufacturer's specifications.

PART 2 - PRODUCTS

2.1 STANDARD

- A. All equipment used in this installation shall be UL inspected, approved, and properly labeled.
- B. All equipment shall be of a design and construction to suit the application where it is used, in accordance with accepted industry standards, specifically NFPA-780, UL96-A, and LPI-175 code requirements.

2.2 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the indicated Thompson Lightning Protection, Inc. (901 Sibley Hwy., St. Paul, MN 55118; 800 777-1230; TLP@TLPInc.com) product or a comparable product by one of the following:
 - 1. East Coast Lightning Equipment (24 Lanson Dr., Winstead, CT 06098; 888 680-9462; Info@ECLE.biz.)
 - 2. HLP Systems, Inc. (426 North Ave. Libertyville, IL 60048; 800 510-0229; Info@HLPSystems.com).
 - 3. ALT Fabrication (122 Leesley Ln, Argyle, TX 76226; 800 950-7960; Sales@ALTFab.com)

2.3 GENERAL

- A. Ground rods shall be copper clad minimum 5/8 inches by 10 feet, Thompson #225, or approved equal.
- B. Cable to ground rod connector shall be heavy duty cast copper bronze, Thompson #231, or approved equal.
- C. Connecting cable from steel column to ground rod shall be heavy duty Class II Copper cable, Thompson #28R, exothermic or approved equal.
- D. Bonding plates used to connect ground cable to steel columns shall be heavy duty with a minimum bonding surface or 8 square inches, Thompson #586, or approved equal.
- E. Cable to ground rod connector shall be heavy duty cast copper bronze, Thompson #230, or approved equal.
- F. "Through the roof" connectors shall be solid brass or stainless steel rods with vice grip connectors at each end housed in 1-1/2 inch Schedule 40 PVC: connectors shall be adjustable for roof thickness, Thompson #709, or approved equal.
- G. Roof Conductors - Copper conductor cable shall be 32 strands of 17 gauge, 99.97% pure copper wires, smooth twist, braided basket weave center with a minimum weight of 230 pounds per 1000 feet, Thompson #32S, or approved equal.

PART 3 - EXECUTION

3.1 INSTALLERS

- A. Guardian Equipment Company (www.GuardianEquipment.com; Info@GuardianEquipment.com).
- B. HLP Systems, Inc. (www.HLPSystems.com; Info@HLPSystems.com).
- C. Michigan Lightning Protection, Inc. (www.MichiganLightning.com; MichiganLightning@SBCGlobal.net).

3.2 INSTALLATION

- A. Lightning Protection Contractor shall provide, design and install the entire system, furnishing all labor, materials and equipment, incidental thereto for a complete and functional installation.
- B. This is a structural steel building and the structural steel framework shall be utilized as the main down conductors of the lightning protection system. The use of cable down conductors will not be permitted.
- C. Grounding of the steel columns around the perimeter of the building shall average not over 60 feet apart and in no case shall the distance between any two such grounds exceed 66 feet.
- D. Connections between ground rods and structural steel columns shall be made with heavy duty Class II copper conductor.
- E. Ground rods shall be electrically driven to a minimum of 12 feet below grade level and shall be driven vertically with no slant permitted without specific approval of the Architect/Engineer.
- F. All connections, except where otherwise specifically approved or accepted, shall be bronze bolt and nut clamps.
- G. Spacing between air terminals shall not exceed 20 feet.
- H. Where the building exceeds 50 feet in width, provide center roof protection.
- I. Approved thru-roof assemblies only with solid bronze or stainless steel rods shall be allowed to penetrate the roof. In no instance shall cable conductor be allowed to penetrate the roof. Final flashings of thru-roof assemblies, and all specialty roof products necessary for the preservation of manufacturer's warranty such as heat welds or slip sheets if required, shall be supplied and installed by the roofing contractor per roofing manufacturer's specifications.
- J. All mechanical and electrical equipment on the roof shall be bonded to the lightning protection system as required.
- K. Wherever vents, ducts, exhausts, and motorized vents made of aluminum are to be bonded to a copper system, a proper aluminum to copper connector shall be used.

- L. In no case shall metal copings of fasciae be substituted for the main roof conductor. However, such metal copings or fasciae shall be bonded to the main roof conductor with an approved connector at intervals not exceeding 100 feet apart.
- M. It is intended that this shall be a complete and functional Lightning Protection system and anything necessary to accomplish this is to be provided as if herein written. All work shall be installed in a neat and workmanlike manner and in accordance with the latest standards of the industry.
- N. Per NFPA 780 any building over 60' above grade shall have a counterpoise loop installed using a #4/0 bare copper cable, or Thompson #28R, connected to the lightning protection ground rods. (Spacing of ground rods shall not exceed 100').

3.3 FIELD QUALITY CONTROL

- A. Obtain the services of Underwriters Laboratories, Inc. or LI-IP to provide inspection and certification of the lightning protection system under provisions of UL 96A, NFPA 780, and LPI-175.
- B. Obtain UL Master Label or LPI-IP certificate and deliver to Owner upon completion.

END OF SECTION 26 4113

PARTNERS 21-130
LIGHTNING PROTECTION
26 4113 - 6

SECTION 26 5119 - LED INTERIOR LIGHTING

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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. Interior solid-state luminaires that use LED technology.
2. Lighting fixture supports.

B. Related Requirements:

1. Division 26 "Lighting Control Devices."

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. Lamp: LED and substrate as a replaceable assembly.
- F. LED: Light-emitting diode.
- G. Lumen: Measured output of lamp and luminaire, or both.
- H. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaires.
 - 4. Include emergency lighting units, including batteries and chargers.
 - 5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
 - 6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps and accessories identical to those indicated for the lighting fixture as applied in this Project per IES LM-79 and IES LM-80.
 - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products or certified by a qualified independent testing agency.
- B. Shop Drawings: For nonstandard or custom luminaires.
 - 1. Include plans, elevations, sections, and mounting and attachment details.
 - 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.
- C. Qualification Data: For testing laboratory providing photometric data for luminaires.
- D. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- E. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.
- F. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

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. Lamps: 5% attic stock of each type and rating installed. Furnish at least one of each type.
 - 2. LED Drivers 5% attic stock of each type and rating installed. Furnish at least one of each type.
 - 3. Diffusers and Lenses: 1% attic stock of each type and rating installed. Furnish at least one of each type.
 - 4. Globes and Guards: 5% attic stock of each type and rating installed. Furnish at least one of each type.

1.7 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Provide luminaires from a single manufacturer for each luminaire type.
- C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- D. 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.
- E. Comply with:
 - 1. NFPA 70 - National Electrical Code.
 - 2. NECA/IESNA 500-1998 – Recommended Practice for Installing Indoor Commercial Lighting Systems.
 - 3. NECA/IESNA 502-1999 – Recommended Practice for Installing Industrial Lighting Systems.
 - 4. Code of Federal Regulations (47 CFR 37342).
 - 5. Michigan Department of Community Industry Services requirements that all lamps shall be protected from breakage. Exposed lamps are not acceptable.
- F. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.9 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.

1.10 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) or manufacturer's standard warranty length (whichever is longer) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRES (LIGHTING FIXTURES)

- A. Provide Luminaires as included in specification 26 5700 "Luminaire Product Data." This section contains product data sheets from the basis of design manufacturer with annotations.
- B. Acceptable alternate manufacturers are indicated on the product data sheets. Alternate manufacturer products shall be equal in all respects including materials, finishes, photometric performance and energy performance and shall include all options, features, and accessories identified.
- C. The Luminaire schedule shown on the drawings is supplemental provided for convenience and reference only. The requirements of this section and 26 5700 shall govern.

2.2 LUMINAIRE 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. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. Unless otherwise specified in Luminaire product data, provide products with a minimum CRI of 80.
- D. Unless otherwise specified in Luminaire product data, provide products with a CCT of 4000 K.

- E. Unless otherwise specified in Luminaire product data, provide products with an IES LM-80 rated lamp life of 50,000 hours.
- F. Driver
 - 1. Provided as an integrated component of the luminaire or as an external component of an assembly of luminaries.
 - 2. Nominal Input Voltage: All drivers shall be rated for use on either 120V or 277V systems.

2.3 EXIT SIGNS

- A. General: Comply with UL 924; for sign colors and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 - 1. Lamps: Light-emitting diodes, 70,000 hours minimum of rated lamp life.
- C. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
 - 1. Battery: Sealed, maintenance-free, nickel-cadmium type with special warranty.
 - 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - 3. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
- D. Provide edge lit signs with a mirror plaque background.
 - 1. Heads or fixtures.

2.4 MATERIALS

- A. Metal Parts:
 - 1. Free of burrs and sharp corners and edges.
 - 2. Sheet metal components shall be steel unless otherwise indicated.
 - 3. Form and support to prevent warping and sagging.
- B. 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.
- C. Diffusers and Globes:
 - 1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - 2. Glass: Annealed crystal glass unless otherwise indicated.
 - 3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

- D. Factory-Applied Labels: Comply with UL 1598 Locate labels 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 characteristics:

- a. "USE ONLY" and include specific lamp type.
- b. Lamp diameter, shape, size, wattage, and coating.
- c. CCT and CRI for all luminaires.

2.5 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.6 LUMINAIRE FIXTURE SUPPORT COMPONENTS

- A. Comply with requirements in Section 26 0529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: Unless otherwise specified in Luminaire product data, provide products with a minimum 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: Unless otherwise specified in Luminaire product data, provide products with a minimum ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.
- D. Rod Hangers: Unless otherwise specified in Luminaire product data, provide products with a minimum 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. Do not use permanent luminaires for temporary lighting.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions and N.E.C.A./I.E.S.N.A. 500-2006 and 502-2006.
- B. Locate ceiling luminaires as indicated on reflected ceiling plan.
- C. Support for Fixtures in or on Grid-Type Suspended Ceilings: Use grid for support.
 - 1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from fixture corners.
 - 2. Support Clips: Fasten to 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 metal channels spanning and secured to ceiling tees.
- D. Install recessed luminaires to permit removal from below.
- E. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- F. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- G. Install fixture with no gaps between adjacent fixtures or between fixtures and surrounding surfaces. Trims of fixtures shall be properly and uniformly aligned.
- H. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Provide support for luminaire without causing deflection of ceiling or wall.
 - 4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.
- I. Flush-Mounted Luminaire Support:
 - 1. Secured to outlet box.
 - 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
 - 3. Trim ring flush with finished surface.
- J. Wall-Mounted Luminaire Support:
 - 1. Attached to a minimum 20 gauge backing plate attached to wall structural members.
 - 2. Do not attach luminaires directly to gypsum board.
- K. Ceiling-Mounted Luminaire Support:
 - 1. Ceiling mount with two 5/32-inch- diameter aircraft cable supports adjustable to 120 inches in length.

L. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

M. Comply with requirements in Section 26 0519 "Conductors and Cables" for wiring connections.

N. Fixtures shall have their exterior labels removed and shall be thoroughly cleaned.

O. Locate the remote test/monitor modules identically so that they are visible and they form a straight line when viewed from the end of the corridor or room. Where a suspended ceiling exists, center the modules in adjacent ceiling tiles.

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- C. Bond products and metal accessories to branch circuit equipment grounding conductor.
- D. Connect luminaires to branch circuit outlet boxes provided under Division 26 Section "Raceways and Boxes" using 1/2" flexible conduit.

3.5 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

- C. Prepare test and inspection reports.
- D. A visual inspection shall be performed to verify cleanliness and alignment of the fixtures, misalignment and light leaks shall be corrected, and rattles due to ventilation system vibration shall be eliminated.

3.7 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
 - 1. During adjustment visits, inspect all luminaires. Replace lamps, drivers, or luminaires that are defective.
 - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 3. Adjust the aim of luminaires in the presence of the Architect.
- B. Adjust exit sign directional arrows as indicated on Drawings.
- C. Adjust and calibrate all dimming system controls until the system works as designed. Contact the Architect/Engineer when dimming is complete and demonstrate operation to owner's representative and Architect/Engineer.

3.8 CLEANING

- A. Clean electrical parts to remove conductive and deleterious materials.
- B. Remove dirt and debris from enclosures and lenses.
- C. Clean photometric control surfaces as recommended by manufacturer.
- D. Clean finishes and touch up damage.

END OF SECTION 26 5119

PARTNERS 21-130
LED INTERIOR LIGHTING
26 5119 - 10

LUMINAIRE SCHEDULE									
REFER TO LIGHTING SPECIFICATIONS DOCUMENT FOR LUMINAIRE DETAILS & ORDERING INFORMATION. DO NOT ATTEMPT TO QUOTE OR ORDER PRODUCTS USING THIS SCHEDULE.									
TYPE	LOCATION	DESCRIPTION	MANUFACTURER(S)	LAMP TYPE	WATTAGE	VOLTAGE	LIGHT CHARACTERISTICS	CONTROLS	REMARKS
QL	CLOSETS	WALL-MOUNTED CLOSET LIGHT - 24"	LITHONIA: FMCL SERIES	INTEGRAL LED	17W	120-277V	1225L, 4000K CCT, 85 CRI	NONDIM	MOUNT TO HEADER ABOVE DOOR.
RL2	LOBBIES & CORRIDOR 210	RECESSED LINEAR LUMINAIRE - 2' LENGTH	MARK: SLOT 2 SERIES	INTEGRAL LED	4W1FT	277V	400LFT, 3500K CCT, 90 CRI	DM 0-10V 100%-1%	IN GYP CEILING AREAS, CENTER RECESSED LUMINAIRE WITHIN CEILING, AS SHOWN ON LIGHTING PLAN.
RL4	LOBBIES	RECESSED LINEAR LUMINAIRE - 4' LENGTH	MARK: SLOT 2 SERIES	INTEGRAL LED	4W1FT	277V	400LFT, 3500K CCT, 90 CRI	DM 0-10V 100%-1%	IN GYP CEILING AREAS, CENTER RECESSED LUMINAIRE WITHIN CEILING, AS SHOWN ON LIGHTING PLAN.
RL6	LOBBIES & CORRIDOR 210	RECESSED LINEAR LUMINAIRE - 6' LENGTH	MARK: SLOT 2 SERIES	INTEGRAL LED	4W1FT	277V	400LFT, 3500K CCT, 90 CRI	DM 0-10V 100%-1%	LENGTH OF RECESSED LUMINAIRE IS NOMINAL. FIELD MEASURE AVAILABLE SPACE WITHIN SOFFIT AND VERIFY DIMENSION WITH ARCHITECT PRIOR TO PLACING ORDER.
RL8	FIRST FLOOR LOBBY	RECESSED LINEAR LUMINAIRE - 8' LENGTH	MARK: SLOT 2 SERIES	INTEGRAL LED	4W1FT	277V	400LFT, 3500K CCT, 90 CRI	DM 0-10V 100%-1%	LENGTH OF RECESSED LUMINAIRE IS NOMINAL. FIELD MEASURE AVAILABLE SPACE WITHIN SOFFIT AND VERIFY DIMENSION WITH ARCHITECT PRIOR TO PLACING ORDER.
RL15	FIRST FLOOR LOBBY	RECESSED LINEAR LUMINAIRE - 15' LENGTH	MARK: SLOT 2 SERIES	INTEGRAL LED	4W1FT	277V	400LFT, 3500K CCT, 90 CRI	DM 0-10V 100%-1%	LENGTH OF RECESSED LUMINAIRE IS NOMINAL. FIELD MEASURE AVAILABLE SPACE WITHIN SOFFIT AND VERIFY DIMENSION WITH ARCHITECT PRIOR TO PLACING ORDER.
S1A	SHOWERS THROUGHOUT	SURFACE-MOUNTED LOW-PROFILE DOWNLIGHT - 5" DIAM	JUNO: SLIMFORM SERIES	INTEGRAL LED	10W	120-277V	700L, 3500K CCT, 90 CRI	DM 0-10V	
S1B	SMALL RESTROOMS	SURFACE-MOUNTED LOW-PROFILE DOWNLIGHT - 7" DIAM	JUNO: SLIMFORM SERIES	INTEGRAL LED	13W	120-277V	1000L, 3500K CCT, 90 CRI	DM 0-10V	
S2	STORAGE & MECHANICAL SPACES	STRIP LIGHT	LITHONIA: CLX SERIES	INTEGRAL LED	19W	120-277V	3000L, 3500K CCT, 80 CRI	DM 0-10V 100%-10%	MOUNTING TYPE TO BE DETERMINED (SURFACE OR SUSPENDED).
SL2	FIRST FLOOR LOBBY	SUSPENDED LINEAR LUMINAIRE - 2' LENGTH	MARK: SLOT 2 SERIES	INTEGRAL LED	4W1FT	120-277V	400LFT, 3500K CCT, 90 CRI	DM 0-10V 100%-1%	ACTUAL LUMINAIRE LOCATIONS AND SUSPENSION HEIGHTS TO BE VERIFIED ON SITE. LUMINAIRES TO BE SUSPENDED SUCH THAT BOTTOMS ARE IN LINE WITH BOTTOMS OF AND CENTERED BETWEEN ROWS OF WOOD SLATS.
SL4	FIRST FLOOR LOBBY	SUSPENDED LINEAR LUMINAIRE - 4' LENGTH	MARK: SLOT 2 SERIES	INTEGRAL LED	4W1FT	120-277V	400LFT, 3500K CCT, 90 CRI	DM 0-10V 100%-1%	ACTUAL LUMINAIRE LOCATIONS AND SUSPENSION HEIGHTS TO BE VERIFIED ON SITE. LUMINAIRES TO BE SUSPENDED SUCH THAT BOTTOMS ARE IN LINE WITH BOTTOMS OF AND CENTERED BETWEEN ROWS OF WOOD SLATS.
SL6	FIRST FLOOR LOBBY	SUSPENDED LINEAR LUMINAIRE - 6' LENGTH	MARK: SLOT 2 SERIES	INTEGRAL LED	4W1FT	120-277V	400LFT, 3500K CCT, 90 CRI	DM 0-10V 100%-1%	ACTUAL LUMINAIRE LOCATIONS AND SUSPENSION HEIGHTS TO BE VERIFIED ON SITE. LUMINAIRES TO BE SUSPENDED SUCH THAT BOTTOMS ARE IN LINE WITH BOTTOMS OF AND CENTERED BETWEEN ROWS OF WOOD SLATS.
T1A	THROUGHOUT	RECESSED 2X4 ARCHITECTURAL TROFFER	LITHONIA: BLT SERIES	INTEGRAL LED	23W	120-277V	3000L, 3500K CCT, 82 CRI	DM 0-10V 100%-1%	
T1B	THROUGHOUT	RECESSED 2X4 ARCHITECTURAL TROFFER	LITHONIA: BLT SERIES	INTEGRAL LED	30W	120-277V	4000L, 3500K CCT, 82 CRI	DM 0-10V 100%-1%	
T1C	KITCHEN 148, STORAGE 144B & 20B	RECESSED 2X4 LED FLAT PANEL	LITHONIA: EPANL SERIES	INTEGRAL LED	23W	120-277V	3000L, 3500K CCT, 82 CRI	DM 0-10V 100%-1%	
T2A	THROUGHOUT	RECESSED 2X2 ARCHITECTURAL TROFFER	LITHONIA: BLT SERIES	INTEGRAL LED	15W	120-277V	2000L, 3500K CCT, 82 CRI	DM 0-10V 100%-1%	
T2B	THROUGHOUT	RECESSED 2X2 ARCHITECTURAL TROFFER	LITHONIA: BLT SERIES	INTEGRAL LED	25W	120-277V	3300L, 3500K CCT, 82 CRI	DM 0-10V 100%-1%	
T2C	TEMP DISPATCH	RECESSED 2X2 LED FLAT PANEL	LITHONIA: EPANL	INTEGRAL LED	16W	120-277V	2000L, 3500K CCT, 80 CRI	DM 0-10V 100%-1%	
T2D	DISPATCH	RECESSED 2X2 LED FLAT PANEL	LITHONIA: EPANL	INTEGRAL LED	27W	120-277V	3400L, 3500K CCT, 80 CRI	DM 0-10V 100%-1%	
T3A	THROUGHOUT	RECESSED 1X4 LED FLAT PANEL	LITHONIA: EPANL SERIES	INTEGRAL LED	12W	120-277V	1500L, 3500K CCT, 80 CRI	DM 0-10V 100%-1%	
T3B	VESTIBULE 153	RECESSED 1X4 LED FLAT PANEL	LITHONIA: EPANL SERIES	INTEGRAL LED	23W	120-277V	3000L, 3500K CCT, 80 CRI	DM 0-10V 100%-1%	
UC	THROUGHOUT	SURFACE-MOUNTED UNDERCABINET LIGHT, VARIOUS LENGTHS (1', 2', 3', 4')	LITHONIA: UCLD SERIES	INTEGRAL LED	7.29W1FT	120V	375LFT, 3000K CCT, 94 CRI	STANDARD INCANDESCENT DIMMING	SURFACE-MOUNT TO THE UNDERSIDE OF UPPER CABINETS AT THE FRONT EDGE, JUST BEHIND THE REVEAL. VERIFY EXACT LENGTHS NEEDED PRIOR TO PLACING ORDER.
W1	TOILETS THROUGHOUT	24" LINEAR VANITY LIGHT	LITHONIA: TRADITIONAL ROUND VANITY LIGHT	INTEGRAL LED	17.68W	120-277V	1300L, 3000K CCT, 90 CRI	NONDIM	WALL-MOUNT OVER MIRRORS AT VANITIES AT APPROX. 7'-0" AFF. VERIFY MOUNTING HEIGHT WITH ARCHITECT PRIOR TO INSTALLATION.
W2	WOMEN'S TOILET 129, MENS LOCKER 131, MENS TOILET 133	24" LINEAR VANITY LIGHT	LITHONIA: TRADITIONAL SQUARE VANITY LIGHT	INTEGRAL LED	17.68W	120-277V	1300L, 3000K CCT, 90 CRI	NONDIM	WALL-MOUNT OVER MIRRORS AT VANITIES AT APPROX. 7'-0" AFF. VERIFY MOUNTING HEIGHT WITH ARCHITECT PRIOR TO INSTALLATION.
X1	THROUGHOUT	EXIT SIGN - SINGLE-SIDED	LITHONIA: PRECISE EDGE-LIT LED SERIES	INTEGRAL LED	2.3W	120-277V	RED LED LETTERS	NONDIM	ALL EXIT SIGNS TO BE CONNECTED TO 120V EMERGENCY CIRCUIT (LP-A-21).
X2	THROUGHOUT	EXIT SIGN - DOUBLE-SIDED	LITHONIA: PRECISE EDGE-LIT LED SERIES	INTEGRAL LED	3.2W	120-277V	RED LED LETTERS	NONDIM	ALL EXIT SIGNS TO BE CONNECTED TO 120V EMERGENCY CIRCUIT (LP-A-21).
GENERAL NOTES: 1. REFER TO SPECIFICATIONS FOR DETAILED LUMINAIRE PRODUCT DATA SHEETS. DO NOT ORDER PRODUCT BASED ON LUMINAIRE SCHEDULE ONLY. ADDITIONAL INFORMATION IS PROVIDED ON THE PRODUCT DATA SHEETS. 2. FINISH TO BE APPROVED BY INTERIOR DESIGNER, ARCHITECT AND/OR CLIENT PRIOR TO PLACING ORDER. 3. FINISH TO BE APPROVED BY INTERIOR DESIGNER, ARCHITECT AND/OR CLIENT PRIOR TO PLACING ORDER. 4. ALL LUMINAIRES TO BE AS SPECIFIED OR EQUAL. APPROVED IN ADVANCE BY PBA. 5. FULL DIMMING COMPATIBILITY AS OUTLINED IN DESIGN INTENT TO BE VERIFIED BY CONTRACTOR AND ELECTRICAL ENGINEER.									



FEATURES & SPECIFICATIONS

INTENDED USE

Provides general illumination in commercial and residential applications. Ideal for use in closets, hallways, pantries, corridors, utility areas and more.

CONSTRUCTION

Features a white acrylic diffuser with either a pull chain or passive infrared (PIR) sensor for easy on/off operation. The PIR sensor activates when motion is detected. After 30 seconds of no motion, the fixture automatically turns off. Pull chain option is supplied with an optional 31" pull string.

OPTICS

The FMMCL produces 575 lumens (7"), 925 lumens (18"), and 1,225 lumens (24") at 50,000 hours life (see chart below).

ELECTRICAL

Fixture operates at 120 volts, 60 Hz. Standard input wattage noted in chart below. Minimum starting temperature Zero degrees.

INSTALLATION

Easily installs in minutes and can be mounted to walls or ceilings. All mounting hardware included for mounting to a standard round, octagon, or horizontal rectangle junction box. 4 1/4" x 4 1/2" mounting plate supplied with 18" and 24" models can be rotated to accommodate vertical junction boxes. Suitable for use within closet storage spaces when installed per NEC requirements.

LISTINGS

UL Certified to US and Canadian standards and listed suitable for damp locations. ENERGY STAR® certified product.

WARRANTY

5-year limited warranty. Complete warranty terms located at:

www.acuitybrands.com/support/customer-support/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.

Specifications subject to change without notice.

Catalog Number	TYPE CL
Notes	
Type	

Decorative Indoor

LED Closet Light

Flush Mount



HIGH-PERFORMANCE LED



	Lumens	Wattage	LPW
7"	575	10.4	55
18"	925	14	66
24"	1,225	17	72

Specifications

	7"	18"	24"
Height:	4-1/4 (10.8)	3-1/4 (8.2)*	3-1/4 (8.2)*
Width:	6-5/8 (16.8)	17-6/8 (45)	23-5/8 (60)
Depth:	1-5/8 (4.1)	1-3/8 (3.6)	1-3/8 (3.6)
Weight:	.88 lb (.4 kg)	1 lb (.5 kg)	1.5 lb (.7 kg)

All dimensions are inches (centimeters) unless otherwise indicated.

*Mounting plate extends height to 4 1/4"

ORDERING INFORMATION

For shortest lead times, configure product using **bolded options**.

Example: FMMCL 840 S1

Series ¹	Width	CRI/Color Temperture	Controls
FMMCL LED closet light	(blank) 7" 18 18" 24 24"	840 85 CRI, 4000K	S1 Pull chain PIR Passive infrared sensor

ELECTRICAL CONTRACTOR TO DETERMINE
APPROPRIATE MOUNTING HARDWARE & ACCESSORIES

Notes

1 Use with non-dimmable switches only.

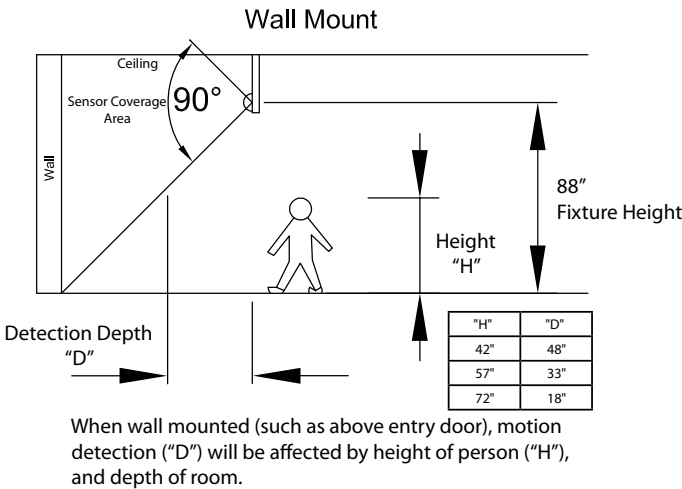
DECORATIVE INDOOR

FMMCL

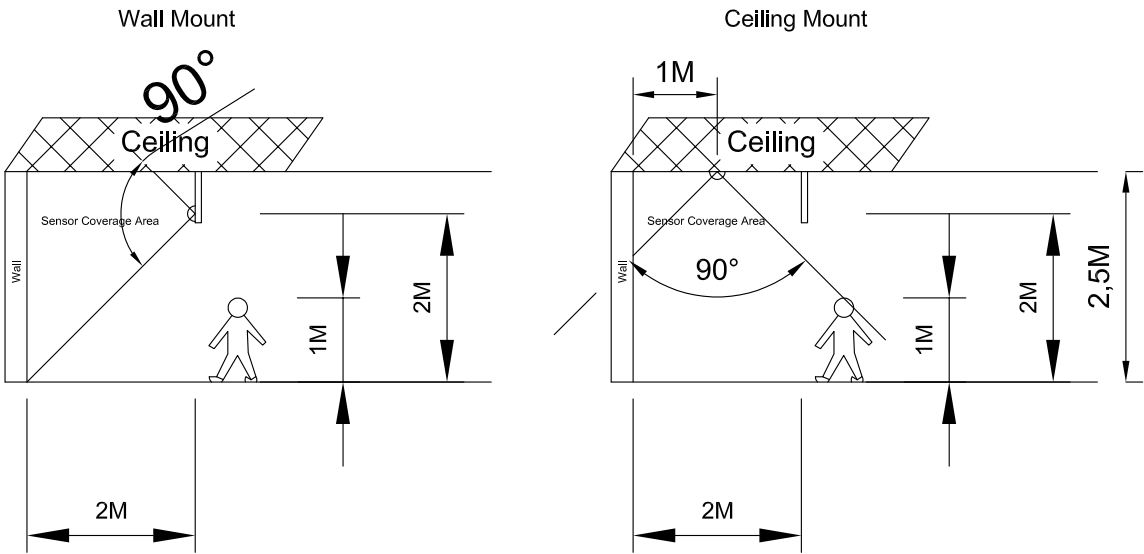
LED Closet Light

TYPE CL

DIAGRAMS



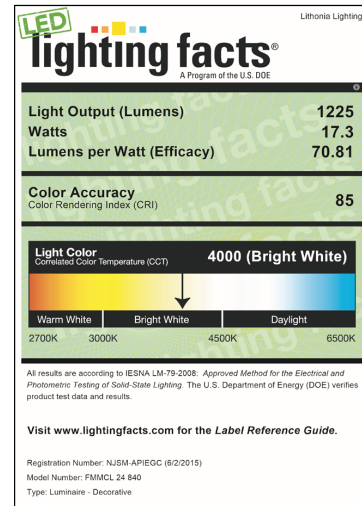
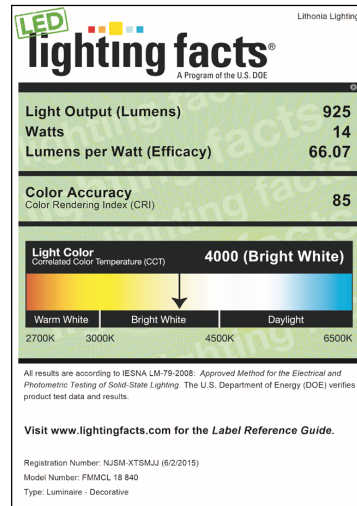
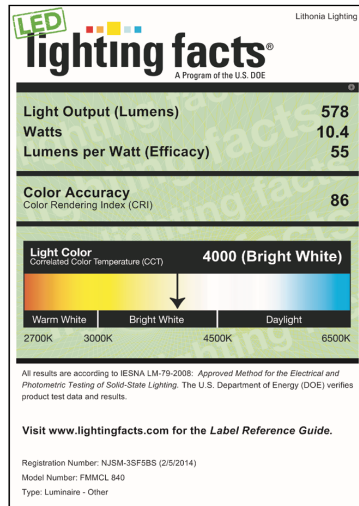
LED CLOSET LIGHT SENSOR COVERAGE



LED Closet Light

TYPE CL

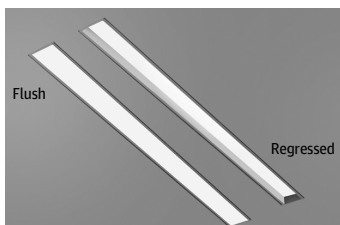
LIGHTING FACTS



PHOTOMETRICS

Full photometric data report available within 2 weeks from request. Consult factory.

MARK ARCHITECTURAL LIGHTING™



Slot 2 LED Recessed Linear

Slot 2 LED takes both form and function a step further with increased efficacy and integral controls creating a digitally addressable luminaire that is perfect where visually harmonious illumination and energy efficiency are desired.

Slot 2 LED is the ideal choice for spaces that emphasize lines and clean contemporary design. It is a perfect fit for Armstrong TechZone™ ceiling systems. A regressed lens option provides added dimension to the sleek, slender design and the flush lens now has a Wet Label option.

Type:

TYPE RL2

Project:

Catalog Number:

DO NOT TYPE HERE. Autopopulated field.

Specification Features

Housing

Nominal 2" x 2', 3', 4', 5', 6', 7', 8' and continuous rows in 1" increments as standard, upper housing fabricated from cold-rolled steel with extruded aluminum ceiling trim.

Finish

Painted high reflectance matte white powder coat.

Reflector

Precision-formed steel; high reflectance matte white powder coat; 93% reflectivity.

Shielding

Flush Lens: Snap-in 90% transmissive satin acrylic lens.

Regressed Lens: Lay-in 90% transmissive satin acrylic lens.

Mounting

Recessed. Available for sheetrock, 9/16" slot grid or 15/16" inverted tee ceilings, or 9/16" inverted tee.

Certification

CSA tested to UL 1598 standards. Optional Damp or Wet location listings available, see ordering tree. This product is IC rated.

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.

Specifications subject to change without notice.

Fixture Performance - SL2L*

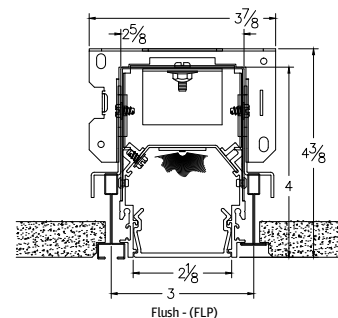
Lumens Output	400 LMF		600 LMF**		800LMF**		1000LMF	
Fixture Style	RLP	FLP	RLP	FLP	RLP	FLP	RLP	FLP
Delivered Lumens/FT	234	308	404	533	534	705	654	862
Input Watts/FT	4	4	6	6	8	8	11	11
Lumen/Watt	68	89	69	91	67	88	62	82

* CCT (35K)

* Consult factory for customized lumen output and wattage

**Based on calculated values

Technical Drawing



Declare.

LED Components

Linear: Nichia® - 757 Series LED chips (available in 80 or 90 CRI)

LED Life

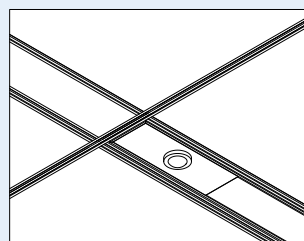
Rated 65,000 hours (L80) at 25 °C ambient temperature.

Color Consistency

The Acuity Brands circuit boards for the linear LED components use a precise binning algorithm which creates a consistent color temperature from board to board. Color variation is no greater than a 2.5 Step MacAdam (2.5SDCM) along the black body locus from board to board.

Driver

eldoLED constant current driver options delivers ultra-smooth dimming resolution from 100% to 0.1%, while assuring flicker free, low current inrush, 89% efficiency and low EMI.



Occupancy Sensor (PDT) and/or Photocell (ADC)

Integrated Controls

Optional nLight® embedded controls make luminaire addressable- allowing it to digitally communicate with other nLight enabled controls such as dimmers, switches, occupancy sensors and photocontrols. Simply connect all the nLight enabled control devices using standard CAT5 Cabling. (Input option: NLIGHT)

Photometry

For photometric information refer to www.marklighting.com.

TYPE RL2

MARK
ARCHITECTURAL
LIGHTING™Slot 2 LED
Recessed LinearA+ Capable options indicated
by this color background.SEE LIGHTING PLANS FOR LUMINAIRE
QUANTITIES NEEDING EACH CEILING
TRIM TYPE.

Ordering

Example: SL2L LOP 4FT RLP FL 80CRI 30K 600LMF DARK 277 EC NLIGHT

Series		Linear Length Plan		Total Run Length		Fixture Style		Ceiling Trim		Direct Light Source Color Rendering	
SL2L Slot 2 LED Linear Recessed		LOP Linear Optimized Plan		2FT 2' 3FT 3' 4FT 4' 5FT 5' 6FT 6'		RLP ^{1,3} Regressed Lens FLP ¹ Flush Lens		FL ¹ 5/8" Flange(sheetrock) TG 9/16" or 15/16" Flat or Inverted Tee GB ⁴ Trimless (sheetrock) WFL Perimeter Mount, 5/8" Flange (Sheetrock) WTG 9/16" Flat or Inverted Tee, Perimeter Mount *For metal pan, hard wood or other ceiling types consult factory.		80CRI 80 CRI 90CRI 90 CRI	
Direct LED Color Temp		Direct LED Light Output		Direct Distribution		Minimum Dimming Level		Voltage		Emergency Options	
27K* 2700K 30K 3000K 35K 3500K 40K 4000K 50K* 5000K		400LMF 400 Lumens per FT 600LMF 600 Lumens per FT 800LMF 800 Lumens per FT 1000LMF 1000 Lumens per FT LMF* ⁹ ## Lumens per FT (Limited to 300LMF to 1000LMF in 50LMF increments)		(blank) Standard Distribution WW ⁵ Wall Wash		NODIM Non - Dim MIN1 Constant current, dimming to 1% DARK Constant current, dimming to 0.1% MIN5 ⁶ Constant current, dimming to 5% MIN10 ¹⁵ Constant current, dimming to 10%		120 120V 277 277V 347 ⁷ 347V		(blank) White, textured xxx/BLKT Black, textured xxx/SLVT Silver, textured xxx/RALTB RAL paint finish xxx = fill in with the appropriate ceiling trim. Only trims are painted. RALTB is for pricing only. Replace with applicable RAL number and texture when placing order.	
Control Input		Primary Sensor ¹²		Secondary Sensor ¹²		Tertiary Zone		Options			
(blank) Non-dim ¹¹ 2T 0 10V NLIGHT nLight enabled NLTAIR2 ¹⁷ nLight Air (Wireless Enabled) ECOD ^{16,18} Lutron Hi-Lume digital driver ECOD2 ^{16,18} Lutron Hi-Lume 2-wire (1% dimming) ECOD5 ^{16,18} Lutron 5-series digital driver (5% dimming) DALI ¹⁹ Dali		(blank) Single Zone, No Sensor NS Multi-zone, No Sensor Main Zone PDT ¹³ Dual Technology Occupancy Sensor, PIR and Microphonics Sensor ADC ¹³ Daylight Dimming Sensor API ¹⁴ Passive Infrared Occupancy Sensor and Daylight Dimming Sensor APD ¹⁴ Dual Technology Occupancy Sensor and Daylight Dimming Sensor		(blank) No additional zones/sensors SNS Multi-zone, with no sensor in secondary zone SPDT ¹³ Dual Technology Occupancy Sensor, PIR and Microphonics Sensor SADC ¹³ Daylight Dimming Sensor SAPI ¹⁴ Passive Infrared Occupancy Sensor and Daylight Dimming Sensor SAPD ¹⁴ Dual Technology Occupancy Sensor and Daylight Dimming Sensor		(blank) No additional zones/sensors TNS Multi-zone, with no sensor in tertiary zone		CP ¹⁸ Chicago Plenum USPOM US point of assembly WL ^{1,9} Wet Location Listing DPL Damp Location Listing PWS 6' Pre-Wire, 3/8" Diameter, 18 Gauge			

* Requires longer lead time.

Notes

- Supplied with lift and shift lay-in lens.
- Supplied with snap-in lens.
- Wet Location label not available with regressed lens, sensor options or PWS. Cannot be installed on vertical surfaces.
- Not intended for post sheetrock installation.
- Wall wash not available with RLP lens or all sensor options.
- MIN5 requires ECOD5 Control Input. ECOD5 only available with MIN5 dimming.
- Not available with 2' sections, E10WLCP or sensors. Only available with NODIM or MIN1 with ZT.
- Default battery pack is integral, battery pack will be remote on 2' & 3' (RE10WLCP) if 5' or 6' unit, integral battery pack is only available with ZT or NLTAIR2. Battery will be remote with RLP, WW or sensors. Only 1 integral battery pack per unit. CP listing must have an integral battery. Remote batteries are not wet location listed, they may be used with a wet location fixture is the battery itself is mounted in a dry location.
- Not available with ECOD, ECOD2 and ECOD5.
- Standard 4' EC section, defaults to end of run. 2ft, 3ft and 5ft powers entire fixture, 6ft powers 3ft EC section.
- Only available with NODIM option.
- Sensors not available with WW, NODIM driver, WL, RLP, downlights or 2' or 3' units. Not available with 347 & NLIGHT together. Default location for sensor is the left side of the fixture. For runs, the first fixture will include the sensor.
- Requires ZT or NLIGHT Control Input.
- Requires ZT, NLIGHT or NLTAIR2 Control Input.
- MIN10 not available with 347, sensors, NLIGHT or NLTAIR2, requires ZT
- ECOD and ECOD2 not available with sensors, requires MIN1 dimming. Must use 120 volt for ECOD2.
- Must select MIN1 or DARK. Not available with RLP, WW, PDT, ADC or 347, DPL or WL. If with EC, cannot be on individual units, and on runs, the EC cannot be on the same section as NLTAIR2.
- CP not available with NLTAIR2.
- DALI is only available with DARK or MIN1. It is not available with sensors or downlights.

ELECTRICAL CONTRACTOR TO DETERMINE
APPROPRIATE MOUNTING HARDWARE & ACCESSORIES

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

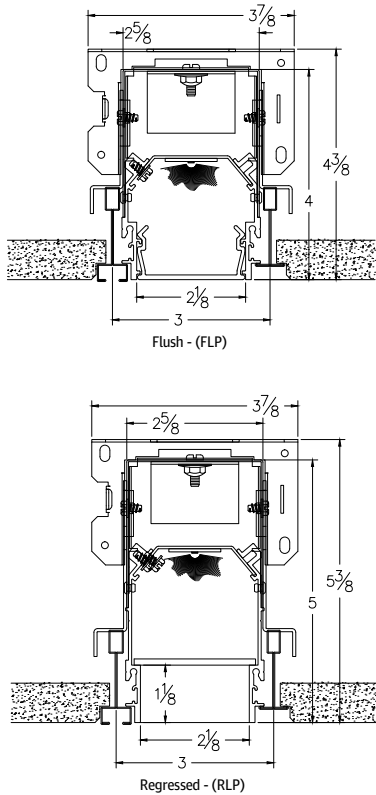
MARK

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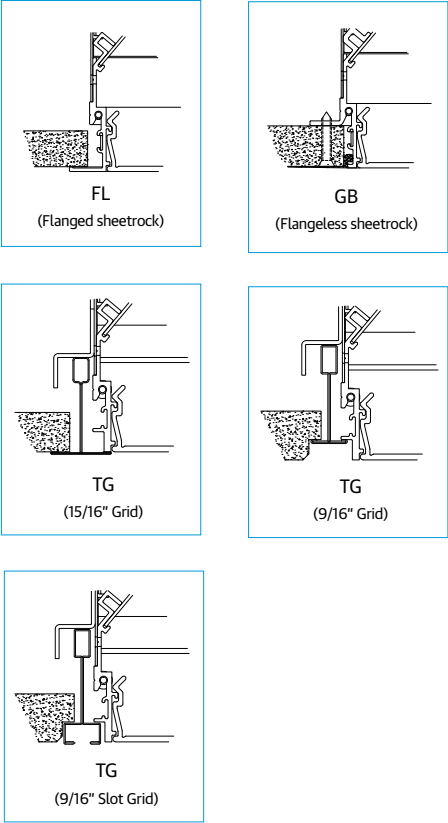
Slot 2 LED

Recessed Linear

Technical Drawing

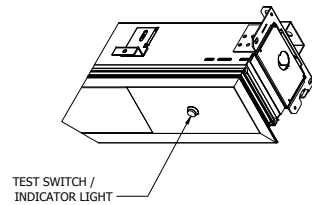


Ceiling Trim



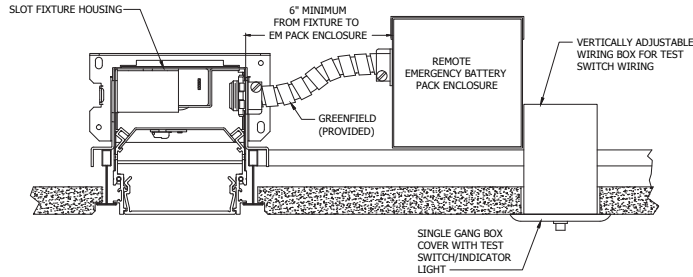
Emergency Battery

Internally Mounted (E10WLCP)



- Notes
- Delivers 700 lumens per 4FT length. Default location is the right side of fixture and end of run.
 - Provided with 4FT of flexible conduit. Maximum of 25FT remote distance if extended. Extension provided by others.
 - See ordering tree notes for remote battery pack scenarios.

Remote Mounted (RE10WLCP)



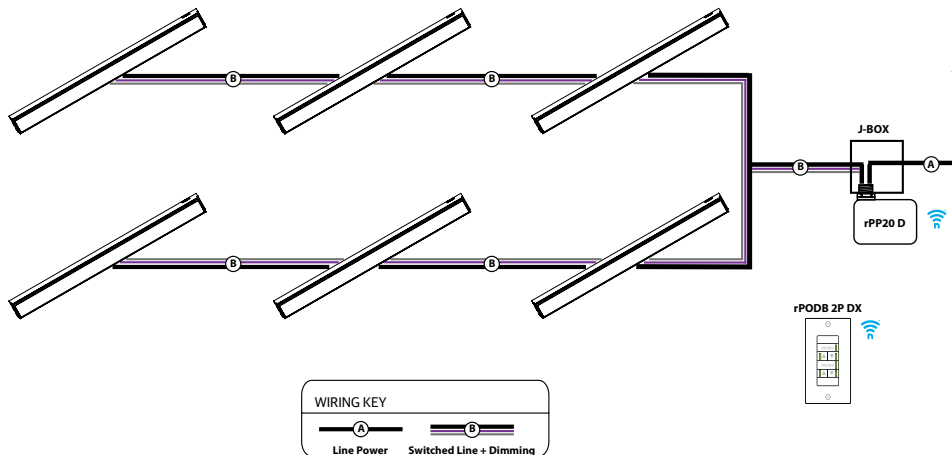
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Slot 2 LED Recessed Linear

nLight Air Wireless

To Make fixture NLTAIR2 compatible the following components are required:

- 1) rpp20 D
- 2) rPODB 2P DX

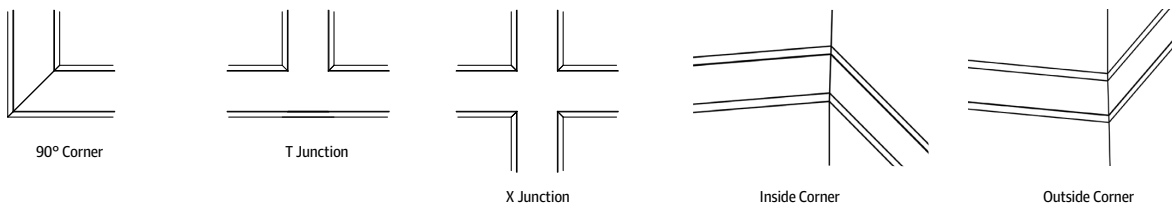


Continuous Runs

Slot 2 LED continuous rows can be configured in 1" increments.

Run Patterns, Corners and Junction

Slot 2 LED patterns be configured in 1' increments with illuminated 90° inside and outside corners, T junctions, and X junctions with standard 2' corner and junction lengths. For custom angles, corner or junction lengths, consult factory.



Layout Sketch

Please draw and configure your linear run below.

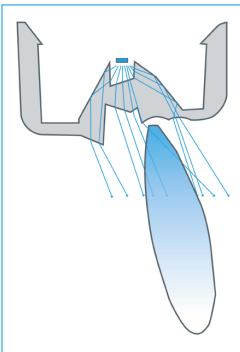
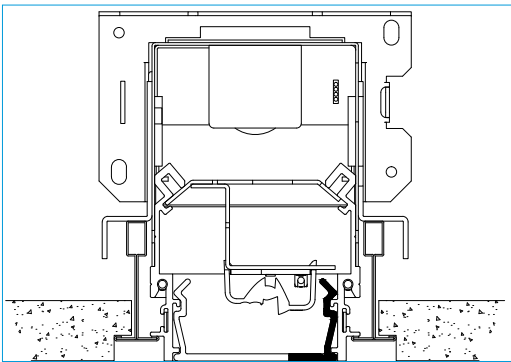
TYPE RL2

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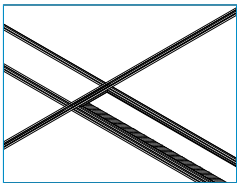
Slot 2 LED
Recessed Linear

OPTICS

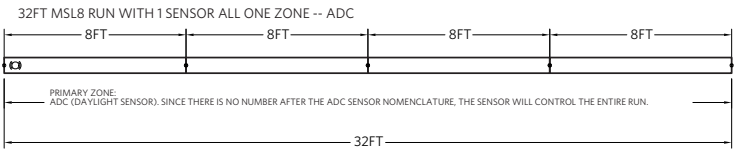
Slot LED's patent-pending, precision lumen DIRECTIR optics condition and refract light to deliver accurately controlled, striation-free, and uniform white light. All lumen DIRECTIR optics are injection-molded, optical grade, UV-resistant acrylic with selective finishing/polishing treatment.



Optional Wall Wash (WW)



INTEGRATED SENSOR LAYOUT



Notes:
● Only one sensor per zone

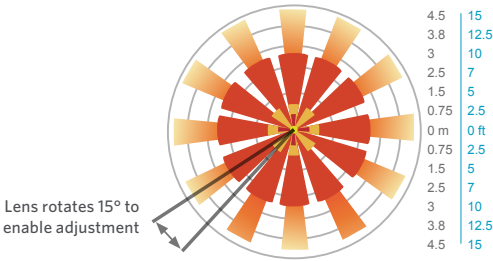
OCCUPANCY DETECTION COVERAGE

At the 7.5 ft (2.9 m) hanging height of a typical pendant mount fixture the sensor provides 10 ft (3.05 m) radial detection of small motion. At a 9 ft (2.74 m) hanging height the radius is 12 ft (3.66 m) for small motion.

Adequate for walking motion detection from mounting heights between 7.5 ft (2.29 m) and 20 ft (6.10 m).

Initial detection will occur earlier when walking across sensor's field of view than when walking directly at sensor.

Initial detection of walking motion into long coverage segment will occur at distances of 2x the mounting height up to 15 ft (4.57 m) and 1.75x up to 20 ft (6.10 m). Lens assembly rotates 15° to enable adjustment in order to line up long segments.



TYPE RL4

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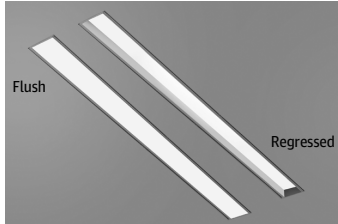
Slot 2 LED Recessed Linear

Type:

Project:

Catalog Number:

DO NOT TYPE HERE. Autopopulated field.



Slot 2 LED takes both form and function a step further with increased efficacy and integral controls creating a digitally addressable luminaire that is perfect where visually harmonious illumination and energy efficiency are desired.

Slot 2 LED is the ideal choice for spaces that emphasize lines and clean contemporary design. It is a perfect fit for Armstrong TechZone™ ceiling systems. A regressed lens option provides added dimension to the sleek, slender design and the flush lens now has a Wet Label option.

Specification Features

Housing

Nominal 2" x 2', 3', 4', 5', 6', 7', 8' and continuous rows in 1" increments as standard, upper housing fabricated from cold-rolled steel with extruded aluminum ceiling trim.

Finish

Painted high reflectance matte white powder coat.

Reflector

Precision-formed steel; high reflectance matte white powder coat; 93% reflectivity.

Shielding

Flush Lens: Snap-in 90% transmissive satin acrylic lens.

Regressed Lens: Lay-in 90% transmissive satin acrylic lens.

Mounting

Recessed. Available for sheetrock, 9/16" slot grid or 15/16" inverted tee ceilings, or 9/16" inverted tee.

Certification

CSA tested to UL 1598 standards. Optional Damp or Wet location listings available, see ordering tree. This product is IC rated.

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.

Specifications subject to change without notice.

Fixture Performance - SL2L*

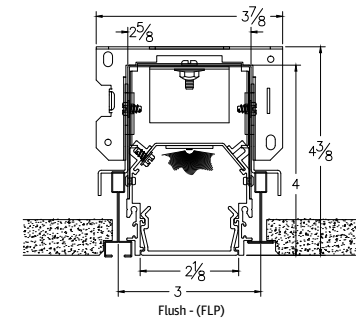
Lumens Output	400 LMF		600 LMF**		800LMF**		1000LMF	
Fixture Style	RLP	FLP	RLP	FLP	RLP	FLP	RLP	FLP
Delivered Lumens/FT	234	308	404	533	534	705	654	862
Input Watts/FT	4	4	6	6	8	8	11	11
Lumen/Watt	68	89	69	91	67	88	62	82

* CCT (35K)

* Consult factory for customized lumen output and wattage

**Based on calculated values

Technical Drawing



Declare.

LED Components

Linear: Nichia® - 757 Series LED chips (available in 80 or 90 CRI)

LED Life

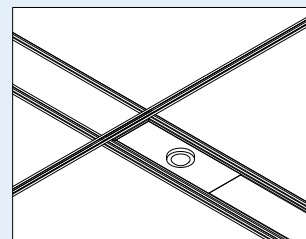
Rated 65,000 hours (L80) at 25 °C ambient temperature.

Color Consistency

The Acuity Brands circuit boards for the linear LED components use a precise binning algorithm which creates a consistent color temperature from board to board. Color variation is no greater than a 2.5 Step MacAdam (2.5SDCM) along the black body locus from board to board.

Driver

eldoLED constant current driver options delivers ultra-smooth dimming resolution from 100% to 0.1%, while assuring flicker free, low current inrush, 89% efficiency and low EMI.



Occupancy Sensor (PDT) and/or Photocell (ADC)

Integrated Controls

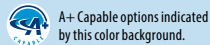
Optional nLight® embedded controls make luminaire addressable- allowing it to digitally communicate with other nLight enabled controls such as dimmers, switches, occupancy sensors and photocontrols. Simply connect all the nLight enabled control devices using standard CAT5 Cabling. (Input option: NLIGHT)

Photometry

For photometric information refer to www.marklighting.com.

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Slot 2 LED
Recessed Linear



SEE LIGHTING PLANS FOR LUMINAIRE
QUANTITIES NEEDING EACH CEILING
TRIM TYPE.

Ordering

Example: SL2L LOP 4FT FLP FL 80CRI 30K 600LMF DARK 277 EC NLIGHT

Series		Linear Length Plan		Total Run Length		Fixture Style		Ceiling Trim		Direct Light Source Color Rendering	
SL2L	Slot 2 LED Linear Recessed	LOP	Linear Optimized Plan	2FT 2' 3FT 3' 4FT 4' 5FT 5' 6FT 6'	7FT 7' 8FT 8' _FT_	*Specify continuous linear feet in 1" increments (7FT6 = 7FT 6IN)	RLP ¹³ Regressed Lens FLP ¹⁴ Flush Lens	FL ¹ 5/8" Flange(sheetrock) TG 9/16" or 15/16" Flat or Inverted Tee GB ⁴ Trimless (sheetrock) WFL Perimeter Mount, 5/8" Flange (Sheetrock) WTG 9/16" Flat or Inverted Tee, Perimeter Mount *For metal pan, hard wood or other ceiling types consult factory.	80CRI 80 CRI 90CRI 90 CRI		
Direct LED Color Temp		Direct LED Light Output		Direct Distribution		Minimum Dimming Level		Voltage		Finish	
27K ⁶ 2700K 30K 3000K 35K 3500K 40K 4000K 50K ⁶ 5000K	400LMF 400 Lumens per FT 600LMF 600 Lumens per FT 800LMF 800 Lumens per FT 1000LMF 1000 Lumens per FT _LMF ⁹ ## Lumens per FT (Limited to 300LMF to 1000LMF in 50LMF increments)	(blank) Standard Distribution WW ⁵ Wall Wash	NODIM Non - Dim MIN1 Constant current, dimming to 1% DARK Constant current, dimming to 0.1% MINS ⁶ Constant current, dimming to 5% MIN10 ¹⁵ Constant current, dimming to 10%	120 120V 277 277V 347 ⁷ 347V	(blank) White, textured xxx/BLKT Black, textured xxx/SLVT Silver, textured xxx/RALTB <u>RAL paint finish</u> xxx = fill in with the appropriate ceiling trim. Only trims are painted. RALTB is for pricing only. Replace with applicable RAL number and texture when placing order.						
Control Input		Primary Sensor ¹²		Secondary Sensor ¹²		Tertiary Zone		Options			
(blank) Non-dim ¹¹ 2T 0 10V NLIGHT nLight enabled NLTAIR2 ¹⁷ nLight Air (Wireless Enabled) ECOD ^{16,18} Lutron Hi-Lume digital driver ECOD2 ^{16,18} Lutron Hi-Lume 2-wire (1% dimming) ECOD5 ^{16,18} Lutron 5-series digital driver (5% dimming) DALI ¹⁹ Dali	(blank) Single Zone, No Sensor NS Multi-zone, No Sensor Main Zone PDT ¹³ Dual Technology Occupancy Sensor, PIR and Microphonics Sensor ADC ¹³ Daylight Dimming Sensor API ¹⁴ Passive Infrared Occupancy Sensor and Daylight Dimming Sensor APD ¹⁴ Dual Technology Occupancy Sensor and Daylight Dimming Sensor	(blank) No additional zones/sensors SNS Multi-zone, with no sensor in secondary zone SPDT ¹³ Dual Technology Occupancy Sensor, PIR and Microphonics Sensor SADC ¹³ Daylight Dimming Sensor SAPI ¹⁴ Passive Infrared Occupancy Sensor and Daylight Dimming Sensor SAPD ¹⁴ Dual Technology Occupancy Sensor and Daylight Dimming Sensor	(blank) No additional zones/sensors TNS Multi-zone, with no sensor in tertiary zone	CP ¹⁸ Chicago Plenum USPOM US point of assembly WL ^{1,4} Wet Location Listing DPL Damp Location Listing PWS 6' Pre-Wire, 3/8" Diameter, 18 Gauge							

INTEGRAL BATTERY PACKS TO BE PROVIDED FOR LUMINAIRES INDICAT

* Requires longer lead time.

INTEGRAL BATTERY PACKS TO BE
PROVIDED FOR LUMINAIRES INDICATED
AS "EM" ON LIGHTING PLANS

Notes

- Supplied with lift and shift lay-in lens.
- Supplied with snap-in lens.
- Wet Location label not available with regressed lens, sensor options or PWS. Cannot be installed on vertical surfaces.
- Not intended for post sheetrock installation.
- Wall wash not available with RLP lens or all sensor options.
- MINS requires ECOD5 Control Input. ECOD5 only available with MINS dimming.
- Not available with 2' sections, E10WLCP or sensors. Only available with NODIM or MIN1 with ZT.
- Default battery pack is integral, battery pack will be remote on 2' & 3' (RE10WLCP) if 5' or 6' unit, integral battery pack is only available with ZT or NLTAIR2. Battery will be remote with RLP, WW or sensors. Only 1 integral battery pack per unit. CP listing must have an integral battery. Remote batteries are not wet location listed, they may be used with a wet location fixture is the battery itself is mounted in a dry location.
- Not available with ECOD, ECOD2 and ECOD5.
- Standard 4' EC section, defaults to end of run. 2ft, 3ft and 5ft powers entire fixture, 6ft powers 3ft EC section.
- Only available with NODIM option.
- Sensors not available with WW, NODIM driver, WL, RLP, downlights or 2' or 3' units. Not available with 347 & NLIGHT together. Default location for sensor is the left side of the fixture. For runs, the first fixture will include the sensor.
- Requires ZT or NLIGHT Control Input.
- Requires ZT, NLIGHT or NLTAIR2 Control Input.
- MIN10 not available with 347, sensors, NLIGHT or NLTAIR2, requires ZT
- ECOD and ECOD2 not available with sensors, requires MIN1 dimming. Must use 120 volt for ECOD2.
- Must select MIN1 or DARK. Not available with RLP, WW, PDT, ADC or 347, DPL or WL. If with EC, cannot be on individual units, and on runs, the EC cannot be on the same section as NLTAIR2.
- CP not available with NLTAIR2.
- DALI is only available with DARK or MIN1. It is not available with sensors or downlights.

ELECTRICAL CONTRACTOR TO DETERMINE
APPROPRIATE MOUNTING HARDWARE & ACCESSORIES

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

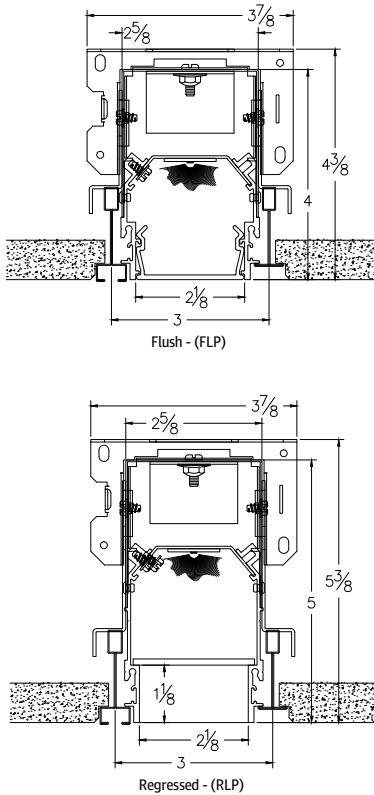
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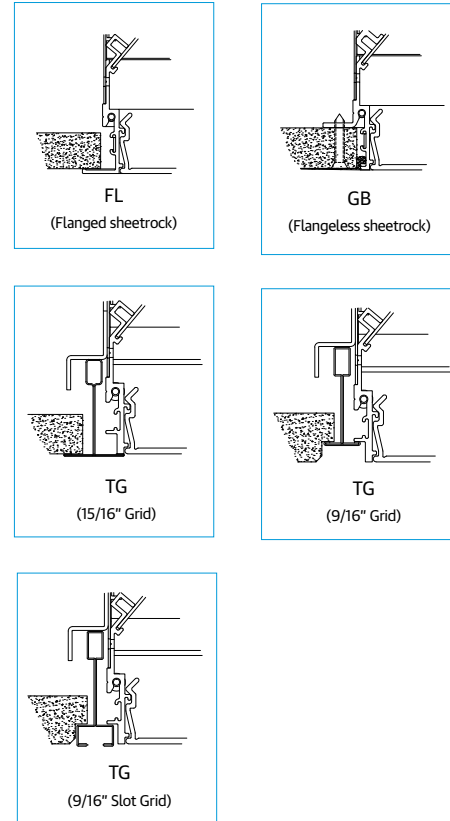
Slot 2 LED

Recessed Linear

Technical Drawing

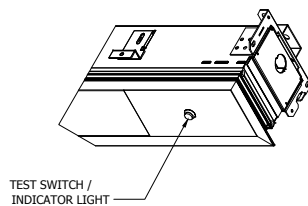


Ceiling Trim



Emergency Battery

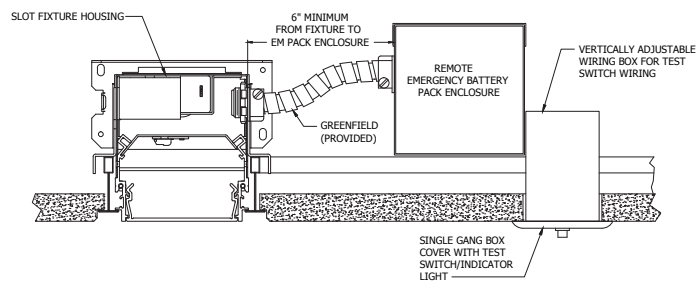
Internally Mounted (E10WLCP)



Notes

- Delivers 700 lumens per 4FT length. Default location is the right side of fixture and end of run.
- Provided with 4FT of flexible conduit. Maximum of 25FT remote distance if extended. Extension provided by others.
- See ordering tree notes for remote battery pack scenarios.

Remote Mounted (RE10WLCP)



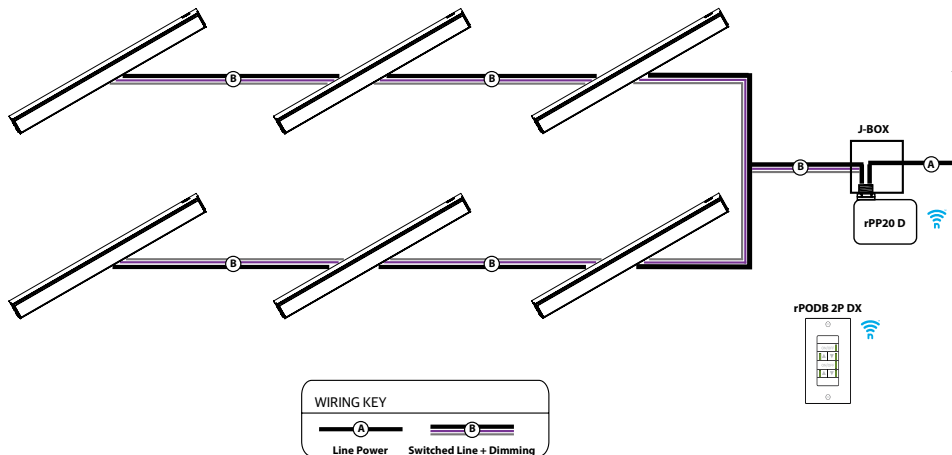
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Slot 2 LED
Recessed Linear

nLight Air Wireless

To Make fixture NLTAIR2 compatible the following components are required:

- 1) rpp20 D
- 2) rPODB 2P DX

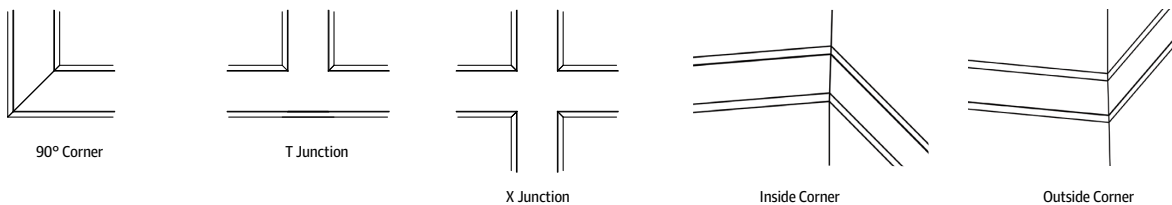


Continuous Runs

Slot 2 LED continuous rows can be configured in 1" increments.

Run Patterns, Corners and Junction

Slot 2 LED patterns be configured in 1' increments with illuminated 90° inside and outside corners, T junctions, and X junctions with standard 2' corner and junction lengths. For custom angles, corner or junction lengths, consult factory.



Layout Sketch

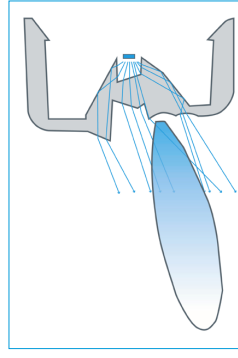
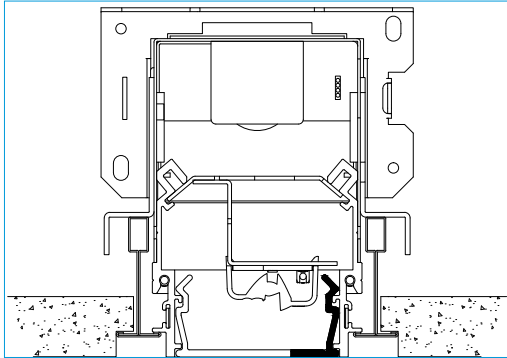
Please draw and configure your linear run below.

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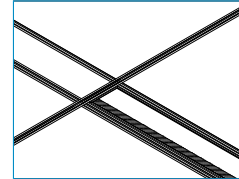
Slot 2 LED
Recessed Linear

OPTICS

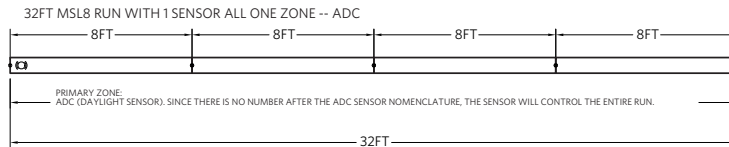
Slot LED's patent-pending, precision lumen DIRECTIR optics condition and refract light to deliver accurately controlled, striation-free, and uniform white light. All lumen DIRECTIR optics are injection-molded, optical grade, UV-resistant acrylic with selective finishing/polishing treatment.



Optional Wall Wash (WW)



INTEGRATED SENSOR LAYOUT



Notes:

- Only one sensor per zone

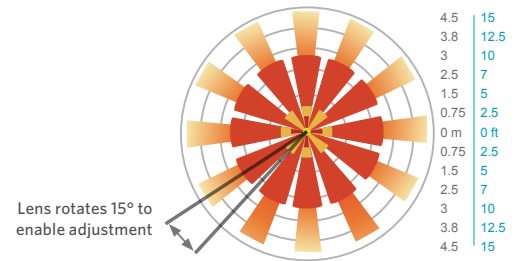
OCCUPANCY DETECTION COVERAGE

At the 7.5 ft (2.9 m) hanging height of a typical pendant mount fixture the sensor provides 10 ft (3.05 m) radial detection of small motion. At a 9 ft (2.74 m) hanging height the radius is 12 ft (3.66 m) for small motion.

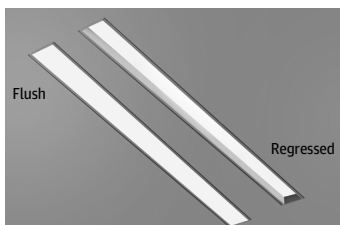
Adequate for walking motion detection from mounting heights between 7.5 ft (2.29 m) and 20 ft (6.10 m).

Initial detection will occur earlier when walking across sensor's field of view than when walking directly at sensor.

Initial detection of walking motion into long coverage segment will occur at distances of 2x the mounting height up to 15 ft (4.57 m) and 1.75x up to 20 ft (6.10 m). Lens assembly rotates 15° to enable adjustment in order to line up long segments.



MARK ARCHITECTURAL LIGHTING™



Slot 2 LED Recessed Linear

Slot 2 LED takes both form and function a step further with increased efficacy and integral controls creating a digitally addressable luminaire that is perfect where visually harmonious illumination and energy efficiency are desired.

Slot 2 LED is the ideal choice for spaces that emphasize lines and clean contemporary design. It is a perfect fit for Armstrong TechZone™ ceiling systems. A regressed lens option provides added dimension to the sleek, slender design and the flush lens now has a Wet Label option.

TYPE RL6

Type:

Project:

Catalog Number:

DO NOT TYPE HERE. Autopopulated field.

Specification Features

Housing

Nominal 2" x 2', 3', 4', 5', 6', 7', 8' and continuous rows in 1" increments as standard, upper housing fabricated from cold-rolled steel with extruded aluminum ceiling trim.

Finish

Painted high reflectance matte white powder coat.

Reflector

Precision-formed steel; high reflectance matte white powder coat; 93% reflectivity.

Shielding

Flush Lens: Snap-in 90% transmissive satin acrylic lens.

Regressed Lens: Lay-in 90% transmissive satin acrylic lens.

Mounting

Recessed. Available for sheetrock, 9/16" slot grid or 15/16" inverted tee ceilings, or 9/16" inverted tee.

Certification

CSA tested to UL 1598 standards. Optional Damp or Wet location listings available, see ordering tree. This product is IC rated.

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.

Specifications subject to change without notice.

Fixture Performance - SL2L*

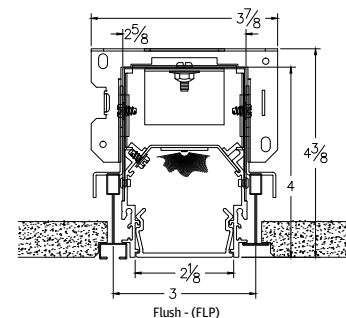
Lumens Output	400 LMF		600 LMF**		800LMF**		1000LMF	
Fixture Style	RLP	FLP	RLP	FLP	RLP	FLP	RLP	FLP
Delivered Lumens/FT	234	308	404	533	534	705	654	862
Input Watts/FT	4	4	6	6	8	8	11	11
Lumen/Watt	68	89	69	91	67	88	62	82

* CCT (35K)

* Consult factory for customized lumen output and wattage

**Based on calculated values

Technical Drawing



Declare.

LED Components

Linear: Nichia® - 757 Series LED chips (available in 80 or 90 CRI)

LED Life

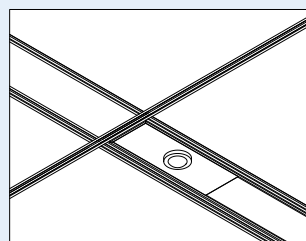
Rated 65,000 hours (L80) at 25 °C ambient temperature.

Color Consistency

The Acuity Brands circuit boards for the linear LED components use a precise binning algorithm which creates a consistent color temperature from board to board. Color variation is no greater than a 2.5 Step MacAdam (2.5SDCM) along the black body locus from board to board.

Driver

eldoLED constant current driver options delivers ultra-smooth dimming resolution from 100% to 0.1%, while assuring flicker free, low current inrush, 89% efficiency and low EMI.



Occupancy Sensor (PDT) and/or Photocell (ADC)

Integrated Controls

Optional nLight® embedded controls make luminaire addressable- allowing it to digitally communicate with other nLight enabled controls such as dimmers, switches, occupancy sensors and photocontrols. Simply connect all the nLight enabled control devices using standard CAT5 Cabling. (Input option: NLIGHT)

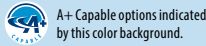
Photometry

For photometric information refer to www.marklighting.com.

TYPE RL6

MARK ARCHITECTURAL LIGHTING™

Slot 2 LED Recessed Linear



SEE LIGHTING PLANS FOR LUMINAIRE
QUANTITIES NEEDING EACH CEILING
TRIM TYPE.

Ordering

Example: SL2L LOP 4FT RLP FL 80CRI 30K 600LMF DARK 277 EC NLIGHT

Series	Linear Length Plan	Total Run Length	Fixture Style	Ceiling Trim	Direct Light Source Color Rendering
SL2L	Slot 2 LED Linear Recessed	LOP Linear Optimized Plan	2FT 2' 3FT 3' 4FT 4' 5FT 5' 6FT 6'	7FT 7' 8FT 8' _FT_ *Specify continuous linear feet in 1" increments (7FT6 = 7FT 6IN)	RLP ¹³ Regressed Lens FLP ¹⁴ Flush Lens
				FL ¹ 5/8" Flange(sheetrock) TG 9/16" or 15/16" Flat or Inverted Tee GB ¹ Trimless (sheetrock) WFL Perimeter Mount, 5/8" Flange (Sheetrock) WTG 9/16" Flat or Inverted Tee, Perimeter Mount <small>*For metal pan, hard wood or other ceiling types consult factory.</small>	80CRI 80 CRI 90CRI 90 CRI
Direct LED Color Temp	Direct LED Light Output	Direct Distribution	Minimum Dimming Level	Voltage	Finish
27K ⁶ 2700K 30K 3000K 35K 3500K 40K 4000K 50K ⁶ 5000K	400LMF 400 Lumens per FT 600LMF 600 Lumens per FT 800LMF 800 Lumens per FT 1000LMF 1000 Lumens per FT _LMF* ⁹ ## Lumens per FT (Limited to 300LMF to 1000LMF in 50LMF increments)	(blank) Standard Distribution WW ⁵ Wall Wash	NODIM Non - Dim MIN1 Constant current, dimming to 1% DARK Constant current, dimming to 0.1% MIN5 ⁶ Constant current, dimming to 5% MIN10 ¹⁵ Constant current, dimming to 10%	120 120V 277 277V 347 ⁷ 347V	(blank) White, textured xxx/BLKT Black, textured xxx/SLVT Silver, textured xxx/RALTB <u>RAL paint finish</u> <small>xxx = fill in with the appropriate ceiling trim. Only trims are painted. RALTB is for pricing only. Replace with applicable RAL number and texture when placing order.</small>
Emergency Options	Control Input	Primary Sensor ¹²	Secondary Sensor ¹²	Tertiary Zone	Options
(blank) No Emergency E10WLCP ⁸ Number of 4ft Emergency Section(s) with Battery pack _EC ¹⁰ # of Emergency Circuits	(blank) Non-dim ¹¹ 0 0V NLIGHT nLight enabled NLTAIR2 ¹⁷ nLight Air (Wireless Enabled) ECOD ^{16,18} Lutron Hi-Lume digital driver ECOD2 ¹⁶ Lutron Hi-Lume 2-wire (1% dimming) ECOD5 ^{16,18} Lutron 5-series digital driver (5% dimming) DALI ¹⁹ Dali	(blank) Single Zone, No Sensor NS Multi-zone, No Sensor Main Zone PDT ¹³ Dual Technology Occupancy Sensor, PIR and Microphonics Sensor ADC ¹³ Daylight Dimming Sensor API ¹⁴ Passive Infrared Occupancy Sensor and Daylight Dimming Sensor APD ¹⁴ Dual Technology Occupancy Sensor and Daylight Dimming Sensor	(blank) No additional zones/sensors SNS Multi-zone, with no sensor in secondary zone SPDT ¹³ Dual Technology Occupancy Sensor, PIR and Microphonics Sensor SADC ¹³ Daylight Dimming Sensor SAPI ¹⁴ Passive Infrared Occupancy Sensor and Daylight Dimming Sensor SAPD ¹⁴ Dual Technology Occupancy Sensor and Daylight Dimming Sensor	(blank) No additional zones/sensors TNS Multi-zone, with no sensor in tertiary zone	CP ¹⁸ Chicago Plenum USPOM US point of assembly WL ^{1,9} Wet Location Listing DPL Damp Location Listing PWS 6' Pre-Wire, 3/8" Diameter, 18 Gauge

* Requires longer lead time.

Notes

- Supplied with lift and shift lay-in lens.
- Supplied with snap-in lens.
- Wet Location label not available with regressed lens, sensor options or PWS. Cannot be installed on vertical surfaces.
- Not intended for post sheetrock installation.
- Wall wash not available with RLP lens or all sensor options.
- MIN5 requires ECOD5 Control Input. ECOD5 only available with MIN5 dimming.
- Not available with 2' sections, E10WLCP or sensors. Only available with NODIM or MIN1 with ZT.
- Default battery pack is integral, battery pack will be remote on 2' & 3' (RE10WLCP) if 5' or 6' unit, integral battery pack is only available with ZT or NLTAIR2. Battery will be remote with RLP, WW or sensors. Only 1 integral battery pack per unit. CP listing must have an integral battery. Remote batteries are not wet location listed, they may be used with a wet location fixture is the battery itself is mounted in a dry location.
- Not available with ECOD, ECOD2 and ECOD5.
- Standard 4' EC section, defaults to end of run. 2ft, 3ft and 5ft powers entire fixture, 6ft powers 3ft EC section.
- Only available with NODIM option.
- Sensors not available with WW, NODIM driver, WL, RLP, downlights or 2' or 3' units. Not available with 347 & NLIGHT together. Default location for sensor is the left side of the fixture. For runs, the first fixture will include the sensor.
- Requires ZT or NLIGHT Control Input.
- Requires ZT, NLIGHT or NLTAIR2 Control Input.
- MIN10 not available with 347, sensors, NLIGHT or NLTAIR2, requires ZT
- ECOD and ECOD2 not available with sensors, requires MIN1 dimming. Must use 120 volt for ECOD2.
- Must select MIN1 or DARK. Not available with RLP, WW, PDT, ADC or 347, DPL or WL. If with EC, cannot be on individual units, and on runs, the EC cannot be on the same section as NLTAIR2.
- CP not available with NLTAIR2.
- DALI is only available with DARK or MIN1. It is not available with sensors or downlights.

ELECTRICAL CONTRACTOR TO DETERMINE
APPROPRIATE MOUNTING HARDWARE & ACCESSORIES

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*

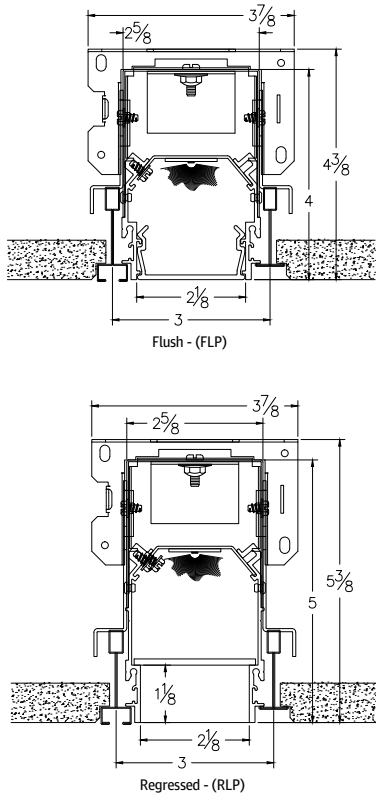
To learn more about A+, visit www.acuitybrands.com/aplus.

*See ordering tree for details

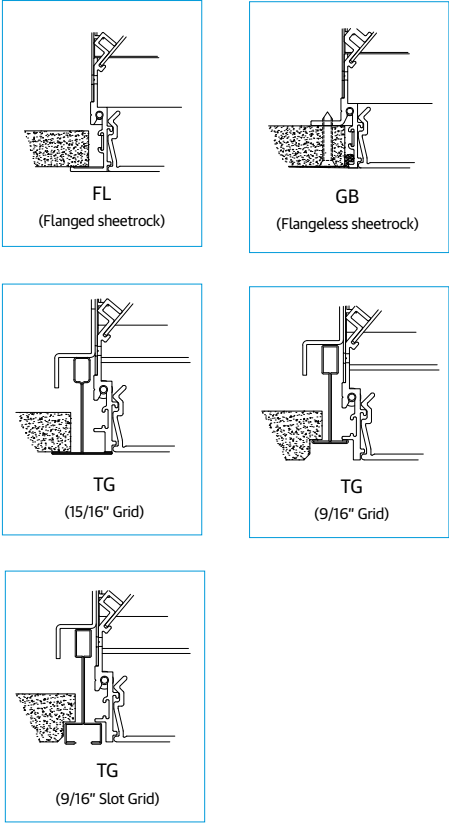
MARK
ARCHITECTURAL
LIGHTING™

Slot 2 LED
Recessed Linear

Technical Drawing

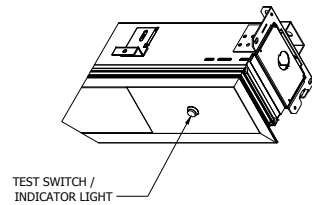


Ceiling Trim



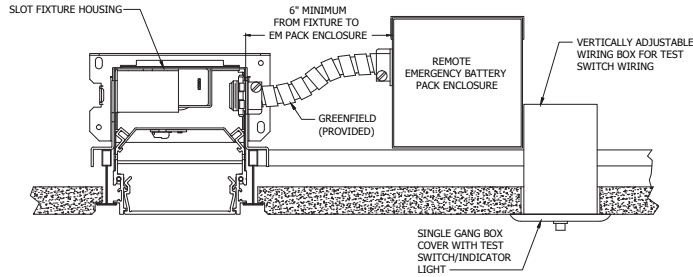
Emergency Battery

Internally Mounted (E10WLCP)



- Notes**
- Delivers 700 lumens per 4FT length. Default location is the right side of fixture and end of run.
 - Provided with 4FT of flexible conduit. Maximum of 25FT remote distance if extended. Extension provided by others.
 - See ordering tree notes for remote battery pack scenarios.

Remote Mounted (RE10WLCP)



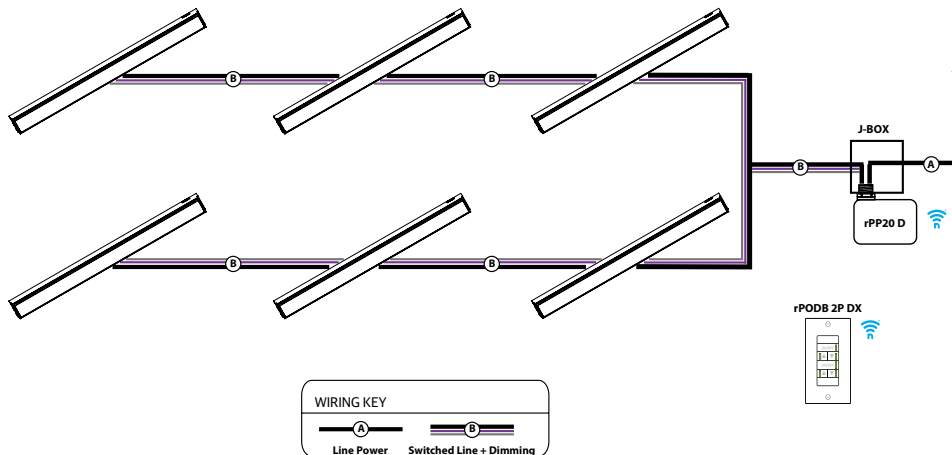
MARK ARCHITECTURAL LIGHTING™

Slot 2 LED Recessed Linear

nLight Air Wireless

To Make fixture NLTAIR2 compatible the following components are required:

- 1) rpp20 D
- 2) rPODB 2P DX

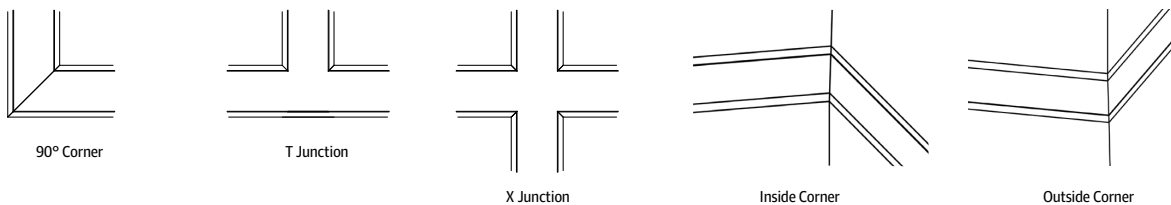


Continuous Runs

Slot 2 LED continuous rows can be configured in 1" increments.

Run Patterns, Corners and Junction

Slot 2 LED patterns be configured in 1' increments with illuminated 90° inside and outside corners, T junctions, and X junctions with standard 2' corner and junction lengths. For custom angles, corner or junction lengths, consult factory.



Layout Sketch

Please draw and configure your linear run below.

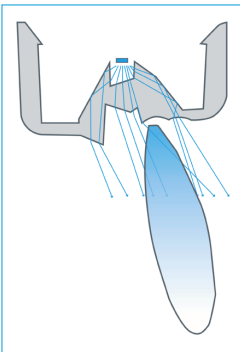
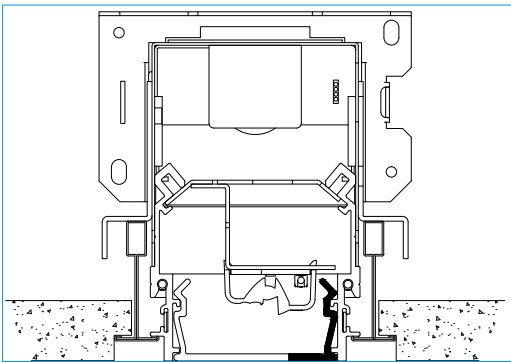
TYPE RL6

MARK
ARCHITECTURAL
LIGHTING™

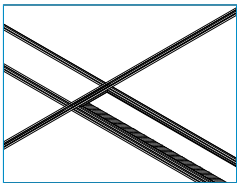
Slot 2 LED
Recessed Linear

OPTICS

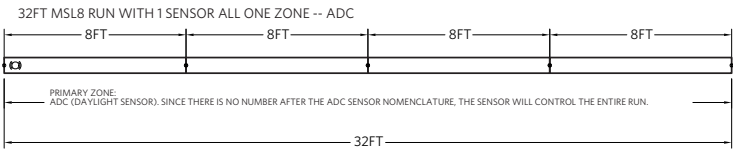
Slot LED's patent-pending, precision lumen DIRECTIR optics condition and refract light to deliver accurately controlled, striation-free, and uniform white light. All lumen DIRECTIR optics are injection-molded, optical grade, UV-resistant acrylic with selective finishing/polishing treatment.



Optional Wall Wash (WW)



INTEGRATED SENSOR LAYOUT



Notes:
● Only one sensor per zone

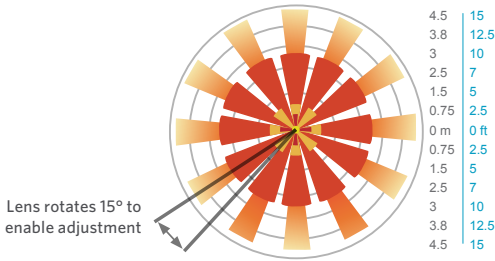
OCCUPANCY DETECTION COVERAGE

At the 7.5 ft (2.9 m) hanging height of a typical pendant mount fixture the sensor provides 10 ft (3.05 m) radial detection of small motion. At a 9 ft (2.74 m) hanging height the radius is 12 ft (3.66 m) for small motion.

Adequate for walking motion detection from mounting heights between 7.5 ft (2.29 m) and 20 ft (6.10 m).

Initial detection will occur earlier when walking across sensor's field of view than when walking directly at sensor.

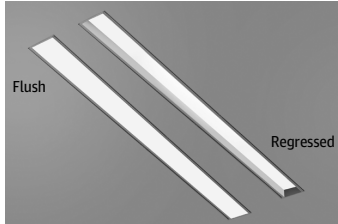
Initial detection of walking motion into long coverage segment will occur at distances of 2x the mounting height up to 15 ft (4.57 m) and 1.75x up to 20 ft (6.10 m). Lens assembly rotates 15° to enable adjustment in order to line up long segments.



TYPE RL8

MARK ARCHITECTURAL LIGHTING™

Slot 2 LED Recessed Linear



Slot 2 LED takes both form and function a step further with increased efficacy and integral controls creating a digitally addressable luminaire that is perfect where visually harmonious illumination and energy efficiency are desired.

Slot 2 LED is the ideal choice for spaces that emphasize lines and clean contemporary design. It is a perfect fit for Armstrong TechZone™ ceiling systems. A regressed lens option provides added dimension to the sleek, slender design and the flush lens now has a Wet Label option.

Type:

Project:

Catalog Number:

DO NOT TYPE HERE. Autopopulated field.

Specification Features

Housing

Nominal 2" x 2', 3', 4', 5', 6', 7', 8' and continuous rows in 1" increments as standard, upper housing fabricated from cold-rolled steel with extruded aluminum ceiling trim.

Finish

Painted high reflectance matte white powder coat.

Reflector

Precision-formed steel; high reflectance matte white powder coat; 93% reflectivity.

Shielding

Flush Lens: Snap-in 90% transmissive satin acrylic lens.

Regressed Lens: Lay-in 90% transmissive satin acrylic lens.

Mounting

Recessed. Available for sheetrock, 9/16" slot grid or 15/16" inverted tee ceilings, or 9/16" inverted tee.

Certification

CSA tested to UL 1598 standards. Optional Damp or Wet location listings available, see ordering tree. This product is IC rated.

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. Specifications subject to change without notice.

Fixture Performance - SL2L*

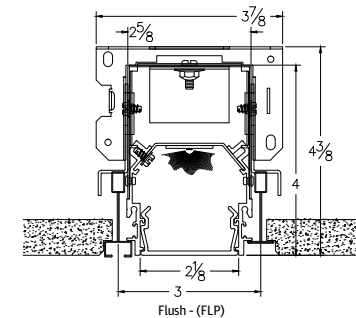
Lumens Output	400 LMF		600 LMF**		800LMF**		1000LMF	
Fixture Style	RLP	FLP	RLP	FLP	RLP	FLP	RLP	FLP
Delivered Lumens/FT	234	308	404	533	534	705	654	862
Input Watts/FT	4	4	6	6	8	8	11	11
Lumen/Watt	68	89	69	91	67	88	62	82

* CCT (35K)

* Consult factory for customized lumen output and wattage

**Based on calculated values

Technical Drawing



Declare.

LED Components

Linear: Nichia® - 757 Series LED chips (available in 80 or 90 CRI)

LED Life

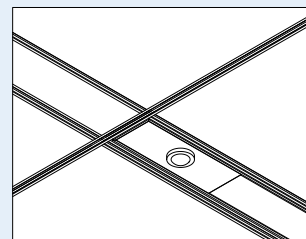
Rated 65,000 hours (L80) at 25 °C ambient temperature.

Color Consistency

The Acuity Brands circuit boards for the linear LED components use a precise binning algorithm which creates a consistent color temperature from board to board. Color variation is no greater than a 2.5 Step MacAdam (2.5SDCM) along the black body locus from board to board.

Driver

eldoLED constant current driver options delivers ultra-smooth dimming resolution from 100% to 0.1%, while assuring flicker free, low current inrush, 89% efficiency and low EMI.



Occupancy Sensor (PDT) and/or Photocell (ADC)

Integrated Controls

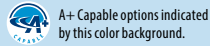
Optional nLight® embedded controls make luminaire addressable- allowing it to digitally communicate with other nLight enabled controls such as dimmers, switches, occupancy sensors and photocontrols. Simply connect all the nLight enabled control devices using standard CAT5 Cabling. (Input option: NLIGHT)

Photometry

For photometric information refer to www.marklighting.com.

MARK ARCHITECTURAL LIGHTING™

Slot 2 LED Recessed Linear



FIXTURE LENGTH IS NOMINAL. EC TO FIELD MEASURE AVAILABLE
SOFFIT SPACE & VERIFY FIXTURE LENGTH WITH ARCHITECT
PRIOR TO PLACING ORDER

Ordering

Example: SL2L LOP 4FT FLP FL 80CRI 30K 600LMF DARK 277 EC NLIGHT

Series		Linear Length Plan		Total Run Length		Fixture Style		Ceiling Trim		Direct Light Source Color Rendering			
SL2L	Slot 2 LED Linear Recessed	LOP	Linear Optimized Plan	2FT 2' 3FT 3' 4FT 4' 5FT 5' 6FT 6'	7FT 7' 8FT 8' _FT_	RLP ¹³ Regressed Lens FLP ¹⁴ Flush Lens	FL ⁴ 5/8" Flange(sheetrock) TG 9/16" or 15/16" Flat or Inverted Tee GB ⁴ Trimless (sheetrock) WFL Perimeter Mount, 5/8" Flange (Sheetrock) WTG 9/16" Flat or Inverted Tee, Perimeter Mount	80CRI 80 CRI 90CRI 90 CRI					
						*Specify continuous linear feet in 1" increments (7FT6 = 7FT 6IN)							
						*For metal pan, hard wood or other ceiling types consult factory.							
Direct LED Color Temp		Direct LED Light Output		Direct Distribution		Minimum Dimming Level		Voltage		Finish		Emergency Options	
27K* 2700K 30K 3000K 35K 3500K 40K 4000K 50K* 5000K	400LMF 400 Lumens per FT 600LMF 600 Lumens per FT 800LMF 800 Lumens per FT 1000LMF 1000 Lumens per FT _LMF* ⁹ ## Lumens per FT (Limited to 300LMF to 1000LMF in 50LMF increments)	(blank) Standard Distribution WW ⁵ Wall Wash	NODIM Non - Dim MIN1 Constant current, dimming to 1% DARK Constant current, dimming to 0.1% MINS ⁶ Constant current, dimming to 5% MIN10 ¹⁵ Constant current, dimming to 10%	120 120V 277 277V 347 ⁷ 347V	(blank) White, textured xxx/BLKT Black, textured xxx/SLVT Silver, textured xxx/RALTB ⁸ RAL paint finish xxx = fill in with the appropriate ceiling trim. Only trims are painted. RALTB ⁸ is for pricing only. Replace with applicable RAL number and texture when placing order.	(blank) No Emergency _E10WLCP ⁸ Number of 4ft Emergency Section(s) with battery pack _EC ⁹ # of Emergency Circuits							
Control Input		Primary Sensor ¹²		Secondary Sensor ¹²		Tertiary Zone		Options					
(blank) Non-dim ¹¹ 2T 0 10V NLIGHT nLight enabled NLTAIR2 ¹⁷ nLight Air (Wireless Enabled) ECOD ^{16,18} Lutron Hi-Lume digital driver ECOD2 ^{16,18} Lutron Hi-Lume 2-wire (1% dimming) ECOD5 ^{16,4} Lutron 5-series digital driver (5% dimming) DALI ¹⁹ Dali	(blank) Single Zone, No Sensor NS Multi-zone, No Sensor Main Zone PDT ¹³ Dual Technology Occupancy Sensor, PIR and Microphonics Sensor ADC ¹³ Daylight Dimming Sensor API ¹⁴ Passive Infrared Occupancy Sensor and Daylight Dimming Sensor APD ¹⁴ Dual Technology Occupancy Sensor and Daylight Dimming Sensor	(blank) No additional zones/sensors SNS Multi-zone, with no sensor in secondary zone SPDT ¹³ Dual Technology Occupancy Sensor, PIR and Microphonics Sensor SADC ¹³ Daylight Dimming Sensor SAPI ¹⁴ Passive Infrared Occupancy Sensor and Daylight Dimming Sensor SAPD ¹⁴ Dual Technology Occupancy Sensor and Daylight Dimming Sensor	(blank) No additional zones/sensors TNS Multi-zone, with no sensor in tertiary zone	CP ¹⁸ Chicago Plenum USPOM US point of assembly WL ^{1,9} Wet Location Listing DPL Damp Location Listing PWS 6' Pre-Wire, 3/8" Diameter, 18 Gauge									

* Requires longer lead time.

Notes

- Supplied with lift and shift lay-in lens.
- Supplied with snap-in lens.
- Wet Location label not available with regressed lens, sensor options or PWS. Cannot be installed on vertical surfaces.
- Not intended for post sheetrock installation.
- Wall wash not available with RLP lens or all sensor options.
- MINS requires ECOD5 Control Input. ECOD5 only available with MINS dimming.
- Not available with 2' sections, E10WLCP or sensors. Only available with NODIM or MIN1 with ZT.
- Default battery pack is integral, battery pack will be remote on 2' & 3' (RE10WLCP) if 5' or 6' unit, integral battery pack is only available with ZT or NLTAIR2. Battery will be remote with RLP, WW or sensors. Only 1 integral battery pack per unit. CP listing must have an integral battery. Remote batteries are not wet location listed, they may be used with a wet location fixture is the battery itself is mounted in a dry location.
- Not available with ECOD, ECOD2 and ECOD5.
- Standard 4' EC section, defaults to end of run. 2ft, 3ft and 5ft powers entire fixture, 6ft powers 3ft EC section.
- Only available with NODIM option.
- Sensors not available with WW, NODIM driver, WL, RLP, downlights or 2' or 3' units. Not available with 347 & NLIGHT together. Default location for sensor is the left side of the fixture. For runs, the first fixture will include the sensor.
- Requires ZT or NLIGHT Control Input.
- Requires ZT, NLIGHT or NLTAIR2 Control Input.
- MIN10 not available with 347, sensors, NLIGHT or NLTAIR2, requires ZT
- ECOD and ECOD2 not available with sensors, requires MIN1 dimming. Must use 120 volt for ECOD2.
- Must select MIN1 or DARK. Not available with RLP, WW, PDT, ADC or 347, DPL or WL. If with EC, cannot be on individual units, and on runs, the EC cannot be on the same section as NLTAIR2.
- CP not available with NLTAIR2.
- DALI is only available with DARK or MIN1. It is not available with sensors or downlights.

ELECTRICAL CONTRACTOR TO DETERMINE
APPROPRIATE MOUNTING HARDWARE & ACCESSORIES

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

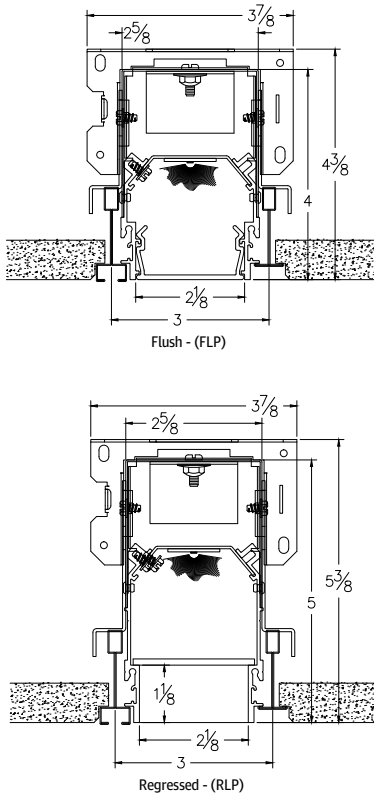
MARK

ARCHITECTURAL LIGHTING™

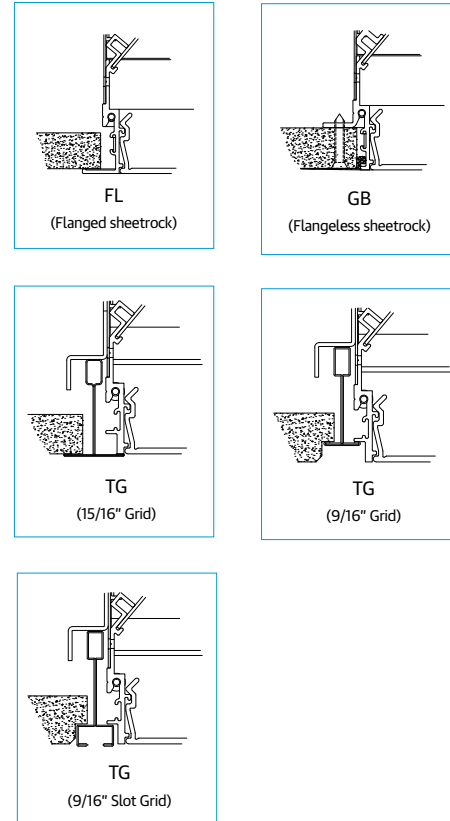
Slot 2 LED

Recessed Linear

Technical Drawing

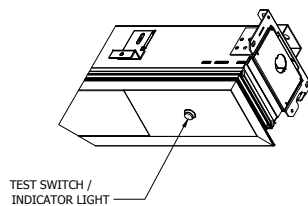


Ceiling Trim



Emergency Battery

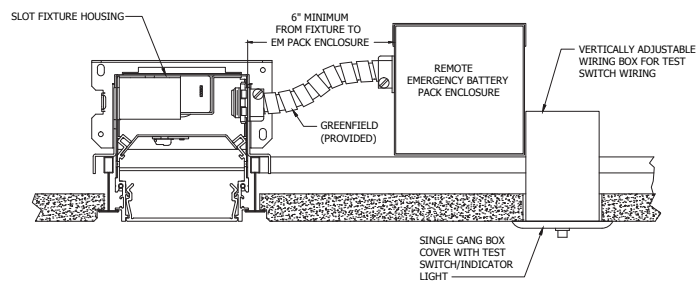
Internally Mounted (E10WLCP)



Notes

- Delivers 700 lumens per 4FT length. Default location is the right side of fixture and end of run.
- Provided with 4FT of flexible conduit. Maximum of 25FT remote distance if extended. Extension provided by others.
- See ordering tree notes for remote battery pack scenarios.

Remote Mounted (RE10WLCP)



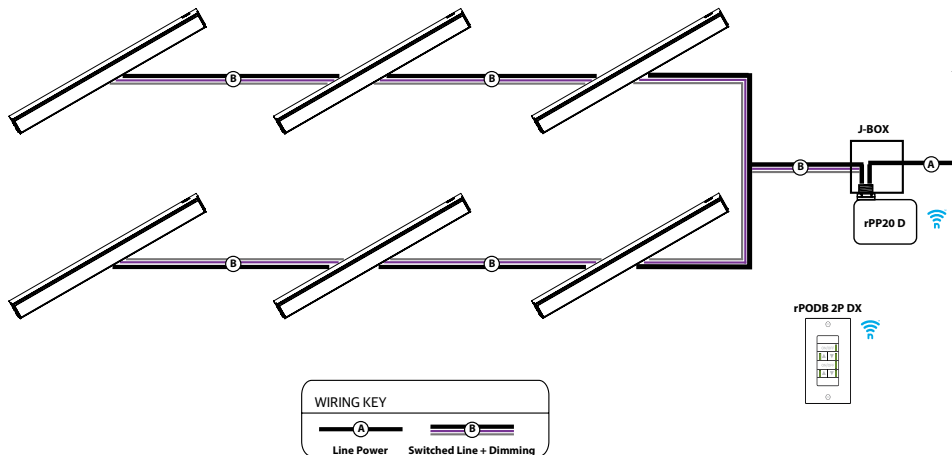
MARK ARCHITECTURAL LIGHTING™

Slot 2 LED Recessed Linear

nLight Air Wireless

To Make fixture NLTAIR2 compatible the following components are required:

- 1) rpp20 D
- 2) rPODB 2P DX

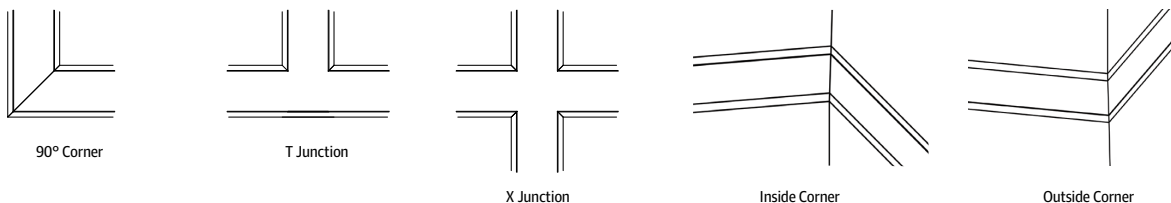


Continuous Runs

Slot 2 LED continuous rows can be configured in 1" increments.

Run Patterns, Corners and Junction

Slot 2 LED patterns be configured in 1' increments with illuminated 90° inside and outside corners, T junctions, and X junctions with standard 2' corner and junction lengths. For custom angles, corner or junction lengths, consult factory.



Layout Sketch

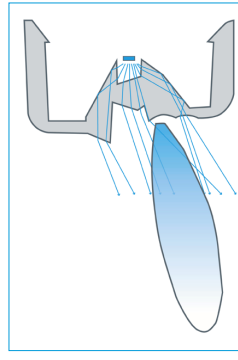
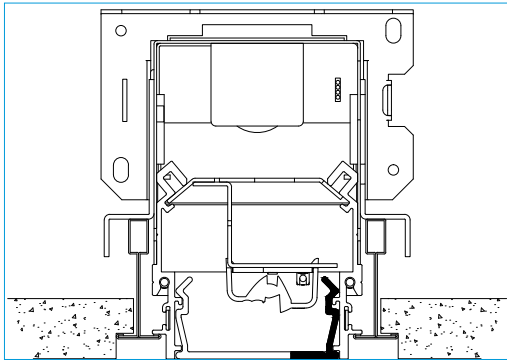
Please draw and configure your linear run below.

MARK
ARCHITECTURAL
LIGHTING™

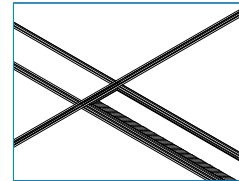
Slot 2 LED
Recessed Linear

OPTICS

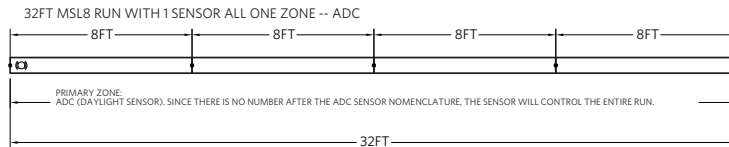
Slot LED's patent-pending, precision lumen DIRECTIR optics condition and refract light to deliver accurately controlled, striation-free, and uniform white light. All lumen DIRECTIR optics are injection-molded, optical grade, UV-resistant acrylic with selective finishing/polishing treatment.



Optional Wall Wash (WW)



INTEGRATED SENSOR LAYOUT



Notes:
• Only one sensor per zone

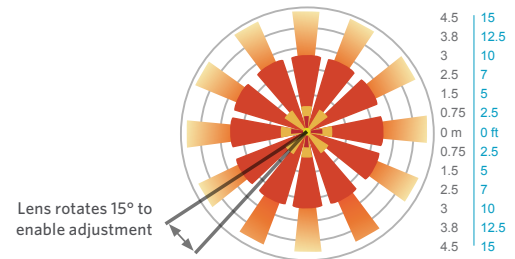
OCCUPANCY DETECTION COVERAGE

At the 7.5 ft (2.9 m) hanging height of a typical pendant mount fixture the sensor provides 10 ft (3.05 m) radial detection of small motion. At a 9 ft (2.74 m) hanging height the radius is 12 ft (3.66 m) for small motion.

Adequate for walking motion detection from mounting heights between 7.5 ft (2.29 m) and 20 ft (6.10 m).

Initial detection will occur earlier when walking across sensor's field of view than when walking directly at sensor.

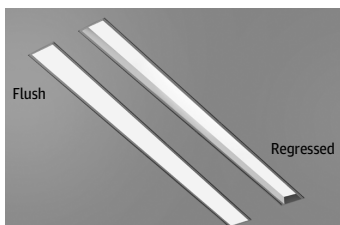
Initial detection of walking motion into long coverage segment will occur at distances of 2x the mounting height up to 15 ft (4.57 m) and 1.75x up to 20 ft (6.10 m). Lens assembly rotates 15° to enable adjustment in order to line up long segments.



TYPE RL15

MARK

ARCHITECTURAL LIGHTING™



Slot 2 LED

Recessed Linear

Slot 2 LED takes both form and function a step further with increased efficacy and integral controls creating a digitally addressable luminaire that is perfect where visually harmonious illumination and energy efficiency are desired.

Slot 2 LED is the ideal choice for spaces that emphasize lines and clean contemporary design. It is a perfect fit for Armstrong TechZone™ ceiling systems. A regressed lens option provides added dimension to the sleek, slender design and the flush lens now has a Wet Label option.

Type:

Project:

Catalog Number:

DO NOT TYPE HERE. Autopopulated field.

Specification Features

Housing

Nominal 2" x 2', 3', 4', 5', 6', 7', 8' and continuous rows in 1" increments as standard, upper housing fabricated from cold-rolled steel with extruded aluminum ceiling trim.

Finish

Painted high reflectance matte white powder coat.

Reflector

Precision-formed steel; high reflectance matte white powder coat; 93% reflectivity.

Shielding

Flush Lens: Snap-in 90% transmissive satin acrylic lens.

Regressed Lens: Lay-in 90% transmissive satin acrylic lens.

Mounting

Recessed. Available for sheetrock, 9/16" slot grid or 15/16" inverted tee ceilings, or 9/16" inverted tee.

Certification

CSA tested to UL 1598 standards. Optional Damp or Wet location listings available, see ordering tree. This product is IC rated.

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.

Specifications subject to change without notice.

Fixture Performance - SL2L*

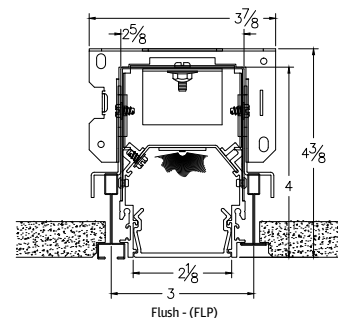
Lumens Output	400 LMF		600 LMF**		800LMF**		1000LMF	
Fixture Style	RLP	FLP	RLP	FLP	RLP	FLP	RLP	FLP
Delivered Lumens/FT	234	308	404	533	534	705	654	862
Input Watts/FT	4	4	6	6	8	8	11	11
Lumen/Watt	68	89	69	91	67	88	62	82

* CCT (35K)

* Consult factory for customized lumen output and wattage

**Based on calculated values

Technical Drawing



Declare.

LED Components

Linear: Nichia® - 757 Series LED chips (available in 80 or 90 CRI)

LED Life

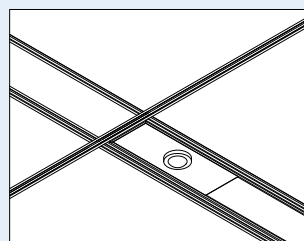
Rated 65,000 hours (L80) at 25 °C ambient temperature.

Color Consistency

The Acuity Brands circuit boards for the linear LED components use a precise binning algorithm which creates a consistent color temperature from board to board. Color variation is no greater than a 2.5 Step MacAdam (2.5SDCM) along the black body locus from board to board.

Driver

eldoLED constant current driver options delivers ultra-smooth dimming resolution from 100% to 0.1%, while assuring flicker free, low current inrush, 89% efficiency and low EMI.



Occupancy Sensor (PDT) and/or Photocell (ADC)

Integrated Controls

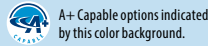
Optional nLight® embedded controls make luminaire addressable- allowing it to digitally communicate with other nLight enabled controls such as dimmers, switches, occupancy sensors and photocontrols. Simply connect all the nLight enabled control devices using standard CAT5 Cabling. (Input option: NLIGHT)

Photometry

For photometric information refer to www.marklighting.com.

MARK ARCHITECTURAL LIGHTING™

Slot 2 LED Recessed Linear



FIXTURE LENGTH IS NOMINAL. EC TO FIELD MEASURE AVAILABLE
SOFFIT SPACE & VERIFY FIXTURE LENGTH WITH ARCHITECT
PRIOR TO PLACING ORDER

Ordering

Example: SL2L LOP 4FT FLP FL 80CRI 30K 600LMF DARK 277 EC NLIGHT

Series		Linear Length Plan		Total Run Length		Fixture Style		Ceiling Trim		Direct Light Source Color Rendering			
SL2L	Slot 2 LED Linear Recessed	LOP	Linear Optimized Plan	2FT 2'	7FT 7'	RLP ^{1,3}	Regressed Lens	FL ⁴	5/8" Flange(sheetrock)	80CRI	80 CRI		
				3FT 3'	8FT 8'	FLP ²	Flush Lens	TG	9/16" or 15/16" Flat or Inverted Tee	90CRI	90 CRI		
				4FT 4'	*Specify continuous linear feet in 1" increments (7FT6 = 7FT 6IN)			GB ⁴	Trimless (sheetrock)				
				5FT 5'				WFL	Perimeter Mount, 5/8" Flange (Sheetrock)				
				6FT 6'				WTG	9/16" Flat or Inverted Tee, Perimeter Mount				
										*For metal pan, hard wood or other ceiling types consult factory.			
Direct LED Color Temp		Direct LED Light Output		Direct Distribution		Minimum Dimming Level		Voltage		Finish		Emergency Options	
27K* 2700K	400LMF 400 Lumens per FT	(blank)	Standard Distribution	NODIM	Non - Dim	120	120V	(blank)	White, textured	(blank)	No Emergency		
30K 3000K	600LMF 600 Lumens per FT		Distribution	MIN1	Constant current, dimming to 1%	277	277V	xxx/BLKT	Black, textured	E10WLCP ⁸	Number of 4ft Emergency Section(s) with battery pack		
35K 3500K	800LMF 800 Lumens per FT	WW ⁵	Wall Wash	DARK	Constant current, dimming to 0.1%		347V	xxx/SLVT	Silver, textured	EC ⁹	# of Emergency Circuits		
40K 4000K	1000LMF 1000 Lumens per FT			MIN5 ⁶	Constant current, dimming to 5%			xxx/RALTB	RAL paint finish				
50K* 5000K	LMF* ⁹ ## Lumens per FT (Limited to 300LMF to 1000LMF in 50LMF increments)			MIN10 ¹⁵	Constant current, dimming to 10%			xxx = fill in with the appropriate ceiling trim. Only trims are painted. RALTB is for pricing only. Replace with applicable RAL number and texture when placing order.					
Control Input		Primary Sensor ¹²		Secondary Sensor ¹²		Tertiary Zone		Options					
(blank) Non-dim ¹¹		(blank) Single Zone, No Sensor		(blank) No additional zones/sensors		(blank) No additional zones/sensors		CP ¹⁸	Chicago Plenum				
2T 0 10V		NS Multi-zone, No Sensor Main Zone		SNS Multi-zone, with no sensor in secondary zone		TNS Multi-zone, with no sensor in tertiary zone		USPOM	US point of assembly				
NLIGHT nLight enabled		PDT ¹³ Dual Technology Occupancy Sensor, PIR and Microphonics Sensor		SPDT ¹³ Dual Technology Occupancy Sensor, PIR and Microphonics Sensor				WL ^{1,9}	Wet Location Listing				
NLTAIR2 ¹⁷ nLight Air (Wireless Enabled)		ADC ¹³ Daylight Dimming Sensor		SADC ¹³ Daylight Dimming Sensor				DPL	Damp Location Listing				
ECOD ^{*,16} Lutron Hi-Lume digital driver		API ¹⁴ Passive Infrared Occupancy Sensor and Daylight Dimming Sensor		SAPI ¹⁴ Passive Infrared Occupancy Sensor and Daylight Dimming Sensor				PWS	6' Pre-Wire, 3/8" Diameter, 18 Gauge				
ECOD2 ^{*,16} Lutron Hi-Lume 2-wire (1% dimming)		APD ¹⁴ Dual Technology Occupancy Sensor and Daylight Dimming Sensor		SAPD ¹⁴ Dual Technology Occupancy Sensor and Daylight Dimming Sensor									
ECOD5 ^{*,16} Lutron 5-series digital driver (5% dimming)													
DALI ¹⁹ Dali													

* Requires longer lead time.

Notes

- Supplied with lift and shift lay-in lens.
- Supplied with snap-in lens.
- Wet Location label not available with regressed lens, sensor options or PWS. Cannot be installed on vertical surfaces.
- Not intended for post sheetrock installation.
- Wall wash not available with RLP lens or all sensor options.
- MIN5 requires ECOD5 Control Input. ECOD5 only available with MIN5 dimming.
- Not available with 2' sections, E10WLCP or sensors. Only available with NODIM or MIN1 with ZT.
- Default battery pack is integral, battery pack will be remote on 2' & 3' (RE10WLCP) if 5' or 6' unit, integral battery pack is only available with ZT or NLTAIR2. Battery will be remote with RLP, WW or sensors. Only 1 integral battery pack per unit. CP listing must have an integral battery. Remote batteries are not wet location listed, they may be used with a wet location fixture is the battery itself is mounted in a dry location.
- Not available with ECOD, ECOD2 and ECOD5.
- Standard 4' EC section, defaults to end of run. 2ft, 3ft and 5ft powers entire fixture, 6ft powers 3ft EC section.
- Only available with NODIM option.
- Sensors not available with WW, NODIM driver, WL, RLP, downlights or 2' or 3' units. Not available with 347 & NLIGHT together. Default location for sensor is the left side of the fixture. For runs, the first fixture will include the sensor.
- Requires ZT or NLIGHT Control Input.
- Requires ZT, NLIGHT or NLTAIR2 Control Input.
- MIN10 not available with 347, sensors, NLIGHT or NLTAIR2, requires ZT
- ECOD and ECOD2 not available with sensors, requires MIN1 dimming. Must use 120 volt for ECOD2.
- Must select MIN1 or DARK. Not available with RLP, WW, PDT, ADC or 347, DPL or WL. If with EC, cannot be on individual units, and on runs, the EC cannot be on the same section as NLTAIR2.
- CP not available with NLTAIR2.
- DALI is only available with DARK or MIN1. It is not available with sensors or downlights.

ELECTRICAL CONTRACTOR TO DETERMINE
APPROPRIATE MOUNTING HARDWARE & ACCESSORIES

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*

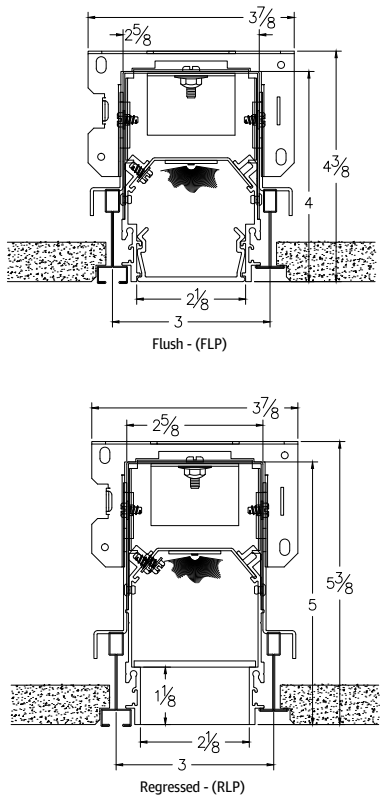
To learn more about A+, visit www.acuitybrands.com/aplus.

*See ordering tree for details

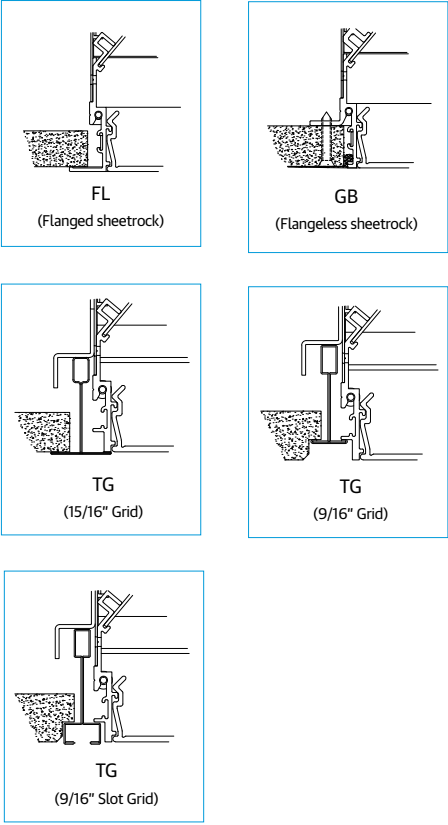
MARK
ARCHITECTURAL
LIGHTING™

Slot 2 LED
Recessed Linear

Technical Drawing

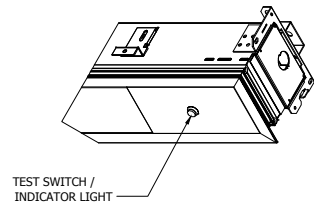


Ceiling Trim



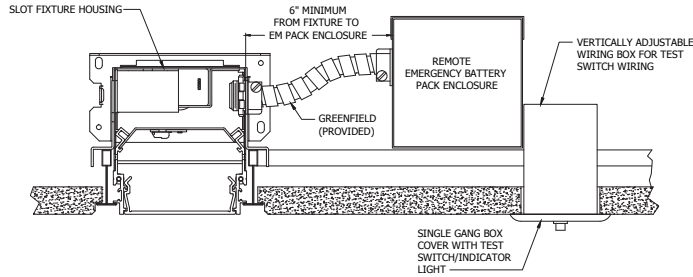
Emergency Battery

Internally Mounted (E10WLCP)



- Notes
- Delivers 700 lumens per 4FT length. Default location is the right side of fixture and end of run.
 - Provided with 4FT of flexible conduit. Maximum of 25FT remote distance if extended. Extension provided by others.
 - See ordering tree notes for remote battery pack scenarios.

Remote Mounted (RE10WLCP)



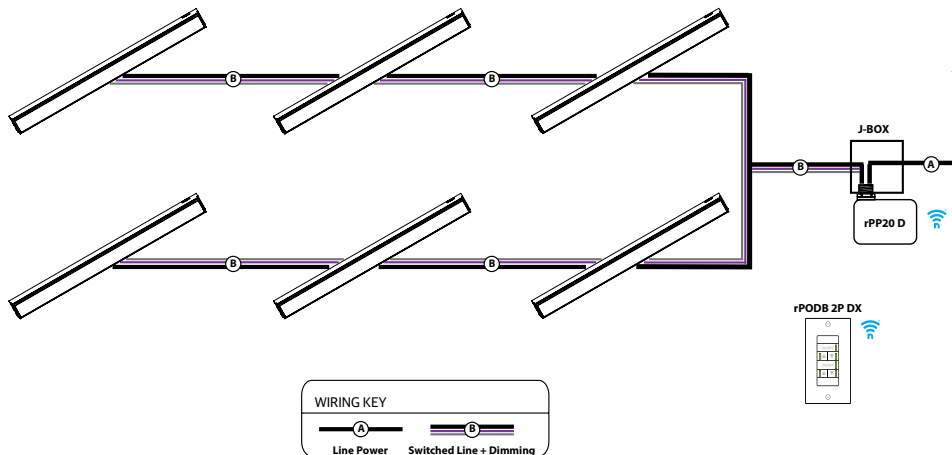
MARK ARCHITECTURAL LIGHTING™

Slot 2 LED Recessed Linear

nLight Air Wireless

To Make fixture NLTAIR2 compatible the following components are required:

- 1) rpp20 D
- 2) rPODB 2P DX

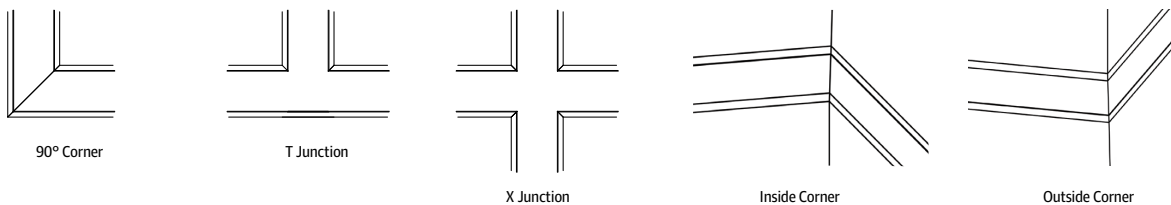


Continuous Runs

Slot 2 LED continuous rows can be configured in 1" increments.

Run Patterns, Corners and Junction

Slot 2 LED patterns be configured in 1' increments with illuminated 90° inside and outside corners, T junctions, and X junctions with standard 2' corner and junction lengths. For custom angles, corner or junction lengths, consult factory.



Layout Sketch

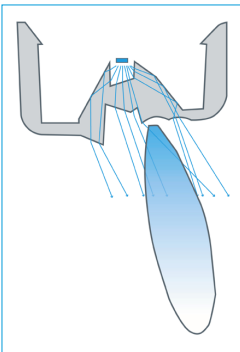
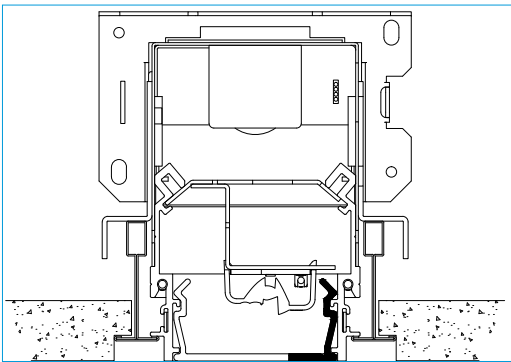
Please draw and configure your linear run below.

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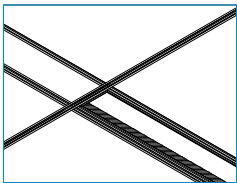
Slot 2 LED
Recessed Linear

OPTICS

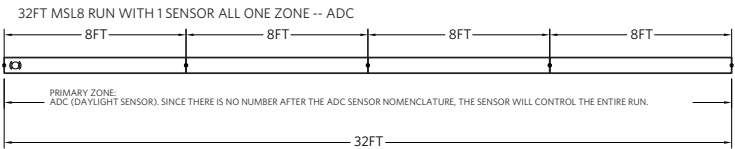
Slot LED's patent-pending, precision lumen DIRECTIR optics condition and refract light to deliver accurately controlled, striation-free, and uniform white light. All lumen DIRECTIR optics are injection-molded, optical grade, UV-resistant acrylic with selective finishing/polishing treatment.



Optional Wall Wash (WW)



INTEGRATED SENSOR LAYOUT



Notes:
• Only one sensor per zone

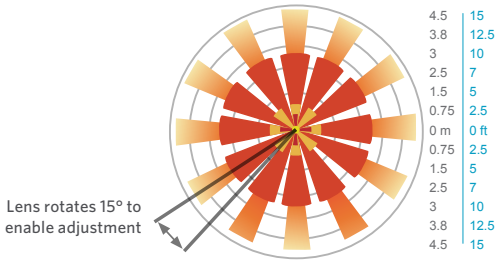
OCCUPANCY DETECTION COVERAGE

At the 7.5 ft (2.9 m) hanging height of a typical pendant mount fixture the sensor provides 10 ft (3.05 m) radial detection of small motion. At a 9 ft (2.74 m) hanging height the radius is 12 ft (3.66 m) for small motion.

Adequate for walking motion detection from mounting heights between 7.5 ft (2.29 m) and 20 ft (6.10 m).

Initial detection will occur earlier when walking across sensor's field of view than when walking directly at sensor.

Initial detection of walking motion into long coverage segment will occur at distances of 2x the mounting height up to 15 ft (4.57 m) and 1.75x up to 20 ft (6.10 m). Lens assembly rotates 15° to enable adjustment in order to line up long segments.



TYPE S1A



Project: _____

Fixture Type: _____

Location: _____

Contact/Phone: _____

JUNO SLIMFORM™ LED SURFACE MOUNT DOWNLIGHTS

FOR J-BOX INSTALLATION

5" 7", 11", 13" ROUND

JSF SERIES



PRODUCT DESCRIPTION

Sleek, ultra-low profile energy efficient LED surface mount downlights in multiple sizes from 5" to 13" • Provides economical installation by mounting directly over standard and fire-rated junction boxes • Optional finish trims and shrouds available for custom, designer look similar to standard recessed downlights • Provides general illumination in residential and commercial applications including multi-family and hospitality • Ideal for use in corridors, living spaces, closets, hallways, pantries, stairways, outdoor covered areas without Emergency Option and much more.

PRODUCT SPECIFICATIONS

Construction Shallow, less than 1", solid ring with white finish • Non conductive fixture for shower light applications • Optional, field installable finish trims available for 5" and 7" versions to change the exterior finish of fixture • Optional, field installable decorative baffle and cone shrouds for 5" and 7" versions provide the aesthetic and source shielding similar to the experience of a fully recessed downlight.

Optics Light guide technology combined with diffusing lens conceals the LEDs from direct view and provides uniform lens luminance.

LED Light Engine LEDs mounted directly to heatsink designed to provide superior thermal management and ensure long life • 2700K, 3000K, 3500K or 4000K LED color temperature • LEDs binned for 4-step MacAdam ellipse color consistency • 90 CRI minimum.

LED Driver Choice of dedicated 120 volt (120) driver or universal voltage (MVOLT) driver that accommodates input voltages from 120-277 volts AC at 50/60Hz • Power factor > 0.9 at 120V input • 120 volt driver is dimmable with the use of most incandescent, magnetic low voltage and electronic low voltage wall box dimmers • Universal voltage driver is dimmable with the use of most 0-10V wall box dimmers • External driver is only available on 5" and 7" models • For a list of compatible dimmers, see [JUNOSLIMFORM-DIM](#).

Emergency Battery Option Available on fixture sizes 11" and larger • Battery factory assembled to fixture with integral test switch (EL option) • Drives LEDs for 90 minutes to meet Life Safety Code (NFPA-LSC), National Electrical Code (NEC), and UL requirements • Emergency battery not available in California due to Title 20 restrictions • EBX option provides back box without battery for consistent look when used in same space as fixtures with EL emergency option • Damp location only with emergency option.

Life Rated for 50,000 hours at >70% lumen maintenance.

Labels ENERGY STAR® certified • Certified to the high efficacy requirements of California T24 JA8-2016 • CSA listed for US and Canada • Suitable for wet locations (covered ceilings) • Damp location only with emergency option.

Testing All reports are based on published industry procedures; actual performance may differ as a result of the end-user environment and applications. All values are design or typical values, measured under laboratory conditions at 25 °C.

Warranty 5-year limited warranty. Complete warranty terms located at: www.acuitybrands.com/support/warranty/terms-and-conditions

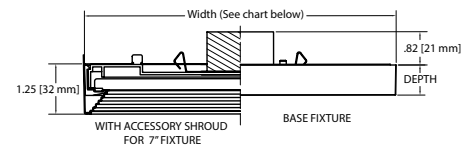
Specifications subject to change without notice.

INSTALLATION

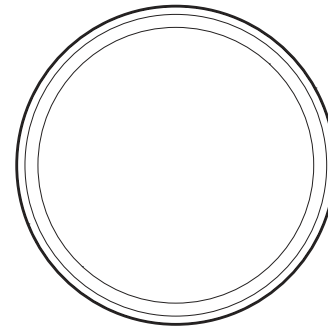
Junction Box Mounting Fixture provided with leads for direct wire connection in j-box • Installs directly to industry standard junction boxes • Compatible boxes include 4" metal or plastic octagonal standard and fire-rated junction boxes (3 1/2" junction box screw-hole spacing required for installation) • Minimum 2 1/8" deep junction box required for 5" and 7" fixtures (no depth requirement for 11" and larger fixtures) • Quick mount bracket provides fast installation of fully assembled fixture to junction box • Suitable for ceiling mount • Suitable for use within closet storage spaces when installed per NEC requirements.

Junction box sizes vary - Verify compatibility with fixture prior to installation

DIMENSIONS



External driver available on 5" and 7" models only.

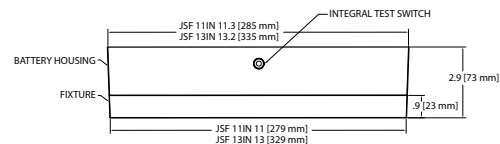


ROUND SPECIFICATIONS

	Width	Depth
JSF 5IN	5.25 (13.34)	0.75 (1.91)
JSF 7IN	7.77 (19.74)	0.75 (1.91)
JSF 11IN	11.08 (28.14)	0.9 (2.29)
JSF 13IN	13.05 (33.15)	0.9 (2.29)

All dimensions are in inches (centimeters) unless otherwise indicated.

EMERGENCY BATTERY FOR 11" AND 13"



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TYPE S1A

JUNO SLIMFORM™ LED SURFACE MOUNT DOWNLIGHTS

FOR J-BOX INSTALLATION
5", 7", 11", 13" ROUND
JSF SERIES

PERFORMANCE DATA

	JSF 5IN		JSF 7IN		JSF 11IN		JSF 13IN	
	120V	MVOLT	120V	MVOLT	120V	MVOLT	120V	MVOLT
Lumens	700	700	1000	1000	1300	1300	1800	1800
CRI	90CRI		90CRI		90CRI		90CRI	
CCT	27K, 30K, 35K, 40K		27K, 30K, 35K, 40K		27K, 30K, 35K, 40K		27K, 30K, 35K, 40K	
Voltage	120V	120V-277V	120V	120V-277V	120V	120V-277V	120V	120V-277V
Input Power	10W	10W	13W	13W	15W	15W	20W	20W
Input Current	110MA	50MA	150MA	60MA	180MA	80MA	240MA	110MA
Frequency	50/60Hz		50/60Hz		50/60Hz		50/60Hz	
Power Factor	>0.9		>0.9		>0.9		>0.9	

ORDERING INFORMATION

Example: JSF 5IN 07LM 27K 90CRI 120 FRPC WH

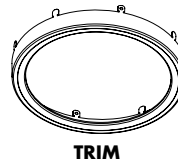
Series	Size/Lumens	Color Temperature	CRI	Voltage/Driver	Finish	Emergency Battery ^{1,2,3}
JSF SlimForm Surface Mount Downlight - Round	5IN 07LM 5", 700 Lumens 7IN 10LM 7", 1000 Lumens 11IN 13LM 11", 1300 Lumens 13IN 18LM 13", 1800 Lumens	27K 2700K 30K 3000K 35K 3500K 40K 4000K	90CRI 90+ CRI	120 FRPC Dedicated 120V, Forward Reverse Phase Dimming MVOLT ZT Universal Voltage 120V-277V, 0-10V Dimming	WH White	EL ^{3†} Battery Back-up Option EBX Empty Back Box for Aesthetics

†: EL Battery Back-up option is not Energy Star certified

ACCESSORIES

TRIM – Optional, field installable finish trim rings available to change the exterior finish of fixture.
Example: JSFTRIM 5IN BL

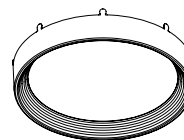
Series	Size	Finish
JSFTRIM SlimForm Accessory- Trim	5IN 5 inches 7IN 7 inches	BL Black BZ Bronze SN Satin Nickel



TRIM

SHROUD – Optional, field installable decorative baffle and cone shrouds provides the aesthetic and source shielding similar to the experience of a fully recessed downlight.
Example: JSFSHROUD 5IN DB WWH

Series	Size	Shroud Style	Finish
JSFSHROUD SlimForm Accessory Shroud - Round	7IN 7 inches	DB Downlight Baffle	WWH White trim, white shroud



BAFFLE SHROUD

Notes:

- 1 Emergency battery available with 11IN and 13IN only.
- 2 Emergency battery is only available with MVOLT ZT.
- 3 Emergency battery option not available in California due to Title 20 restrictions.



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2 of 3

TYPE S1A

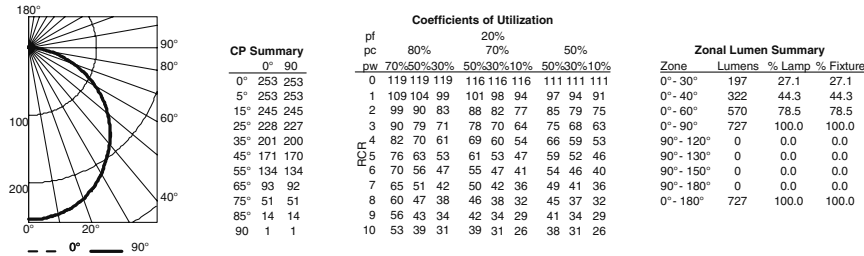
JUNO SLIMFORM™ LED SURFACE MOUNT DOWNLIGHTS

FOR J-BOX INSTALLATION
5", 7", 11", 13" ROUND
JSF SERIES

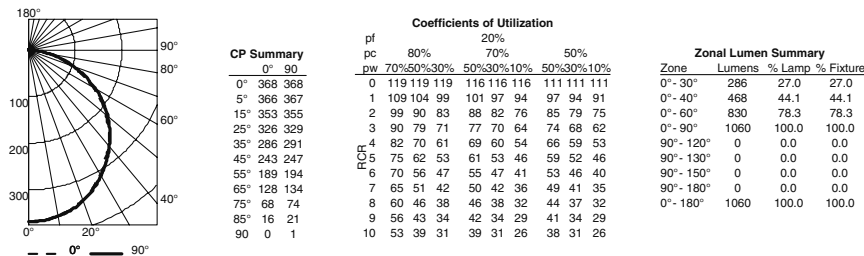
PHOTOMETRICS

Distribution Curve **Distribution Data** **Coefficient of Utilization** **Illuminance Data at 30" Above Floor for a Single Luminaire**

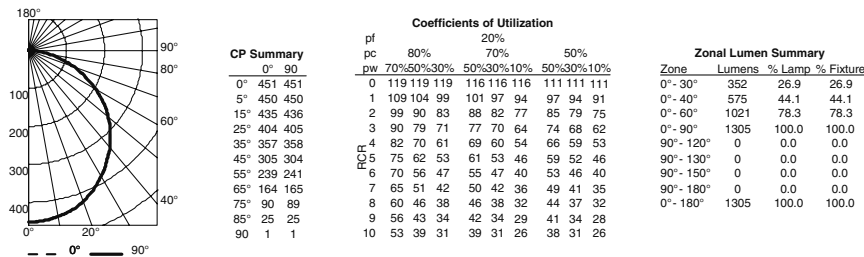
JSF 5IN 27K, 2700K LEDs, input watts: 9.72, delivered lumens: 727, LM/W = 74.8, test no. ISF 33599, tested in accordance to IESNA LM-79.



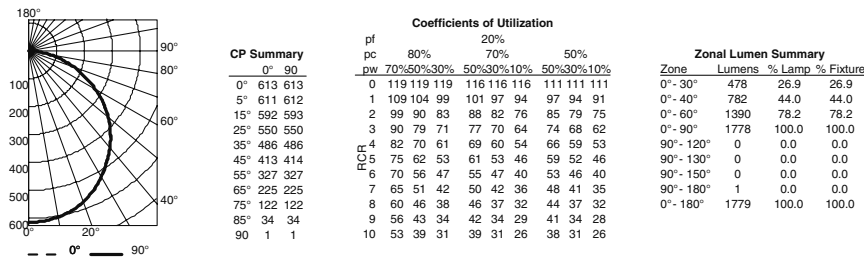
JSF 7IN 27K, 2700K LEDs, input watts: 12.8, delivered lumens: 1060, LM/W = 82.8, test no. ISF 33600, tested in accordance to IESNA LM-79.



JSF 11IN 27K, 2700K LEDs, input watts: 15.2, delivered lumens: 1305, LM/W = 85.9, test no. ISF 33661, tested in accordance to IESNA LM-79.



JSF 13IN 27K, 2700K LEDs, input watts: 20.2, delivered lumens: 1779, LM/W = 88, test no. ISF 33663, tested in accordance to IESNA LM-79.



For 30K fixtures, use 1.02 multiplier; For 35K fixtures, use 1.03 multiplier, For 40K fixtures, use 1.07 multiplier.



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TYPE S1B



Project: _____

Fixture Type: _____

Location: _____

Contact/Phone: _____

JUNO SLIMFORM™ LED SURFACE MOUNT DOWNLIGHTS

FOR J-BOX INSTALLATION

5" 7" 11" 13" ROUND

JSF SERIES



PRODUCT DESCRIPTION

Sleek, ultra-low profile energy efficient LED surface mount downlights in multiple sizes from 5" to 13" • Provides economical installation by mounting directly over standard and fire-rated junction boxes • Optional finish trims and shrouds available for custom, designer look similar to standard recessed downlights • Provides general illumination in residential and commercial applications including multi-family and hospitality • Ideal for use in corridors, living spaces, closets, hallways, pantries, stairways, outdoor covered areas without Emergency Option and much more.

PRODUCT SPECIFICATIONS

Construction Shallow, less than 1", solid ring with white finish • Non conductive fixture for shower light applications • Optional, field installable finish trims available for 5" and 7" versions to change the exterior finish of fixture • Optional, field installable decorative baffle and cone shrouds for 5" and 7" versions provide the aesthetic and source shielding similar to the experience of a fully recessed downlight.

Optics Light guide technology combined with diffusing lens conceals the LEDs from direct view and provides uniform lens luminance.

LED Light Engine LEDs mounted directly to heatsink designed to provide superior thermal management and ensure long life • 2700K, 3000K, 3500K or 4000K LED color temperature • LEDs binned for 4-step MacAdam ellipse color consistency • 90 CRI minimum.

LED Driver Choice of dedicated 120 volt (120) driver or universal voltage (MVOLT) driver that accommodates input voltages from 120-277 volts AC at 50/60Hz • Power factor > 0.9 at 120V input • 120 volt driver is dimmable with the use of most incandescent, magnetic low voltage and electronic low voltage wall box dimmers • Universal voltage driver is dimmable with the use of most 0-10V wall box dimmers • External driver is only available on 5" and 7" models • For a list of compatible dimmers, see [JUNOSLIMFORM-DIM](#).

Emergency Battery Option Available on fixture sizes 11" and larger • Battery factory assembled to fixture with integral test switch (EL option) • Drives LEDs for 90 minutes to meet Life Safety Code (NFPA-LSC), National Electrical Code (NEC), and UL requirements • Emergency battery not available in California due to Title 20 restrictions • EBX option provides back box without battery for consistent look when used in same space as fixtures with EL emergency option • Damp location only with emergency option.

Life Rated for 50,000 hours at >70% lumen maintenance.

Labels ENERGY STAR® certified • Certified to the high efficacy requirements of California T24 JA8-2016 • CSA listed for US and Canada • Suitable for wet locations (covered ceilings) • Damp location only with emergency option.

Testing All reports are based on published industry procedures; actual performance may differ as a result of the end-user environment and applications. All values are design or typical values, measured under laboratory conditions at 25 °C.

Warranty 5-year limited warranty. Complete warranty terms located at: www.acuitybrands.com/support/warranty/terms-and-conditions

Specifications subject to change without notice.

INSTALLATION

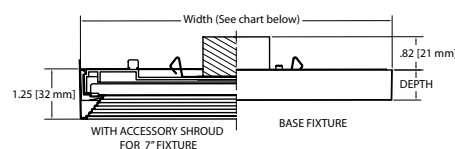
Junction Box Mounting Fixture provided with leads for direct wire connection in j-box • Installs directly to industry standard junction boxes • Compatible boxes include 4" metal or plastic octagonal standard and fire-rated junction boxes (3 1/2" junction box screw-hole spacing required for installation) • Minimum 2 1/8" deep junction box required for 5" and 7" fixtures (no depth requirement for 11" and larger fixtures) • Quick mount bracket provides fast installation of fully assembled fixture to junction box • Suitable for ceiling mount • Suitable for use within closet storage spaces when installed per NEC requirements.

Junction box sizes vary - Verify compatibility with fixture prior to installation

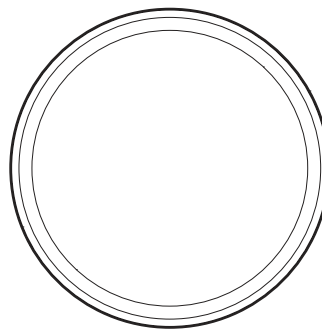


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DIMENSIONS



External driver available on 5" and 7" models only.

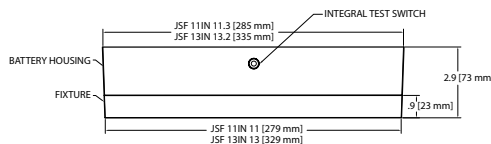


ROUND SPECIFICATIONS

	Width	Depth
JSF 5IN	5.25 (13.34)	0.75 (1.91)
JSF 7IN	7.77 (19.74)	0.75 (1.91)
JSF 11IN	11.08 (28.14)	0.9 (2.29)
JSF 13IN	13.05 (33.15)	0.9 (2.29)

All dimensions are in inches (centimeters) unless otherwise indicated.

EMERGENCY BATTERY FOR 11" AND 13"



TYPE S1B

JUNO SLIMFORM™ LED SURFACE MOUNT DOWNLIGHTS

ELECTRICAL CONTRACTOR ORDER & INSTALL LED EMERGENCY BATTERY BACKUP DRIVERS FOR TYPE S1B LUMINAIRES DESIGNATED AS "EM". SEE FOLLOWING PAGES FOR DETAILS & ORDERING INFO.

FOR J-BOX INSTALLATION
5", 7", 11", 13" ROUND
JSF SERIES

PERFORMANCE DATA

	JSF 5IN		JSF 7IN		JSF 11IN		JSF 13IN	
	120V	MVOLT	120V	MVOLT	120V	MVOLT	120V	MVOLT
Lumens	700	700	1000	1000	1300	1300	1800	1800
CRI	90CRI		90CRI		90CRI		90CRI	
CCT	27K, 30K, 35K, 40K		27K, 30K, 35K, 40K		27K, 30K, 35K, 40K		27K, 30K, 35K, 40K	
Voltage	120V	120V-277V	120V	120V-277V	120V	120V-277V	120V	120V-277V
Input Power	10W	10W	13W	13W	15W	15W	20W	20W
Input Current	110MA	50MA	150MA	60MA	180MA	80MA	240MA	110MA
Frequency	50/60Hz		50/60Hz		50/60Hz		50/60Hz	
Power Factor	>0.9		>0.9		>0.9		>0.9	

ORDERING INFORMATION

Example: JSF 5IN 07LM 27K 90CRI 120 FRPC WH

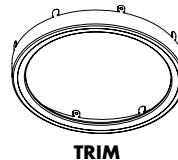
Series	Size/Lumens	Color Temperature	CRI	Voltage/Driver	Finish	Emergency Battery ^{1,2,3}
JSF SlimForm Surface Mount Downlight - Round	5IN 07LM 5", 700 Lumens	27K 2700K	90CRI 90+ CRI	120 FRPC Dedicated 120V, Forward Reverse Phase Dimming Universal Voltage 120V-277V, 0-10V Dimming	WH White	EL ^{3†} Battery Back-up Option EBX Empty Back Box for Aesthetics
	7IN 10LM 7", 1000 Lumens	30K 3000K				
	11IN 13LM 11", 1300 Lumens	35K 3500K				
	13IN 18LM 13", 1800 Lumens	40K 4000K				

†: EL Battery Back-up option is not Energy Star certified

ACCESSORIES

TRIM – Optional, field installable finish trim rings available to change the exterior finish of fixture.
Example: JSFTRIM 5IN BL

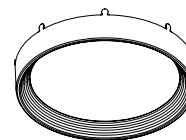
Series	Size	Finish
JSFTRIM SlimForm Accessory- Trim	5IN 5 inches	BL Black
	7IN 7 inches	BZ Bronze
		SN Satin Nickel



TRIM

SHROUD – Optional, field installable decorative baffle and cone shrouds provides the aesthetic and source shielding similar to the experience of a fully recessed downlight.
Example: JSFSHROUD 5IN DB WWH

Series	Size	Shroud Style	Finish
JSFSHROUD SlimForm Accessory Shroud - Round	7IN 7 inches	DB Downlight Baffle	WWH White trim, white shroud



BAFFLE SHROUD

Notes:

- 1 Emergency battery available with 11IN and 13IN only.
- 2 Emergency battery is only available with MVOLT ZT.
- 3 Emergency battery option not available in California due to Title 20 restrictions.

TYPE S1B

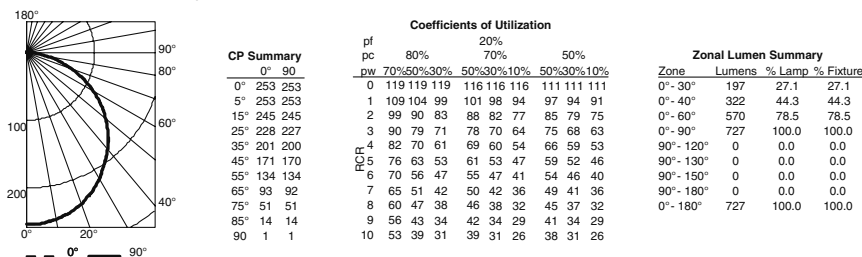
JUNO SLIMFORM™ LED SURFACE MOUNT DOWNLIGHTS

FOR J-BOX INSTALLATION
5", 7", 11", 13" ROUND
JSF SERIES

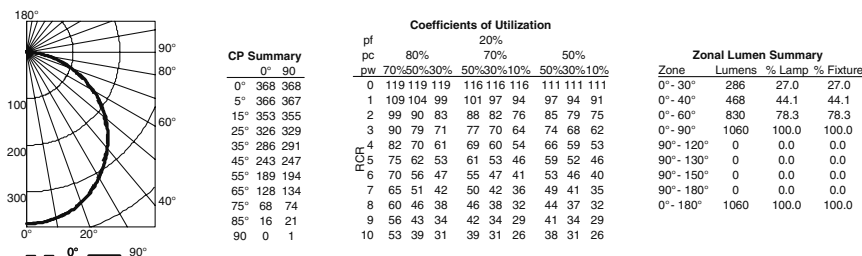
PHOTOMETRICS

Distribution Curve **Distribution Data** **Coefficient of Utilization** **Illuminance Data at 30" Above Floor for a Single Luminaire**

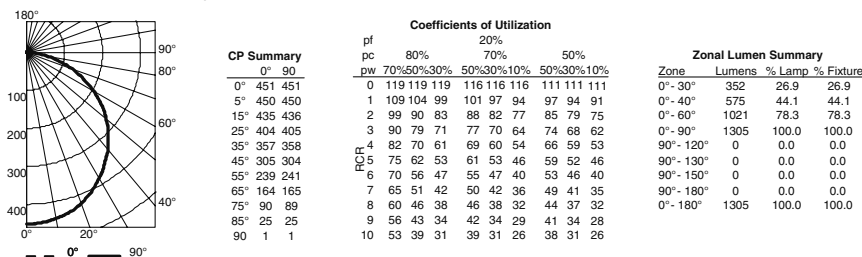
JSF 5IN 27K, 2700K LEDs, input watts: 9.72, delivered lumens: 727, LM/W = 74.8, test no. ISF 33599, tested in accordance to IESNA LM-79.



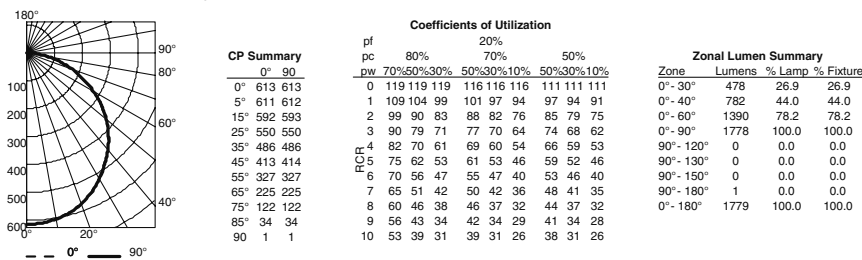
JSF 7IN 27K, 2700K LEDs, input watts: 12.8, delivered lumens: 1060, LM/W = 82.8, test no. ISF 33600, tested in accordance to IESNA LM-79.



JSF 11IN 27K, 2700K LEDs, input watts: 15.2, delivered lumens: 1305, LM/W = 85.9, test no. ISF 33661, tested in accordance to IESNA LM-79.



JSF 13IN 27K, 2700K LEDs, input watts: 20.2, delivered lumens: 1779, LM/W = 88, test no. ISF 33663, tested in accordance to IESNA LM-79.



For 30K fixtures, use 1.02 multiplier; For 35K fixtures, use 1.03 multiplier, For 40K fixtures, use 1.07 multiplier.



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FEATURES & SPECIFICATIONS

INTENDED USE — The LEM08 emergency LED driver enables the lighting fixture to deliver a minimum of 90 minutes illumination during a loss of normal AC power. It is cUL Listed for factory or field installation with indoor, damp location luminaires utilizing 20-50VDC output voltage.

CONSTRUCTION

UL rated, painted steel enclosure (white)
Flexible metallic conduit

PERFORMANCE — When normal AC power fails, the LEM08 immediately drives the LED load at reduced light output for a minimum of 90 minutes. When AC power is present, the emergency LED driver ensures the sealed, maintenance-free, high-temperature nickel-cadmium batteries are fully charged within 24 hours after a discharge and remains fully charged until the next loss of AC power. The included test switch/pilot light provides visual and manual means of monitoring the system operation.

ELECTRICAL

Multi-volt capability — 120V thru 277V; 50/60hz
Output Voltage — 20-50VDC
Initial Output Power — 8 watts
Maximum AC input — 95mA

INSTALLATION — Available for integral mounting (no metal conduit) or with dual metal conduit for mounting inside or outside of wireway. One 1/2" hole in fixture channel permits mounting test switch/pilot light behind fixture lens

Unit wires two ways: on a night light circuit (permanently energized) or on a switchable circuit (unswitched circuit to battery charger and switched circuit to the fixture driver.)

Ambient temp rating 0°C to 50°C (32°F to 122°F)

Polarized test switch/pilot light assembly

Standardized mounting centers

LISTINGS — cUL Listed. Meets UL 924, NFPA 101 (current Life Safety Code), NEC and OSHA illumination standards.

UL 1310 Certified, Output Class 2 Compliant

UL Listed for installation in damp location, recessed type IC fixtures.

Meets CA Title 20 requirements. Registered in the Modernized Appliance Efficiency Database System (MAEDBS) as a small battery charger.

WARRANTY — 3-year limited warranty. Complete warranty terms located at www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx

Note: Actual performance may differ as a result of end-user environment and application. Specifications subject to change without notice.

ELECTRICAL CONTRACTOR ORDER & INSTALL LED EMERGENCY BATTERY BACKUP DRIVERS FOR TYPE S1B LUMINAIRES DESIGNATED AS "EM"

LEM08

LED Emergency Battery Backup



MOUNTING

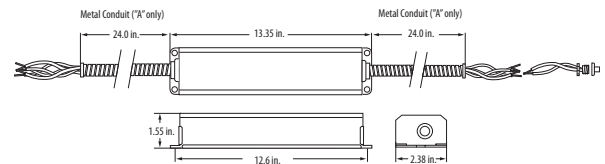
All dimensions are in inches.

Enclosure Length: 13.35"

Width: 2.38"

Height: 1.55"

Shipping weight: 3.4 lbs (1.54 kg) (with metal conduit)
2.8 lbs (1.27 kg) (no metal conduit)



ELECTRICAL CONTRACTOR TO DETERMINE APPROPRIATE OPTION AND MOUNTING HARDWARE & ACCESSORIES NEEDED.

ORDERING INFORMATION

Lead times will vary depending on options selected. Consult with your sales representative.

Example: LEM08 A

LEM08	
Series	Options
LEM08 LED emergency battery pack, 8W 20-50VDC	A Dual metal conduit (24" length each) B Integral (no metal conduit)

LEM08 Emergency LED Driver

TYPE S1B

SPECIFICATIONS

BATTERY				
Sealed Nickel-Cadmium				
Voltage	Typical Shelf Life ¹	Typical Life ¹	Maintenance ²	Temperature Rating ³
6.0V	3 years	7-10 years	none	0° C to 50° C (32° F to 122° F)

Notes

- ¹ At 77°F ambient temperature, charge/discharge cycles and prolonged full discharge may reduce useful life.
- ² All life safety equipment, including emergency lighting for path of egress must be tested in accordance with all National Fire Protection Associate (NFPA) and local codes. Failure to perform the required testing could jeopardize the safety of occupants and will void all warranties.
- ³ Ambient temperature range where unit will provide capacity for 90 minutes. Higher and lower temperatures affect life and capacity.



LEM08

EMERGENCY: One Lithonia Way, Conyers, GA 30012 Phone: 1-800-866-4682 www.acuitybrands.com

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FEATURES & SPECIFICATIONS

INTENDED USE — The CLX is a linear lighting solution that is available in multiple lengths, lumen packages and distributions. Designed for versatility, the CLX can address virtually any indoor lighting need. The CLX is also offered in standard and high efficacy configurations and capable of being continuous row mounted or installed as a stand-alone fixture. Ideal for uplight and downlight in commercial, retail, manufacturing, warehouse, and display applications. **Certain airborne contaminants can diminish the integrity of acrylic and/or polycarbonate. [Click here for Acrylic-Polycarbonate Compatibility table for suitable uses.](#)**

CONSTRUCTION — Channel and cover are formed from code-gauge cold-rolled steel. Housing and lens endcaps are injection molded plastic to provide a more architectural look and feel. The endcaps come standard with a 7/8" knock out for continuous mounting but can be ordered without.

Finish: Paint options include high-gloss, baked white polyester (WH), galvanized (GALV), matte black (MB) and smoke gray (SKGY). Five-stage iron phosphate pre-treatment ensures superior paint adhesion and rust resistance.

OPTICS — Offered with acrylic lens and less lens configurations. Provides a choice of optical distributions including, wide, narrow, and aisle.

ELECTRICAL — Utilizes high-output LEDs integrated on a two-layer circuit board, ensuring cool-running operation. Optional internal pluggable wiring harness for reduced labor cost in row mounting applications. (See PLR ordering information on page 14.) Electronic LED driver is multi-volt input and 0-10V dimming standard (see Operational Data on page 6 for actual wattage consumption). This fixture is designed to withstand a maximum line surge of 2.5kV at 0.75kA combination wave for indoor locations, for applications requiring higher level of protection additional surge protection must be provided.

L70>100,000 hours at 25°C.

LEDs provide nominal 80 CRI or 90 CRI at 3000 K, 3500 K, 4000 K, or 5000 K.

Lumen output up to 2,500 lumens per foot.

INSTALLATION — Fixture may be ceiling or wall mounted (with or without THCLX hanger or angle mounted with CLXANBRT), pendant or stem mounted with appropriate mounting options.

WARNING — Removing the lens and opening the fixture during installation exposes the LEDs, putting them at risk for damage.

If you plan to surface mount the fixture, we recommend using the THCLX. This eliminates the need to open the fixture.

If you plan to continuous row mount, we recommend using the PLR wiring harness option. This eliminates the need to open the fixture.

Damage to the LEDs caused during installation will not be covered under the warranty.

LISTINGS — CSA certified to US and Canadian safety standards. For use in damp locations between -4°F (-20°C) and 104°F (40°C). Optional High Ambient (HA) ranging to 122°F (50°C) available on certain lumen packages (See ambient temperature chart for additional information).

DesignLights Consortium® (DLC) Premium qualified product and DLC qualified product. Not all versions of this product may be DLC Premium qualified or DLC qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.

BUY AMERICAN — Product with the BAA option 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. Specifications subject to change without notice.

Stock configurations are offered for shorter lead times:

Stock Part Number	UPC	DLC QPL Product ID	DLC Premium
CLX L48 3000LM SEF FDL MVOLT GZ10 40K 80CRI WH	00191723525816	PJANKZR4	Yes
CLX L48 3000LM SEF FDL MVOLT GZ10 50K 80CRI WH	00191723525885	PKW32VKL	Yes
CLX L48 5000LM SEF FDL MVOLT GZ10 40K 80CRI WH	00191723525939	P7718Z20	Yes
CLX L48 5000LM SEF FDL MVOLT GZ10 50K 80CRI WH	00191723525908	P8A42C1H	Yes
CLX L96 6000LM SEF FDL MVOLT GZ10 40K 80CRI WH	00191723525861	PPFTGRBV	Yes
CLX L96 6000LM SEF FDL MVOLT GZ10 50K 80CRI WH	00191723525915	PW6250TE	Yes
CLX L96 10000LM SEF FDL MVOLT GZ10 40K 80CRI WH	00191723525922	PKYOC7EW	Yes
CLX L96 10000LM SEF FDL MVOLT GZ10 50K 80CRI WH	00191723525830	PKYPL35K	Yes
CLX L48 3000LM SEF RDL MVOLT GZ10 40K 80CRI WH	00191723525960	PJANKZR4	Yes
CLX L48 3000LM SEF RDL MVOLT GZ10 50K 80CRI WH	00191723525892	PKW32VKL	Yes
CLX L48 5000LM SEF RDL MVOLT GZ10 40K 80CRI WH	00191723525854	P7718Z20	Yes
CLX L48 5000LM SEF RDL MVOLT GZ10 50K 80CRI WH	00191723525946	P8A42C1H	Yes
CLX L96 6000LM SEF RDL MVOLT GZ10 40K 80CRI WH	00191723525878	PPFTGRBV	Yes
CLX L96 6000LM SEF RDL MVOLT GZ10 50K 80CRI WH	00191723525823	PD05SIAD	Yes
CLX L96 10000LM SEF RDL MVOLT GZ10 40K 80CRI WH	00191723525953	PKYOC7EW	Yes
CLX L96 10000LM SEF RDL MVOLT GZ10 50K 80CRI WH	00191723525847	PKYPL35K	Yes

TYPE S2

Catalog Number
Notes
Type

LED Linear

CLX

24", 36", 48" and 96" Lengths

Flat Diffuse Lens

Round Diffuse Lens

Wide Diffuse Lens



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 marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.

*See ordering tree for details

CLX LED Linear

TYPE S2

ORDERING INFORMATION

Lead times will vary depending on options selected. Consult with your sales representative.

Example: CLX L48 5000LM SEF WDL MVOLT GZ10 40K 80CRI WH

Series	Length	Nominal lumens	Performance package	Louver	Lens
CLX LED linear	L24 24" ^{1,2}	1500LM 1,500 lumens	SEF Standard efficiency ⁵	(Blank) Less louver	L/Lens Less lens
		2000LM 2,000 lumens	HEF Premium efficiency	SBLW Straight blade louver, white ⁶	FDL Flat diffuse ^{7,8}
	L36 36" ²	2500LM 2,500 lumens		SBLMB Straight blade louver, matte black ⁶	RDL Round diffuse ^{7,8}
		3500LM 3,500 lumens		SBLGV Straight blade louver, galvanized ⁶	WDL Wide diffuse ^{7,8}
	L48 48"	4500LM 4,500 lumens		SBLSGY Straight blade louver, smoke gray ⁶	
		5000LM 5,000 lumens ^{3,4}			
	L96 96"	2250LM 2,250 lumens			
		3000LM 3,000 lumens			
		3750LM 3,750 lumens			
		5250LM 5,250 lumens			
		6750LM 6,750 lumens			
		7500LM 7,500 lumens ^{3,4}			
		10000LM 10,000 lumens ^{2,4}			
		14000LM 14,000 lumens ^{2,4}			
		18000LM 18,000 lumens ^{2,4}			
		20000LM 20,000 lumens ^{2,4}			

Distribution	Voltage	Driver ¹⁴	Color temperature	Coloring rendering index
(Blank) General	MVOLT 120-277V ¹⁰	GZ10 Generic 0-10V, dims to 10% ¹⁵	30K 3000 K	80CRI 80 CRI
ND Narrow ^{8,9}	120 120V	EZ1 eldoLED 0-10V, dims to 1% ²	35K 3500 K	90CRI 90 CRI
WD Wide ^{8,9}	208 208V ¹¹		40K 4000 K	
AD2 Aisle, 24" off center ^{8,9}	240 240V ¹¹		50K 5000 K	

Options	Finish
PS1050 Emergency battery pack, 10W, CA Title 20 Noncompliant ^{2,11,13,16,17}	WH White
E10WLCP Emergency battery pack, 10W Linear Constant Power, Certified in CA Title 20 MAEDBS ^{1,2,11,13,16,17}	GALVW Galvanized with white lens end caps
BGTD Generator transfer device, not available with PS1050 ^{13,16,18}	GALVB Galvanized with black lens end caps
OCS 5', 18/3 Reloc selectable One Pass cable ¹⁶	MB Matte black
HA High ambient, for use in ambient temperatures up to 50°C ¹¹	SKGYW Smoke gray with white lens end caps
EPNKO Decorative endplate, no knock out ¹⁹	SKGYB Smoke gray with black lens end caps
OUTCTR Wiring leads pulled through back center of fixture ²¹	
OUTEND Wiring leads pulled through end of fixture ²¹	
<u>Cord Sets:</u>	
CS1W Straight blade plug, 120V ^{10,16}	
CS3W NEMA twist-lock plug, 120V ^{10,16}	
CS7W Straight blade plug, 277V ^{10,16}	
CS11W NEMA twist-lock plug, 277V ^{10,16}	
CS25W NEMA twist-lock plug, 347V ^{10,16}	
CS97W NEMA twist-lock plug, 480V ^{10,16}	
CS93W 600V SE00W white cord, no plug (no voltage required)	
CS6WG16STOWDSD 6' white cord, 16/5, no plug, includes low voltage dimming wires (no voltage required) ¹⁵	
PLR Plug-in wiring, see page 14 for ordering information	
PLR1LVG Plug-in wiring, low voltage dimming ²²	
RRL RELOC [®] -ready luminaire. See page 14 for ordering information	
SPD Surge protection device, provides up to 6kV protection ²⁰	
BAA Buy America(n) Act Compliant	
<u>nLight[®] Wireless:</u> ^{23,24}	
NLTAR2 RES7 nLight [®] Generation 2 enabled PIR integral occupancy sensor with automatic dimming photocell	
NLTAR2 RES7PDT nLight [®] AIR Generation 2 enabled dual technology integral occupancy sensor with automatic dimming photocell	
NLTAR2 RIO No sensor control	
<u>nLight[®] Wired:</u> ^{23,25}	
N100 nLight [®] without lumen management	
NES7 nLight [®] nES 7 PIR integral occupancy sensor ²⁶	
NESPDT7 nLight [®] nES PDT 7 dual technology integral occupancy control ²⁶	
NES7ADCX nLight [®] nES 7 ADCX PIR integral occupancy sensor with automatic dimming photocell ²⁶	
NESPDT7ADCX nLight [®] nES PDT 7 dual technology integral occupancy sensor with automatic dimming photocell ²⁶	
<u>Individual controls:</u> ^{23,25}	
MSD7 PIR integral occupancy sensor	
MSDPDT7 PDT 7 dual technology integral occupancy control	
MSD7ADC PIR integral occupancy sensor with automatic dimming control photocell	
MSDPDT7ADC PDT integral occupancy sensor with automatic dimming control photocell	

INTEGRAL BATTERY PACKS TO BE PROVIDED FOR LUMINAIRES INDICATED AS "EM" ON LIGHTING PLANS

See Accessories and footnotes on next page



CLX

CLX LED Linear

TYPE S2

ELECTRICAL CONTRACTOR TO DETERMINE APPROPRIATE MOUNTING HARDWARE & ACCESSORIES

Accessories: Order as separate catalog number.			
Mounting:			
ZACVH M100	Adjustable 10' aircraft cable with Y hanger (1 pair)	THCLX ____	Tong hanger (Must specify color) (one pair) ²⁸
ZAC120	One adjustable aircraft cable with canopy 120" ²⁷	CLXANGBKT ____	Angle bracket, (Must specify color) (one pair) ²⁸
ZACFP120	One adjustable aircraft cable with feed (3 conductor) and canopy, 120" ²⁷	HC36 M12	Hanger chain, 36" (1 pair)
ZACFPD120	One adjustable aircraft cable with feed (5 conductor) and canopy 120" ²⁷	Sensors & Controls:	
ZAC240	One adjustable aircraft cable with canopy 240" ²⁷	LSXR	Sensor Switch * LSXR occupancy sensor ²⁹
ZACFP240	One adjustable aircraft cable with feed (3 conductor) and canopy, 240" ²⁷	NPP16D	nLight® switching/dimming module
ZACFPD240	One adjustable aircraft cable with feed (5 conductor) and canopy 240" ²⁷	NPP16DER	nLight® switching/dimming module with emergency relay
SQ_	Swivel stem hanger (specify length in 2" increments up to 48") ²⁷	rPP20D	nLight® air dimming/switching module
		Reflectors:	
		CLXRW24_	Wide decorative 24" reflector, (Must specify color) ³⁰
		CLXRW36_	Wide decorative 36" reflector, (Must specify color) ³⁰
		CLXRW48_	Wide decorative 48" reflector, (Must specify color) ³⁰
		CLXRW96_	Two wide decorative 48" reflectors, (Must specify color) ³⁰
		CLXRWU24_	Wide decorative 24" reflector with uplight, (Must specify color) ³⁰
		CLXRWU36_	Wide decorative 36" reflector with uplight, (Must specify color) ³⁰
		CLXRWU48_	Wide decorative 48" reflector with uplight, (Must specify color) ³⁰
		CLXRWU96_	Two wide decorative 48" reflectors with uplight, (Must specify color) ³⁰
		CLXRN24_	Narrow 24" reflector, (Must specify color) ³¹
		CLXRN36_	Narrow 36" reflector, (Must specify color) ³¹
		CLXRN48_	Narrow 48" reflector, (Must specify color) ³¹
		CLXRN96_	Two narrow 48" reflectors, (Must specify color) ³¹
		Wireguards:	
		WGCLX24_	24" wireguard, (Must specify color) ³²
		WGCLX36_	36" wireguard, (Must specify color) ³²
		WGCLX48_	48" wireguard, XX, (Must specify color) 96" fixture requires two ³²

Notes

- Not available with OUTCTR option.
- Not available with HA option.
- Not available with SEF when ordered in combination with EZ1.
- Not available with NLTAIR2 RES7, NLTAIR2 RES7PDT, or NLTAIR2 RIO.
- Not available with EZ1 when ordered with L24 with 5000LM or L36 with 7500LM.
- When ordered with L24 only available with 1500LM or 2000LM in combination with G210 driver. Not for use with THCLX, CLXANGBKT, CLX reflectors or WGCLX accessories. Not available with RDL lens options.
- Only available with general distribution.
- Not available with CLXRN accessories.
- Available L/LENS only.
- Not available with PS1050, E10WLCP, or BGTD.
- Not available with BGTD option.
- Voltage selected utilizes a step-down transformer. Not available with L24 when ordered with N100. Not available with PS1050, E10WLCP or BGTD option.
- Requires SPD option.
- When continuous row mounting, fixtures must all have the same driver selection.
- Not available with Individual controls, nLight wired networking, nLight wireless networking, nLight wireless zone control options.
- Must specify voltage.
- Not available with L24 or L36. Not available with L48 in combination with N100.
- Available with L48 or L96 only. 20 Not available with PS1050 or E10WLCP options. Not available with 208 or 240V. Not available Individual controls, nLight Wired, or nLight Wireless options.
- Not available OUTEND.
- Required with PS1050, E10WLCP, BGTD, XAD, or XAD924.
- Not available with PLR options.
- Not available with Individual controls, nLight Wired, or nLight Wireless options. Refer to page 14 for more PLR details.
- Sensor housing will be the same color as lens end caps.
- Not available with L24 in combination with 5000LM, not available with L36 in combination with 7500LM, not available with L48 in combination with 10000LM, and not available with L96 in combination with 14000LM, 18000LM, or 20000LM. Not available with PLRs containing low voltage dimming wires.
- Not available with any other control option. Requires EZ1.
- Requires N100 option.
- Ships standard as white.
- Not available with louver, wireguards, wide reflectors.
- More configurations on [LSXR Specification Sheet](#).
- L24 reflector is 22.65", L36 reflector is 34.01", L48 reflector is 46.80", L96 comes with two L48 reflectors.
- For use with L/LENS fixtures only. L24 reflector is 22.75", L36 reflector is 34.20", L48 reflector is 46.85", L96 comes with two L48 reflectors.
- Not for use with CLX wide reflector accessories.

OPTIONS AND ACCESSORIES



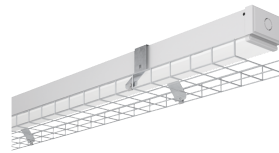
Narrow reflector
Ships separately from fixture.

Order as:
CLXRN24_ ____
CLXRN36_ ____
CLXRN48_ ____
CLXRN96_ ____



Wide decorative reflector
Ships separately from fixture.

Order as:
CLXRW24_ ____
CLXRW36_ ____
CLXRW48_ ____
CLXRW96_ ____



Wireguard
Ships separately from fixture:
96" fixture requires two WGCLX48.

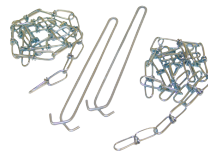
Order as:
WGCLX24_ ____
WGCLX36_ ____
WGCLX48_ ____



Aircraft Cable with Canopy

Available in 120" or 240"

Order as:
ZAC120
ZAC240



HANGER CHAIN

36" chain with Y hanger. ships as a pair

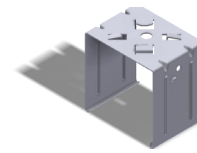
Order as:
HC36



ZACVH HANGER

10' Aircraft cable with Y hanger.

Order as:
ZACVH



Tong hanger

Ships as a pair

Order As:
THCLX_

CLX LED Linear

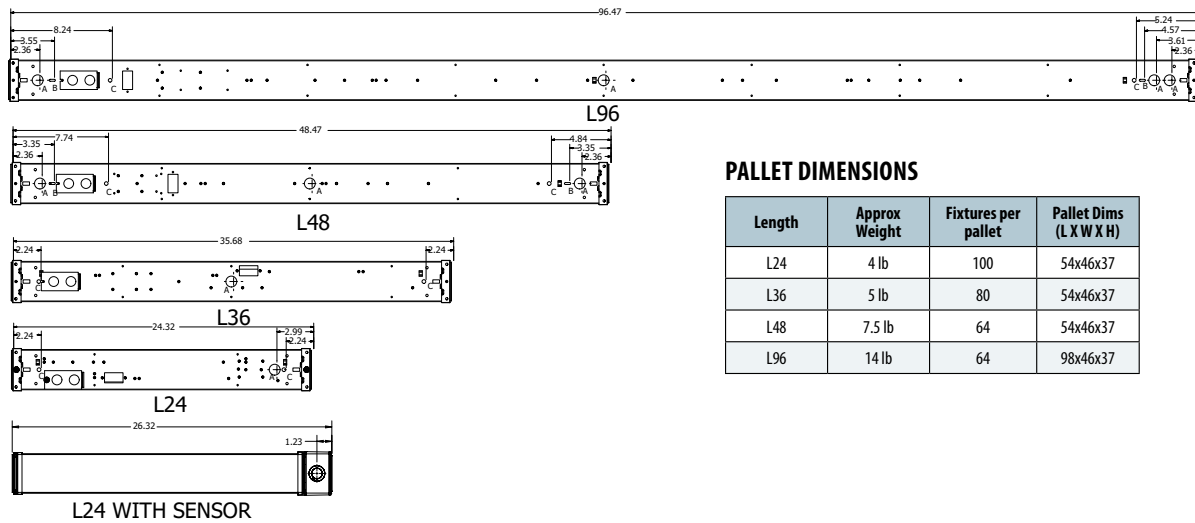
TYPE S2

DIMENSIONS

All dimensions are in inches (centimeters) unless otherwise indicated.
Dimensions may vary with options or accessories.

INTEGRATED SENSOR ADDS 2.0 INCHES TO STANDALONE FIXTURE LENGTH
HOUSING END CAP ADDS 0.236 INCHES TO FIXTURE LENGTH PER SIDE. DIMENSIONS BELOW INCLUDE ENDCAPS.

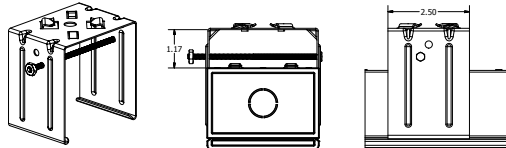
A - 7/8" KNOCK OUT
B - 0.5" by 0.16" SLOT
C - 0.3" DIA HOLE



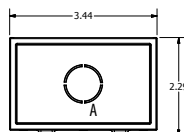
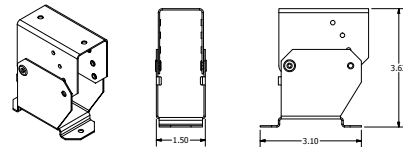
PALLET DIMENSIONS

Length	Approx Weight	Fixtures per pallet	Pallet Dims (L X W X H)
L24	4 lb	100	54x46x37
L36	5 lb	80	54x46x37
L48	7.5 lb	64	54x46x37
L96	14 lb	64	98x46x37

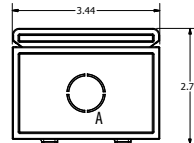
THCLX - SHIPS TWO PER ORDER,
UTILIZES A #8 HEX HEAD SCREW AND NUT
FIXTURE SITS 1.3 INCHES FROM STRUCTURE WHEN MOUNTED



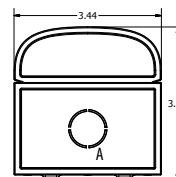
CLXANGBKT - SHIPS TWO PER ORDER
HOLES TO MOUNTING STRUCTURE ARE 0.175" DIA, 2.5" APART
FIXTURE SITS APPROXIMATELY 3.5" FROM STRUCTURE
WHEN MOUNTED HORIZONTAL TO STRUCTURE



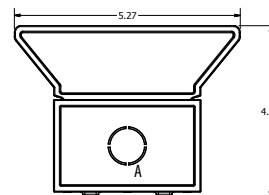
L/LENS



FDL



RDL



WDL

PHOTOMETRICS

See www.lithonia.com.



CLX

CLX LED Linear

TYPE S2

POWER SENTRY EMERGENCY BATTERY PACKS

		SEF Emergency Lumens	HEF Emergency Lumens
PS1050	Factory installable	1400	1500
E10WLCP	Factory installable	1400	1500
PS1555LCP	Field installable, remote mount only	2000	2100

Note: For emergency lumen output of specific model, please consult factory. One board will be illuminated during emergency operation.

CLX CHARACTERISTICS

Nominal Lumen Package	Length	Wattage								Length	Width	Depth	Comparable Light Source
		Standard efficiency				High efficiency							
		120V	277V	347V	480V	120V	277V	347V	480V	Dimensions are shown in inches			
2500LM	24"	19.9	19.9	25.9	25.9	18.5	18.5	24.5	24.5	24	3.5	3.75	1-lamp 32WT8, 1-lamp 54W T5HO, 50W HID
5000LM	24"	41.9	41.9	47.9	47.9	37.9	37.9	43.9	43.9	24	3.5	3.75	2-lamp 32WT8, 1-lamp 54W T5HO, 70W HID
3750LM	36"	28.1	28.1	34.1	34.1	27.0	27.0	33.0	33.0	36	3.5	3.75	1-lamp 32WT8, 1-lamp 54W T5HO, 50W HID
7500LM	36"	62.9	62.9	68.9	68.9	56.8	56.8	62.8	62.8	36	3.5	3.75	2-lamp 32WT8, 1-lamp 54W T5HO, 70W HID
5000LM	48"	35.4	35.4	41.4	41.4	32.9	32.9	38.9	38.9	48	3.5	3.75	2-lamp 32WT8, 1-lamp 54W T5HO, 70W HID
10000LM	48"	77.1	77.1	83.1	83.1	70.4	70.4	76.4	76.4	48	3.5	3.75	3-lamp 32WT8, 2-lamp 54W T5HO, 100W HID
10000LM	96"	70.8	70.8	76.8	76.8	65.8	65.8	71.8	71.8	96	3.5	3.75	3-lamp 32WT8, 2-lamp 54W T5HO, 100W HID
20000LM	96"	154.2	154.2	160.2	160.2	140.8	140.8	146.8	146.8	96	3.5	3.75	6-lamp 32WT8, 4-lamp 54T5HO, 200W HID

AMBIENT TEMPERATURE RATINGS

Driver Package		GZ10			EZ1			Any Driver	
Length	Lumen package	Direct Surface	THCLX/ Suspended	HA Option (Direct or Suspended)	Direct Surface	THCLX	Suspended 18"	BGTD Direct Surface	PS1050 Suspended
L24	1500LM	40C°	40C°	N/A	35C°	35C°	35C°	N/A	N/A
	2000LM	40C°	40C°		35C°	35C°	35C°		
	2500LM	40C°	40C°		35C°	35C°	35C°		
	3500LM	40C°	40C°		40C°	40C°	40C°		
	4500LM	40C°	40C°		35C°	35C°	40C°		
	5000LM	40C°	40C°		25C°	30C°	35C°		
L36	2250LM	40C°	40C°		40C°	40C°	40C°		
	3000LM	40C°	40C°		40C°	40C°	40C°		
	3750LM	40C°	40C°		40C°	40C°	40C°		
	5250LM	40C°	40C°		35C°	35C°	40C°		
	6750LM	30C°	40C°		35C°	35C°	40C°		
	7500LM	30C°	40C°		25C°	30C°	35C°		
L48	3000LM	40C°	40C°	50C°	40C°	40C°	40C°	35C°	25C°
	4000LM	40C°	40C°	50C°	40C°	40C°	40C°		
	5000LM	40C°	40C°	50C°	35C°	35C°	40C°		
	7000LM	30C°	40C°	N/A	35C°	35C°	40C°		
	9000LM	30C°	40C°		25C°	30C°	35C°		
	10000LM	30C°	40C°		25C°	30C°	35C°		
L96	6000LM	40C°	40C°	50C°	35C°	35C°	40C°		
	8000LM	30C°	40C°	50C°	35C°	35C°	40C°		
	10000LM	30C°	40C°	50C°	25C°	30C°	35C°		
	14000LM	40C°	40C°	N/A	35C°	35C°	40C°		
	18000LM	30C°	40C°		25C°	30C°	35C°		
	20000LM	30C°	40C°		25C°	30C°	35C°		

CLX LED Linear

TYPE S2

CLX OPERATIONAL DATA

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage	
					Color Temperature					
					3000K	3500K	4000K	5000K		
L/Lens	L24	1500LM	SEF	80	1497	1540	1582	1619	10.85	
				90	1305	1333	1371	1441	10.85	
			HEF	80	1493	1514	1582	1586	10.39	
				90	1220	1237	1301	1301	10.39	
		2000LM	SEF	80	2066	2125	2183	2235	14.48	
				90	1801	1840	1892	1989	14.48	
			HEF	80	2060	2089	2183	2189	13.46	
				90	1684	1708	1796	1796	13.46	
		2500LM	SEF	80	2616	2689	2763	2829	18.41	
				90	2279	2329	2394	2517	18.41	
			HEF	80	2607	2644	2763	2771	17.42	
				90	2132	2161	2273	2273	17.42	
		3500LM	SEF	80	3518	3617	3716	3804	25.83	
				90	3065	3132	3220	3385	25.83	
			HEF	80	3506	3556	3716	3726	25.04	
				90	2867	2907	3057	3057	25.04	
		4500LM	SEF	80	5040	5182	5325	5451	38.7	
				90	4392	4487	4614	4851	38.7	
			HEF	80	5024	5096	5325	5339	34.8	
				90	4108	4165	4380	4380	34.8	
		5000LM	SEF	80	5355	5506	5657	5791	41.48	
				90	4667	4767	4902	5153	41.48	
			HEF	80	5338	5414	5657	5672	38.11	
				90	4364	4425	4653	4653	38.11	
	L36	2250LM	SEF	80	2411	2547	2101	2207	16.36	
				90	2479	2607	2146	2320	16.36	
			HEF	80	2437	2554	1965	2095	15.47	
				90	2547	2403	1992	2095	15.47	
			3000LM	SEF	80	3221	3388	2730	2868	20.8
					90	3310	3133	2789	3015	20.8
				HEF	80	3167	3319	2553	2722	19.98
					90	3310	3123	2589	2722	19.98
			3750LM	SEF	80	4123	4337	3495	3671	26.47
					90	4236	4010	3570	3859	26.47
				HEF	80	4054	4248	3268	3485	25.09
					90	4236	3997	3314	3485	25.09
		5250LM	SEF	80	5545	5833	4700	4937	39.9	
				90	5698	5393	4801	5190	39.9	
			HEF	80	5452	5713	4396	4687	34.3	
				90	5698	5376	4457	4687	34.3	
		6750LM	SEF	80	7081	7448	6001	6303	54.85	
				90	7275	6886	6131	6627	54.85	
			HEF	80	6962	7294	5613	5984	47.97	
				90	7275	6864	5691	5984	47.97	
		7500LM	SEF	80	7756	8158	6574	6905	62.6	
				90	7969	7543	6716	7260	62.6	
			HEF	80	7626	7991	6148	6555	54.02	
				90	7969	7519	6234	6555	54.02	

CLX LED Linear

TYPE S2

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
L/Lens	L48	3000LM	SEF	80	3019	3104	3190	3265	20.32
				90	2631	2688	2764	2906	20.32
			HEF	80	3010	3052	3190	3198	19.01
				90	2461	2495	2624	2624	19.01
		4000LM	SEF	80	4034	4148	4262	4363	27.58
				90	3515	3591	3693	3882	27.58
			HEF	80	4021	4078	4262	4273	24.75
				90	3288	3334	3505	3505	24.75
		5000LM	SEF	80	5047	5189	5332	5458	34.8
				90	4398	4493	4620	4857	34.8
			HEF	80	5031	5102	5332	5346	31.77
				90	4113	4171	4386	4386	31.77
		7000LM	SEF	80	7311	7517	7724	7907	49.05
				90	6371	6509	6692	7036	49.05
			HEF	80	7288	7391	7724	7744	44.67
				90	5959	6042	6353	6353	44.67
		9000LM	SEF	80	9215	9475	9735	9967	63.99
				90	8031	8204	8435	8869	63.99
			HEF	80	9186	9317	9735	9762	58.58
				90	7511	7615	8008	8008	58.58
		10000LM	SEF	80	10299	10590	10880	11139	73.37
				90	8975	9169	9427	9912	73.37
			HEF	80	10266	10412	10880	10910	66.27
				90	8394	8511	8950	8950	66.27
	L96	6000LM	SEF	80	5942	6110	6278	6427	38.15
				90	5178	5290	5439	5719	38.15
			HEF	80	5923	6008	6278	6294	35.54
				90	4843	4911	5164	5164	35.54
		8000LM	SEF	80	7929	8153	8376	8575	52.32
				90	6910	7059	7258	7631	52.32
			HEF	80	7903	8016	8376	8399	48.5
				90	6462	6552	6890	6890	48.5
		10000LM	SEF	80	9808	10085	10362	10608	66.47
				90	8548	8732	8978	9439	66.47
			HEF	80	9777	9916	10362	10390	60.89
				90	7994	8106	8523	8523	60.89
		14000LM	SEF	80	14323	14727	15131	15491	94.78
				90	12482	12752	13111	13784	94.78
			HEF	80	14277	14480	15131	15172	85.96
				90	11674	11836	12447	12447	85.96
		18000LM	SEF	80	18458	18979	19500	19963	128.98
				90	16086	16433	16896	17764	128.98
			HEF	80	18399	18661	19500	19552	116.92
				90	15044	15254	16040	16040	116.92
		20000LM	SEF	80	20386	20962	21537	22048	146.83
				90	17766	18150	18661	19619	146.83
			HEF	80	20321	20610	21537	21595	131.6
				90	16616	16847	17716	17716	131.6

CLX LED Linear

TYPE S2

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
RDL	L24	1500LM	SEF	80	1359	1397	1436	1470	10.85
				90	1184	1210	1244	1308	10.85
			HEF	80	1355	1374	1436	1439	10.39
				90	1107	1123	1181	1181	10.39
		2000LM	SEF	80	1875	1928	1981	2028	14.48
				90	1634	1670	1717	1805	14.48
			HEF	80	1869	1896	1981	1987	13.46
				90	1528	1550	1630	1630	13.46
		2500LM	SEF	80	2374	2441	2508	2567	18.41
				90	2069	2113	2173	2284	18.41
			HEF	80	2366	2400	2508	2514	17.42
				90	1935	1962	2063	2063	17.42
		3500LM	SEF	80	3192	3282	3372	3452	25.83
				90	2782	2842	2922	3072	25.83
			HEF	80	3182	3227	3372	3381	25.04
				90	2602	2638	2774	2774	25.04
		4500LM	SEF	80	4574	4703	4832	4947	38.7
				90	3986	4072	4187	4402	38.7
			HEF	80	4560	4624	4832	4845	34.8
				90	3728	3780	3975	3975	34.8
		5000LM	SEF	80	4860	4997	5134	5256	41.48
				90	4235	4327	4448	4677	41.48
			HEF	80	4844	4913	5134	5148	38.11
				90	3961	4016	4223	4223	38.11
	L36	2250LM	SEF	80	2188	2250	2311	2366	16.36
				90	1907	1948	2003	2106	16.36
			HEF	80	2181	2212	2311	2318	15.47
				90	1783	1808	1901	1901	15.47
		3000LM	SEF	80	2843	2924	3004	3075	20.8
				90	2478	2531	2603	2736	20.8
			HEF	80	2834	2875	3004	3012	19.98
				90	2317	2350	2471	2471	19.98
		3750LM	SEF	80	3639	3742	3845	3936	26.47
				90	3171	3240	3331	3502	26.47
			HEF	80	3628	3679	3845	3855	25.09
				90	2966	3007	3162	3162	25.09
		5250LM	SEF	80	4895	5033	5171	5294	39.9
				90	4265	4357	4480	4710	39.9
			HEF	80	4879	4948	5171	5185	34.3
				90	3989	4045	4253	4253	34.3
		6750LM	SEF	80	6250	6426	6602	6759	54.85
				90	5446	5564	5721	6014	54.85
			HEF	80	6230	6318	6602	6620	47.97
				90	5094	5165	5431	5431	47.97
		7500LM	SEF	80	6846	7039	7232	7404	62.6
				90	5966	6095	6266	6588	62.6
			HEF	80	6824	6921	7232	7252	54.02
				90	5580	5657	5949	5949	54.02

CLX LED Linear

TYPE S2

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
RDL	L48	3000LM	SEF	80	2740	2817	2895	2963	20.32
				90	2388	2439	2508	2637	20.32
			HEF	80	2731	2770	2895	2902	19.01
				90	2233	2264	2381	2381	19.01
		4000LM	SEF	80	3661	3764	3868	3959	27.58
				90	3190	3259	3351	3523	27.58
			HEF	80	3649	3701	3868	3878	24.75
				90	2984	3025	3181	3181	24.75
		5000LM	SEF	80	4580	4710	4839	4954	34.8
				90	3992	4078	4193	4408	34.8
			HEF	80	4566	4631	4839	4852	31.77
				90	3733	3785	3980	3980	31.77
		7000LM	SEF	80	6635	6822	7009	7176	49.05
				90	5782	5907	6073	6385	49.05
			HEF	80	6614	6708	7009	7028	44.67
				90	5408	5483	5766	5766	44.67
		9000LM	SEF	80	8363	8599	8835	9045	63.99
				90	7288	7446	7655	8049	63.99
			HEF	80	8336	8455	8835	8859	58.58
				90	6816	6911	7268	7268	58.58
		10000LM	SEF	80	9347	9611	9874	10109	73.37
				90	8145	8321	8556	8995	73.37
			HEF	80	9317	9450	9874	9901	66.27
				90	7618	7724	8122	8122	66.27
	L96	6000LM	SEF	80	5393	5545	5697	5832	38.15
				90	4700	4801	4936	5190	38.15
			HEF	80	5375	5452	5697	5712	35.54
				90	4395	4457	4686	4686	35.54
		8000LM	SEF	80	7196	7399	7602	7782	52.32
				90	6271	6406	6587	6925	52.32
			HEF	80	7173	7275	7602	7622	48.5
				90	5865	5946	6253	6253	48.5
		10000LM	SEF	80	8902	9153	9404	9627	66.47
				90	7757	7925	8148	8567	66.47
			HEF	80	8873	8999	9404	9429	60.89
				90	7255	7356	7735	7735	60.89
		14000LM	SEF	80	12999	13366	13732	14058	94.78
				90	11328	11573	11899	12510	94.78
			HEF	80	12957	13142	13732	13769	85.96
				90	10594	10742	11296	11296	85.96
		18000LM	SEF	80	16751	17224	17697	18117	128.98
				90	14598	14913	15334	16121	128.98
			HEF	80	16698	16936	17697	17744	116.92
				90	13653	13843	14557	14557	116.92
		20000LM	SEF	80	18501	19023	19545	20009	146.83
				90	16123	16471	16935	17805	146.83
			HEF	80	18442	18705	19545	19598	131.6
				90	15079	15290	16078	16078	131.6

CLX LED Linear

TYPE S2

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
FDL	L24	1500LM	SEF	80	1320	1358	1395	1428	10.85
				90	1151	1175	1208	1271	10.85
			HEF	80	1316	1335	1395	1399	10.39
				90	1076	1091	1147	1147	10.39
		2000LM	SEF	80	1822	1874	1925	1971	14.48
				90	1588	1622	1668	1754	14.48
			HEF	80	1816	1842	1925	1930	13.46
				90	1485	1506	1583	1583	13.46
		2500LM	SEF	80	2306	2371	2436	2494	18.41
				90	2010	2053	2111	2219	18.41
			HEF	80	2299	2332	2436	2443	17.42
				90	1880	1906	2004	2004	17.42
		3500LM	SEF	80	3102	3189	3277	3354	25.83
				90	2703	2761	2839	2985	25.83
			HEF	80	3092	3136	3277	3285	25.04
				90	2528	2563	2695	2695	25.04
		4500LM	SEF	80	4444	4570	4695	4807	38.7
				90	3873	3957	4068	4277	38.7
			HEF	80	4430	4493	4695	4708	34.8
				90	3622	3673	3862	3862	34.8
		5000LM	SEF	80	4722	4855	4988	5107	41.48
				90	4115	4204	4322	4544	41.48
			HEF	80	4707	4774	4988	5002	38.11
				90	3848	3902	4103	4103	38.11
	L36	2250LM	SEF	80	2126	2186	2246	2299	16.36
				90	1852	1892	1946	2046	16.36
			HEF	80	2119	2149	2246	2252	15.47
				90	1732	1757	1847	1847	15.47
		3000LM	SEF	80	2762	2840	2918	2988	20.8
				90	2407	2459	2529	2659	20.8
			HEF	80	2754	2793	2918	2926	19.98
				90	2251	2283	2401	2401	19.98
		3750LM	SEF	80	3536	3636	3735	3824	26.47
				90	3081	3148	3237	3403	26.47
			HEF	80	3525	3575	3735	3745	25.09
				90	2882	2922	3073	3073	25.09
		5250LM	SEF	80	4755	4890	5024	5143	39.9
				90	4144	4234	4353	4577	39.9
			HEF	80	4740	4808	5024	5037	34.3
				90	3876	3930	4132	4132	34.3
		6750LM	SEF	80	6072	6243	6415	6567	54.85
				90	5292	5406	5558	5844	54.85
			HEF	80	6053	6139	6415	6432	47.97
				90	4949	5018	5276	5276	47.97
		7500LM	SEF	80	6651	6839	7027	7194	62.6
				90	5796	5922	6088	6401	62.6
			HEF	80	6630	6725	7027	7046	54.02
				90	5421	5497	5780	5780	54.02

CLX LED Linear

TYPE S2

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
FDL	L48	3000LM	SEF	80	2662	2737	2812	2879	20.32
				90	2320	2370	2437	2562	20.32
			HEF	80	2654	2691	2812	2820	19.01
				90	2170	2200	2313	2313	19.01
		4000LM	SEF	80	3557	3657	3758	3847	27.58
				90	3100	3167	3256	3423	27.58
			HEF	80	3546	3596	3758	3768	24.75
				90	2899	2939	3091	3091	24.75
		5000LM	SEF	80	4450	4576	4701	4813	34.8
				90	3878	3962	4073	4283	34.8
			HEF	80	4436	4499	4701	4714	31.77
				90	3627	3678	3867	3867	31.77
		7000LM	SEF	80	6446	6628	6810	6972	49.05
				90	5618	5739	5901	6204	49.05
			HEF	80	6426	6517	6810	6829	44.67
				90	5254	5327	5602	5602	44.67
		9000LM	SEF	80	8126	8355	8584	8788	63.99
				90	7081	7234	7438	7820	63.99
			HEF	80	8100	8215	8584	8607	58.58
				90	6623	6715	7061	7061	58.58
		10000LM	SEF	80	9081	9338	9594	9822	73.37
				90	7914	8085	8313	8740	73.37
			HEF	80	9052	9181	9594	9620	66.27
				90	7402	7505	7892	7892	66.27
	L96	6000LM	SEF	80	5240	5387	5535	5667	38.15
				90	4566	4665	4796	5042	38.15
			HEF	80	5223	5297	5535	5550	35.54
				90	4270	4330	4553	4553	35.54
		8000LM	SEF	80	6991	7189	7386	7561	52.32
				90	6093	6224	6400	6728	52.32
			HEF	80	6969	7068	7386	7406	48.5
				90	5698	5778	6075	6075	48.5
		10000LM	SEF	80	8649	8893	9137	9354	66.47
				90	7537	7700	7917	8323	66.47
			HEF	80	8621	8744	9137	9161	60.89
				90	7049	7147	7516	7516	60.89
		14000LM	SEF	80	12630	12986	13342	13659	94.78
				90	11006	11244	11561	12154	94.78
			HEF	80	12589	12768	13342	13378	85.96
				90	10293	10437	10975	10975	85.96
		18000LM	SEF	80	16276	16735	17194	17602	128.98
				90	14184	14490	14898	15663	128.98
			HEF	80	16223	16454	17194	17240	116.92
				90	13265	13450	14143	14143	116.92
		20000LM	SEF	80	17976	18483	18990	19441	146.83
				90	15665	16004	16454	17300	146.83
			HEF	80	17918	18173	18990	19041	131.6
				90	14651	14855	15621	15621	131.6

CLX LED Linear

TYPE S2

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
WDL	L24	1500LM	SEF	80	1377	1415	1454	1489	10.85
				90	1200	1226	1260	1325	10.85
			HEF	80	1372	1392	1454	1458	10.39
				90	1122	1138	1196	1196	10.39
		2000LM	SEF	80	1900	1953	2007	2055	14.48
				90	1656	1691	1739	1828	14.48
			HEF	80	1894	1921	2007	2012	13.46
				90	1548	1570	1651	1651	13.46
		2500LM	SEF	80	2405	2472	2540	2601	18.41
				90	2095	2141	2201	2314	18.41
			HEF	80	2397	2431	2540	2547	17.42
				90	1960	1987	2090	2090	17.42
		3500LM	SEF	80	3234	3325	3416	3497	25.83
				90	2818	2879	2960	3112	25.83
			HEF	80	3223	3269	3416	3426	25.04
				90	2636	2672	2810	2810	25.04
		4500LM	SEF	80	4634	4765	4895	5012	38.7
				90	4038	4125	4242	4459	38.7
			HEF	80	4619	4685	4895	4908	34.8
				90	3777	3829	4027	4027	34.8
		5000LM	SEF	80	4923	5062	5201	5324	41.48
				90	4290	4383	4506	4738	41.48
			HEF	80	4907	4977	5201	5215	38.11
				90	4012	4068	4278	4278	38.11
	L36	2250LM	SEF	80	2216	2279	2341	2397	16.36
				90	1931	1973	2029	2133	16.36
			HEF	80	2209	2241	2341	2348	15.47
				90	1806	1832	1926	1926	15.47
		3000LM	SEF	80	2880	2962	3043	3115	20.8
				90	2510	2564	2636	2772	20.8
			HEF	80	2871	2912	3043	3051	19.98
				90	2347	2380	2503	2503	19.98
		3750LM	SEF	80	3687	3791	3895	3987	26.47
				90	3213	3282	3375	3548	26.47
			HEF	80	3675	3727	3895	3905	25.09
				90	3005	3047	3204	3204	25.09
		5250LM	SEF	80	4958	5098	5238	5362	39.9
				90	4321	4414	4539	4772	39.9
			HEF	80	4942	5013	5238	5252	34.3
				90	4041	4097	4309	4309	34.3
		6750LM	SEF	80	6331	6510	6688	6847	54.85
				90	5517	5636	5795	6093	54.85
			HEF	80	6311	6401	6688	6706	47.97
				90	5160	5232	5502	5502	47.97
		7500LM	SEF	80	6935	7131	7326	7500	62.6
				90	6044	6174	6348	6674	62.6
			HEF	80	6913	7011	7326	7346	54.02
				90	5652	5731	6027	6027	54.02

CLX LED Linear

TYPE S2

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
WDL	L48	3000LM	SEF	80	2776	2854	2932	3002	20.32
				90	2419	2471	2541	2671	20.32
			HEF	80	2767	2806	2932	2940	19.01
				90	2262	2294	2412	2412	19.01
		4000LM	SEF	80	3709	3813	3918	4011	27.58
				90	3232	3302	3395	3569	27.58
			HEF	80	3697	3749	3918	3929	24.75
				90	3023	3065	3223	3223	24.75
		5000LM	SEF	80	4640	4771	4902	5018	34.8
				90	4044	4131	4247	4465	34.8
			HEF	80	4625	4691	4902	4915	31.77
				90	3782	3834	4032	4032	31.77
		7000LM	SEF	80	6721	6911	7101	7269	49.05
				90	5857	5984	6152	6469	49.05
			HEF	80	6700	6795	7101	7120	44.67
				90	5478	5554	5841	5841	44.67
		9000LM	SEF	80	8472	8711	8950	9163	63.99
				90	7383	7543	7755	8154	63.99
			HEF	80	8445	8565	8950	8974	58.58
				90	6905	7001	7362	7362	58.58
		10000LM	SEF	80	9469	9736	10003	10240	73.37
				90	8252	8430	8667	9112	73.37
			HEF	80	9438	9573	10003	10030	66.27
				90	7717	7825	8228	8228	66.27
	L96	6000LM	SEF	80	5463	5617	5771	5908	38.15
				90	4761	4864	5001	5258	38.15
			HEF	80	5445	5523	5771	5787	35.54
				90	4452	4515	4747	4747	35.54
		8000LM	SEF	80	7289	7495	7701	7884	52.32
				90	6353	6490	6672	7015	52.32
			HEF	80	7266	7370	7701	7722	48.5
				90	5941	6024	6334	6334	48.5
		10000LM	SEF	80	9017	9272	9526	9752	66.47
				90	7858	8028	8254	8678	66.47
			HEF	80	8988	9117	9526	9552	60.89
				90	7349	7452	7836	7836	60.89
		14000LM	SEF	80	13168	13540	13911	14241	94.78
				90	11476	11723	12054	12673	94.78
			HEF	80	13126	13313	13911	13949	85.96
				90	10732	10882	11443	11443	85.96
		18000LM	SEF	80	16970	17448	17927	18353	128.98
				90	14788	15108	15533	16331	128.98
			HEF	80	16915	17156	17927	17975	116.92
				90	13831	14024	14746	14746	116.92
		20000LM	SEF	80	18742	19271	19800	20270	146.83
				90	16333	16686	17156	18037	146.83
			HEF	80	18682	18948	19800	19853	131.6
				90	15276	15489	16287	16287	131.6

CLX LED Linear

TYPE S2

RRL - RELOC®-Ready Luminaire

- RRL connectors can be used with Quick-Flex®, System 820 and OnePass® systems.
- Load side of connector factory installed to luminaire.
- 4-pole mating connector with push-in terminations allows for simple installation.
- Touch-safe design on both halves meets UL/CSA requirement.
- Wiping contact design allows safe disconnect under load.



ORDERING INFORMATION

Lead times will vary depending on options selected. Consult with your sales representative.

Example: RRLA

Series	Wiring instructions
RRL RELOC®-ready luminaire	<p>A Hot conductor wired to position #1 (phase A)</p> <p>B Hot conductor wired to position #2 (phase B)</p> <p>C Hot conductor wired to position #3 (phase C) ¹</p>

Compatible RELOC® Cables for Industrial Luminaires (ordered and shipped separately)



Notes

¹ C, ABE, and C125 options are not used with Quick-Flex QFC, QSFC, QPT, and QD.

PLUG-IN WIRING INFORMATION

Advanced plug-in system with two-circuit capability. Available on industrial and strip products and a variety of architectural products mounted in continuous rows. PLR22 (2-circuit) and crossover harness switches hot circuit serving next fixture in row. Reduces fixture types on job for alternating circuit applications (see example below.)

Easy one-step installation, saves up to 35% on labor costs. Expanded switching flexibility helps save energy.

Rows can be 50% longer with two-circuit systems. Polarized, lock-together nylon connectors prevent miswiring in the field. #12 THHN conductor, rated 600V, 90°C. White neutral wire included. Grounding accomplished by fixture in-row connectors.

CSA certified systems available with up to 2 circuits. G ground required.

Not for use with dedicated emergency circuits.

Note: Specifications subject to change without notice.



Wiring

PLR

Advanced 1 or 2-Circuit Plug-In

ORDERING INFORMATION

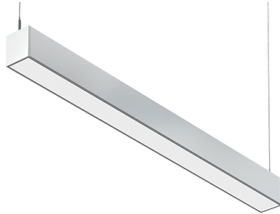
Lead times will vary depending on options selected. Consult with your sales representative.

Series	Number of hot wires	Branch circuits	Dimming	Ground
PLR	(blank) Not required for PLR22	Circuits to which driver is connected	LV Low-voltage dimming	G Ground (required)
PLR22	1 Black	(blank) Not required for PLR22		
	2 Black and red	A Black wire		
		B Red wire		
		Battery charging circuit (must be unswitched)		
		(blank) No battery charging circuit		
		ELA Battery pack wired to black wire		
		ELB Battery pack wired to red wire		

Typical Applications

- Multiple-circuit and single-circuit for longer continuous rows
- Multiple-circuit with alternating fixtures on separate circuits and 2-circuit PLR22
- Multiple circuit with night-lights located along row as desired

MARK ARCHITECTURAL LIGHTING™



Slot 2 LED Direct Pendant

The Slot LED family of luminaires offers an unparalleled package of performance and features for your next lighting project. Precision lumen DIRECTIR optics deliver optimized light where needed for ceilings and walls. With other key features such as simplified installation, seamless controls integration and superior color constancy, the Slot LED family from Mark Lighting offers exceptional quality and design flexibility.

Type:

TYPE SL2

Project:

Catalog Number:

DO NOT TYPE HERE. Autopopulated field.

Specification Features

Housing

Nominal 2.5" x 3.75" extruded aluminum housing

Finish

White, Black or Silver powdercoat

Reflector

Formed steel with high reflectance white

Distribution/Shielding

Extruded 90% transmissive acrylic lens with a textured surface providing diffuse illumination and a uniform appearance for direct lambertian distribution (No Optics). Wall Wash (WW) and Wall Graze (WG) distribution options incorporate co-extruded lenses. Shielding is available as an external blade louver for WW or WG options, or an internal blade louver in lieu of lambertian distribution diffuser.

LED Components

Linear: Nichia®- 757 series LED chips (>80 CRI)

Electrical

Long-life LEDs, coupled with high-efficiency drivers, provide superior quantity and quality of illumination for extended service life. 80% LED lumen maintenance at 60,000 hours (L80/60,000).

Color Consistency

The Acuity Brands circuit boards for the linear LED components use a precise binning algorithm which creates a consistent color temperature from board to board. The color a variation of no greater than a 2.5 Step MacAdam (2.5SDCM) along the black body locus from board to board.

Driver

Factory tuned constant current electronic dimming driver is standard. Flicker free dimming available down to <1%. LED drivers perform within the recommended operating areas for flicker as a function of frequency and modulation (%) IEEE Standard 1789-2015 (IEEE Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers), in typical operating conditions at representative dimming levels. Electrical specifications at maximum driver load: PF > 0.9 and THD <20%. Meets FCC Title 47 Class A or Class B. Other available drivers include Lutron, DMX and DALI protocol drivers.

Certification

CSA tested to UL 1598 standards, assembled in the USA. Damp Location Listed.

Listings

DesignLights Consortium® (DLC) Premium qualified product. Not all versions of this product may be DLC Premium qualified. Please check the DLC Qualified Products List at www.designlights.org/OPL to confirm which versions are qualified.

Warranty

5-year limited warranty. Complete warranty terms located at:

www.acuitybrands.com/support/warranty/terms-and-conditions

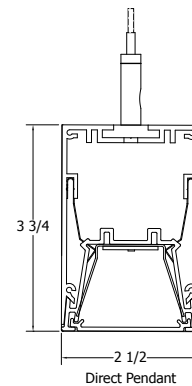
Note: Actual performance may differ as a result of end-user environment and application. All values are design or typical values, measured under laboratory conditions at 25 °C. Specifications subject to change without notice.

Fixture Performance

4FT INDIVIDUAL (35K)	DIRECT			
Lumens Output	400LMF	600LMF	800LMF	1000LMF
Delivered Lumens	1766	2710	3577	4225
Input Watts	14.4	22.5	30.6	37.1
Lumen/Watt	122	120	116	113

* Consult factory for customized lumen output and wattage between 350LMF and 1050LMF.

Technical Drawing



eldoLED
your product is our drive

Declare.



Buy American



Buy American:

Product with the BAA option 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.

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

MARK
ARCHITECTURAL
LIGHTING™

Slot 2 LED
Direct Pendant

TYPE SL2



A+ Capable options indicated by this color background.

Ordering

Example: S2LD 32FT MSL8 80CRI 30K 400LMF MIN1 MVOLT WHT ZT F1/36A RDCY WHTCY WCRD

Series	Plan	Total Run Length	Max Section Length	Direct Light Source Color Rendering	Direct LED Color Temp	Direct LED Light Output	Direct Distribution (Optics)
S2LD Slot 2 Pendant - Direct	LCB Linear center balanced LLP Linear longest possible	2FT Specify continuous run length (in whole feet, 2' minimum) Unit length may affect available options. 2' & 3' only available as individual units For runs longer than 8FT: ALWAYS order the run by the TOTAL RUN LENGTH. Ordering the sections individually will not provide the correct joining hardware to allow connection in the field.	MSL4 4' MSL5 5' MSL6 6' MSL7 7' MSL8 8' MSL2 2'	80CRI 80 CRI 90CRI 90 CRI	27K 2700K 30K 3000K 35K 3500K 40K 4000K 50K 5000K	400LMF 400 Lumens per FT 600LMF 600 Lumens per FT 800LMF 800 Lumens per FT 1000LMF 1000 Lumens per FT _LMF¹ # Lumens per FT	(blank) Standard Lambertian Distribution WW Wallwash Distribution WG Wall Graze Distribution WW and WG not available with Downlights, EGLD, LVRR or LVRRRA.

Downlight	Downlight Shape	Downlight Color Rendering	Downlight Color Temp	Minimum Dimming Level	Optional Shielding	Voltage
(blank) No Downlight modules in fixture 2DL LED Downlights (2 per unit) _DL LED Downlights per run (3DL, 4DL, etc)	(blank) No Downlight modules in fixture RDD Round SQD Square	(blank) No Downlight modules in fixture S80CRI 80CRI	(blank) No Downlight modules in fixture S27K 2700K S30K 3000K S35K 3500K S40K 4000K	NODIM ² Non - dimming MIN1 Constant current, dimming to 1% DARK Constant current, dimming to 0.1%	(blank) No louvers LVRR ³ Dropped louvers LVRR ⁴ Regressed louvers painted to match fixture finish LVRRRA ⁴ Regressed louvers, aluminum finish EGLD ³ Edge View direct lens Not available with Downlights. Not available with NLTAIR2	MVOLT Multi-volt, 120-277V 120 120V 277 277V 347 ³ 347V

Must select all Downlight options. Specify number of downlights modules.
Not available on 2' or 3' units.
Not available with 347V.

Maximum of 2DL in 4' & 5' units.
Not available with emergency options. Not available with any sensors on the same unit.

Finish	Emergency Options	Control Input	Sensor	Secondary Sensor
WHT White (gloss) BLK Black (gloss) SLV Silver (gloss) WHTT White (textured) BLKT Black (textured) SLVT Silver (textured) RALTB RAL paint finishes	E10WLCP ⁶ 4' emergency section w/ battery pack, 1250 lumens _E10WLCP ⁵ 4' emergency section w/ battery pack, 1250 lumens _EC ⁷ # of emergency circuits BGTD ⁷,⁸ Generator transfer device Not available with 347V.	(blank) Non-dimming, line voltage ZT 0-10V control NLIGHT ⁹ nLight enabled NLTAIR2 ²⁴ nLight Air Wireless Enabled DALI ¹⁰ DALI compatible DMX ¹⁰,¹¹ DMX compatible ECOD ¹¹,¹² Lutron Hi-Lume digital driver ECOD2 ¹¹,¹²,¹³ Lutron Hi-Lume 2-wire (1% dimming) ECOD5 ¹¹,¹² Lutron 5-series digital driver (5% dimming)	(blank) Select if single zone/no zone without sensor NS Select if multi-zone fixture with no sensor in main zone PDT ¹⁴ Occupancy sensor - dual technology (passive infrared & microphonics) ADC ¹⁴ Photocell-daylight dimming sensor API ¹⁷ PIR occupancy sensor & photocell APD ¹⁷ PDT occupancy sensor & photocell Not available with Downlights. Not available with 347V & nLight. (Use ZT Control Inputs where applicable.) Not available on 2' or 3' units.	(blank) No additional zones/sensors SNS Select if multi-zone fixture with no sensor in secondary zone SPDT ¹⁴ Occupancy sensor - dual technology (passive infrared & microphonics) SADC ¹⁴ Photocell-daylight dimming sensor SAPI ¹⁷ PIR occupancy sensor & photocell SAPD ¹⁷ PDT occupancy sensor & photocell Not available with Downlights. Not available with 347V & nLight. (Use ZT Control Inputs where applicable.) Not available on 2' or 3' units.

Tertiary Sensor	Mounting Type	Overall Suspension	Canopy Form	Canopy Color	Cord Color	Options
(blank) No additional zones/sensors TNS Select if multi-zone fixture with no sensor in tertiary zone	F1/ T-bar ceiling (universal mounting bracket) F1A/ T-bar ceiling (UMB with integrated J-box) F2/ Hard ceiling (horizontal J-box)	36A 36" adjustable 72A 72" adjustable 144A 144" adjustable * Measured from ceiling to bottom of luminaire.	RDCY Round canopy SQCY Square canopy	BLKCY Black canopy WHTCY White canopy SLVCY Silver canopy	WCRD White cord CCRD Clear cord BCRD ¹⁵ Black cord	BAA Buy America(n) Compliant DPL Damp location listing GLR ¹³ Fast-blow fuse GMF ¹³ Slow-blow fuse MCS 5" support canopy to match feed canopy PIF Power Feed Installed

EC TO CHOOSE MOUNTING TYPE & DETERMINE LENGTH OF MOUNTING CABLE NEEDED

ARCHITECT TO VERIFY CANOPY FORM

COLORS TO BE CHOSEN BY ARCHITECT

Notes:

- Limited to 350LMF to 1050LMF in 50LMF increments. Not available with ECOD, ECOD2, ECOD5 or DMX control input.
- Not available with Control Input.
- Not available with Sensor Options.
- Not available with sensors on 2', 3' & 5' units.
- DCI & 347V not available with 2' & 3' units. 347V also not available with ZT & sensors, emergency options, NLIGHT in 5' units, & NLIGHT with downlights. Only available with WCRD.
- Not available with 2' or 3' units. Not available with DMX control option. One battery pack per unit. Only available on 8' unit with ECOD, ECOD2, ECOD5. If with ZT & API or APD, only available in 7' & 8' units.
- Powers entire direct unit. Not available with DMX.
- Must select 120 or 277 volt. Remote mounted. Not available with sensor and BGTD in same unit. Not available with DMX.
- Comes with white CAT5 cord in addition to the standard power cord. Will require remote mounted nIO on 2' unit. One nLight device per zone or sensor, for multiple zones consult factory.
- Must select DARK Dim Level.
- Not available with 347V.
- Must select MIN1 Dim Level. Not available on 2', 3' or 5' units.
- 120V only.
- Requires ZT or NLIGHT Control Input.
- Longer lead time item.
- Must select MIN1 or DARK Dim Level. Not available with 347. Not available with 347, WW, 2' or 3' units. If ordered with E10WLCP, only available in 7' & 8' units. One NLTAIR2 device per zone or sensor, for multiple zones consult factory. For antenna location, see page 10.
- Requires ZT, NLIGHT or NLTAIR2 Control Input.

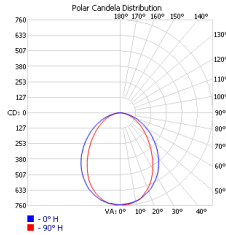
ELECTRICAL CONTRACTOR TO DETERMINE APPROPRIATE MOUNTING HARDWARE & ACCESSORIES

MARK
ARCHITECTURAL
LIGHTING™

Slot 2 LED
Direct Pendant

TYPE SL2

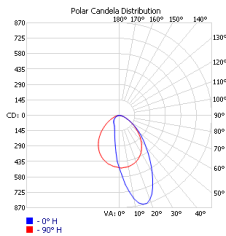
PHOTOMETRICS



Test Report: ISF 37224P0
IES LM 79-08
S2LD 4FT 80CRI 30K 400LMF
Lumens: 1697
Wattage: 14.44
Efficacy: 117.5

Zonal Lumen Summary		
Zone	Lumens	% Luminaire
0-30	559.6	33%
0-40	879	51.80%
0-60	1415.1	83.40%
60-90	281.4	16.60%
70-100	115.5	6.80%
90-120	0.3	0%
0-90	1696.6	100%
90-180	0.4	0%
0-180	1697	100%

Angle	Candlepower Distribution									
	Plane									
	0	22.5	45	67.5	90	112.5	135	157.5	180	
0	753	753	753	753	753	753	753	753	753	753
5	745	748	749	749	753	749	751	751	747	
10	734	739	737	735	735	736	740	742	738	
15	712	714	710	705	708	706	711	721	718	
20	684	685	676	662	662	663	677	689	689	
25	643	642	627	606	603	610	630	649	653	
30	601	596	574	544	535	545	575	602	609	
35	548	539	510	475	462	474	512	548	557	
40	490	479	443	408	393	406	447	488	500	
45	428	416	379	339	328	344	384	427	438	
50	366	354	314	282	271	284	322	363	378	
55	308	295	257	231	223	233	263	303	314	
60	248	236	205	183	177	187	212	244	256	
65	193	184	161	142	137	143	163	190	201	
70	143	133	117	105	102	107	122	141	151	
75	96	89	78	72	69	73	84	95	101	
80	53	51	46	41	41	44	49	55	59	
85	20	19	19	19	19	20	22	24	24	
90	0	0	1	1	1	2	2	2	2	



Test Report: ISF 37225P0
IES LM 79-08
S2LD 4FT 80CRI 30K 400LMF WW
Lumens: 1047
Wattage: 14.5
Efficacy: 72.2

Zonal Lumen Summary		
Zone	Lumens	% Luminaire
0-30	390.8	37.30%
0-40	605.7	57.90%
0-60	921.1	88%
60-90	119.6	11.40%
70-100	44.5	4.20%
90-120	3.1	0.30%
0-90	1040.7	99.40%
90-180	6.3	0.60%
0-180	1047	100%

Angle	Candlepower Distribution									
	Plane									
	0	22.5	45	67.5	90	112.5	135	157.5	180	
0	493	493	493	493	493	493	493	493	493	
5	652	637	603	558	493	443	391	362	353	
10	796	773	715	619	490	378	296	250	236	
15	866	853	791	666	479	321	222	178	164	
20	843	843	818	693	464	270	172	136	128	
25	745	766	792	697	439	225	138	114	108	
30	620	645	718	672	408	191	116	100	97	
35	499	525	616	614	367	161	101	80	89	
40	392	420	506	538	322	136	90	83	81	
45	311	331	400	448	270	114	79	73	73	
50	241	255	314	353	217	96	69	65	64	
55	177	191	238	265	166	79	58	54	54	
60	126	136	171	191	123	61	47	43	43	
65	85	91	117	131	86	47	36	34	33	
70	57	60	76	84	56	34	26	24	24	
75	36	38	45	50	35	22	17	16	16	
80	20	20	23	25	19	11	9	9	9	
85	8	8	8	8	7	5	4	4	5	
90	1	1	0	0	0	0	0	1	1	

EXPECTED LIFE: L85 @ 60,000
CALCULATED LIFE: L70 @ 120,000

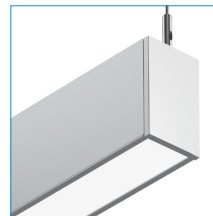
Shielding



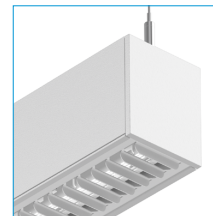
Co-Extruded WG



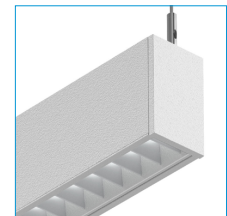
Co-Extruded WW



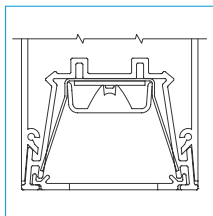
Edge View Lens



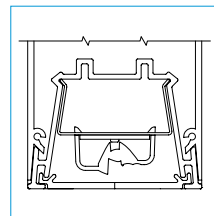
External Louver



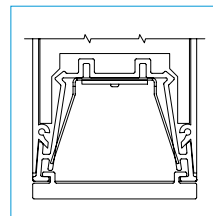
Regressed Louver



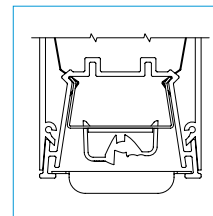
Co-Extruded WG
(Standard)



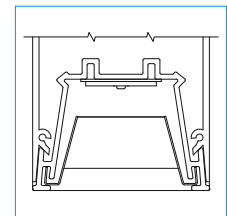
Co-Extruded WW
(Standard)



Edge View Lens
(Optional)



External Louver WW
(Painted to Match Housing)



Regressed Louver
(Natural Aluminum or Painted
to Match Housing)

MARK
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LIGHTING™

Slot 2 LED
Direct Pendant

TYPE SL2

LINEAR PLAN:

Mark Lighting offers the ability to provide a continuous run plan to suit your requirements by optionally offering three different methods of configuration.

LLP- Linear Longest Possible

In this configuration, the longest length available is optimized, resulting in the fewest segments and mounting locations. Caution, should be used where balanced appearance is a concern. Example: 20 FT run would have 2, 8 FT segment and 1, 4 FT segment at the end of the run.

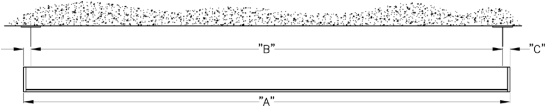
LLP	8 FT	8 FT	4 FT
-----	------	------	------

LCB- Linear Center Balanced:

This configuration incorporates the longest center segment(s) along with any additional lengths required to fill the run length, added to the run ends. Example: 16 FT run would have 2, 4 FT segments (one at each end) and 1, 8 FT segment in the center.

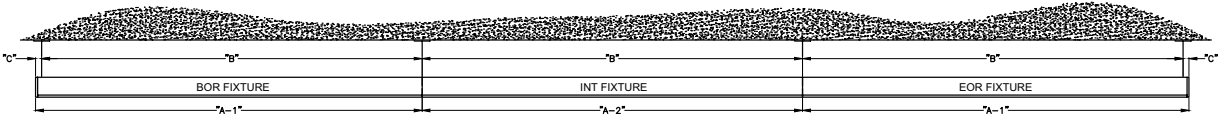
LCB	4 FT	8 FT	4 FT
-----	------	------	------

Individual Fixture Configurations



LENGTH	INDIVIDUAL UNITS (MOUNTING)		
	"A" O.A.L.	"B" O.C.	"C" FROM END
2FT	2'- 5/8"	2'-0"	5/16"
3FT	3'- 5/8"	3'-0"	5/16"
4FT	4'- 5/8"	4'-0"	5/16"
5FT	5'- 5/8"	5'-0"	5/16"
6FT	6'- 5/8"	6'-0"	5/16"
7FT	7'- 5/8"	7'-0"	5/16"
8FT	8'- 5/8"	8'-0"	5/16"

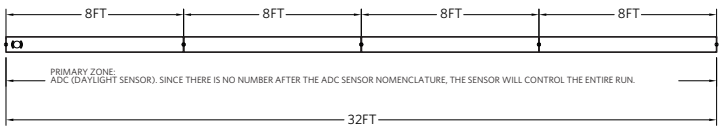
Run Configurations



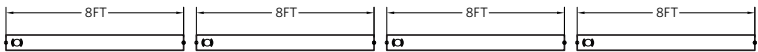
LENGTH	RUN LAYOUT (MOUNTING)		
	"A-1" O.A.L.	"A-2" O.A.L.	"B" O.C.
4FT	4'-0 5/16"	4'-0"	4'-0"
5FT	5'-0 5/16"	5'-0"	5'-0"
6FT	6'-0 5/16"	6'-0"	6'-0"
7FT	7'-0 5/16"	7'-0"	7'-0"
8FT	8'-0 5/16"	8'-0"	8'-0"

TOTAL RUN LENGTH

This system is not modular. Runs longer than 8FT will be automatically configured with Starter, Middle and Ender sections, based on how you specify the TOTAL RUN LENGTH and MAXIMUM SECTION LENGTH parameters in the ordering information. Always order the total run length, not the individual sections



Example: This run must be ordered as 1pc "S2LD LLP 32FT MSL8..."



Example: If you order as 4pcs "S2LD LLP 8FT MSL8..." you will receive these INDIVIDUAL sections that cannot be joined together

MAXIMUM SECTION LENGTH

The run will be broken out using as many sections at the chosen MSL length as possible. Shorter sections will then complete the desired run length.

Examples:
S2LD LLP 21FT MSL5... = 5FT / 4FT / 4FT / 4FT / 4FT
S2LD LLP 21FT MSL6... = 6FT / 6FT / 5FT / 4FT
S2LD LLP 21FT MSL7... = 7FT / 7FT / 7FT
S2LD LLP 21FT MSL8... = 8FT / 8FT / 5FT

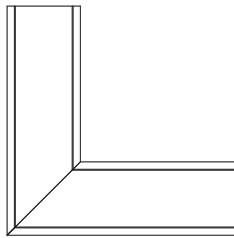
MARK
ARCHITECTURAL
LIGHTING™

Slot 2 LED
Direct Pendant

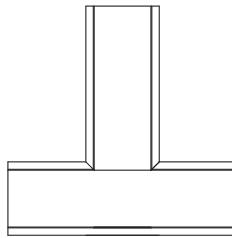
TYPE SL2

Run Patterns, Corners and Junction

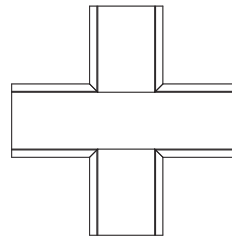
Slot 2 LED patterns can be configured in 1' increments with illuminated 90° inside and outside corners, T junctions, and X junctions with standard 2' corner and junction lengths. For custom angles, corner or junction lengths, consult factory. See separate patterns spec sheets for more details.



90° Corner



T Junction



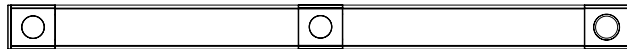
X Junction

Downlights

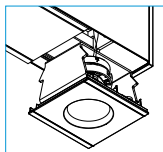
Optional downlights powered by Xicato Spot Modules are available with 4', 5', 6', and 8' length luminaires, maximum (2) Xicato downlights per length. Each downlight module is 10W with 700 lumens delivered, 28 degree beam spread. Downlights are supplied with a dedicated feed-point and will be controlled separately.



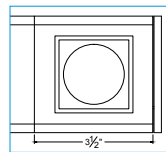
Standard Downlight Location



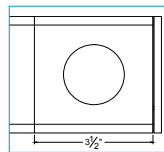
Other Downlight Configuration (consult factory)



Downlight Module



Square Downlight
Plate (SQ)



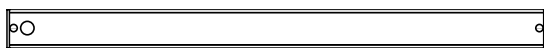
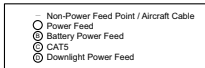
Round Downlight
Plate (RD)

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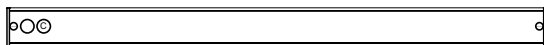
Slot 2 LED
Direct Pendant

TYPE SL2

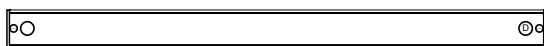
Feed Point Locations



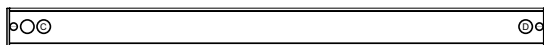
Direct, Dimming* or Non-Dimming



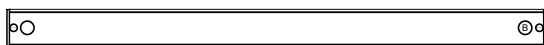
Direct, nLight Controls (wired)



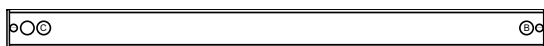
Direct, w/ Downlights**, Dimming* or Non-Dimming



Direct, w/ Downlights**, nLight Controls (wired)**



Direct, Battery (E10WLCP), Dimming* or Non-Dimming



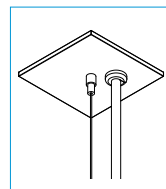
Direct, Battery (E10WLCP), nLight Controls (wired)

* 2-Wire Dimming (ZT, DALI, and Lutron EcoSystem)

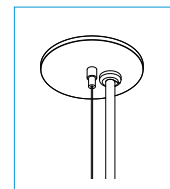
** Downlights are supplied with a dedicated feed-point and will be controlled separately.

*** Downlights with nLight wired controls will use a J-Box mounted control module outside of fixture.

Single Feed Points

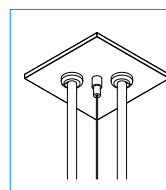


5" Square

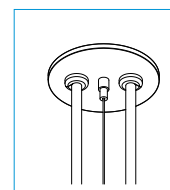


5" Round

Feed and Cat 5 points

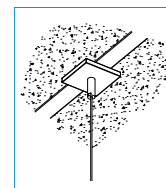


5" Square

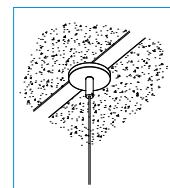


5" Round

Non-Feed Points for T-Bar Mounting



2" Square

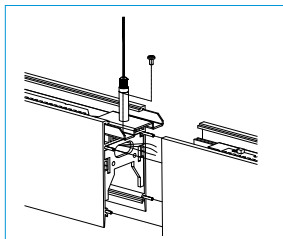


2" Round

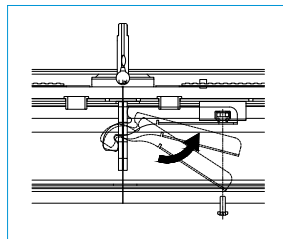
Refer to page 7 for mounting details.

Joiners

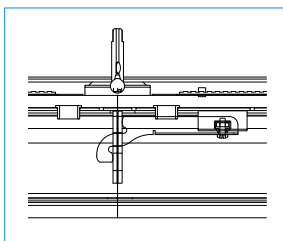
AEL Precision Row-Mount 3-step fixture-to-fixture connection method



Step 1: Align



Step 2: Engage



Step 3: Lock

Continuous Runs

Slot 2 LED continuous rows can be configured in 1' increments and featuring the AEL precision joiner to create a hairline seam between luminaires, providing a monolithic visual aesthetic. For custom run lengths less than a 1' increment, consult factory.

MARK
ARCHITECTURAL
LIGHTING™

Slot 2 LED
Direct Pendant

TYPE SL2

MOST COMMON MOUNTING TYPES AND OPTIONS Options available for this specific luminaire are checked in the boxes below.

Mounting Type

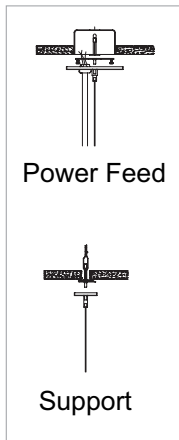
- F1/** For use with most T-Bar and screw slot grid ceilings. Designed for on-grid and off-grid applications.
- F2/** For use with recessed or surface mount horizontal J-box applications.
- F1A/** For use with most T-Bar grid ceilings. Designed for on-grid applications. *Comes complete with J-box with built-in cutout to go over grid.*

Mounting Options

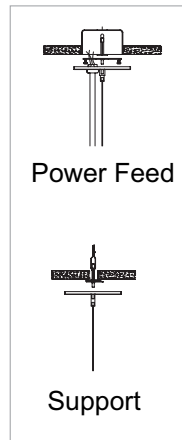
- MCS** Matching canopy at support for aesthetics.

✓ Indicates mounting options available with this luminaire.

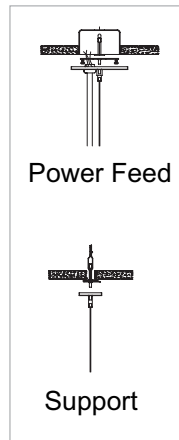
✓ F1/



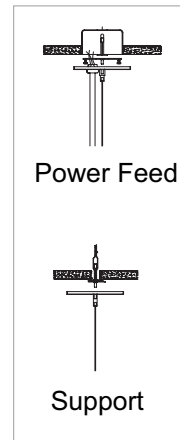
✓ F1/ ordered with MCS



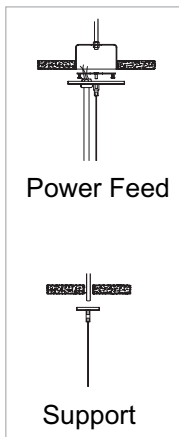
✓ F1A/



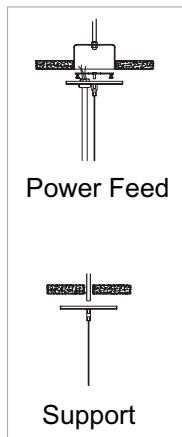
✓ F1A/ ordered with MCS



✓ F2/



✓ F2/ ordered with MCS



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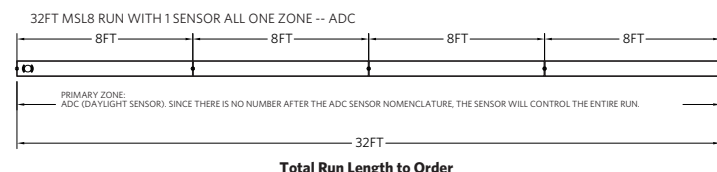
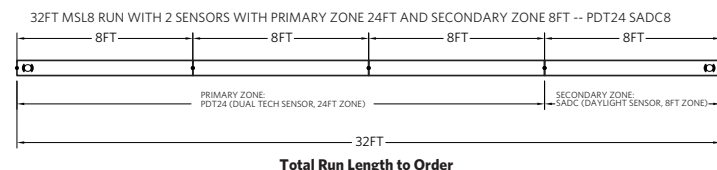
Slot 2 LED
Direct Pendant

TYPE SL2

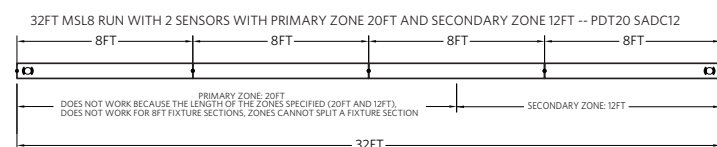
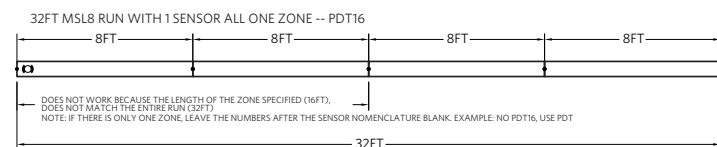
INTEGRATED SENSOR LAYOUT

For runs longer than 8FT:
ALWAYS order the run by the TOTAL RUN LENGTH. Ordering the sections individually will not provide the correct joining hardware to allow connection in the field.

CORRECT:



INCORRECT:



Notes:

- Only one sensor per zone
- At the most, the entire run can only have 2 sensors (thus 2 sensors zones at the most)
- Sensor zone can not split fixture sections
- No overlapping zones

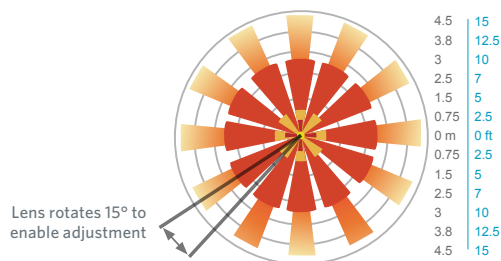
OCCUPANCY DETECTION COVERAGE

At the 7.5 ft (2.9 m) hanging height of a typical pendant mount fixture the sensor provides 10 ft (3.05 m) radial detection of small motion. At a 9 ft (2.74 m) hanging height the radius is 12 ft (3.66 m) for small motion.

Adequate for walking motion detection from mounting heights between 7.5 ft (2.29 m) and 20 ft (6.10 m).

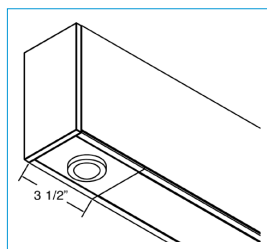
Initial detection will occur earlier when walking across sensor's field of view than when walking directly at sensor.

Initial detection of walking motion into long coverage segment will occur at distances of 2x the mounting height up to 15 ft (4.57 m) and 1.75x up to 20 ft (6.10 m). Lens assembly rotates 15° to enable adjustment in order to line up long segments.



Integrated Controls

Optional nLight® integrated controls make Slot LED luminaires addressable- allowing them to digitally communicate with other nLight enabled controls such as dimmers, switches, occupancy sensors and photocontrols. Simply connect all the nLight enabled control devices using standard CAT5 Cabling.



Occupancy Sensor and/or Photocell

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Slot 2 LED
Direct Pendant

TYPE SL2

Intelligent Luminaire Technology Guide

Choose nomenclature from these columns					Notes	
Minimum Dimming Level		Control Input	=	Driver		Dimming Range
NODIM	+	(blank)	=	0 10V Generic Driver	-	Includes no 0 10V leads from the driver.
MIN10	+	ZT	=	0 10V Generic Driver	100 to 10%	Linear dimming
MIN1	+	ZT	=	0 10V eldoLED ECOdrive	100 to 1%	Formerly (EZ1) nomenclature. Linear dimming
MIN1	+	NLIGHT	=	0 10V eldoLED ECOdrive	100 to 1%	Logarithmic dimming
MIN1	+	ECOD2	=	Lutron forward phase control	100 to 1%	LUTRON Hi-lume 1% 2-wire (model LTEA4U1U)
MIN1	+	ECOD5	=	Lutron Ecosystem	100 to 5%	LUTRON 5 Seires EcoSystem LED Driver (model LDES)
MIN1		ECOD		Lutron Ecosystem	100 to 1%	LUTRON Hi-lume 1% EcoSystem LED Driver with Soft-on, Fade-to-Black (model LDE1)
DARK		ZT		0 10V eldoLED SOLOdrive	100 to 0.1%	Formerly (EZB) nomenclature. Linear dimming
DARK		NLIGHT		0 10V eldoLED SOLOdrive	100 to 0.1%	Logarithmic dimming
DARK		DALI		DALI compatible eldoLED SOLOdrive	100 to 0.1%	"Compatible with DALI. Formerly (EDB & EDAB) nomenclature." Logarithmic dimming
DARK		DMX		DMX compatible eldoLED POWERdrive	100 to 0.1%	"Compatible with DMX / Remote Device Management. Formerly (EXB & EDXB) nomenclature." Linear dimming

Driver Configurations

Control / Sensor Configurations

Choose nomenclature from these columns		
Control Input		Sensor
ZT	+	API
ZT	+	APD
NLIGHT	+	(blank)
NLIGHT		EMG
NLIGHT	+	API
NLIGHT	+	PDT
NLIGHT	+	APD
NLTAIR2		(blank)
NLTAIR2		API
NLTAIR2		APD

Sensor
MSD 7 ADCX
MSD PDT 7 ADCX
nIO EZ PH
nIO EZ PH ER
nIO EZ PH + nES 7 ADCX
nIO EZ PH + nES PDT 7
nIO EZ PH + nES PDT 7 ADCX
RIO EZDL 90D G2
RES7 G2
RES7 PDT G2

Notes
Individual fixture control only. PIR integral occupancy sensor with automatic dimming control photocell. (Old nomenclature: ZT + PIR + ADC)
Individual fixture control only. PDT integral occupancy sensor with automatic dimming control photocell. (Old nomenclature: ZT + PDT + ADC)
nLight enabled only. No onboard sensor.
Emergency nLight enabled only. No onboard sensor.
nLight nES 7 ADCX PIR integral occupancy sensor with automatic dimming photocell. (Old nomenclature: NLIGHT + PIR + ADC)
nLight nES PDT 7 dual technology integral occupancy sensor. (Old nomenclature: NLIGHT + PDT)
nLight nES PDT 7 dual technology integral occupancy sensor with automatic dimming photocell. (Old nomenclature: NLIGHT + PDT + ADC)
https://www.acuitybrands.com/products/detail/778845/nLight/rIO/Fixture-embedded-nLight-AIR-network-interface
https://www.acuitybrands.com/products/detail/593899/nLight/RES7_Sensor/nLight-AIR_Fixture-Integrated-Wireless-Sensor
https://www.acuitybrands.com/products/detail/593899/nLight/RES7_Sensor/nLight-AIR_Fixture-Integrated-Wireless-Sensor

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Slot 2 LED

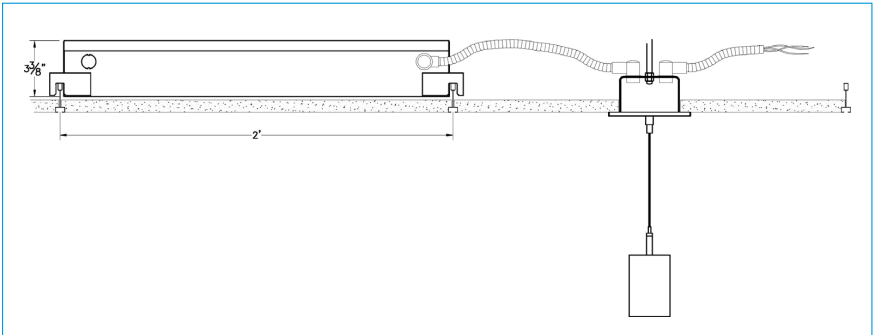
Direct Pendant

TYPE SL2

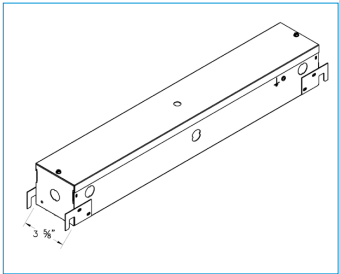
Remote BGTD Mounting Option

Recessed in sheetrock ceiling; rod mounted to structure. Consult factory for other ceiling types or canopy options.

6 foot flexible conduit included, BGTD option should be mounted within 6 feet of junction box above fixture.



Accessible Ceiling

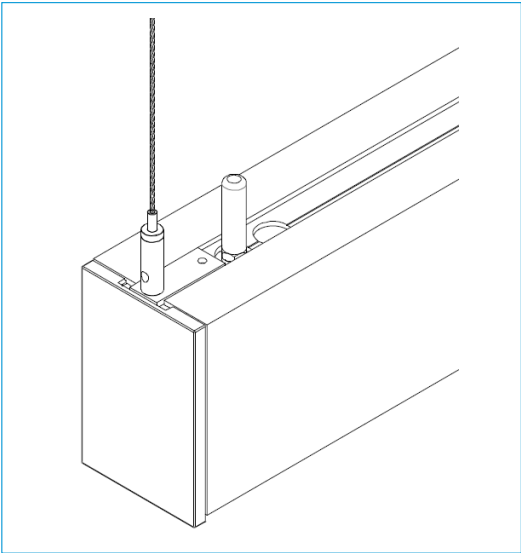


Emergency Battery Packs

The PS1055LCP battery is integral to the fixture and comes standard with a remote test switch and self-diagnostics.

nLight Air Wireless Antenna Location

Note: Antenna will be shipped separately and will need to be attached to the coax connector.



MARK ARCHITECTURAL LIGHTING™



Slot 2 LED Direct Pendant

The Slot LED family of luminaires offers an unparalleled package of performance and features for your next lighting project. Precision lumen DIRECTIR optics deliver optimized light where needed for ceilings and walls. With other key features such as simplified installation, seamless controls integration and superior color constancy, the Slot LED family from Mark Lighting offers exceptional quality and design flexibility.

Type:

TYPE SL4

Project:

Catalog Number:

DO NOT TYPE HERE. Autopopulated field.

Specification Features

Housing

Nominal 2.5" x 3.75" extruded aluminum housing

Finish

White, Black or Silver powdercoat

Reflector

Formed steel with high reflectance white

Distribution/Shielding

Extruded 90% transmissive acrylic lens with a textured surface providing diffuse illumination and a uniform appearance for direct lambertian distribution (No Optics). Wall Wash (WW) and Wall Graze (WG) distribution options incorporate co-extruded lenses. Shielding is available as an external blade louver for WW or WG options, or an internal blade louver in lieu of lambertian distribution diffuser.

LED Components

Linear: Nichia®- 757 series LED chips (>80 CRI)

Electrical

Long-life LEDs, coupled with high-efficiency drivers, provide superior quantity and quality of illumination for extended service life. 80% LED lumen maintenance at 60,000 hours (L80/60,000).

Color Consistency

The Acuity Brands circuit boards for the linear LED components use a precise binning algorithm which creates a consistent color temperature from board to board. The color a variation of no greater than a 2.5 Step MacAdam (2.5SDCM) along the black body locus from board to board.

Driver

Factory tuned constant current electronic dimming driver is standard. Flicker free dimming available down to <1%. LED drivers perform within the recommended operating areas for flicker as a function of frequency and modulation (%) IEEE Standard 1789-2015 (IEEE Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers), in typical operating conditions at representative dimming levels. Electrical specifications at maximum driver load: PF > 0.9 and THD <20%. Meets FCC Title 47 Class A or Class B. Other available drivers include Lutron, DMX and DALI protocol drivers.

Certification

CSA tested to UL 1598 standards, assembled in the USA. Damp Location Listed.

Listings

DesignLights Consortium® (DLC) Premium qualified product. Not all versions of this product may be DLC Premium qualified. Please check the DLC Qualified Products List at www.designlights.org/OPL to confirm which versions are qualified.

Warranty

5-year limited warranty. Complete warranty terms located at:

www.acuitybrands.com/support/warranty/terms-and-conditions

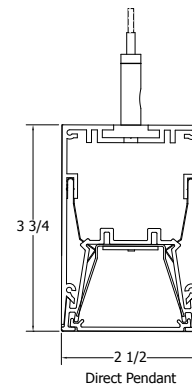
Note: Actual performance may differ as a result of end-user environment and application. All values are design or typical values, measured under laboratory conditions at 25 °C. Specifications subject to change without notice.

Fixture Performance

4FT INDIVIDUAL (35K)	DIRECT			
Lumens Output	400LMF	600LMF	800LMF	1000LMF
Delivered Lumens	1766	2710	3577	4225
Input Watts	14.4	22.5	30.6	37.1
Lumen/Watt	122	120	116	113

* Consult factory for customized lumen output and wattage between 350LMF and 1050LMF.

Technical Drawing



Buy American



Buy American:

Product with the BAA option 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.

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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Slot 2 LED
Direct Pendant

TYPE SL4



A+ Capable options indicated by this color background.

Ordering

Example: S2LD 32FT MSL8 80CRI 30K 400LMF MIN1 MVOLT WHT ZT F1/36A RDCY WHTCY WCRD

Series	Plan	Total Run Length	Max Section Length	Direct Light Source Color Rendering	Direct LED Color Temp	Direct LED Light Output	Direct Distribution (Optics)
S2LD Slot 2 Pendant - Direct	LCB Linear center balanced LLP Linear longest possible	4 FT Specify continuous run length (in whole feet, 2' minimum) Unit length may affect available options. 2' & 3' only available as individual units For runs longer than 8FT: ALWAYS order the run by the TOTAL RUN LENGTH. Ordering the sections individually will not provide the correct joining hardware to allow connection in the field.	MSL4 4' MSL5 5' MSL6 6' MSL7 7' MSL8 8'	80CRI 80 CRI 90CRI 90 CRI	27K 2700K 30K 3000K 35K 3500K 40K 4000K 50K 5000K	400LMF 400 Lumens per FT 600LMF 600 Lumens per FT 800LMF 800 Lumens per FT 1000LMF 1000 Lumens per FT _LMF¹ ## Lumens per FT	(blank) Standard Lambertian Distribution WW Wallwash Distribution WG Wall Graze Distribution WW and WG not available with Downlights, EGLD, LVRR or LVRRRA.

Downlight	Downlight Shape	Downlight Color Rendering	Downlight Color Temp	Minimum Dimming Level	Optional Shielding	Voltage
(blank) No Downlight modules in fixture 2DL LED Downlights (2 per unit) _DL LED Downlights per run (3DL, 4DL, etc)	(blank) No Downlight modules in fixture RDD Round SQD Square	(blank) No Downlight modules in fixture S80CRI 80CRI	(blank) No Downlight modules in fixture S27K 2700K S30K 3000K S35K 3500K S40K 4000K	NODIM² Non - dimming MIN1 Constant current, dimming to 1% DARK Constant current, dimming to 0.1%	(blank) No louver LVRR³ Dropped louver LVRR⁴ Regressed louver painted to match fixture finish LVRRRA⁴ Regressed louver, aluminum finish EGLD³ Edge View direct lens Not available with Downlights. Not available with NLTAIR2	MVOLT Multi-volt, 120-277V 120 120V 277 277V 347² 347V

Must select all Downlight options. Specify number of downlights modules.
Not available on 2' or 3' units.
Not available with 347V.

Maximum of 2DL in 4' & 5' units.
Not available with emergency options. Not available with any sensors on the same unit.

Finish	Emergency Options	Control Input	Sensor	Secondary Sensor
WHT White (gloss) BLK Black (gloss) SLV Silver (gloss) WHTT White (textured) BLKT Black (textured) SLVT Silver (textured) RALTB RAL paint finishes	E10WLCP⁶ 4' emergency section w/ battery pack, 1250 lumens E10WLCP⁵ 4' emergency section w/ battery pack, 1250 lumens _EC⁷ # of emergency circuits BGTD⁷,⁸ Generator transfer device Not available with 347V.	(blank) Non-dimming, line voltage ZT 0-10V control NLIGHT⁹ nLight enabled NLTAIR2¹⁴ nLight Air Wireless Enabled DALI¹⁰ DALI compatible DMX¹⁰,¹¹ DMX compatible ECOD¹¹,¹² Lutron Hi-Lume digital driver ECOD2¹¹,¹²,¹³ Lutron Hi-Lume 2-wire (1% dimming) ECOD5¹¹,¹² Lutron 5-series digital driver	(blank) Select if single zone/no zone without sensor NS Select if multi-zone fixture with no sensor in main zone PDT¹⁴ Occupancy sensor - dual technology (passive infrared & microphonics) ADC¹⁴ Photocell-daylight dimming sensor API¹⁷ PIR occupancy sensor & photocell APD¹⁷ PDT occupancy sensor & photocell Not available with Downlights. Not available with 347V & nLight. (Use ZT Control Inputs where applicable.) Not available on 2' or 3' units.	(blank) No additional zones/sensors SNS Select if multi-zone fixture with no sensor in secondary zone SPDT¹⁴ Occupancy sensor - dual technology (passive infrared & microphonics) SADC¹⁴ Photocell-daylight dimming sensor SAPI¹⁷ PIR occupancy sensor & photocell SAPD¹⁷ PDT occupancy sensor & photocell Not available with Downlights. Not available with 347V & nLight. (Use ZT Control Inputs where applicable.) Not available on 2' or 3' units.

INTEGRAL BATTERY PACKS TO BE PROVIDED FOR LUMINAIRES INDICATED AS "EM" ON LIGHTING PLANS

Tertiary Sensor	Mounting Type	Overall Suspension	Canopy Form	Canopy Color	Cord Color	Options
(blank) No additional zones/sensors TNS Select if multi-zone fixture with no sensor in tertiary zone	F1/ T-bar ceiling (universal mounting bracket) F1A/ T-bar ceiling (UMB with integrated J-box) F2/ Hard ceiling (horizontal J-box)	36A 36" adjustable 72A 72" adjustable 144A 144" adjustable * Measured from ceiling to bottom of luminaire.	RDCY Round canopy SQCY Square canopy	BLKCY Black canopy WHTCY White canopy SLVCY Silver canopy	WCRD White cord CCRD Clear cord BCRD¹⁵ Black cord	BAA Buy America(n) Compliant DPL Damp location listing GLR¹³ Fast-blow fuse GMF¹³ Slow-blow fuse MCS 5" support canopy to match feed canopy PIF Power Feed Installed

EC TO CHOOSE MOUNTING TYPE & DETERMINE LENGTH OF MOUNTING CABLE NEEDED

ARCHITECT TO VERIFY CANOPY FORM

COLORS TO BE CHOSEN BY ARCHITECT

Notes:

- Limited to 350LMF to 1050LMF in 50LMF increments. Not available with ECOD, ECOD2, ECOD5 or DMX control input.
- Not available with Control Input.
- Not available with Sensor Options.
- Not available with sensors on 2', 3' & 5' units.
- DCT & 347V not available with 2' & 3' units. 347V also not available with ZT & sensors, emergency options, NLIGHT in 5' units, & NLIGHT with downlights. Only available with WCRD.
- Not available with 2' or 3' units. Not available with DMX control option. One battery pack per unit. Only available on 8' unit with ECOD, ECOD2, ECOD5. If with ZT & API or APD, only available in 7' & 8' units.
- Powers entire direct unit. Not available with DMX.
- Must select 120 or 277 volt. Remote mounted. Not available with sensor and BGTD in same unit. Not available with DMX.
- Comes with white CAT5 cord in addition to the standard power cord. Will require remote mounted nIO on 2' unit. One nLight device per zone or sensor, for multiple zones consult factory.
- Must select DARK Dim Level.
- Not available with 347V.
- Must select MIN1 Dim Level. Not available on 2', 3' or 5' units.
- 120V only.
- Requires ZT or NLIGHT Control Input.
- Longer lead time item.
- Must select MIN1 or DARK Dim Level. Not available with 347. Not available with 347, WW, 2' or 3' units. If ordered with E10WLCP, only available in 7' & 8' units. One NLTAIR2 device per zone or sensor, for multiple zones consult factory. For antenna location, see page 10.
- Requires ZT, NLIGHT or NLTAIR2 Control Input.

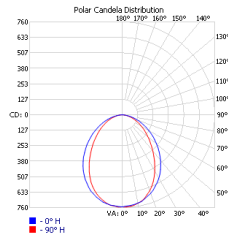
ELECTRICAL CONTRACTOR TO DETERMINE APPROPRIATE MOUNTING HARDWARE & ACCESSORIES

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Slot 2 LED
Direct Pendant

TYPE SL4

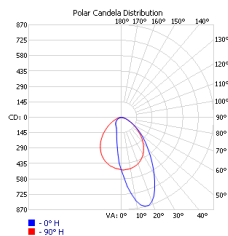
PHOTOMETRICS



Test Report: ISF 37224P0
IES LM 79-08
S2LD 4FT 80CRI 30K 400LMF
Lumens: 1697
Wattage: 14.44
Efficacy: 117.5

Zonal Lumen Summary		
Zone	Lumens	% Luminaire
0-30	559.6	33%
0-40	879	51.80%
0-60	1415.1	83.40%
60-90	281.4	16.60%
70-100	115.5	6.80%
90-120	0.3	0%
0-90	1696.6	100%
90-180	0.4	0%
0-180	1697	100%

Angle	Candlepower Distribution									
	0	22.5	45	67.5	90	112.5	135	157.5	180	
0	753	753	753	753	753	753	753	753	753	
5	745	748	749	749	753	749	751	751	747	
10	734	739	737	735	735	736	740	742	738	
15	712	714	710	705	708	706	711	721	718	
20	684	685	676	662	662	663	677	689	689	
25	643	642	627	606	603	610	630	649	653	
30	601	596	574	544	535	545	575	602	609	
35	548	539	510	475	462	474	512	548	557	
40	490	479	443	408	393	406	447	488	500	
45	428	416	379	339	328	344	384	427	438	
50	366	354	314	282	271	284	322	363	378	
55	308	295	257	231	223	233	263	303	314	
60	248	236	205	183	177	187	212	244	256	
65	193	184	161	142	137	143	163	190	201	
70	143	133	117	105	102	107	122	141	151	
75	96	89	78	72	69	73	84	95	101	
80	53	51	46	41	41	44	49	55	59	
85	20	19	19	19	19	20	22	24	24	
90	0	0	1	1	1	2	2	2	2	



Test Report: ISF 37225P0
IES LM 79-08
S2LD 4FT 80CRI 30K 400LMF WW
Lumens: 1047
Wattage: 14.5
Efficacy: 72.2

Zonal Lumen Summary		
Zone	Lumens	% Luminaire
0-30	390.8	37.30%
0-40	605.7	57.90%
0-60	921.1	88%
60-90	119.6	11.40%
70-100	44.5	4.20%
90-120	3.1	0.30%
0-90	1040.7	99.40%
90-180	6.3	0.60%
0-180	1047	100%

Angle	Candlepower Distribution									
	0	22.5	45	67.5	90	112.5	135	157.5	180	
0	493	493	493	493	493	493	493	493	493	
5	652	637	603	558	493	443	391	362	353	
10	796	773	715	619	490	378	296	250	236	
15	866	853	791	666	479	321	222	178	164	
20	843	843	818	693	464	270	172	136	128	
25	745	766	792	697	439	225	138	114	108	
30	620	645	718	672	408	191	116	100	97	
35	499	525	616	614	367	161	101	80	89	
40	392	420	506	538	322	136	90	63	81	
45	311	331	400	448	270	114	79	73	73	
50	241	255	314	353	217	96	69	65	64	
55	177	191	238	265	166	79	58	54	54	
60	126	136	171	191	123	61	47	43	43	
65	85	91	117	131	86	47	36	34	33	
70	57	60	76	84	56	34	26	24	24	
75	36	38	45	50	35	22	17	16	16	
80	20	20	23	25	19	11	9	9	9	
85	8	8	8	8	7	5	4	4	5	
90	1	1	0	0	0	0	0	1	1	

EXPECTED LIFE: L85 @ 60,000
CALCULATED LIFE: L70 @ 120,000

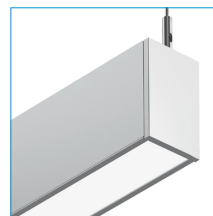
Shielding



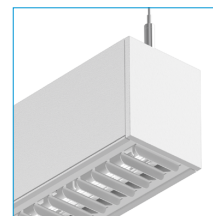
Co-Extruded WG



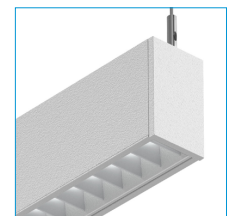
Co-Extruded WW



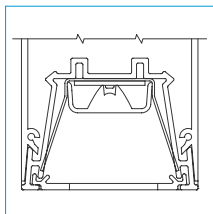
Edge View Lens



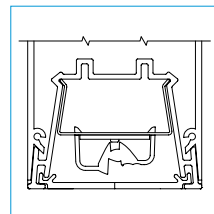
External Louver



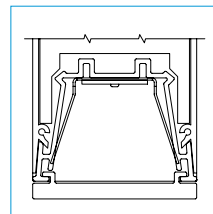
Regressed Louver



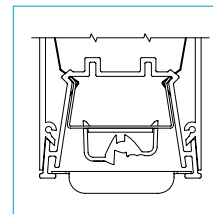
Co-Extruded WG
(Standard)



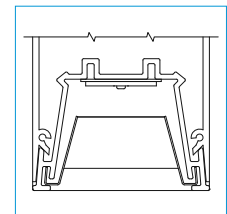
Co-Extruded WW
(Standard)



Edge View Lens
(Optional)



External Louver WW
(Painted to Match Housing)



Regressed Louver
(Natural Aluminum or Painted
to Match Housing)

MARK
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LIGHTING™

Slot 2 LED
Direct Pendant

TYPE SL4

LINEAR PLAN:

Mark Lighting offers the ability to provide a continuous run plan to suit your requirements by optionally offering three different methods of configuration.

LLP- Linear Longest Possible

In this configuration, the longest length available is optimized, resulting in the fewest segments and mounting locations. Caution, should be used where balanced appearance is a concern. Example: 20 FT run would have 2, 8 FT segment and 1, 4 FT segment at the end of the run.

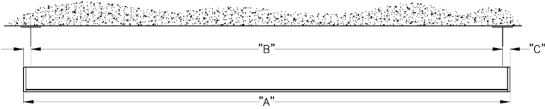
LLP	8 FT	8 FT	4 FT
-----	------	------	------

LCB- Linear Center Balanced:

This configuration incorporates the longest center segment(s) along with any additional lengths required to fill the run length, added to the run ends. Example: 16 FT run would have 2, 4 FT segments (one at each end) and 1, 8 FT segment in the center.

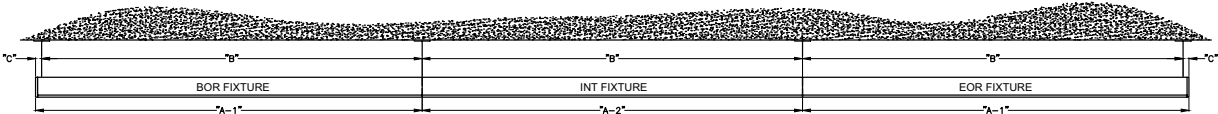
LCB	4 FT	8 FT	4 FT
-----	------	------	------

Individual Fixture Configurations



LENGTH	INDIVIDUAL UNITS (MOUNTING)		
	"A" O.A.L.	"B" O.C.	"C" FROM END
2FT	2'- 5/8"	2'-0"	5/16"
3FT	3'- 5/8"	3'-0"	5/16"
4FT	4'- 5/8"	4'-0"	5/16"
5FT	5'- 5/8"	5'-0"	5/16"
6FT	6'- 5/8"	6'-0"	5/16"
7FT	7'- 5/8"	7'-0"	5/16"
8FT	8'- 5/8"	8'-0"	5/16"

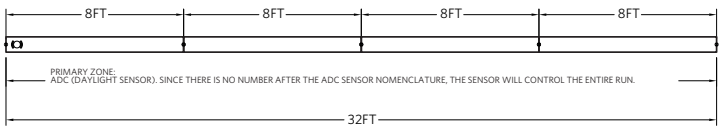
Run Configurations



LENGTH	RUN LAYOUT (MOUNTING)		
	"A-1" O.A.L.	"A-2" O.A.L.	"B" O.C.
4FT	4'-0 5/16"	4'-0"	4'-0"
5FT	5'-0 5/16"	5'-0"	5'-0"
6FT	6'-0 5/16"	6'-0"	6'-0"
7FT	7'-0 5/16"	7'-0"	7'-0"
8FT	8'-0 5/16"	8'-0"	8'-0"

TOTAL RUN LENGTH

This system is not modular. Runs longer than 8FT will be automatically configured with Starter, Middle and Ender sections, based on how you specify the TOTAL RUN LENGTH and MAXIMUM SECTION LENGTH parameters in the ordering information. Always order the total run length, not the individual sections



Example: This run must be ordered as 1pc "S2LD LLP 32FT MSL8..."



Example: If you order as 4pcs "S2LD LLP 8FT MSL8..." you will receive these INDIVIDUAL sections that cannot be joined together

MAXIMUM SECTION LENGTH

The run will be broken out using as many sections at the chosen MSL length as possible. Shorter sections will then complete the desired run length.

Examples:
S2LD LLP 21FT MSL5... = 5FT / 4FT / 4FT / 4FT / 4FT
S2LD LLP 21FT MSL6... = 6FT / 6FT / 5FT / 4FT
S2LD LLP 21FT MSL7... = 7FT / 7FT / 7FT
S2LD LLP 21FT MSL8... = 8FT / 8FT / 5FT

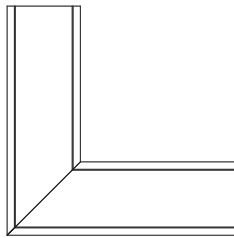
MARK
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Slot 2 LED
Direct Pendant

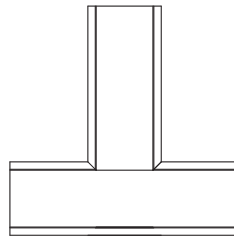
TYPE SL4

Run Patterns, Corners and Junction

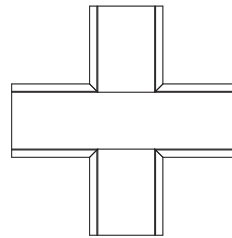
Slot 2 LED patterns can be configured in 1' increments with illuminated 90° inside and outside corners, T junctions, and X junctions with standard 2' corner and junction lengths. For custom angles, corner or junction lengths, consult factory. See separate patterns spec sheets for more details.



90° Corner



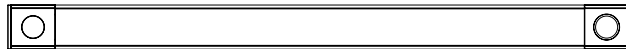
T Junction



X Junction

Downlights

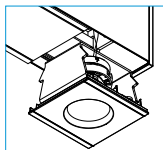
Optional downlights powered by Xicato Spot Modules are available with 4', 5', 6', and 8' length luminaires, maximum (2) Xicato downlights per length. Each downlight module is 10W with 700 lumens delivered, 28 degree beam spread. Downlights are supplied with a dedicated feed-point and will be controlled separately.



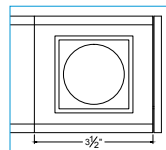
Standard Downlight Location



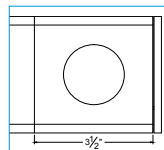
Other Downlight Configuration (consult factory)



Downlight Module



Square Downlight
Plate (SQ)



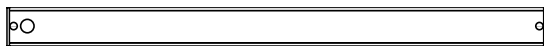
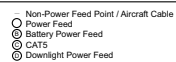
Round Downlight
Plate (RD)

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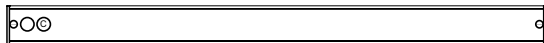
Slot 2 LED
Direct Pendant

TYPE SL4

Feed Point Locations



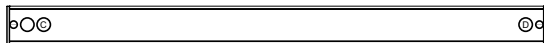
Direct, Dimming* or Non-Dimming



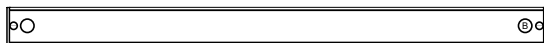
Direct, nLight Controls (wired)



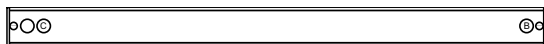
Direct, w/ Downlights**, Dimming* or Non-Dimming



Direct, w/ Downlights**, nLight Controls (wired)**



Direct, Battery (E10WLCP), Dimming* or Non-Dimming



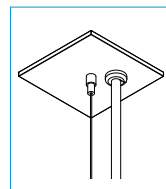
Direct, Battery (E10WLCP), nLight Controls (wired)

* 2-Wire Dimming (ZT, DALI, and Lutron EcoSystem)

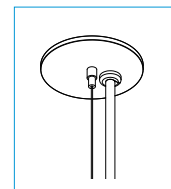
** Downlights are supplied with a dedicated feed-point and will be controlled separately.

*** Downlights with nLight wired controls will use a J-Box mounted control module outside of fixture.

Single Feed Points

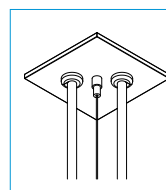


5" Square

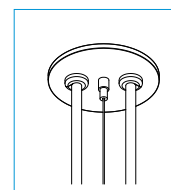


5" Round

Feed and Cat 5 points

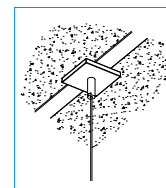


5" Square

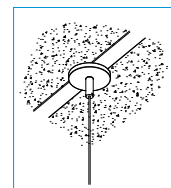


5" Round

Non-Feed Points for T-Bar Mounting



2" Square

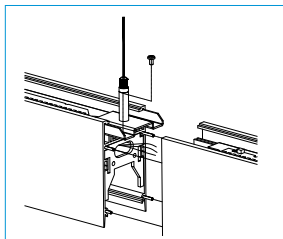


2" Round

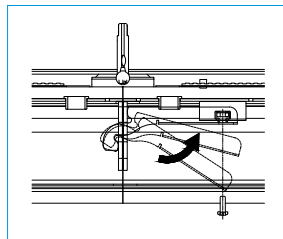
Refer to page 7 for mounting details.

Joiners

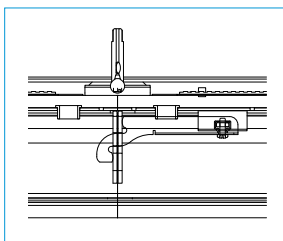
AEL Precision Row-Mount 3-step fixture-to-fixture connection method



Step 1: Align



Step 2: Engage



Step 3: Lock

Continuous Runs

Slot 2 LED continuous rows can be configured in 1' increments and featuring the AEL precision joiner to create a hairline seam between luminaires, providing a monolithic visual aesthetic. For custom run lengths less than a 1' increment, consult factory.

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Slot 2 LED
Direct Pendant

TYPE SL4

MOST COMMON MOUNTING TYPES AND OPTIONS Options available for this specific luminaire are checked in the boxes below.

Mounting Type

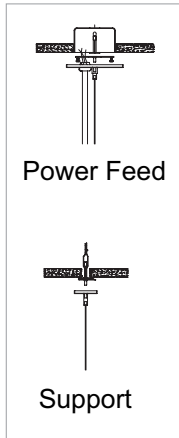
- F1/** For use with most T-Bar and screw slot grid ceilings. Designed for on-grid and off-grid applications.
- F2/** For use with recessed or surface mount horizontal J-box applications.
- F1A/** For use with most T-Bar grid ceilings. Designed for on-grid applications. *Comes complete with J-box with built-in cutout to go over grid.*

Mounting Options

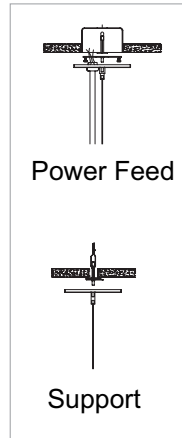
- MCS** Matching canopy at support for aesthetics.

✓ Indicates mounting options available with this luminaire.

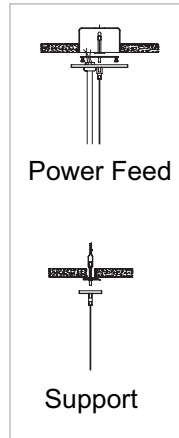
✓ F1/



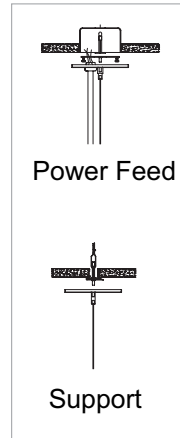
✓ F1/ ordered with MCS



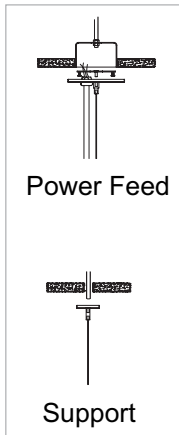
✓ F1A/



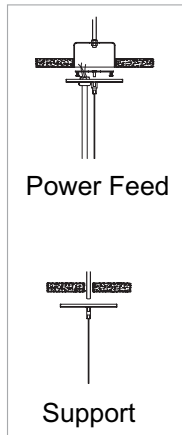
✓ F1A/ ordered with MCS



✓ F2/



✓ F2/ ordered with MCS



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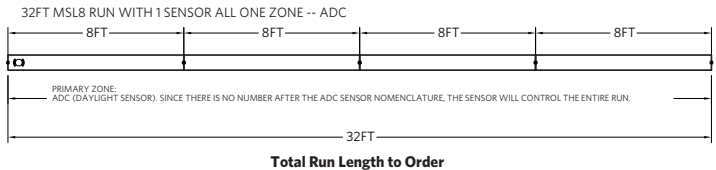
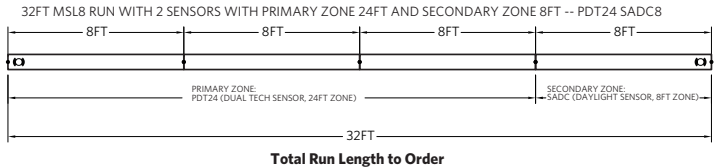
Slot 2 LED
Direct Pendant

TYPE SL4

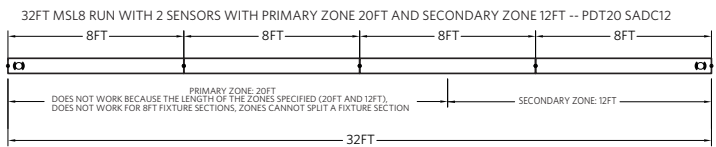
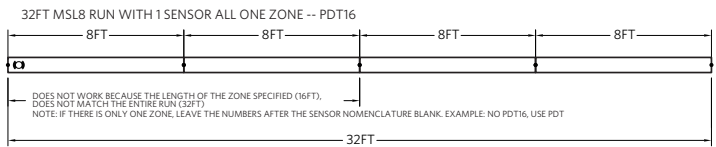
INTEGRATED SENSOR LAYOUT

For runs longer than 8FT:
ALWAYS order the run by the TOTAL RUN LENGTH. Ordering the sections individually
will not provide the correct joining hardware to allow connection in the field.

CORRECT:



INCORRECT:



- Notes:
- Only one sensor per zone
 - At the most, the entire run can only have 2 sensors (thus 2 sensors zones at the most)
 - Sensor zone can not split fixture sections
 - No overlapping zones

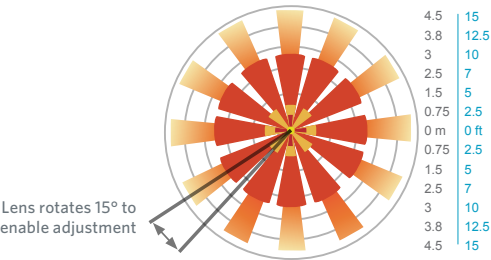
OCCUPANCY DETECTION COVERAGE

At the 7.5 ft (2.9 m) hanging height of a typical pendant mount fixture the sensor provides 10 ft (3.05 m) radial detection of small motion. At a 9 ft (2.74 m) hanging height the radius is 12 ft (3.66 m) for small motion.

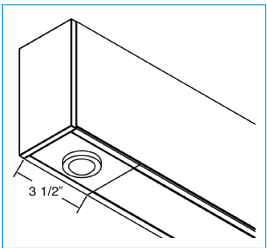
Adequate for walking motion detection from mounting heights between 7.5 ft (2.29 m) and 20 ft (6.10 m).

Initial detection will occur earlier when walking across sensor's field of view than when walking directly at sensor.

Initial detection of walking motion into long coverage segment will occur at distances of 2x the mounting height up to 15 ft (4.57 m) and 1.75x up to 20 ft (6.10 m). Lens assembly rotates 15° to enable adjustment in order to line up long segments.



Integrated Controls
Optional nLight® integrated controls make Slot LED luminaires addressable- allowing them to digitally communicate with other nLight enabled controls such as dimmers, switches, occupancy sensors and photocontrols. Simply connect all the nLight enabled control devices using standard CAT5 Cabling.



Occupancy Sensor and/or Photocell

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Slot 2 LED
Direct Pendant

TYPE SL4

Intelligent Luminaire Technology Guide

Choose nomenclature from these columns					Notes	
Minimum Dimming Level		Control Input		Driver		Dimming Range
NODIM	+	(blank)	=	0 10V Generic Driver	-	Includes no 0 10V leads from the driver.
MIN10	+	ZT	=	0 10V Generic Driver	100 to 10%	Linear dimming
MIN1	+	ZT	=	0 10V eldoLED ECOdrive	100 to 1%	Formerly (EZ1) nomenclature. Linear dimming
MIN1	+	NLIGHT	=	0 10V eldoLED ECOdrive	100 to 1%	Logarithmic dimming
MIN1	+	ECOD2	=	Lutron forward phase control	100 to 1%	LUTRON Hi-lume 1% 2-wire (model LTEA4U1U)
MIN1	+	ECOD5	=	Lutron Ecosystem	100 to 5%	LUTRON 5 Seires EcoSystem LED Driver (model LDES)
MIN1		ECOD		Lutron Ecosystem	100 to 1%	LUTRON Hi-lume 1% EcoSystem LED Driver with Soft-on, Fade-to-Black (model LDE1)
DARK		ZT		0 10V eldoLED SOLOdrive	100 to 0.1%	Formerly (EZB) nomenclature. Linear dimming
DARK		NLIGHT		0 10V eldoLED SOLOdrive	100 to 0.1%	Logarithmic dimming
DARK		DALI		DALI compatible eldoLED SOLOdrive	100 to 0.1%	"Compatible with DALI. Formerly (EDB & EDAB) nomenclature." Logarithmic dimming
DARK		DMX		DMX compatible eldoLED POWERdrive	100 to 0.1%	"Compatible with DMX / Remote Device Management. Formerly (EXB & EDXB) nomenclature." Linear dimming

Driver Configurations

Control / Sensor Configurations

Choose nomenclature from these columns		
Control Input		Sensor
ZT	+	API
ZT	+	APD
NLIGHT	+	(blank)
NLIGHT		EMG
NLIGHT	+	API
NLIGHT	+	PDT
NLIGHT	+	APD
NLTAIR2		(blank)
NLTAIR2		API
NLTAIR2		APD

Sensor
MSD 7 ADCX
MSD PDT 7 ADCX
nIO EZ PH
nIO EZ PH ER
nIO EZ PH + nES 7 ADCX
nIO EZ PH + nES PDT 7
nIO EZ PH + nES PDT 7 ADCX
RIO EZDL 90D G2
RES7 G2
RES7 PDT G2

Notes
Individual fixture control only. PIR integral occupancy sensor with automatic dimming control photocell. (Old nomenclature: ZT + PIR + ADC)
Individual fixture control only. PDT integral occupancy sensor with automatic dimming control photocell. (Old nomenclature: ZT + PDT + ADC)
nLight enabled only. No onboard sensor.
Emergency nLight enabled only. No onboard sensor.
nLight nES 7 ADCX PIR integral occupancy sensor with automatic dimming photocell. (Old nomenclature: NLIGHT + PIR + ADC)
nLight nES PDT 7 dual technology integral occupancy sensor. (Old nomenclature: NLIGHT + PDT)
nLight nES PDT 7 dual technology integral occupancy sensor with automatic dimming photocell. (Old nomenclature: NLIGHT + PDT + ADC)
https://www.acuitybrands.com/products/detail/778845/nLight/rIO/Fixture-embedded-nLight-AIR-network-interface
https://www.acuitybrands.com/products/detail/593899/nLight/RES7_Sensor/nLight-AIR_Fixture-Integrated-Wireless-Sensor
https://www.acuitybrands.com/products/detail/593899/nLight/RES7_Sensor/nLight-AIR_Fixture-Integrated-Wireless-Sensor

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Slot 2 LED

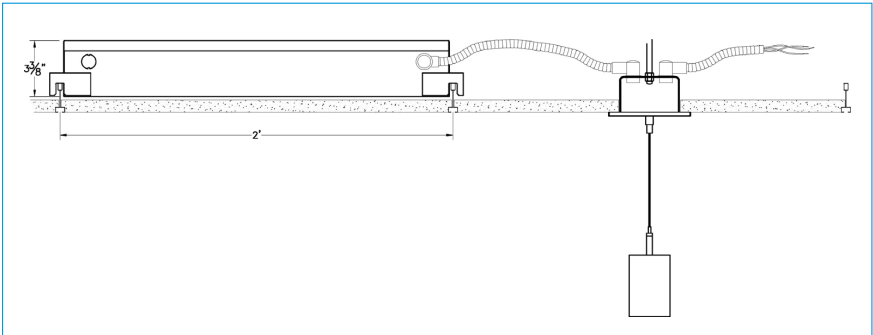
Direct Pendant

TYPE SL4

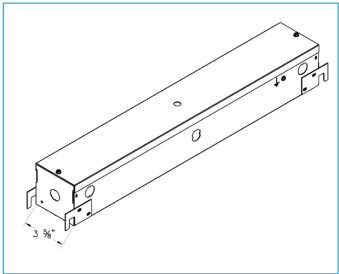
Remote BGTD Mounting Option

Recessed in sheetrock ceiling; rod mounted to structure. Consult factory for other ceiling types or canopy options.

6 foot flexible conduit included, BGTD option should be mounted within 6 feet of junction box above fixture.



Accessible Ceiling

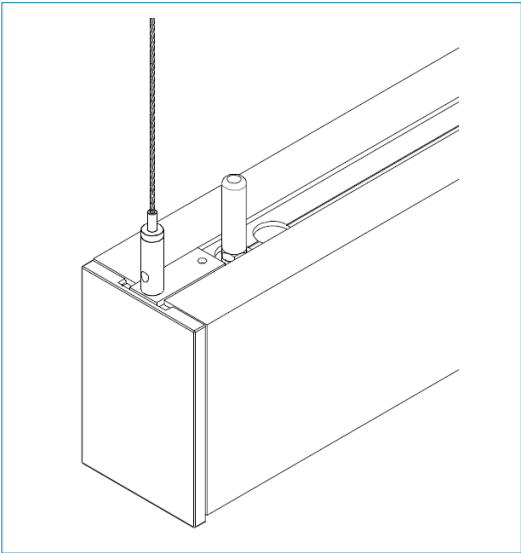


Emergency Battery Packs

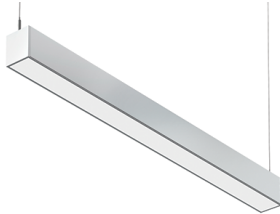
The PS1055LCP battery is integral to the fixture and comes standard with a remote test switch and self-diagnostics.

nLight Air Wireless Antenna Location

Note: Antenna will be shipped separately and will need to be attached to the coax connector.



MARK ARCHITECTURAL LIGHTING™



Slot 2 LED Direct Pendant

The Slot LED family of luminaires offers an unparalleled package of performance and features for your next lighting project. Precision lumen DIRECTIR optics deliver optimized light where needed for ceilings and walls. With other key features such as simplified installation, seamless controls integration and superior color constancy, the Slot LED family from Mark Lighting offers exceptional quality and design flexibility.

Type:

TYPE SL6

Project:

Catalog Number:

DO NOT TYPE HERE. Autopopulated field.

Specification Features

Housing

Nominal 2.5" x 3.75" extruded aluminum housing

Finish

White, Black or Silver powdercoat

Reflector

Formed steel with high reflectance white

Distribution/Shielding

Extruded 90% transmissive acrylic lens with a textured surface providing diffuse illumination and a uniform appearance for direct lambertian distribution (No Optics). Wall Wash (WW) and Wall Graze (WG) distribution options incorporate co-extruded lenses. Shielding is available as an external blade louver for WW or WG options, or an internal blade louver in lieu of lambertian distribution diffuser.

LED Components

Linear: Nichia®- 757 series LED chips (>80 CRI)

Electrical

Long-life LEDs, coupled with high-efficiency drivers, provide superior quantity and quality of illumination for extended service life. 80% LED lumen maintenance at 60,000 hours (L80/60,000).

Color Consistency

The Acuity Brands circuit boards for the linear LED components use a precise binning algorithm which creates a consistent color temperature from board to board. The color a variation of no greater than a 2.5 Step MacAdam (2.5SDCM) along the black body locus from board to board.

Driver

Factory tuned constant current electronic dimming driver is standard. Flicker free dimming available down to <1%. LED drivers perform within the recommended operating areas for flicker as a function of frequency and modulation (%) IEEE Standard 1789-2015 (IEEE Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers), in typical operating conditions at representative dimming levels. Electrical specifications at maximum driver load: PF > 0.9 and THD <20%. Meets FCC Title 47 Class A or Class B. Other available drivers include Lutron, DMX and DALI protocol drivers.

Certification

CSA tested to UL 1598 standards, assembled in the USA. Damp Location Listed.

Listings

DesignLights Consortium® (DLC) Premium qualified product. Not all versions of this product may be DLC Premium qualified. Please check the DLC Qualified Products List at www.designlights.org/OPL to confirm which versions are qualified.

Warranty

5-year limited warranty. Complete warranty terms located at:

www.acuitybrands.com/support/warranty/terms-and-conditions

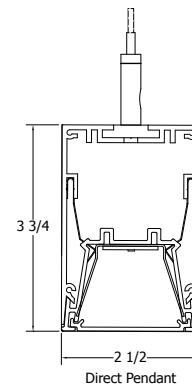
Note: Actual performance may differ as a result of end-user environment and application. All values are design or typical values, measured under laboratory conditions at 25 °C. Specifications subject to change without notice.

Fixture Performance

4FT INDIVIDUAL (35K)	DIRECT			
Lumens Output	400LMF	600LMF	800LMF	1000LMF
Delivered Lumens	1766	2710	3577	4225
Input Watts	14.4	22.5	30.6	37.1
Lumen/Watt	122	120	116	113

* Consult factory for customized lumen output and wattage between 350LMF and 1050LMF.

Technical Drawing



eldoLED
your product & our drive

Declare.



Buy American



Buy American:

Product with the BAA option 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.

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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LIGHTING™

Slot 2 LED
Direct Pendant

TYPE SL6



A+ Capable options indicated by this color background.

Ordering

Example: S2LD 32FT MSL8 80CRI 30K 400LMF MIN1 MVOLT WHT ZT F1/36A RDCY WHTCY WCRD

Series S2LD Slot 2 Pendant - Direct	Plan LCB Linear center balanced LLP Linear longest possible	Total Run Length 6 FT Specify continuous run length (in whole feet, 2' minimum) Unit length may affect available options. 2' & 3' only available as individual units For runs longer than 8FT: ALWAYS order the run by the TOTAL RUN LENGTH. Ordering the sections individually will not provide the correct joining hardware to allow connection in the field.	Max Section Length MSL4 4' MSL5 5' MSL6 6' MSL7 7' MSL8 8'	Direct Light Source Color Rendering 80CRI 80 CRI 90CRI 90 CRI	Direct LED Color Temp 27K 2700K 30K 3000K 35K 3500K 40K 4000K 50K 5000K	Direct LED Light Output 400LMF 400 Lumens per FT 600LMF 600 Lumens per FT 800LMF 800 Lumens per FT 1000LMF 1000 Lumens per FT _LMF¹ ## Lumens per FT	Direct Distribution (Optics) (blank) Standard Lambertian Distribution WW Wallwash Distribution WG Wall Graze Distribution WW and WG not available with Downlights, EGLD, LVRR or LVRRRA.
Downlight (blank) No Downlight modules in fixture 2DL LED Downlights (2 per unit) _DL LED Downlights per run (3DL, 4DL, etc)	Downlight Shape (blank) No Downlight modules in fixture RDD Round SQD Square	Downlight Color Rendering (blank) No Downlight modules in fixture S80CRI 80CRI	Downlight Color Temp (blank) No Downlight modules in fixture S27K 2700K S30K 3000K S35K 3500K S40K 4000K	Minimum Dimming Level NODIM² Non - dimming MIN1 Constant current, dimming to 1% DARK Constant current, dimming to 0.1%	Optional Shielding (blank) No louver LVRR³ Dropped louver LVRR⁴ Regressed louver painted to match fixture finish LVRRRA⁴ Regressed louver, aluminum finish EGLD³ Edge View direct lens Not available with Downlights. Not available with NLTAIR2	Voltage MVOLT Multi-volt, 120-277V 120 120V 277 277V 347³ 347V	
Finish WHT White (gloss) BLK Black (gloss) SLV Silver (gloss) WHTT White (textured) BLKT Black (textured) SLVT Silver (textured) RALTBD RAL paint finishes	Emergency Options E10WLCP⁶ 4" emergency section w/ battery pack, 1250 lumens E10WLCP⁵ 4" emergency section w/ battery pack, 1250 lumens _EC⁷ # of emergency circuits BGTD⁷,⁸ Generator transfer device Not available with 347V.	Control Input (blank) Non-dimming, line voltage ZT 0-10V control NLIGHT⁹ nLight enabled NLTAIR2¹⁰ nLight Air Wireless Enabled DALI¹⁰ DALI compatible DMX¹⁰,¹¹ DMX compatible ECOD¹¹,¹² Lutron Hi-Lume digital driver ECOD2¹¹,¹²,¹³ Lutron Hi-Lume 2-wire (1% dimming) ECOD5¹¹,¹² Lutron 5-series digital driver	Sensor (blank) Select if single zone/no zone without sensor NS Select if multi-zone fixture with no sensor in main zone PDT¹⁴ Occupancy sensor - dual technology (passive infrared & microphonics) ADC¹⁴ Photocell-daylight dimming sensor API¹⁷ PIR occupancy sensor & photocell APD¹⁷ PDT occupancy sensor & photocell Not available with Downlights. Not available with 347V & nLight. (Use ZT Control Inputs where applicable.) Not available on 2' or 3' units.	Secondary Sensor (blank) No additional zones/sensors SNS Select if multi-zone fixture with no sensor in secondary zone SPDT¹⁴ Occupancy sensor - dual technology (passive infrared & microphonics) SADC¹⁴ Photocell-daylight dimming sensor SAPI¹⁷ PIR occupancy sensor & photocell SAPD¹⁷ PDT occupancy sensor & photocell Not available with Downlights. Not available with 347V & nLight. (Use ZT Control Inputs where applicable.) Not available on 2' or 3' units.			
Tertiary Sensor (blank) No additional zones/sensors TNS Select if multi-zone fixture with no sensor in tertiary zone	Mounting Type F1/ T-bar ceiling (universal mounting bracket) F1A/ T-bar ceiling (UMB with integrated J-box) F2/ Hard ceiling (horizontal J-box)	Overall Suspension 36A 36" adjustable 72A 72" adjustable 144A 144" adjustable * Measured from ceiling to bottom of luminaire.	Canopy Form RDCY Round canopy SQCY Square canopy	Canopy Color BLKCY Black canopy WHTCY White canopy SLVCY Silver canopy	Cord Color WCRD White cord CCRD Clear cord BCRD¹⁵ Black cord	Options BAA Buy America(n) Compliant DPL Damp location listing GLR¹³ Fast-blow fuse GMF¹³ Slow-blow fuse MCS 5" support canopy to match feed canopy PIF Power Feed Installed	

EC TO CHOOSE MOUNTING TYPE & DETERMINE LENGTH OF MOUNTING CABLE NEEDED

ARCHITECT TO VERIFY CANOPY FORM

COLORS TO BE CHOSEN BY ARCHITECT

ELECTRICAL CONTRACTOR TO DETERMINE APPROPRIATE MOUNTING HARDWARE & ACCESSORIES

Notes:

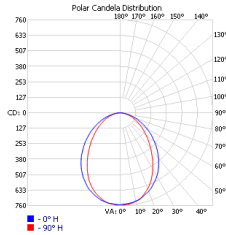
- Limited to 350LMF to 1050LMF in 50LMF increments. Not available with ECOD, ECOD2, ECOD5 or DMX control input.
- Not available with Control Input.
- Not available with Sensor Options.
- Not available with sensors on 2', 3' & 5' units.
- 347V not available with 2' & 3' units. 347V also not available with ZT & sensors, emergency options, NLIGHT in 5' units, & NLIGHT with downlights. Only available with WCRD.
- Not available with 2' or 3' units. Not available with DMX control option. One battery pack per unit. Only available on 8' unit with ECOD, ECOD2, ECOD5. If with ZT & API or APD, only available in 7' & 8' units.
- Powers entire direct unit. Not available with DMX.
- Must select 120 or 277 volt. Remote mounted. Not available with sensor and BGTD in same unit. Not available with DMX.
- Comes with white CAT5 cord in addition to the standard power cord. Will require remote mounted nIO on 2' unit. One nLight device per zone or sensor, for multiple zones consult factory.
- Must select DARK Dim Level.
- Not available with 347V.
- Must select MIN1 Dim Level. Not available on 2', 3' or 5' units.
- 120V only.
- Requires ZT or NLIGHT Control Input.
- Longer lead time item.
- Must select MIN1 or DARK Dim Level. Not available with 347. Not available with 347, WW, 2' or 3' units. If ordered with E10WLCP, only available in 7' & 8' units. One NLTAIR2 device per zone or sensor, for multiple zones consult factory. For antenna location, see page 10.
- Requires ZT, NLIGHT or NLTAIR2 Control Input.

MARK
ARCHITECTURAL
LIGHTING™

Slot 2 LED
Direct Pendant

TYPE SL6

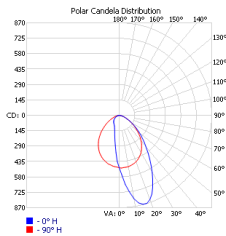
PHOTOMETRICS



Test Report: ISF 37224P0
IES LM 79-08
S2LD 4FT 80CRI 30K 400LMF
Lumens: 1697
Wattage: 14.44
Efficacy: 117.5

Zonal Lumen Summary		
Zone	Lumens	% Luminaire
0-30	559.6	33%
0-40	879	51.80%
0-60	1415.1	83.40%
60-90	281.4	16.60%
70-100	115.5	6.80%
90-120	0.3	0%
0-90	1696.6	100%
90-180	0.4	0%
0-180	1697	100%

Angle	Candlepower Distribution									
	Plane									
	0	22.5	45	67.5	90	112.5	135	157.5	180	
0	753	753	753	753	753	753	753	753	753	753
5	745	748	749	749	753	749	751	751	747	
10	734	739	737	735	735	736	740	742	738	
15	712	714	710	705	708	706	711	721	718	
20	684	685	676	662	662	663	677	689	689	
25	643	642	627	606	603	610	630	649	653	
30	601	596	574	544	535	545	575	602	609	
35	548	539	510	475	462	474	512	548	557	
40	490	479	443	408	393	406	447	488	500	
45	428	416	379	339	328	344	384	427	438	
50	366	354	314	282	271	284	322	363	378	
55	308	295	257	231	223	233	263	303	314	
60	248	236	205	183	177	187	212	244	256	
65	193	184	161	142	137	143	163	190	201	
70	143	133	117	105	102	107	122	141	151	
75	96	89	78	72	69	73	84	95	101	
80	53	51	46	41	41	44	49	55	59	
85	20	19	19	19	19	20	22	24	24	
90	0	0	1	1	1	2	2	2	2	



Test Report: ISF 37225P0
IES LM 79-08
S2LD 4FT 80CRI 30K 400LMF WW
Lumens: 1047
Wattage: 14.5
Efficacy: 72.2

Zonal Lumen Summary		
Zone	Lumens	% Luminaire
0-30	390.8	37.30%
0-40	605.7	57.90%
0-60	921.1	88%
60-90	119.6	11.40%
70-100	44.5	4.20%
90-120	3.1	0.30%
0-90	1040.7	99.40%
90-180	6.3	0.60%
0-180	1047	100%

Angle	Candlepower Distribution									
	Plane									
	0	22.5	45	67.5	90	112.5	135	157.5	180	
0	493	493	493	493	493	493	493	493	493	
5	652	637	603	558	493	443	391	362	353	
10	796	773	715	619	490	378	296	250	236	
15	866	853	791	666	479	321	222	178	164	
20	843	843	818	693	464	270	172	136	128	
25	745	766	792	697	439	225	138	114	108	
30	620	645	718	672	408	191	116	100	97	
35	499	525	616	614	367	161	101	80	89	
40	392	420	506	538	322	136	90	83	81	
45	311	331	400	448	270	114	79	73	73	
50	241	255	314	353	217	96	69	65	64	
55	177	191	238	265	166	79	58	54	54	
60	126	136	171	191	123	61	47	43	43	
65	85	91	117	131	86	47	36	34	33	
70	57	60	76	84	56	34	26	24	24	
75	36	38	45	50	35	22	17	16	16	
80	20	20	23	25	19	11	9	9	9	
85	8	8	8	8	7	5	4	4	5	
90	1	1	0	0	0	0	0	1	1	

EXPECTED LIFE: L85 @ 60,000
CALCULATED LIFE: L70 @ 120,000

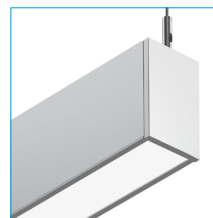
Shielding



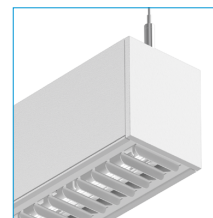
Co-Extruded WG



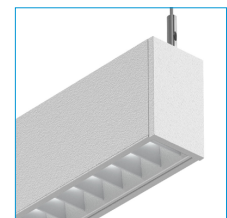
Co-Extruded WW



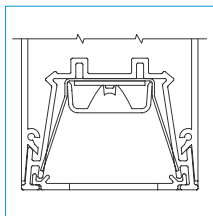
Edge View Lens



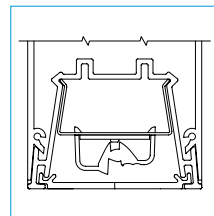
External Louver



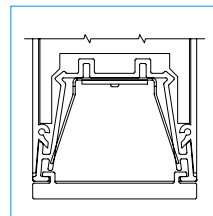
Regressed Louver



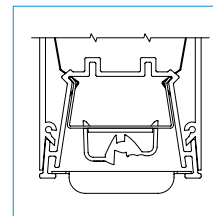
Co-Extruded WG
(Standard)



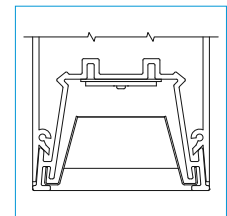
Co-Extruded WW
(Standard)



Edge View Lens
(Optional)



External Louver WW
(Painted to Match Housing)



Regressed Louver
(Natural Aluminum or Painted
to Match Housing)

MARK ARCHITECTURAL LIGHTING™

Slot 2 LED Direct Pendant

TYPE SL6

LINEAR PLAN:

Mark Lighting offers the ability to provide a continuous run plan to suit your requirements by optionally offering three different methods of configuration.

LLP- Linear Longest Possible

In this configuration, the longest length available is optimized, resulting in the fewest segments and mounting locations. Caution, should be used where balanced appearance is a concern. Example: 20 FT run would have 2, 8 FT segment and 1, 4 FT segment at the end of the run.

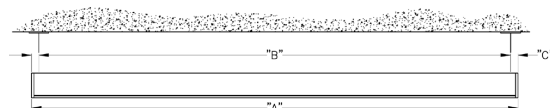
LLP	8 FT	8 FT	4 FT
-----	------	------	------

LCB- Linear Center Balanced:

This configuration incorporates the longest center segment(s) along with any additional lengths required to fill the run length, added to the run ends. Example: 16 FT run would have 2, 4 FT segments (one at each end) and 1, 8 FT segment in the center.

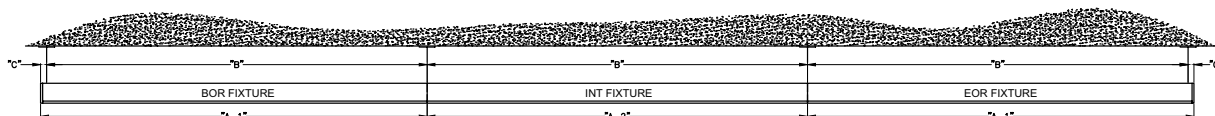
LCB	4 FT	8 FT	4 FT
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Individual Fixture Configurations



LENGTH	INDIVIDUAL UNITS (MOUNTING)		
	"A" O.A.L.	"B" O.C.	"C" FROM END
2FT	2'- 5/8"	2'-0"	5/16"
3FT	3'- 5/8"	3'-0"	5/16"
4FT	4'- 5/8"	4'-0"	5/16"
5FT	5'- 5/8"	5'-0"	5/16"
6FT	6'- 5/8"	6'-0"	5/16"
7FT	7'- 5/8"	7'-0"	5/16"
8FT	8'- 5/8"	8'-0"	5/16"

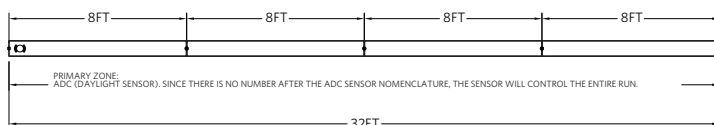
Run Configurations



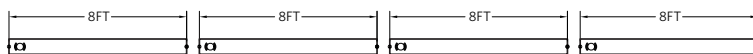
LENGTH	RUN LAYOUT (MOUNTING)		
	"A-1" O.A.L.	"A-2" O.A.L.	"B" O.C.
4FT	4'-0 5/16"	4'-0"	4'-0"
5FT	5'-0 5/16"	5'-0"	5'-0"
6FT	6'-0 5/16"	6'-0"	6'-0"
7FT	7'-0 5/16"	7'-0"	7'-0"
8FT	8'-0 5/16"	8'-0"	8'-0"

TOTAL RUN LENGTH

This system is not modular. Runs longer than 8FT will be automatically configured with Starter, Middle and Ender sections, based on how you specify the TOTAL RUN LENGTH and MAXIMUM SECTION LENGTH parameters in the ordering information. Always order the total run length, not the individual sections



Example: This run must be ordered as 1pc "S2LD LLP 32FT MSL8..."



Example: If you order as 4pcs "S2LD LLP 8FT MSL8..." you will receive these INDIVIDUAL sections that cannot be joined together

MAXIMUM SECTION LENGTH

The run will be broken out using as many sections at the chosen MSL length as possible. Shorter sections will then complete the desired run length.

Examples:

S2LD LLP 21FT MSL5... = 5FT / 4FT / 4FT / 4FT / 4FT
S2LD LLP 21FT MSL6... = 6FT / 6FT / 5FT / 4FT
S2LD LLP 21FT MSL7... = 7FT / 7FT / 7FT
S2LD LLP 21FT MSL8... = 8FT / 8FT / 5FT

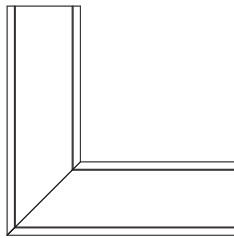
MARK
ARCHITECTURAL
LIGHTING™

Slot 2 LED
Direct Pendant

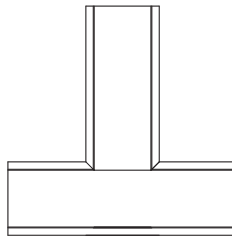
TYPE SL6

Run Patterns, Corners and Junction

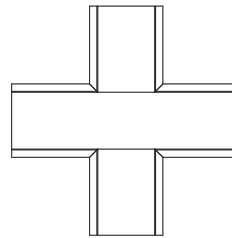
Slot 2 LED patterns can be configured in 1' increments with illuminated 90° inside and outside corners, T junctions, and X junctions with standard 2' corner and junction lengths. For custom angles, corner or junction lengths, consult factory. See separate patterns spec sheets for more details.



90° Corner



T Junction



X Junction

Downlights

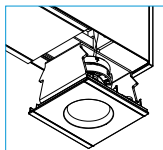
Optional downlights powered by Xicato Spot Modules are available with 4', 5', 6', and 8' length luminaires, maximum (2) Xicato downlights per length. Each downlight module is 10W with 700 lumens delivered, 28 degree beam spread. Downlights are supplied with a dedicated feed-point and will be controlled separately.



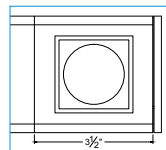
Standard Downlight Location



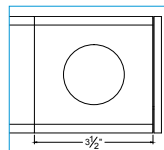
Other Downlight Configuration (consult factory)



Downlight Module



Square Downlight
Plate (SQ)



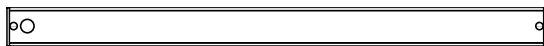
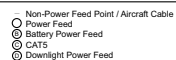
Round Downlight
Plate (RD)

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ARCHITECTURAL
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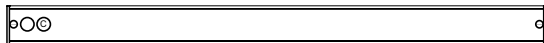
Slot 2 LED
Direct Pendant

TYPE SL6

Feed Point Locations



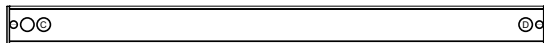
Direct, Dimming* or Non-Dimming



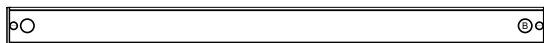
Direct, nLight Controls (wired)



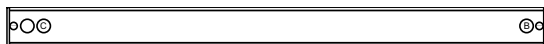
Direct, w/ Downlights**, Dimming* or Non-Dimming



Direct, w/ Downlights**, nLight Controls (wired)**



Direct, Battery (E10WLCP), Dimming* or Non-Dimming



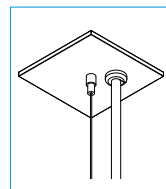
Direct, Battery (E10WLCP), nLight Controls (wired)

* 2-Wire Dimming (ZT, DALI, and Lutron EcoSystem)

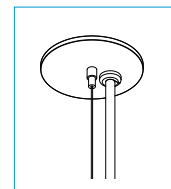
** Downlights are supplied with a dedicated feed-point and will be controlled separately.

*** Downlights with nLight wired controls will use a J-Box mounted control module outside of fixture.

Single Feed Points

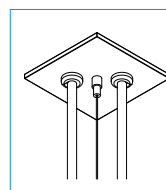


5" Square

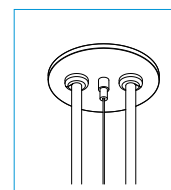


5" Round

Feed and Cat 5 points

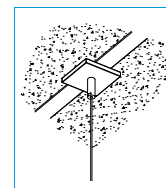


5" Square

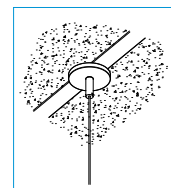


5" Round

Non-Feed Points for T-Bar Mounting



2" Square

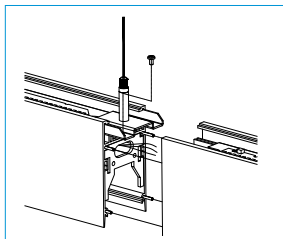


2" Round

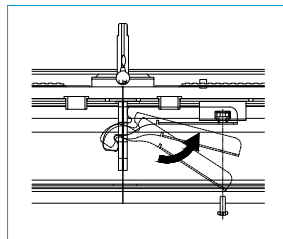
Refer to page 7 for mounting details.

Joiners

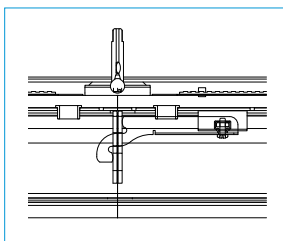
AEL Precision Row-Mount 3-step fixture-to-fixture connection method



Step 1: Align



Step 2: Engage



Step 3: Lock

Continuous Runs

Slot 2 LED continuous rows can be configured in 1' increments and featuring the AEL precision joiner to create a hairline seam between luminaires, providing a monolithic visual aesthetic. For custom run lengths less than a 1' increment, consult factory.

MARK
ARCHITECTURAL
LIGHTING™

Slot 2 LED
Direct Pendant

TYPE SL6

MOST COMMON MOUNTING TYPES AND OPTIONS Options available for this specific luminaire are checked in the boxes below.

Mounting Type

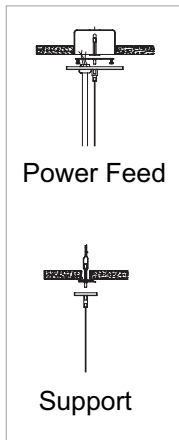
- F1/** For use with most T-Bar and screw slot grid ceilings. Designed for on-grid and off-grid applications.
- F2/** For use with recessed or surface mount horizontal J-box applications.
- F1A/** For use with most T-Bar grid ceilings. Designed for on-grid applications. *Comes complete with J-box with built-in cutout to go over grid.*

Mounting Options

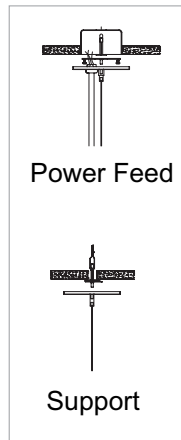
- MCS** Matching canopy at support for aesthetics.

✓ Indicates mounting options available with this luminaire.

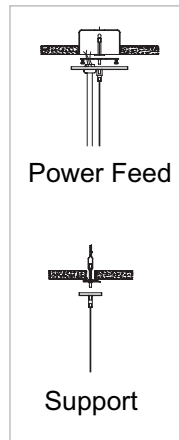
✓ F1/



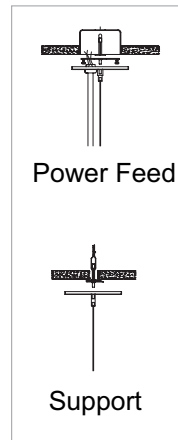
✓ F1/ ordered with MCS



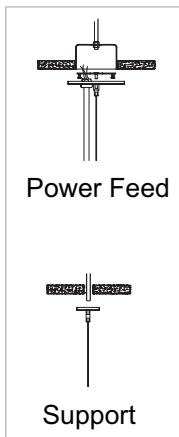
✓ F1A/



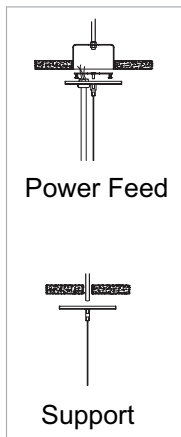
✓ F1A/ ordered with MCS



✓ F2/



✓ F2/ ordered with MCS



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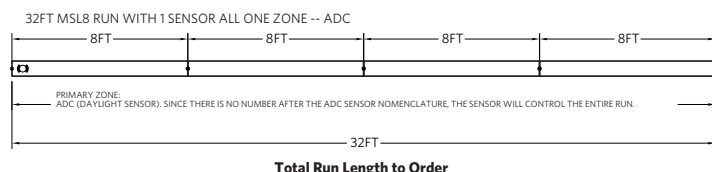
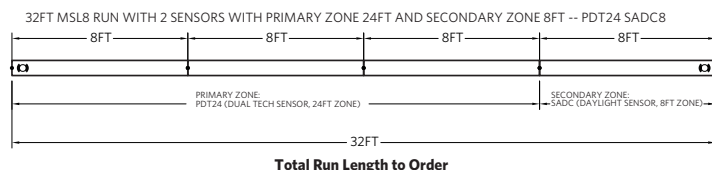
Slot 2 LED
Direct Pendant

TYPE SL6

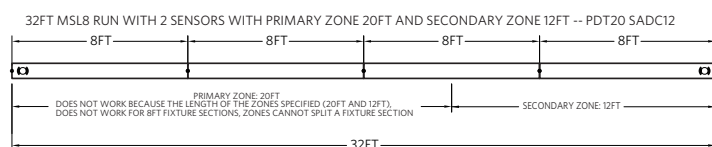
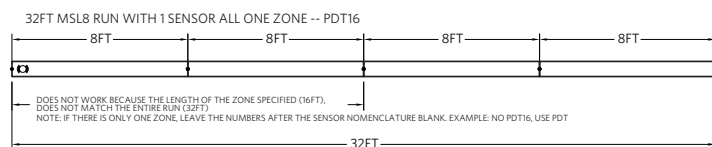
INTEGRATED SENSOR LAYOUT

For runs longer than 8FT:
ALWAYS order the run by the TOTAL RUN LENGTH. Ordering the sections individually will not provide the correct joining hardware to allow connection in the field.

CORRECT:



INCORRECT:



Notes:

- Only one sensor per zone
- At the most, the entire run can only have 2 sensors (thus 2 sensors zones at the most)
- Sensor zone can not split fixture sections
- No overlapping zones

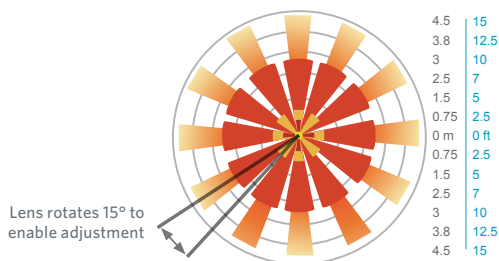
OCCUPANCY DETECTION COVERAGE

At the 7.5 ft (2.9 m) hanging height of a typical pendant mount fixture the sensor provides 10 ft (3.05 m) radial detection of small motion. At a 9 ft (2.74 m) hanging height the radius is 12 ft (3.66 m) for small motion.

Adequate for walking motion detection from mounting heights between 7.5 ft (2.29 m) and 20 ft (6.10 m).

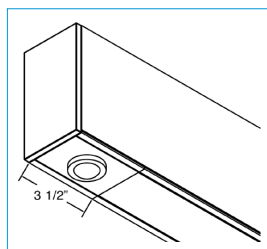
Initial detection will occur earlier when walking across sensor's field of view than when walking directly at sensor.

Initial detection of walking motion into long coverage segment will occur at distances of 2x the mounting height up to 15 ft (4.57 m) and 1.75x up to 20 ft (6.10 m). Lens assembly rotates 15° to enable adjustment in order to line up long segments.



Integrated Controls

Optional nLight® integrated controls make Slot LED luminaires addressable- allowing them to digitally communicate with other nLight enabled controls such as dimmers, switches, occupancy sensors and photocontrols. Simply connect all the nLight enabled control devices using standard CAT5 Cabling.



Occupancy Sensor and/or Photocell

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Slot 2 LED
Direct Pendant

TYPE SL6

Intelligent Luminaire Technology Guide

Choose nomenclature from these columns							
Driver Configurations	Minimum Dimming Level		Control Input		Driver	Dimming Range	Notes
	NODIM	+	(blank)	=	0 10V Generic Driver	-	Includes no 0 10V leads from the driver.
	MIN10	+	ZT	=	0 10V Generic Driver	100 to 10%	Linear dimming
	MIN1	+	ZT	=	0 10V eldoLED ECOdrive	100 to 1%	Formerly (EZ1) nomenclature. Linear dimming
	MIN1	+	NLIGHT	=	0 10V eldoLED ECOdrive	100 to 1%	Logarithmic dimming
	MIN1	+	ECOD2	=	Lutron forward phase control	100 to 1%	LUTRON Hi-lume 1% 2-wire (model LTEA4U1U)
	MIN1	+	ECOD5	=	Lutron Ecosystem	100 to 5%	LUTRON 5 Seires EcoSystem LED Driver (model LDES)
	MIN1		ECOD		Lutron Ecosystem	100 to 1%	LUTRON Hi-lume 1% EcoSystem LED Driver with Soft-on, Fade-to-Black (model LDE1)
	DARK		ZT		0 10V eldoLED SOLOdrive	100 to 0.1%	Formerly (EZB) nomenclature. Linear dimming
	DARK		NLIGHT		0 10V eldoLED SOLOdrive	100 to 0.1%	Logarithmic dimming
	DARK		DALI		DALI compatible eldoLED SOLOdrive	100 to 0.1%	"Compatible with DALI. Formerly (EDB & EDAB) nomenclature." Logarithmic dimming
	DARK		DMX		DMX compatible eldoLED POWERdrive	100 to 0.1%	"Compatible with DMX / Remote Device Management. Formerly (EXB & EDXB) nomenclature." Linear dimming

Control / Sensor Configurations

Choose nomenclature from these columns		
Control Input		Sensor
ZT	+	API
ZT	+	APD
NLIGHT	+	(blank)
NLIGHT		EMG
NLIGHT	+	API
NLIGHT	+	PDT
NLIGHT	+	APD
NLTAIR2		(blank)
NLTAIR2		API
NLTAIR2		APD

Sensor
MSD 7 ADCX
MSD PDT 7 ADCX
nIO EZ PH
nIO EZ PH ER
nIO EZ PH + nES 7 ADCX
nIO EZ PH + nES PDT 7
nIO EZ PH + nES PDT 7 ADCX
RIO EZDL 90D G2
RES7 G2
RES7 PDT G2

Notes
Individual fixture control only. PIR integral occupancy sensor with automatic dimming control photocell. (Old nomenclature: ZT + PIR + ADC)
Individual fixture control only. PDT integral occupancy sensor with automatic dimming control photocell. (Old nomenclature: ZT + PDT + ADC)
nLight enabled only. No onboard sensor.
Emergency nLight enabled only. No onboard sensor.
nLight nES 7 ADCX PIR integral occupancy sensor with automatic dimming photocell. (Old nomenclature: NLIGHT + PIR + ADC)
nLight nES PDT 7 dual technology integral occupancy sensor. (Old nomenclature: NLIGHT + PDT)
nLight nES PDT 7 dual technology integral occupancy sensor with automatic dimming photocell. (Old nomenclature: NLIGHT + PDT + ADC)
https://www.acuitybrands.com/products/detail/778845/nLight/rIO/Fixture-embedded-nLight-AIR-network-interface
https://www.acuitybrands.com/products/detail/593899/nLight/RES7_Sensor/nLight-AIR_Fixture-Integrated-Wireless-Sensor
https://www.acuitybrands.com/products/detail/593899/nLight/RES7_Sensor/nLight-AIR_Fixture-Integrated-Wireless-Sensor

MARK

ARCHITECTURAL
LIGHTING™

Slot 2 LED

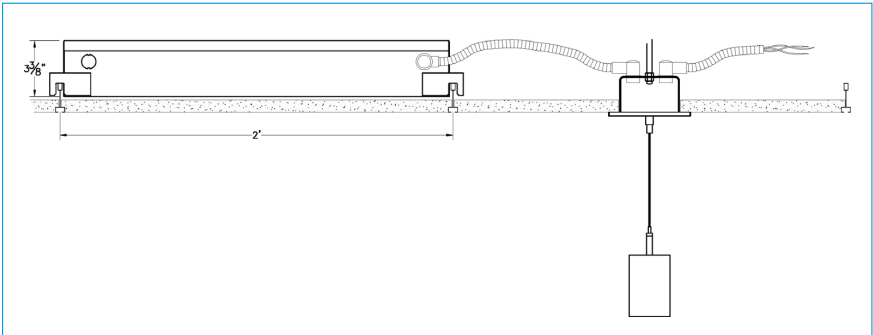
Direct Pendant

TYPE SL6

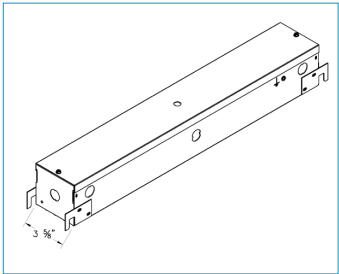
Remote BGTD Mounting Option

Recessed in sheetrock ceiling; rod mounted to structure. Consult factory for other ceiling types or canopy options.

6 foot flexible conduit included, BGTD option should be mounted within 6 feet of junction box above fixture.



Accessible Ceiling

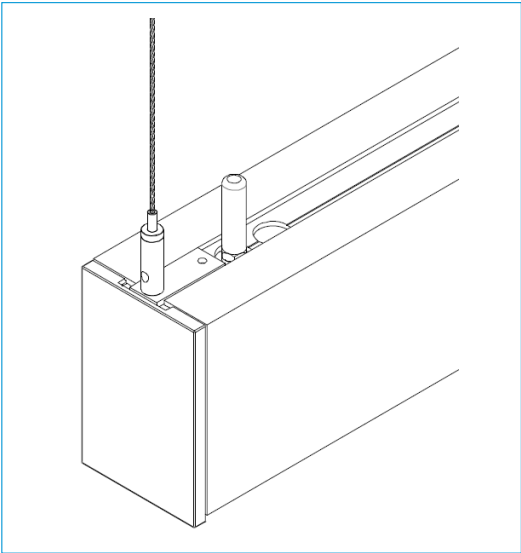


Emergency Battery Packs

The PS1055LCP battery is integral to the fixture and comes standard with a remote test switch and self-diagnostics.

nLight Air Wireless Antenna Location

Note: Antenna will be shipped separately and will need to be attached to the coax connector.





DIGITAL NAVIGATION

Ordering Tree nLight Platform Sensor Switch JOT Photometrics Performance Data

FEATURES & SPECIFICATIONS

INTENDED USE — The BLT Best-in-Value Low Profile LED luminaire features a popular center basket design that offers a clean, versatile style and volumetric distribution. High efficacy LED light engines deliver energy savings and low maintenance compared to traditional sources. An extensive selection of configurations and options make the BLT the perfect choice for many lighting applications including schools, offices and other commercial spaces, retail, hospitals and healthcare facilities. The low profile BLT design (2-3/8") also makes it an excellent choice for renovation projects.

CONSTRUCTION — Prior to fabrication, BLT components are coated with a proprietary paint blend and die-formed for dimensional consistency.

The BLT reflector is available in both smooth and ribbed finishes. Choose RB from the fixture style section below for a ribbed finish.

End plates contain easy-to-position integral T-bar clips for securely attaching the luminaire to the T-grid. For additional T-grid security, optional screw on T-bar clips are available.

Diffusers are extruded from impact modified acrylic for increased durability.

LED boards and drivers are accessible from the plenum.

OPTICS — Volumetric illumination is achieved by creating an optimal mix of light to walls, partitions and vertical and horizontal work surfaces — rendering the interior space, objects and occupants in a more balanced, complementary luminous environment. High performance extruded acrylic diffusers conceal LEDs and efficiently deliver light in a volumetric distribution. Four diffuser choices available — curved and square designs with ribbed or a smooth frosted finish.

ELECTRICAL — Long-life LEDs, coupled with high-efficiency drivers, provide superior quantity and quality of illumination for extended service life. 80% LED lumen maintenance at 60,000 hours (L80/60,000). Color Variation within 3-step MacAdam ellipse (3SDCM).

Non-Configurable BLT: Generic 0-10 volt dimming driver. Dims to 10%

Configurable BLT: available in High Efficiency (HE) versions for applications where a lower wattage (over the standard product) is required. The High Efficiency versions deliver >130 LPW and can be specified via the Lumen Package designations in the Ordering Information below.

eldoLED driver options deliver choice of dimming range, and choices for control, while assuring flicker-free, low-current inrush, 89% efficiency and low EMI.

Optional integrated nLight® controls make each luminaire addressable — allowing it to digitally communicate with other nLight enabled controls such as dimmers, switches, occupancy sensors and photocontrols. Connection to nLight is simple. It can be accomplished with integrated nLight AIR wireless RIO, RES7 sensors, or through standard Cat-5 cabling. nLight offers unique plug-and-play convenience as devices and luminaires automatically discover each other and self-commission. nLight AIR is commissioned easily through an intuitive mobile app.

Lumen Management: Unique lumen management system (option N80) provides on board intelligence that actively manages the LED light source so that constant lumen output is maintained over the system life, preventing the energy waste created by the traditional practice of over-lighting.

Step-level dimming option allows system to be switched to 50% power for compliance with common energy codes while maintaining fixture appearance.

SENSOR — Integrated sensor (individual control): Sensor Switch MSD7ADCX ((Passive infrared (PIR)) or MSDPDT7ADCX ((PIR/Microphonics Dual Tech (PDT))) integrated occupancy sensor/automatic dimming photocell allows the luminaire to power off when the space is unoccupied or enough ambient light is entering the space. See page 4 for more details on the integrated sensor.

Integrated Sensor (nLight Wired Networking): This sensor is nLight-enabled, meaning it has the ability to communicate over an nLight network. When wired, using CAT-5 cabling, with other nLight-enabled sensors, power packs, or WallPods, an nLight control zone is created. Once linked to a Gateway, directly or via a Bridge, the zone becomes capable of remote status monitoring and control via SensorView software. See page 4 for the nLight sensor options.

Integrated Smart Sensor (nLight Air Wireless Platform): The RES7 sensor is nLight AIR enabled, meaning it has the ability to communicate over the wireless nLight control platform. It is available with an automatic dimming photocell, and either a digital PIR or a microphonics (PDT) dual technology occupancy sensor. It pairs to other luminaires and wall switches through our mobile app, CLAIRITY, which allows for simple sensor adjustment. See page 4 for more details on the Integrated Smart Sensor.

Integrated Wireless Sensor (single room control): Sensor Switch VERTEX JOT or JOTVIX15 luminaire-embedded occupancy and ambient light sensor allows the luminaire to power off when the space is unoccupied or when enough ambient light is entering the space. See page X for more details on the integrated wireless sensor.

INSTALLATION — The BLT's low profile design of only 2-3/8" provides increased installation flexibility especially in restrictive plenum applications. The BLT fits into standard 15/16" and narrow 9/16" T-grid ceiling systems.

Suitable for damp location.

For recessed mounting in hard ceiling applications, Drywall Grid Adapters (DGA) are available as an accessory. See Accessories section.

LISTINGS — CSA Certified to meet U.S. and Canadian standards. IC rated. Tested in accordance with ISO 14644-1; suitable for ISO Class 5-9 positive and negative pressure clean rooms.

DesignLights Consortium® (DLC) Premium qualified product and DLC qualified product. Not all versions of this product may be DLC Premium qualified or DLC qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.

BUY AMERICAN — Product with the BAA option 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. Specifications subject to change without notice.

TYPE T1A

Catalog
Number

Notes

Type

BLT Series LED

2BLT4



ADP Diffuser Option

2' x 4'
LED



Ribbed Reflector Option



Buy American

JUST ONE TOUCH

Specifications

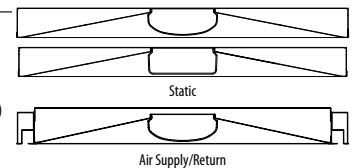
Length: 47-3/4 (121.2)

Width: 23-3/4 (60.3)

Depth: 2-3/8 (6.0)

Depth with Air supply/return: 2-3/4 (6.9)

All dimensions are inches (centimeters)
unless otherwise specified.



Embed nLight controls today. Prepare for tomorrow.

Now

- User-friendly install
- Enhanced energy savings
- Code compliance

Tomorrow

- Scalability
- Space configuration
- Future-ready

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

2BLT Volumetric Recessed Lighting 2'x4'

TYPE T1A



A+ Capable options indicated by this color background.

ORDERING INFORMATION

Lead times will vary depending on options selected. Consult with your sales representative.

Example: 2BLT4 40L ADP EZ1 LP840

Series	Fixture Style	Air function	Lumens ‡	Diffuser	Voltage	Driver	Color temperature
2BLT4	2x4 BLT	(blank) Static	Standard efficiency (>100 LPW)	ADP Curved, ribbed	(blank) MVOLT	EZ1 eldoLED dims to 1% (0-10 volt dimming)	LP830 82CRI, 3000 K
	RB Ribbed Reflector	A Air supply/return ‡	High efficiency (>130 LPW)	ADSM Curved, smooth	120 120V		LP835 82CRI, 3500 K
			30L 3000	SDP Square, ribbed	277 277V	GZ1 Dims to 1% (0-10V dimming) ‡	LP840 82CRI, 4000 K
			40L 4000	SDSM Square, smooth	347 347V ‡		LP850 82CRI, 5000 K
			48L 4800	Includes trim rings to match sensed version		GZ10 Dims to 10% (0-10V dimming) ‡	LP930 90CRI, 3000K
			60L 6000	ADPT Curved, ribbed			LP935 90CRI, 3500K
			72L 7200	ADSMT Curved, smooth		SLD Step-level dimming ‡	LP940 90CRI, 4000K
			85L 8500	SDPT Square, ribbed			LP950 90CRI, 5000K
			100L 10000	SDSMT Square, smooth			
			120L 12000				

nLight Interface	Control ‡
nLight Wired (blank) no nLight ® interface N80 nLight with 80% lumen management N80EMG nLight with 80% lumen management For use with generator supply EM power ‡ N100 nLight without lumen management N100EMG nLight without lumen management For use with generator supply EM power ‡ nLight Wireless (blank) no nLight ® interface NLTAIR2 nLight AIR Generation 2 enabled ‡	nLight Wired ‡ (blank) No sensor control NES7 nLight™ nES 7 PIR integral occupancy sensor NESPD7 nLight™ nES PDT 7 dual technology integral occupancy control NES7ADCX nLight™ nES 7 ADCX PIR integral occupancy sensor with automatic dimming photocell NESPD7ADCX nLight™ nES PDT 7 dual technology integral occupancy sensor with automatic dimming photocell nLight Wireless RES7 nLight AIR PIR integral occupancy sensor with automatic dimming photocell for Networking Capabilities RES7PDT nLight AIR microphonics dual technology occupancy sensor with automatic dimming photocell RIO nLight AIR radio module without sensor RES7EM nLight AIR PIR integral occupancy sensor with automatic dimming photocell and UL924 Emergency Operation, via power interrupt detection ‡ RES7PDTEM nLight AIR microphonics dual technology occupancy sensor with automatic dimming photocell and UL924 Emergency Operation, via power interrupt detection ‡ RIOEM nLight AIR radio module less sensor, with UL924 Emergency Operation, via power interrupt detection ‡
	Individual Control MSD7ADCX PIR integral occupancy sensor with automatic dimming control photocell ‡ MSDPD7ADCX PDT integral occupancy sensor with automatic dimming control photocell ‡ JOT Wireless room control with "Just One Touch" pairing ‡ JOTVTX15 Wireless occupancy sensor with "Just One Touch" pairing ‡

Standby Mode	Options
NOC NOC Occupancy sensor disabled ‡	BDP Disconnect Plug EL7L 700 lumen battery pack (Noncompliant with CA T20) ‡ EL14L 1400 lumen battery pack (Noncompliant with CA T20) ‡ EL14LSD 1400 lumen battery pack with self-diagnostic testing feature (Noncompliant with CA T20) ‡ E10WLCP EM Self-Diagnostic battery pack 10W Constant Power, Certified in CA Title 20 MAEDBS ‡ CP Chicago plenum ‡ BGTD Bodine Generator Transfer Device ‡ PWS1836 6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit PWS1846 6' pre-wire, 3/8" diameter, 18 gauge, 2 circuit PWS1846 PWSLV Two cables: one 6' pre-wire, 3/8" diameter, 18 gauge, 2 circuits; one 6' pre-wire, 3/8" diameter, 18 gauge ‡ PWS1856LV 6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit w/low voltage wires ‡ GLR Fast-blowing fuse ‡ GMF Slow-blowing fuse ‡ NPLT Narrow pallet RRL RELOC®-ready luminaire ‡ LATC Earthquake clip DWAM Anti-Microbial paint JP14 Job packaging ‡ JP18 Job packaging ‡ IPSX Gasketed diffuser compartment to meet IPSX rating ‡ BAA Buy America(n) Act Compliant

NOTE: ‡ indicates option value has ordering restrictions. Please reference the Option Value Ordering Restrictions chart on the next page. Options are sorted alphanumerically.

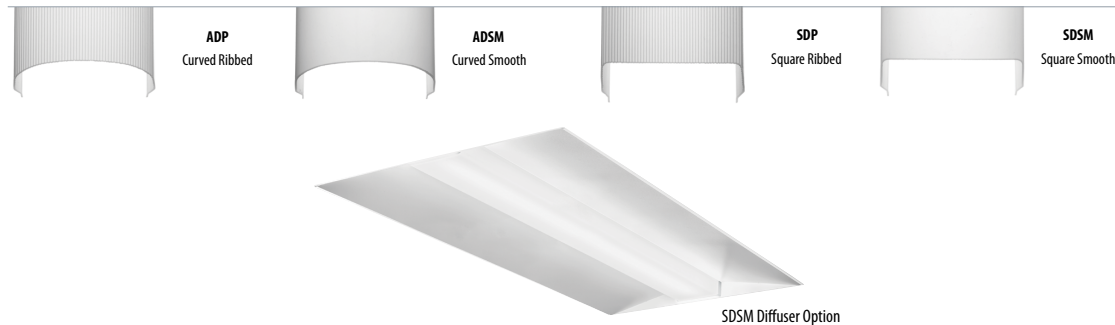
INTEGRAL BATTERY PACKS TO BE PROVIDED FOR LUMINAIRES INDICATED AS "EM" ON LIGHTING PLANS

ELECTRICAL CONTRACTOR TO DETERMINE APPROPRIATE MOUNTING HARDWARE & ACCESSORIES

2BLT Volumetric Recessed Lighting 2'x4'

† Option Value Ordering Restrictions	
Option value	Restriction
347	Not available with SLD, EL7L, EL14L, or E10WLCP options.
A	Not available with RB fixture style, consult factory for air flow data.
BGTD	Not available with TD, JOT, JOTVTX15 sensor options or emergency battery options. Must specify voltage. Requires BSE labeling, voltage specific. Consult factory for options. Example: BGTD BSE10.
Controls	Must specify diffuser with trim rings.
CP	Not available with N80, N80EMG, N100, or N100EMG.
GZ1, GZ10	Not available with any Control or Sensor options except JOT & JOTVTX15
EL14LSD, E10WLCP, EL7L, EL14L	When using pre-wire option, use PWS1846 or PWS1846 PWSLV. For more information, please see the PSSD2 specification sheet .
FAO	EZ1 driver required. Not available with USPOM, FAO or lumen packages > 6000LM. FAO restricts use of external Dimming controls. See chart on page 3 for additional details.
GLR, GMF	Must specify voltage. 120 or 277, with GLR and GMF fusing.
IP5X	Not available with air supply/return or Wired Networking (NES) and Individual Control (MSD) sensors.
JOT, JOTVTX15	Not available with standard efficiency 85L, 100L or 120L lumen options. Not available with SLD, nLight, NLTAIR2, NOC, or BGTD options.
JP14	Only available on fixtures with NES7, NESPD7, NESPD7ADCX, MSD7ADCX, MSDPD7ADCX, RES7, RES7PDT, RIO, JOT, JOTVTX15. Not available when air supply/return function and sensor options are combined.
JP18	Not available with option: NES7, NESPD7, NESPD7ADCX, MSD7ADCX, MSDPD7ADCX, RES7, RES7PDT, RIO, JOT, JOTVTX15.
Lumens	Approximate lumen output. For high Efficiency, all versions may not achieve 130+ LPW. Refer to photometry on www.acuitybrands.com . Air supply/return option, 90 CRI, and versions with integral sensor trim rings may not achieve 130 LPW.
MSD7ADCX, MSDPD7ADCX	Only available with EZ1 driver option. 0-10v dimming wires not accessible via access plate.
NES7, NESPD7, NES7ADCX, NESPD7ADCX	Requires N80, N80EMG, N100, or N100EMG. Only available with EZ1 driver.
NLTAIR2	Must order with nLight Wireless option from Control section. Only available with EZ1 driver. Not available with 85L, 100L, or 120L options.
NOC	Can only be ordered in conjunction with EZ1, NLTAIR2, RES7/RES7PDT. Occupancy sensor disabled at factory but can be re-enabled upon commissioning.
N80EMG, N100EMG	nLight EMG option requires a connection to existing nLight network. Power is provided from a separate N80 or N100 enabled fixture.
RES7EM, RES7PDTEM, RIOEM	See UL924 Sequence of Operation chart on page 4. Not available with 72L, 72LHE, or 85LHE lumen packages.
RRL	For ordering logic consult: RRL_2013 .
SLD	Not available with any nLight Interface or Control options.

Multiple Diffuser Options



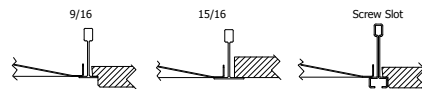
2BLT Volumetric Recessed Lighting 2'x4'

Non-Configurable BLT

Non-Configurable BLT								
Stock/MTD	Catalog Description *	UPC	Lumens	Wattage	LPW	Color Temperature	Voltage	Pallet Qty
Stock	2BLT4 40L ADP LP835	00190887470789	4000	31.69	126.22	3500K/82 CRI	120-277	28
	2BLT4 40L ADP LP840	00190887470765	4063	31.69	128.23	4000K/82CRI	120-277	28
	2BLT4 46L ADP LP835	00190887468656	4960	38	130.5	3500K/82 CRI	120-277	28
	2BLT4 46L ADP LP840	00190887468649	5039.18	38	132.58	4000K/82CRI	120-277	28
	2BLT4 40L ADP EL14L LP835	00190887470925	4000	31.69	126.22	3500K/82 CRI	120-277	28
	2BLT4 40L ADP EL14L LP840	00190887470918	4063	31.69	128.23	4000K/82 CRI	120-277	28
	2BLT4 46L ADP EL14L LP835	00190887468670	4960	38	130.5	3500K/82 CRI	120-277	28
	2BLT4 46L ADP EL14L LP840	00190887468663	5039.18	38	132.58	4000K/82 CRI	120-277	28

*Generic 0-10V Dimming to 10%.

MOUNTING DATA	
Ceiling Type	Appropriate Trim Type
Exposed grid tee (1' and 9/16")	G
Concealed grid tee	G
Plaster or plasterboard	G*



*DGA accessory available to provide ceiling trim flange and fixture support for plaster or plasterboard ceiling. Recommended rough-in dimensions for DGA installation is 24-3/4" x 24-3/4" (Tolerance is +1/8", -0").

UL924 Sequence of Operation

For 90 minutes following any complete AC power interruption >200 ms:

- Digital dimming is commanded to high end trim level.
- Device ignores wireless lighting control commands.

Accessories & Replacement Parts

Accessories: Order as separate catalog number.	
DGA24	Drywall grid adapter for 2x4 recessed fixture
2X4SMKSH PAF	Surface Mount Troffer Kit Post Paint
RK8BDP 2P U	Disconnect Plug (BDP), 2 Pole, Package of 1
RK8BDP 3P U	Disconnect Plug (BDP), 3 Pole, Package of 1
RK8BDP 2P J10	Disconnect Plug (BDP), 2 Pole, Package of 10
RK8BDP 2P J40	Disconnect Plug (BDP), 2 Pole, Package of 40

Replacement Parts: Order as separate catalog number.		
*249P2N	2DBLT48 ADP LENS ASSEMBLY	4 ft. replacement lens
*249P2T	2DBLT48 SDP LENS ASSEMBLY	4 ft. replacement lens
*249P30	2DBLT48 ADSM LENS ASSEMBLY	4 ft. replacement lens
*249P33	2DBLT48 SDSM LENS ASSEMBLY	4 ft. replacement lens
*237LT2	2DBLT48 ADPT LENS ASSEMBLY	4 ft. replacement lens
*237LT4	2DBLT48 SDPT LENS ASSEMBLY	4 ft. replacement lens
*237LT6	2DBLT48 ADSMT LENS ASSEMBLY	4 ft. replacement lens
*237LT8	2DBLT48 SDSMT LENS ASSEMBLY	4 ft. replacement lens
*237LTA	2DBLT48 ADPT SENSOR LENS ASSEMBLY	4 ft. replacement lens
*237MS2	2DBLT48 SDPT SENSOR LENS ASSEMBLY	4 ft. replacement lens
*237MSA	2DBLT48 ADSMT SENSOR LENS ASSEMBLY	4 ft. replacement lens
*237MSL	2DBLT48 SDSMT SENSOR LENS ASSEMBLY	4 ft. replacement lens

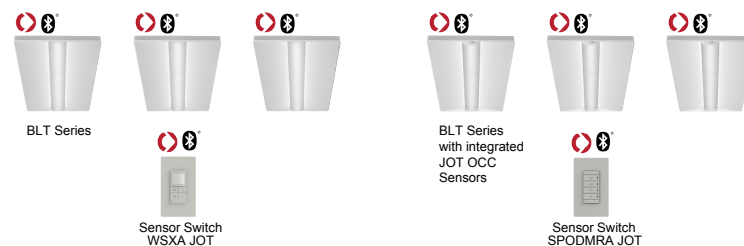
JOT Wireless

Just One Touch

Sensor Switch JOT Enabled Wireless Solution

Designed with contractors in mind, the Sensor Switch JOT enabled wireless solution offers a straightforward approach to the installation and pairing of lighting fixtures and controls. Absolutely no 0-10V control wires and no mobile apps are needed with JOT enabled products, allowing for lightning speed installation right out of the box.

- Power:** Install JOT enabled fixtures and controls as instructed.
- Pair:** Insert the pairing tool into the pinhole on the wall switch; press and hold any button for 6 seconds.
- Play:** Once paired, each fixture will individually dim down to 10% brightness. All products will be fully functional.



BLT-2X4

2BLT Volumetric Recessed Lighting 2'x4'

nLight Platform

nLight embedded fixtures offer:	Customers get:
Manual Dimming	Convenience and visual comfort for occupants
Motion Sensing and/or Daylight Harvesting	Energy savings and code compliance
Fixture or Group Level Control	Ability to configure lighting to the space requirements
Flexibility	Ease of fixture moves, adds and changes
Wireless Wall Switch (nLight AIR Only)	Ease and flexibility of placement
Astronomical and Time of Day Scheduling	Energy savings and building security
Scalable Solution	nLight controls to grow with your business
Future-Ready	nLight platform to set foundation for future upgrades and capabilities

nLight Air Wireless



Simple as 1,2,3

1. Install the nLight® AIR fixtures with embedded smart sensor
2. Install the wireless battery-powered wall switch
3. With CLAIRITY app, pair the fixtures with the wall switch and if desired, customize the sensor settings for the desired outcome



nLight Wired Networking



Simple as 1,2,3

1. Install the nLight® Wired fixtures with embedded control
2. Install the nLight Wired wall switch
3. Connect the fixtures using standard CAT5e cables and the devices will automatically discover each other and work (plug and play)

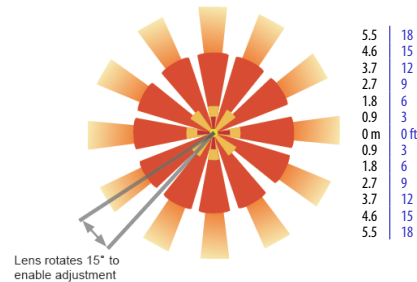
2BLT Volumetric Recessed Lighting 2'x4'

Sensor Options					
Option	Automatic Dimming Photocell	Occupancy Sensing		nLight Wired Networking	nLight AIR Networking
		PIR	PDT		
MSD7ADCX	X	X			
MSDPDT7ADCX	X		X		
NES7		X		X	
NES7ADCX	X	X		X	
NESPD7			X	X	
NESPD7ADCX	X		X	X	
RES7	X	X			X
RESPDT7	X	X	X		X

Sensor Coverage Pattern Mini 360° Lens

- Recommended for walking motion detection from mounting heights between 8 ft (2.44 m) and 20 ft (6.10 m)
- Initial detection of walking motion along sensor axes at distances of 2x the mounting height up to 15 ft (4.57 m) and
- 1.75x up to 20 ft (6.10 m).
- Provides 12 ft (3.66 m) radial detection of small motion when mounted at 9 ft (2.74 m)
- Initial detection will occur earlier when walking across sensor's field of view than when walking directly at sensor

9 FT Mounting



Integrated Sensor with Individual Control

The MSD7ADCX PIR occupancy sensor/automatic dimming photocell is ideal for areas without obstructions and where daylight harvesting may be desired. Suggested applications include, but not limited to, hallways, corridors, storage rooms, and breakrooms or other areas where people are typically moving.

The MSDPDT7ADCX PIR/Microphonics Dual Tech occupancy sensor/automatic dimming photocell is ideal for areas with obstructions and where daylight harvesting is desired. Suggested applications include, but not limited to, open offices, private offices, classrooms, public restrooms, and conference rooms.

nLight AIR Wireless

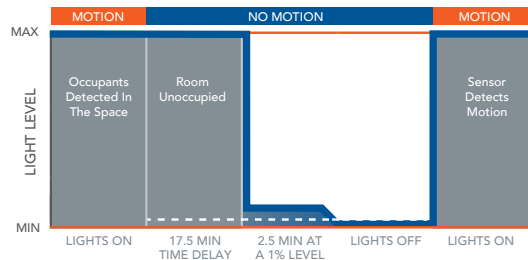
nLight AIR is the ideal solution for retrofit or new construction spaces where adding additional wiring can be labor intensive and nLight AIR is available with or without an integral sensor. The integrated rES7 or rES7PDT smart sensors are part of each luminaire in the nLight AIR network, which can be grouped to control multiple luminaires. The granularity of control with the digital PIR occupancy detection and daylight sensing makes a great solution for any application.

nLight Wired Networking

The nES7 is ideal for small rooms without obstructions or areas with primarily walking motion. Ideal areas include hallways, corridors, storage rooms, and breakrooms. Additionally, the nES7ADCX includes an integrated photocell, which enables daylight harvesting controls.

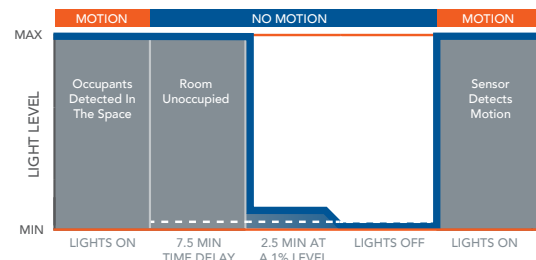
For areas like restrooms, private offices, open offices, conference rooms or any space with obstructions, the nES PDT 7 dual technology sensor is recommended. The nES PDT 7 utilizes both PIR (passive infrared) and Microphonics technologies to detect occupancy. Additionally, the nESPD7ADCX includes an integrated photocell, which enables daylight harvesting controls which is ideal for areas where windows are present.

Sequence of Operation (MSD7 Sensor)



*The presetting on the automatic dimming photocell is 5fc.

Sequence of Operation (nES7 and rES7 and Sensor)



*The presetting on the automatic dimming photocell is 5fc (nES7) and 10fc (rES7).

2BLT Volumetric Recessed Lighting 2'x4'

Controls Accessories

nLight® Wired Control Accessories:

Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlight.

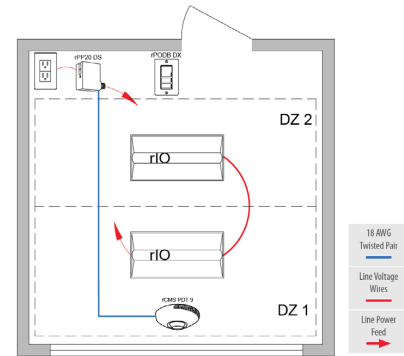
WallPod stations	Model number	Occupancy sensors	Model number
On/Off	nPODMA [Color]	Small motion 360°, ceiling (PIR / dual tech)	nCM 9 RJB / nCM PDT 9 RJB
On/Off & raise/lower	nPODMA DX [Color]	Large motion 360°, ceiling (PIR / dual tech)	nCM10 RJB / nCM PDT 10 RJB
Graphic touchscreen	nPOD TOUCH [Color]	Wall switch with raise/lower	nWSX PDT LV DX [color]
Photocell controls	Model number	Cat-5 cable (plenum rated)	Model number
Full range dimming	nCM ADCX RJB	10' cable	CAT5 10FT J1
		30' cable	CAT5 30FT J1

nLight® AIR Control Accessories:

Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlightair.

Wall switches	Model number
On/Off single pole	rPODBA [color] G2
On/Off two pole	rPODB A2P [color] G2
On/Off & raise/lower single pole	rPODBA DX [color] G2
On/Off & raise/lower two pole	rPODBA 2P DX [color] G2

BLT fixtures with integrated rIO devices complement any small office space. Pair them with an rCMS occupancy sensor and the space now has wireless occupancy sensing and dimming capability. For additional configuration options please consult with Tech Support.



rCMS ¹						Example: RCMS PDT 10 AR G2		
Series / Detection	Power Supply ¹	Occupancy Detection	Lens (Required)	Operating Mode	Generation			
RCMS nLight AIR occupancy and daylight sensor	[blank] Power Supply ordered separately PS 150 Standard 150 mA Power Supply	[blank] PIR Detection PDT Dual Tech PIR/ Microphonics	10 Large Motion/ Extended Range 360° 9 Small Motion/ Extended Range 360° 6 High Bay 360° Lens	[BLANK] None AR Auxiliary Relay	G2 Generation 2 compatibility			

Notes

¹ RCMS requires low voltage power from either RPP20 DS 24V G2 or PS150.



Sensor Switch
WSX



nLight WIRED
nPOD UNITOUCH



nLight WIRED
nPODMA DX



nLight AIR
rPODBA



BLT with rIO



rPODBA

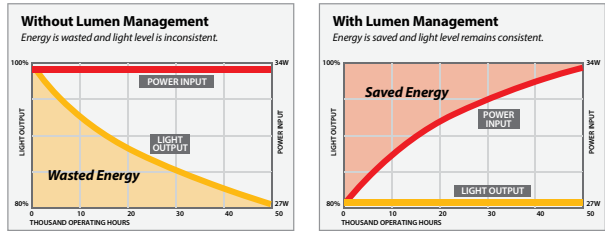


RCMS

2BLT Volumetric Recessed Lighting 2'x4'

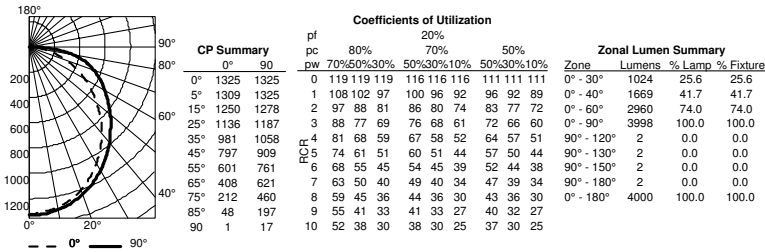
Constant Lumen Management

Enabled by the embedded nLight control, the BLT actively tracks its run-time and manages its light source such that constant lumen output is maintained over the system life. Referred to as lumen management, this feature eliminates the energy waste created by the traditional practice of over-lighting.

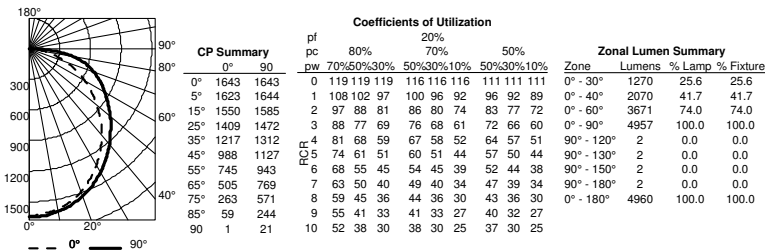


PHOTOMETRICS

2BLT4 40L ADP LP835, 4000 delivered lumens, test no. ISF36900P109, tested in accordance to IESNA LM-79



2BLT4 48L ADP LP835, 4960 delivered lumens, test no. ISF 36900P117, tested in accordance to IESNA LM-79



2BLT Volumetric Recessed Lighting 2'x4'

Performance Data					
Model Number	Lumens	LPW	Watts	DLC Listing	DLC ID
2BLT4 30L ADP E21 (G21, G210) LP835 [All Options]	2962	127.31	23.26	Premium	PWJDEMHS
2BLT4 30L ADP E21 (G21, G210) LP840 [All Options]	3009.28	129.34	23.26	Premium	P18J5GLD
2BLT4 30L ADPT E21 (G21, G210) LP840 [All Options]	2969.16	127.62	23.26	Premium	P3HB2XSG
2BLT4 40L ADP E21 (G21, G210) LP835 [All Options]	4000	126.22	31.69	Premium	PDWKYXFD
2BLT4 40L ADP E21 (G21, G210) LP840 [All Options]	4063.86	128.23	31.69	Premium	PEYXAZWD
2BLT4 40L ADPT E21 (G21, G210) LP835 [All Options]	3946.66	124.53	31.69	Premium	P563CPK6
2BLT4 40L ADPT E21 (G21, G210) LP840 [All Options]	4009.67	126.52	31.69	Premium	PK79UR9W
2BLT4 48L ADP E21 (G21, G210) LP835 [All Options]	4960	130.5	38	Premium	PJ9CK6C1
2BLT4 48L ADP E21 (G21, G210) LP840 [All Options]	5039.18	132.58	38	Premium	P9W2R5AK
2BLT4 48L ADPT E21 (G21, G210) LP835 [All Options]	4893.86	128.76	38	Premium	PPFKZU3U
2BLT4 48L ADPT E21 (G21, G210) LP840 [All Options]	4971.99	130.82	38	Premium	PC8HMC9
2BLT4 60L ADP E21 (G21, G210) LP835 [All Options]	6016	126.39	47.59	Premium	PSJ6QERM
2BLT4 60L ADP E21 (G21, G210) LP840 [All Options]	6112.04	128.4	47.59	Premium	PVXQXPVU
2BLT4 60L ADPT E21 (G21, G210) LP835 [All Options]	5935.78	124.7	47.59	Premium	PHT84BW4
2BLT4 60L ADPT E21 (G21, G210) LP840 [All Options]	6030.55	126.69	47.59	Premium	PXV55BC8
2BLT4 72L ADP E21 (G210) LP840 [All Options]	7360.66	125.3	58.74	Premium	P5C222CB
2BLT4 72L ADP G21 LP835 [All Options]	7245	119.07	60.84	standard	PSHTCT5
2BLT4 72L ADP G21 LP840 [All Options]	7360.66	120.97	60.84	standard	PBERALG7
2BLT4 72L ADPT E21 (G21, G210) LP835 [All Options]	7148.4	117.48	60.84	standard	PDQ53CYK
2BLT4 72L ADPT E21 (G210) LP840 [All Options]	7262.52	123.63	58.74	Premium	P2KKMMVN
2BLT4 72L ADPT G21 LP840 [All Options]	7262.52	119.36	60.84	standard	P10DUPC0
2BLT4 85L ADP E21 (G21, G210) LP835 [All Options]	8567	116.43	73.58	standard	PYD2G06V
2BLT4 85L ADP E21 (G21, G210) LP840 [All Options]	8703.77	118.28	73.58	standard	P8Z4IV4X
2BLT4 85L ADPT E21 (G21, G210) LP835 [All Options]	8452.77	114.87	73.58	standard	PTZEW3QM
2BLT4 85L ADPT E21 (G21, G210) LP840 [All Options]	8587.72	116.71	73.58	standard	P01DMEK9
2BLT4 100L ADP E21 (G21, G210) LP835 [All Options]	9837	103.14	95.36	standard	PGDES20R
2BLT4 100L ADP E21 (G21, G210) LP840 [All Options]	9994.04	104.79	95.36	standard	P007CHGX
2BLT4 100L ADPT E21 (G21, G210) LP835 [All Options]	9705.84	101.77	95.36	standard	PSZUQY7M
2BLT4 100L ADPT E21 (G21, G210) LP840 [All Options]	9860.79	103.39	95.36	standard	P6V6X6HY
2BLT4 120L ADP E21 (G21, G210) LP835 [All Options]	11709	118.18	99.07	standard	PGM4Y7DP
2BLT4 120L ADP E21 (G21, G210) LP840 [All Options]	11895.9	120.07	99.07	standard	P00DDCG2
2BLT4 120L ADPT E21 (G21, G210) LP835 [All Options]	11552.9	116.61	99.07	standard	PXMOF509
2BLT4 120L ADPT E21 (G21, G210) LP840 [All Options]	11737.3	118.47	99.07	standard	PJ4GEBZM

DLC information is subject to change, for the most up-to-date information please refer to www.dlc.org. Above listings do not cover 347v or SLD.

How to Estimate Delivered Lumens in Emergency Mode

Use the formula below to estimate the delivered lumens in emergency mode

Delivered Lumens = 1.25 x P x LPW

P = Output power of emergency driver, P = 10W for E10WLCP option.

LPW = Lumen per watt rating of the luminaire. This information is available on the ABL luminaire spec sheet. LPW = Lumen per watt rating of the luminaire. LPW information available in Performance Data section.

HE Performance Data					
Model Number	Lumens	LPW	Watts	DLC Listing	DLC ID
2BLT4 30LHE ADP E21 (G21, G210) LP835 [All Options]	3107	135.17	22.98	Premium	P7KEICW5
2BLT4 30LHE ADP E21 (G21, G210) LP840 [All Options]	3156.6	137.33	22.98	Premium	PD0M06BH
2BLT4 30LHE ADPT E21 (G21, G210) LP835 [All Options]	3065.57	133.37	22.98	Premium	P7PZAJDZ
2BLT4 30LHE ADPT E21 (G21, G210) LP840 [All Options]	3114.51	135.5	22.98	Premium	P2N23EBP
2BLT4 40LHE ADP E21 (G21, G210) LP835 [All Options]	4085	138.56	29.48	Premium	P67P65SY
2BLT4 40LHE ADP E21 (G21, G210) LP840 [All Options]	4150.21	140.77	29.48	Premium	P95UQD66
2BLT4 40LHE ADPT E21 (G21, G210) LP835 [All Options]	4030.53	136.71	29.48	Premium	PC15DQEC
2BLT4 40LHE ADPT E21 (G21, G210) LP840 [All Options]	4094.88	138.89	29.48	Premium	PGRC5J2T
2BLT4 48LHE ADP E21 (G21, G210) LP835 [All Options]	4770	138.16	34.52	Premium	PX8JBG8N
2BLT4 48LHE ADP E21 (G21, G210) LP840 [All Options]	4846.15	140.37	34.52	Premium	P5PQ5RRX
2BLT4 48LHE ADPT E21 (G21, G210) LP835 [All Options]	4706.4	136.32	34.52	Premium	P2NK2H33
2BLT4 48LHE ADPT E21 (G21, G210) LP840 [All Options]	4781.53	138.5	34.52	Premium	PK8C1321
2BLT4 60LHE ADP E21 (G21, G210) LP835 [All Options]	5894	135.12	43.61	Premium	PQZN176R
2BLT4 60LHE ADP E21 (G21, G210) LP840 [All Options]	5988.09	137.28	43.61	Premium	PG5CYJUC
2BLT4 60LHE ADPT E21 (G21, G210) LP835 [All Options]	5815.41	133.32	43.61	Premium	PZ72TAWM
2BLT4 60LHE ADPT E21 (G21, G210) LP840 [All Options]	5908.25	135.45	43.61	Premium	PRC4W72B
2BLT4 72LHE ADP E21 (G21, G210) LP835 [All Options]	7149	135.94	52.58	Premium	PUB38GEQ
2BLT4 72LHE ADP E21 (G21, G210) LP840 [All Options]	7263.13	138.11	52.58	Premium	P7GDH7TN
2BLT4 72LHE ADPT E21 (G21, G210) LP835 [All Options]	7053.68	134.12	52.58	Premium	P5CC2VKV
2BLT4 72LHE ADPT E21 (G21, G210) LP840 [All Options]	7166.29	136.26	52.58	Premium	P6P1BKDM
2BLT4 85LHE ADP E21 (G21, G210) LP835 [All Options]	8158	128.96	63.25	Premium	PRTW6BXW
2BLT4 85LHE ADP E21 (G21, G210) LP840 [All Options]	8288.24	131.02	63.25	Premium	P6H1V2D6
2BLT4 85LHE ADPT E21 (G21, G210) LP835 [All Options]	8049.22	127.24	63.25	Premium	P1VG5TA3
2BLT4 85LHE ADPT E21 (G21, G210) LP840 [All Options]	8177.73	129.27	63.25	Premium	PN5BKJ6E

DLC information is subject to change, for the most up-to-date information please refer to www.dlc.org. Above listings do not cover 347v or SLD.



DIGITAL NAVIGATION

Ordering Tree nLight Platform Sensor Switch JOT Photometrics Performance Data

FEATURES & SPECIFICATIONS

INTENDED USE — The BLT Best-in-Value Low Profile LED luminaire features a popular center basket design that offers a clean, versatile style and volumetric distribution. High efficacy LED light engines deliver energy savings and low maintenance compared to traditional sources. An extensive selection of configurations and options make the BLT the perfect choice for many lighting applications including schools, offices and other commercial spaces, retail, hospitals and healthcare facilities. The low profile BLT design (2-3/8") also makes it an excellent choice for renovation projects.

CONSTRUCTION — Prior to fabrication, BLT components are coated with a proprietary paint blend and die-formed for dimensional consistency.

The BLT reflector is available in both smooth and ribbed finishes. Choose RB from the fixture style section below for a ribbed finish.

End plates contain easy-to-position integral T-bar clips for securely attaching the luminaire to the T-grid. For additional T-grid security, optional screw on T-bar clips are available.

Diffusers are extruded from impact modified acrylic for increased durability.

LED boards and drivers are accessible from the plenum.

OPTICS — Volumetric illumination is achieved by creating an optimal mix of light to walls, partitions and vertical and horizontal work surfaces — rendering the interior space, objects and occupants in a more balanced, complementary luminous environment. High performance extruded acrylic diffusers conceal LEDs and efficiently deliver light in a volumetric distribution. Four diffuser choices available — curved and square designs with ribbed or a smooth frosted finish.

ELECTRICAL — Long-life LEDs, coupled with high-efficiency drivers, provide superior quantity and quality of illumination for extended service life. 80% LED lumen maintenance at 60,000 hours (L80/60,000). Color Variation within 3-step MacAdam ellipse (3SDCM).

Non-Configurable BLT: Generic 0-10 volt dimming driver. Dims to 10%

Configurable BLT: available in High Efficiency (HE) versions for applications where a lower wattage (over the standard product) is required. The High Efficiency versions deliver >130 LPW and can be specified via the Lumen Package designations in the Ordering Information below.

eldoLED driver options deliver choice of dimming range, and choices for control, while assuring flicker-free, low-current inrush, 89% efficiency and low EMI.

Optional integrated nLight® controls make each luminaire addressable — allowing it to digitally communicate with other nLight enabled controls such as dimmers, switches, occupancy sensors and photocontrols. Connection to nLight is simple. It can be accomplished with integrated nLight AIR wireless RIO, RES7 sensors, or through standard Cat-5 cabling. nLight offers unique plug-and-play convenience as devices and luminaires automatically discover each other and self-commission. nLight AIR is commissioned easily through an intuitive mobile app.

Lumen Management: Unique lumen management system (option N80) provides on board intelligence that actively manages the LED light source so that constant lumen output is maintained over the system life, preventing the energy waste created by the traditional practice of over-lighting.

Step-level dimming option allows system to be switched to 50% power for compliance with common energy codes while maintaining fixture appearance.

SENSOR — Integrated sensor (individual control): Sensor Switch MSD7ADCX ((Passive infrared (PIR)) or MSDPDT7ADCX ((PIR/Microphonics Dual Tech (PDT)) integrated occupancy sensor/automatic dimming photocell allows the luminaire to power off when the space is unoccupied or enough ambient light is entering the space. See page 4 for more details on the integrated sensor.

Integrated Sensor (nLight Wired Networking): This sensor is nLight-enabled, meaning it has the ability to communicate over an nLight network. When wired, using CAT-5 cabling, with other nLight-enabled sensors, power packs, or WallPods, an nLight control zone is created. Once linked to a Gateway, directly or via a Bridge, the zone becomes capable of remote status monitoring and control via SensorView software. See page 4 for the nLight sensor options.

Integrated Smart Sensor (nLight Air Wireless Platform): The RES7 sensor is nLight AIR enabled, meaning it has the ability to communicate over the wireless nLight control platform. It is available with an automatic dimming photocell, and either a digital PIR or a microphonics (PDT) dual technology occupancy sensor. It pairs to other luminaires and wall switches through our mobile app, CLAIRITY, which allows for simple sensor adjustment. See page 4 for more details on the Integrated Smart Sensor.

Integrated Wireless Sensor (single room control): Sensor Switch VERTEX JOT or JOTVIX15 luminaire-embedded occupancy and ambient light sensor allows the luminaire to power off when the space is unoccupied or when enough ambient light is entering the space. See page X for more details on the integrated wireless sensor.

INSTALLATION — The BLT's low profile design of only 2-3/8" provides increased installation flexibility especially in restrictive plenum applications. The BLT fits into standard 15/16" and narrow 9/16" T-grid ceiling systems.

Suitable for damp location.

For recessed mounting in hard ceiling applications, Drywall Grid Adapters (DGA) are available as an accessory. See Accessories section.

LISTINGS — CSA Certified to meet U.S. and Canadian standards. IC rated. Tested in accordance with ISO 14644-1; suitable for ISO Class 5-9 positive and negative pressure clean rooms.

Designlights Consortium® (DLC) Premium qualified product and DLC qualified product. Not all versions of this product may be DLC Premium qualified or DLC qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.

BUY AMERICAN — Product with the BAA option 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. Specifications subject to change without notice.

Catalog Number	TYPE T1B
Notes	
Type	

BLT Series LED

2BLT4



ADP Diffuser Option

2' x 4'
LED



Ribbed Reflector Option



Specifications

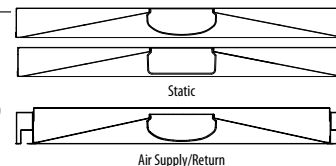
Length: 47-3/4 (121.2)

Width: 23-3/4 (60.3)

Depth: 2-3/8 (6.0)

Depth with Air supply/return: 2-3/4 (6.9)

All dimensions are inches (centimeters) unless otherwise specified.



Embed nLight controls today. Prepare for tomorrow.

Now



User-friendly install



Enhanced energy savings



Code compliance

Tomorrow



Scalability



Space configuration



Future-ready

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

COMMERCIAL INDOOR

BLT-2X4

2BLT Volumetric Recessed Lighting 2'x4'



A+ Capable options
by this color background.

TYPE T1B

ORDERING INFORMATION

Lead times will vary depending on options selected. Consult with your sales representative.

Example: 2BLT4 40L ADP EZ1 LP840

Series	Fixture Style	Air function	Lumens ‡	Diffuser	Voltage	Driver	Color temperature
2BLT4	2x4 BLT	(blank) Smooth Reflector RB Ribbed Reflector	(blank) Static A Air supply/return ‡	ADP Curved, ribbed ADSM Curved, smooth SDP Square, ribbed SDSM Square, smooth Includes trim rings to match sensed version ADPT Curved, ribbed ADSMT Curved, smooth SDPT Square, ribbed SDSMT Square, smooth	(blank) MVOLT 120 120V 277 277V 347 347V ‡	EZ1 eldoLED dims to 1% (0-10 volt dimming) GZ1 Dims to 1% (0-10V dimming) ‡ GZ10 Dims to 10% (0-10V dimming) ‡ SLD Step-level dimming ‡	LP830 82CRI, 3000 K LP835 82CRI, 3500 K LP840 82CRI, 4000 K LP850 82CRI, 5000 K LP930 90CRI, 3000K LP935 90CRI, 3500K LP940 90CRI, 4000K LP950 90CRI, 5000K
			Standard efficiency (>100 LPW) 30L 3000 40L 4000 48L 4800 60L 6000 72L 7200 85L 8500 100L 10000 120L 12000 High efficiency (>130 LPW) 30LHE 3000 40LHE 4000 48LHE 4800 60LHE 6000 72LHE 7200 85LHE 8500				

nLight Interface	Control ‡
nLight Wired (blank) no nLight ® interface N80 nLight with 80% lumen management N80EMG nLight with 80% lumen management For use with generator supply EM power ‡ N100 nLight without lumen management N100EMG nLight without lumen management For use with generator supply EM power ‡ nLight Wireless (blank) no nLight ® interface NLTAIR2 nLight AIR Generation 2 enabled ‡	nLight Wired ‡ (blank) No sensor control NES7 nLight™ nES 7 PIR integral occupancy sensor NESPD7 nLight™ nES PDT 7 dual technology integral occupancy control NES7ADCX nLight™ nES 7 ADCX PIR integral occupancy sensor with automatic dimming photocell NESPD7ADCX nLight™ nES PDT 7 dual technology integral occupancy sensor with automatic dimming photocell nLight Wireless RES7 nLight AIR PIR integral occupancy sensor with automatic dimming photocell for Networking Capabilities RES7PDT nLight AIR microphonics dual technology occupancy sensor with automatic dimming photocell RIO nLight AIR radio module without sensor RES7EM nLight AIR PIR integral occupancy sensor with automatic dimming photocell and UL924 Emergency Operation, via power interrupt detection ‡ RES7PDTEM nLight AIR microphonics dual technology occupancy sensor with automatic dimming photocell and UL924 Emergency Operation, via power interrupt detection ‡ RIOEM nLight AIR radio module less sensor, with UL924 Emergency Operation, via power interrupt detection ‡
	Individual Control MSD7ADCX PIR integral occupancy sensor with automatic dimming control photocell ‡ MSDPD7ADCX PDT integral occupancy sensor with automatic dimming control photocell ‡ JOT Wireless room control with "Just One Touch" pairing ‡ JOTVTX15 Wireless occupancy sensor with "Just One Touch" pairing ‡

Standby Mode	Options
NOC NOC Occupancy sensor disabled ‡	BDP Disconnect Plug EL7L 700 lumen battery pack (Noncompliant with CA T20) ‡ EL14L 1400 lumen battery pack (Noncompliant with CA T20) ‡ EL14LSD 1400 lumen battery pack with self-diagnostic testing feature (Noncompliant with CA T20) ‡ E10WLCP EM Self-Diagnostic battery pack, 10W Constant Power, Certified in CA Title 20 MAEDBS ‡ CP Chicago plenum ‡ BGTD Bodine Generator Transfer Device ‡ PWS1836 6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit PWS1846 6' pre-wire, 3/8" diameter, 18 gauge, 2 circuit PWS1846 PWSLV Two cables: one 6' pre-wire, 3/8" diameter, 18 gauge, 2 circuits; one 6' pre-wire, 3/8" diameter, 18 gauge ‡ PWS1856LV 6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit w/low voltage wires ‡ GLR Fast-blowing fuse ‡ GMF Slow-blowing fuse ‡ NPLT Narrow pallet RRL RELOC®-ready luminaire ‡ LATC Earthquake clip DWAM Anti-Microbial paint JP14 Job packaging ‡ JP18 Job packaging ‡ IPSX Gasketed diffuser compartment to meet IPSX rating ‡ BAA Buy America(n) Act Compliant

NOTE: ‡ indicates option value has ordering restrictions. Please reference the Option Value Ordering Restrictions chart on the next page. Options are sorted alphanumerically.

INTEGRAL BATTERY PACKS TO BE PROVIDED FOR LUMINAIRES INDICATED AS "EM" ON LIGHTING PLANS

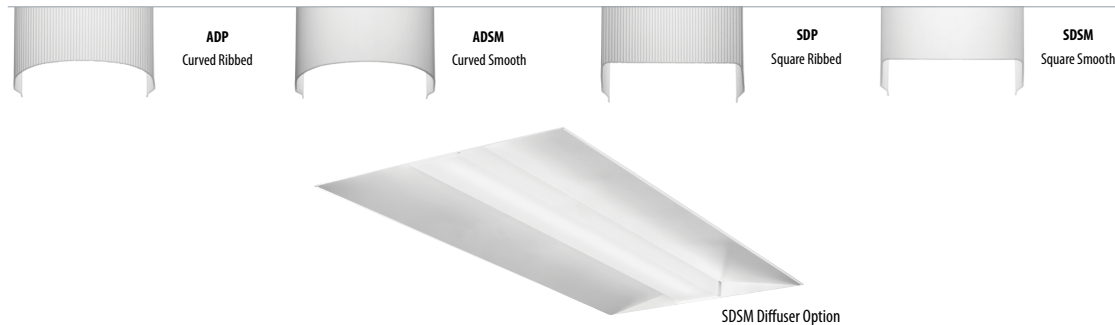
ELECTRICAL CONTRACTOR TO DETERMINE APPROPRIATE MOUNTING HARDWARE & ACCESSORIES

2BLT Volumetric Recessed Lighting 2'x4'

TYPE T1B

† Option Value Ordering Restrictions	
Option value	Restriction
347	Not available with SLD, EL7L, EL14L, or E10WLCP options.
A	Not available with RB fixture style, consult factory for air flow data.
BGTD	Not available with TD, JOT, JOTVTX15 sensor options or emergency battery options. Must specify voltage. Requires BSE labeling, voltage specific. Consult factory for options. Example: BGTD BSE10.
Controls	Must specify diffuser with trim rings.
CP	Not available with N80, N80EMG, N100, or N100EMG.
GZ1, GZ10	Not available with any Control or Sensor options except JOT & JOTVTX15
EL14LSD, E10WLCP, EL7L, EL14L	When using pre-wire option, use PWS1846 or PWS1846 PWSLV. For more information, please see the PSSD2 specification sheet .
FAO	EZ1 driver required. Not available with USPOM, FAO or lumen packages > 6000LM. FAO restricts use of external Dimming controls. See chart on page 3 for additional details.
GLR, GMF	Must specify voltage. 120 or 277, with GLR and GMF fusing.
IP5X	Not available with air supply/return or Wired Networking (NES) and Individual Control (MSD) sensors.
JOT, JOTVTX15	Not available with standard efficiency 85L, 100L or 120L lumen options. Not available with SLD, nLight, NLTAIR2, NOC, or BGTD options.
JP14	Only available on fixtures with NES7, NESPD7, NESPD7ADCX, MSD7ADCX, MSDPD7ADCX, RES7, RES7PDT, RIO, JOT, JOTVTX15. Not available when air supply/return function and sensor options are combined.
JP18	Not available with option: NES7, NESPD7, NESPD7ADCX, MSD7ADCX, MSDPD7ADCX, RES7, RES7PDT, RIO, JOT, JOTVTX15.
Lumens	Approximate lumen output. For high Efficiency, all versions may not achieve 130+ LPW. Refer to photometry on www.acuitybrands.com . Air supply/return option, 90 CRI, and versions with integral sensor trim rings may not achieve 130 LPW.
MSD7ADCX, MSDPD7ADCX	Only available with EZ1 driver option. 0-10v dimming wires not accessible via access plate.
NES7, NESPD7, NES7ADCX, NESPD7ADCX	Requires N80, N80EMG, N100, or N100EMG. Only available with EZ1 driver.
NLTAIR2	Must order with nLight Wireless option from Control section. Only available with EZ1 driver. Not available with 85L, 100L, or 120L options.
NOC	Can only be ordered in conjunction with EZ1, NLTAIR2, RES7/RES7PDT. Occupancy sensor disabled at factory but can be re-enabled upon commissioning.
N80EMG, N100EMG	nLight EMG option requires a connection to existing nLight network. Power is provided from a separate N80 or N100 enabled fixture.
RES7EM, RES7PDTEM, RIOEM	See UL924 Sequence of Operation chart on page 4. Not available with 72L, 72LHE, or 85LHE lumen packages.
RRL	For ordering logic consult: RRL_2013 .
SLD	Not available with any nLight Interface or Control options.

Multiple Diffuser Options



2BLT Volumetric Recessed Lighting 2'x4'

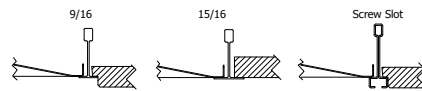
TYPE T1B

Non-Configurable BLT

Non-Configurable BLT								
Stock/MTD	Catalog Description *	UPC	Lumens	Wattage	LPW	Color Temperature	Voltage	Pallet Qty
Stock	2BLT4 40L ADP LP835	00190887470789	4000	31.69	126.22	3500K/82 CRI	120-277	28
	2BLT4 40L ADP LP840	00190887470765	4063	31.69	128.23	4000K/82CRI	120-277	28
	2BLT4 46L ADP LP835	00190887468656	4960	38	130.5	3500K/82 CRI	120-277	28
	2BLT4 46L ADP LP840	00190887468649	5039.18	38	132.58	4000K/82CRI	120-277	28
	2BLT4 40L ADP EL14L LP835	00190887470925	4000	31.69	126.22	3500K/82 CRI	120-277	28
	2BLT4 40L ADP EL14L LP840	00190887470918	4063	31.69	128.23	4000K/82 CRI	120-277	28
	2BLT4 46L ADP EL14L LP835	00190887468670	4960	38	130.5	3500K/82 CRI	120-277	28
	2BLT4 46L ADP EL14L LP840	00190887468663	5039.18	38	132.58	4000K/82 CRI	120-277	28

*Generic 0-10V Dimming to 10%.

MOUNTING DATA	
Ceiling Type	Appropriate Trim Type
Exposed grid tee (1' and 9/16")	G
Concealed grid tee	G
Plaster or plasterboard	G*



*DGA accessory available to provide ceiling trim flange and fixture support for plaster or plasterboard ceiling. Recommended rough-in dimensions for DGA installation is 24-3/4" x 24-3/4" (Tolerance is +1/8", -0").

UL924 Sequence of Operation

For 90 minutes following any complete AC power interruption >200 ms:

- Digital dimming is commanded to high end trim level.
- Device ignores wireless lighting control commands.

Accessories & Replacement Parts

Accessories: Order as separate catalog number.	
DGA24	Drywall grid adapter for 2x4 recessed fixture
2X4SMKSH PAF	Surface Mount Troffer Kit Post Paint
RK8BDP 2P U	Disconnect Plug (BDP), 2 Pole, Package of 1
RK8BDP 3P U	Disconnect Plug (BDP), 3 Pole, Package of 1
RK8BDP 2P J10	Disconnect Plug (BDP), 2 Pole, Package of 10
RK8BDP 2P J40	Disconnect Plug (BDP), 2 Pole, Package of 40

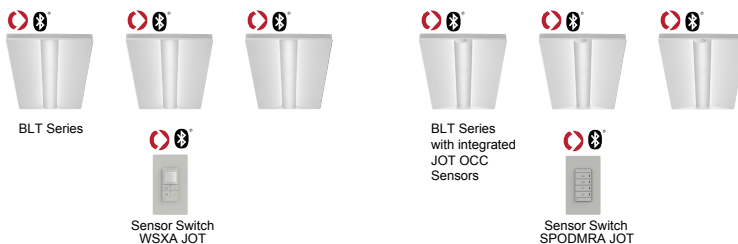
Replacement Parts: Order as separate catalog number.		
*249P2N	2DBLT48 ADP LENS ASSEMBLY	4 ft. replacement lens
*249P2T	2DBLT48 SDP LENS ASSEMBLY	4 ft. replacement lens
*249P30	2DBLT48 ADSM LENS ASSEMBLY	4 ft. replacement lens
*249P33	2DBLT48 SDSM LENS ASSEMBLY	4 ft. replacement lens
*237LT2	2DBLT48 ADPT LENS ASSEMBLY	4 ft. replacement lens
*237LT4	2DBLT48 SDPT LENS ASSEMBLY	4 ft. replacement lens
*237LT6	2DBLT48 ADSMT LENS ASSEMBLY	4 ft. replacement lens
*237LT8	2DBLT48 SDSMT LENS ASSEMBLY	4 ft. replacement lens
*237LTA	2DBLT48 ADPT SENSOR LENS ASSEMBLY	4 ft. replacement lens
*237MS2	2DBLT48 SDPT SENSOR LENS ASSEMBLY	4 ft. replacement lens
*237MSA	2DBLT48 ADSMT SENSOR LENS ASSEMBLY	4 ft. replacement lens
*237MSL	2DBLT48 SDSMT SENSOR LENS ASSEMBLY	4 ft. replacement lens

JOT Wireless

Sensor Switch JOT Enabled Wireless Solution

Designed with contractors in mind, the Sensor Switch JOT enabled wireless solution offers a straightforward approach to the installation and pairing of lighting fixtures and controls. Absolutely no 0-10V control wires and no mobile apps are needed with JOT enabled products, allowing for lightning speed installation right out of the box.

- Power:** Install JOT enabled fixtures and controls as instructed.
- Pair:** Insert the pairing tool into the pinhole on the wall switch; press and hold any button for 6 seconds.
- Play:** Once paired, each fixture will individually dim down to 10% brightness. All products will be fully functional.



LITHONIA LIGHTING

BLT-2X4

COMMERCIAL INDOOR: One Lithonia Way, Conyers, GA 30012 Phone: 800-705-SERV (7378) www.lithonia.com

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2BLT Volumetric Recessed Lighting 2'x4'

TYPE T1B

nLight Platform

nLight embedded fixtures offer:	Customers get:
Manual Dimming	Convenience and visual comfort for occupants
Motion Sensing and/or Daylight Harvesting	Energy savings and code compliance
Fixture or Group Level Control	Ability to configure lighting to the space requirements
Flexibility	Ease of fixture moves, adds and changes
Wireless Wall Switch (nLight AIR Only)	Ease and flexibility of placement
Astronomical and Time of Day Scheduling	Energy savings and building security
Scalable Solution	nLight controls to grow with your business
Future-Ready	nLight platform to set foundation for future upgrades and capabilities

nLight Air Wireless



Simple as 1,2,3

1. Install the nLight® AIR fixtures with embedded smart sensor
2. Install the wireless battery-powered wall switch
3. With CLAIRITY app, pair the fixtures with the wall switch and if desired, customize the sensor settings for the desired outcome



nLight Wired Networking



Simple as 1,2,3

1. Install the nLight® Wired fixtures with embedded control
2. Install the nLight Wired wall switch
3. Connect the fixtures using standard CAT5e cables and the devices will automatically discover each other and work (plug and play)



2BLT Volumetric Recessed Lighting 2'x4'

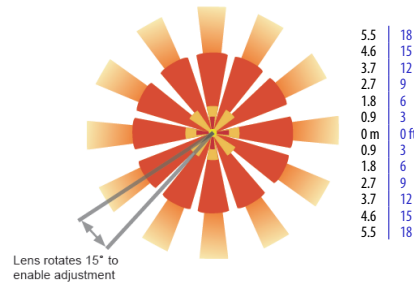
TYPE T1B

Sensor Options					
Option	Automatic Dimming Photocell	Occupancy Sensing		nLight Wired Networking	nLight AIR Networking
		PIR	PDT		
MSD7ADCX	X	X			
MSDPDT7ADCX	X		X		
NES7		X		X	
NES7ADCX	X	X		X	
NESPD7			X	X	
NESPD7ADCX	X		X	X	
RES7	X	X			X
RESPD7	X	X	X		X

Sensor Coverage Pattern Mini 360° Lens

- Recommended for walking motion detection from mounting heights between 8 ft (2.44 m) and 20 ft (6.10 m)
- Initial detection of walking motion along sensor axes at distances of 2x the mounting height up to 15 ft (4.57 m) and
- 1.75x up to 20 ft (6.10 m).
- Provides 12 ft (3.66 m) radial detection of small motion when mounted at 9 ft (2.74 m)
- Initial detection will occur earlier when walking across sensor's field of view than when walking directly at sensor

9 FT Mounting



Integrated Sensor with Individual Control

The MSD7ADCX PIR occupancy sensor/automatic dimming photocell is ideal for areas without obstructions and where daylight harvesting may be desired. Suggested applications include, but not limited to, hallways, corridors, storage rooms, and breakrooms or other areas where people are typically moving.

The MSDPDT7ADCX PIR/Microphonics Dual Tech occupancy sensor/automatic dimming photocell is ideal for areas with obstructions and where daylight harvesting is desired. Suggested applications include, but not limited to, open offices, private offices, classrooms, public restrooms, and conference rooms.

nLight AIR Wireless

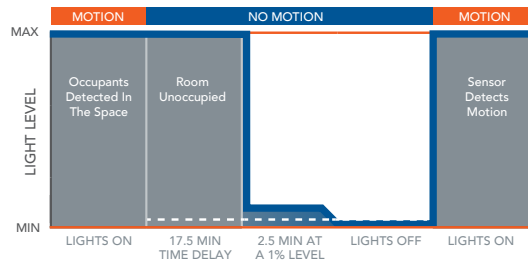
nLight AIR is the ideal solution for retrofit or new construction spaces where adding additional wiring can be labor intensive and nLight AIR is available with or without an integral sensor. The integrated rES7 or rES7PDT smart sensors are part of each luminaire in the nLight AIR network, which can be grouped to control multiple luminaires. The granularity of control with the digital PIR occupancy detection and daylight sensing makes a great solution for any application.

nLight Wired Networking

The nES7 is ideal for small rooms without obstructions or areas with primarily walking motion. Ideal areas include hallways, corridors, storage rooms, and breakrooms. Additionally, the nES7ADCX includes an integrated photocell, which enables daylight harvesting controls.

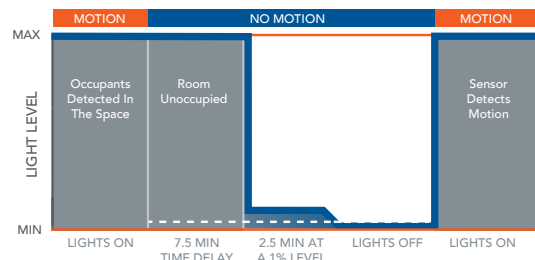
For areas like restrooms, private offices, open offices, conference rooms or any space with obstructions, the nES PDT 7 dual technology sensor is recommended. The nES PDT 7 utilizes both PIR (passive infrared) and Microphonics technologies to detect occupancy. Additionally, the nESPD7ADCX includes an integrated photocell, which enables daylight harvesting controls which is ideal for areas where windows are present.

Sequence of Operation (MSD7 Sensor)



*The presetting on the automatic dimming photocell is 5fc.

Sequence of Operation (nES7 and rES7 and Sensor)



*The presetting on the automatic dimming photocell is 5fc (nES7) and 10fc (rES7).

2BLT Volumetric Recessed Lighting 2'x4'

TYPE T1B

Controls Accessories

nLight® Wired Control Accessories:

Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlight.

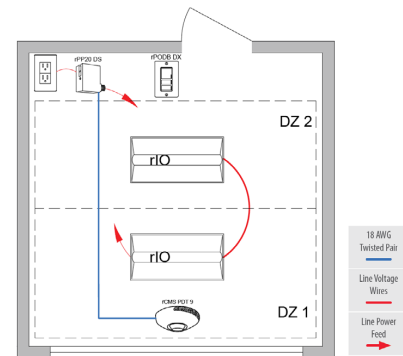
WallPod stations	Model number	Occupancy sensors	Model number
On/Off	nPODMA [Color]	Small motion 360°, ceiling (PIR / dual tech)	nCM 9 RJB / nCM PDT 9 RJB
On/Off & raise/lower	nPODMA DX [Color]	Large motion 360°, ceiling (PIR / dual tech)	nCM10 RJB / nCM PDT 10 RJB
Graphic touchscreen	nPOD TOUCH [Color]	Wall switch with raise/lower	nWSX PDT LV DX [color]
Photocell controls	Model number	Cat-5 cable (plenum rated)	Model number
Full range dimming	nCM ADCX RJB	10' cable	CAT5 10FT J1
		30' cable	CAT5 30FT J1

nLight® AIR Control Accessories:

Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlightair.

Wall switches	Model number
On/Off single pole	rPODBA [color] G2
On/Off two pole	rPODB A2P [color] G2
On/Off & raise/lower single pole	rPODBA DX [color] G2
On/Off & raise/lower two pole	rPODBA 2P DX [color] G2

BLT fixtures with integrated rIO devices complement any small office space. Pair them with an rCMS occupancy sensor and the space now has wireless occupancy sensing and dimming capability. For additional configuration options please consult with Tech Support.



rCMS ¹		Example: RCMS PDT 10 AR G2						
Series / Detection	Power Supply ¹	Occupancy Detection		Lens (Required)		Operating Mode		Generation
RCMS nLight AIR occupancy and daylight sensor	[blank]	[blank]	PIR Detection Dual Tech PIR/ Microphonics	10	Large Motion/ Extended Range 360°	[BLANK] None AR Auxiliary Relay	G2	Generation 2 compatibility
	PS 150			9	Small Motion/ Extended Range 360°			
	Standard 150 mA Power Supply			6	High Bay 360° Lens			

Notes

¹ RCMS requires low voltage power from either RPP20 DS 24V G2 or PS150.



Sensor Switch
WSX



nLight WIRED
NPOD UNITOUCH



nLight WIRED
nPODMA DX



nLight AIR
rPODBA



BLT with rIO



rPODBA



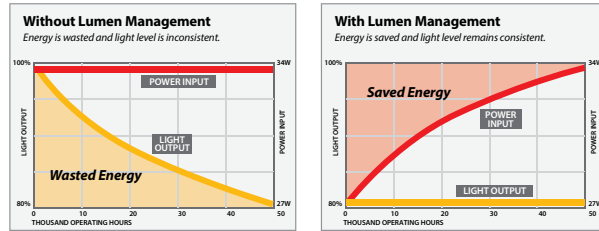
RCMS

2BLT Volumetric Recessed Lighting 2'x4'

TYPE T1B

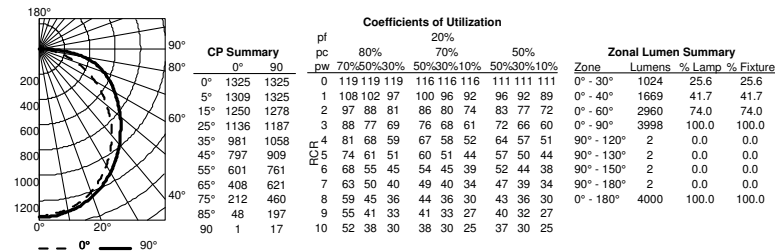
Constant Lumen Management

Enabled by the embedded nLight control, the BLT actively tracks its run-time and manages its light source such that constant lumen output is maintained over the system life. Referred to as lumen management, this feature eliminates the energy waste created by the traditional practice of over-lighting.

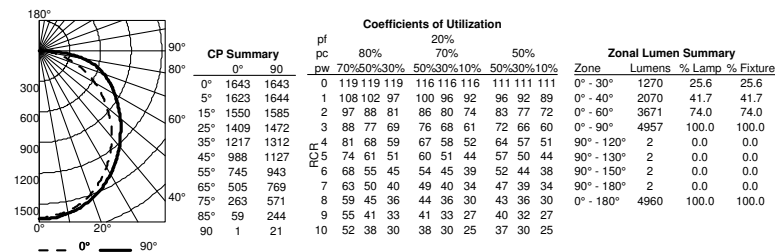


PHOTOMETRICS

2BLT4 40L ADP LP835, 4000 delivered lumens, test no. ISF36900P109, tested in accordance to IESNA LM-79



2BLT4 48L ADP LP835, 4960 delivered lumens, test no. ISF 36900P117, tested in accordance to IESNA LM-79



2BLT Volumetric Recessed Lighting 2'x4'

TYPE T1B

Performance Data					
Model Number	Lumens	LPW	Watts	DLC Listing	DLC ID
2BLT4 30L ADP E21 (G21, G210) LP835 [All Options]	2962	127.31	23.26	Premium	PWJDEMHS
2BLT4 30L ADP E21 (G21, G210) LP840 [All Options]	3009.28	129.34	23.26	Premium	P18J5GLD
2BLT4 30L ADPT E21 (G21, G210) LP840 [All Options]	2969.16	127.62	23.26	Premium	P3HB2XSG
2BLT4 40L ADP E21 (G21, G210) LP835 [All Options]	4000	126.22	31.69	Premium	PDWKYXFD
2BLT4 40L ADP E21 (G21, G210) LP840 [All Options]	4063.86	128.23	31.69	Premium	PEYXAZWD
2BLT4 40L ADPT E21 (G21, G210) LP835 [All Options]	3946.66	124.53	31.69	Premium	P563CPK6
2BLT4 40L ADPT E21 (G21, G210) LP840 [All Options]	4009.67	126.52	31.69	Premium	PK79UR9W
2BLT4 48L ADP E21 (G21, G210) LP835 [All Options]	4960	130.5	38	Premium	PJ9CK6C1
2BLT4 48L ADP E21 (G21, G210) LP840 [All Options]	5039.18	132.58	38	Premium	P9W2R5AK
2BLT4 48L ADPT E21 (G21, G210) LP835 [All Options]	4893.86	128.76	38	Premium	PPFKZU3U
2BLT4 48L ADPT E21 (G21, G210) LP840 [All Options]	4971.99	130.82	38	Premium	PC8HMC9
2BLT4 60L ADP E21 (G21, G210) LP835 [All Options]	6016	126.39	47.59	Premium	PSJ6QERM
2BLT4 60L ADP E21 (G21, G210) LP840 [All Options]	6112.04	128.4	47.59	Premium	PVXQXPVU
2BLT4 60L ADPT E21 (G21, G210) LP835 [All Options]	5935.78	124.7	47.59	Premium	PHT84BW4
2BLT4 60L ADPT E21 (G21, G210) LP840 [All Options]	6030.55	126.69	47.59	Premium	PXV55BC8
2BLT4 72L ADP E21 (G210) LP840 [All Options]	7360.66	125.3	58.74	Premium	P5C222CB
2BLT4 72L ADP G21 LP835 [All Options]	7245	119.07	60.84	standard	PSHTCT5
2BLT4 72L ADP G21 LP840 [All Options]	7360.66	120.97	60.84	standard	PBERALG7
2BLT4 72L ADPT E21 (G21, G210) LP835 [All Options]	7148.4	117.48	60.84	standard	PDQ53CYK
2BLT4 72L ADPT E21 (G210) LP840 [All Options]	7262.52	123.63	58.74	Premium	P2KKMMVN
2BLT4 72L ADPT G21 LP840 [All Options]	7262.52	119.36	60.84	standard	P10DUPC0
2BLT4 85L ADP E21 (G21, G210) LP835 [All Options]	8567	116.43	73.58	standard	PYD2G06V
2BLT4 85L ADP E21 (G21, G210) LP840 [All Options]	8703.77	118.28	73.58	standard	P8Z4IV4X
2BLT4 85L ADPT E21 (G21, G210) LP835 [All Options]	8452.77	114.87	73.58	standard	PTZEW3QM
2BLT4 85L ADPT E21 (G21, G210) LP840 [All Options]	8587.72	116.71	73.58	standard	P01DMEK9
2BLT4 100L ADP E21 (G21, G210) LP835 [All Options]	9837	103.14	95.36	standard	PGDES20R
2BLT4 100L ADP E21 (G21, G210) LP840 [All Options]	9994.04	104.79	95.36	standard	P007CHGX
2BLT4 100L ADPT E21 (G21, G210) LP835 [All Options]	9705.84	101.77	95.36	standard	PSZUQY7M
2BLT4 100L ADPT E21 (G21, G210) LP840 [All Options]	9860.79	103.39	95.36	standard	P6V6X6HY
2BLT4 120L ADP E21 (G21, G210) LP835 [All Options]	11709	118.18	99.07	standard	PGM4Y7DP
2BLT4 120L ADP E21 (G21, G210) LP840 [All Options]	11895.9	120.07	99.07	standard	P00DDCG2
2BLT4 120L ADPT E21 (G21, G210) LP835 [All Options]	11552.9	116.61	99.07	standard	PXMOF509
2BLT4 120L ADPT E21 (G21, G210) LP840 [All Options]	11737.3	118.47	99.07	standard	PJ4GEBZM

DLC information is subject to change, for the most up-to-date information please refer to www.dlc.org. Above listings do not cover 347v or SLD.

How to Estimate Delivered Lumens in Emergency Mode

Use the formula below to estimate the delivered lumens in emergency mode

Delivered Lumens = 1.25 x P x LPW

P = Output power of emergency driver, P = 10W for E10WLCP option.

LPW = Lumen per watt rating of the luminaire. This information is available on the ABL luminaire spec sheet. LPW = Lumen per watt rating of the luminaire. LPW information available in Performance Data section.

HE Performance Data					
Model Number	Lumens	LPW	Watts	DLC Listing	DLC ID
2BLT4 30LHE ADP E21 (G21, G210) LP835 [All Options]	3107	135.17	22.98	Premium	P7KEICW5
2BLT4 30LHE ADP E21 (G21, G210) LP840 [All Options]	3156.6	137.33	22.98	Premium	PD0M06BH
2BLT4 30LHE ADPT E21 (G21, G210) LP835 [All Options]	3065.57	133.37	22.98	Premium	P7PZAJDZ
2BLT4 30LHE ADPT E21 (G21, G210) LP840 [All Options]	3114.51	135.5	22.98	Premium	P2N23EBP
2BLT4 40LHE ADP E21 (G21, G210) LP835 [All Options]	4085	138.56	29.48	Premium	P67P65SY
2BLT4 40LHE ADP E21 (G21, G210) LP840 [All Options]	4150.21	140.77	29.48	Premium	P95UQD66
2BLT4 40LHE ADPT E21 (G21, G210) LP835 [All Options]	4030.53	136.71	29.48	Premium	PC15DQEC
2BLT4 40LHE ADPT E21 (G21, G210) LP840 [All Options]	4094.88	138.89	29.48	Premium	PGRC5J2T
2BLT4 48LHE ADP E21 (G21, G210) LP835 [All Options]	4770	138.16	34.52	Premium	PX8JBG8N
2BLT4 48LHE ADP E21 (G21, G210) LP840 [All Options]	4846.15	140.37	34.52	Premium	P5PQ5RRX
2BLT4 48LHE ADPT E21 (G21, G210) LP835 [All Options]	4706.4	136.32	34.52	Premium	P2NK2H33
2BLT4 48LHE ADPT E21 (G21, G210) LP840 [All Options]	4781.53	138.5	34.52	Premium	PK8C1321
2BLT4 60LHE ADP E21 (G21, G210) LP835 [All Options]	5894	135.12	43.61	Premium	PQZN176R
2BLT4 60LHE ADP E21 (G21, G210) LP840 [All Options]	5988.09	137.28	43.61	Premium	PG5CYJUC
2BLT4 60LHE ADPT E21 (G21, G210) LP835 [All Options]	5815.41	133.32	43.61	Premium	PZ72TAWM
2BLT4 60LHE ADPT E21 (G21, G210) LP840 [All Options]	5908.25	135.45	43.61	Premium	PRC4W72B
2BLT4 72LHE ADP E21 (G21, G210) LP835 [All Options]	7149	135.94	52.58	Premium	PUB38GEQ
2BLT4 72LHE ADP E21 (G21, G210) LP840 [All Options]	7263.13	138.11	52.58	Premium	P7GDH7TN
2BLT4 72LHE ADPT E21 (G21, G210) LP835 [All Options]	7053.68	134.12	52.58	Premium	P5CC2VKV
2BLT4 72LHE ADPT E21 (G21, G210) LP840 [All Options]	7166.29	136.26	52.58	Premium	P6P1BKDM
2BLT4 85LHE ADP E21 (G21, G210) LP835 [All Options]	8158	128.96	63.25	Premium	PRTW6BXW
2BLT4 85LHE ADP E21 (G21, G210) LP840 [All Options]	8288.24	131.02	63.25	Premium	P6H1V2D6
2BLT4 85LHE ADPT E21 (G21, G210) LP835 [All Options]	8049.22	127.24	63.25	Premium	P1VG5TA3
2BLT4 85LHE ADPT E21 (G21, G210) LP840 [All Options]	8177.73	129.27	63.25	Premium	PN5BKJ6E

DLC information is subject to change, for the most up-to-date information please refer to www.dlc.org. Above listings do not cover 347v or SLD.



DIGITAL NAVIGATION

[Ordering Tree](#) [nLight Platform](#) [Sensor Switch JOT](#) [Photometrics](#) [Performance Data](#) [Drawings](#)

FEATURES & SPECIFICATIONS

INTENDED USE — The EPANL Series LED Edge-Lit Flat Panel provides a fully luminous appearance across the face of the lens. This provides a soft, glare-free solution that is visually comfortable within the space. Suitable for many lighting applications including schools, offices and other commercial spaces, retail, convenience stores, hospitals and healthcare facilities. **Certain airborne contaminants can diminish the integrity of acrylic and/or polycarbonate.** [Click here for Acrylic-Polycarbonate Compatibility table for suitable uses.](#)

CONSTRUCTION — Built to last with an aluminum frame for strength and durability, the seamless frame prevents light leak in the corners. The PMMA light guide plate and lens resists yellowing and transmits light with superior efficacy. The satin white lens provides excellent shielding and fully luminous appearance. EPANL's low-profile design provides increased installation flexibility especially in restricted plenum spaces. The back plate includes integral T-bar clips for installation into 15/16" or 9/16" T-grid ceilings. Fixture may be recessed, suspended, surface box mounted or mounted in a hard-ceiling see accessories section for more information. Fixture may be mounted and wired in continuous rows.

Integrated Sensor (nLight Wired Networking): This sensor is nLight-enabled, meaning it has the ability to communicate over an nLight network. When wired, using CAT-5 cabling, with other nLight-enabled sensors, power packs, or WallPods, an nLight control zone is created. Once linked to a Gateway, directly or via a Bridge, the zone becomes capable of remote status monitoring and control via SensorView software.

Integrated Smart Sensor (nLight Air Wireless Platform): The RES7 sensor is nLight AIR enabled, meaning it has the ability to communicate over the wireless nLight control platform. It is available with an automatic dimming photocell, and either a digital PIR or a microphonics (PDT) dual technology occupancy sensor. It pairs to other luminaires and wall switches through our mobile app, CLAIRITY, which allows for simple sensor adjustment

Integrated Wireless Sensor (single room control): Sensor Switch VERTEX JOT or JOTVTX15 luminaire-embedded occupancy and ambient light sensor allows the luminaire to power off when the space is unoccupied or when enough ambient light is entering the space. See page 7 for more details on the integrated wireless sensor.

ELECTRICAL — Long-life LEDs, coupled with a high-efficiency driver, provide superior illumination for extended service life. See page 3 for detailed lumen maintenance information. 0-10V dimming driver, dims to 1% or 10% and contains non-isolated dimming leads.

LISTINGS — CSA Certified to meet US and Canadian standards. Tested to meet UL1958. Intended for indoor use only. Product is not to be stored in non-climate controlled spaces. DesignLights Consortium® (DLC) Premium qualified product and DLC qualified product. Not all versions of this product may be DLC Premium qualified or DLC qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified. Damp location listed. IC rated. IPSX rated. Long nomenclature, configurable product is rated and certified to meet NSF Splash Zone 2. Tested in accordance with ISO 14644-1; suitable for ISO Class 5-9 positive and negative pressure clean rooms. Suitable for ambient temperatures from 32°F (0°C) to 77°F (25°C).

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. Specifications subject to change without notice.

Dimensions

	1x4	2x2	2x4
Length	47.72"	23.70"	47.72"
Width	11.85"	23.70"	23.70"
Depth	2.19"	2.19"	2.19"
Weight	13.9 lbs	7.4 lbs	15.1 lbs

* Base configurations; options may add weight

Catalog
Number

Notes

Type

TYPE T1C

EPANL LED

1'x4', 2'x2', and 2'x4'



Embed nLight controls today. Prepare for tomorrow.

Now

- User-friendly install
- Enhanced energy savings
- Code compliance

Tomorrow

- Scalability
- Space configuration
- Future-ready

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.

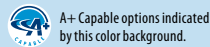
- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® control networks when ordered with drivers marked by a shaded background*
- This luminaire is part of an A+ Certified solution for nLight 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

EPANL LED Flat Panel

TYPE T1C



ORDERING INFORMATION

Example: EPANL 2X4 4000LM 80CRI 35K MIN1 MVOLT E10WCP NLTAIR2 RIO

Series	Width and Length	Lumens	CRI	Color Temperature	Minimum Dimming Level ‡
EPANL LED Flat Panel	1x4 1'x4'	Standard Lumens: 1500LM 1500 Lumens 3000LM 3000 Lumens 4000LM 4000 Lumens 4800LM 4800 Lumens 6000LM 6000 Lumens High Efficiency Lumens: 1500LMHE 1500 Lumens 3000LMHE 3000 Lumens 4000LMHE 4000 Lumens 4800LMHE 4800 Lumens 6000LMHE 6000 Lumens	80CRI 80 CRI	30K 3000K 35K 3500K 40K 4000K 50K 5000K	MIN10 Dims to 10% ‡ MIN1 Dims to 1%
	2x2 2'x2'	2000LM 2000 Lumens 3400LM 3400 Lumens 4000LM 4000 Lumens 4800LM 4800 Lumens			
	2x4 2'x4'	3000LM 3000 Lumens 4000LM 4000 Lumens 4800LM 4800 Lumens 5400LM 5400 Lumens 6000LM 6000 Lumens 6800LM 6800 Lumens 7200LM 7200 Lumens 3000LMHE 3000 Lumens 4000LMHE 4000 Lumens 4800LMHE 4800 Lumens 5400LMHE 5400 Lumens 6000LMHE 6000 Lumens 6800LMHE 6800 Lumens 7200LMHE 7200 Lumens			

Dimming ‡	Voltage	Step Level Dimming	Emergency Option
ZT Generic 0-10V Dimming	MVOLT 120-277V	(Blank) None	E10WCP EM Self-Diagnostic battery pack, 10W Constant Power, Certified in CA Title 20 MAEDBS ‡
EZT eldoLED 0-10V Dimming	120 120V	SLD Step Level Dimming ‡	GTD Generator Transfer Device ‡
DALI eldoLED DALI	277 277V		EMG for use with NLIGHT or NLTAIR2 on generator supply EM power ‡
	347 347V ‡		

INTEGRAL BATTERY PACKS TO BE PROVIDED FOR LUMINAIRES INDICATED AS "EM" ON LIGHTING PLANS

Control Options		
Control Input nLight Wired: NLIGHT nLight enabled, no constant lumen management CL80 NLIGHT nLight enabled, constant lumen output 80% nLight Wireless: NLTAIR2 nLight AIR Generation 2 enabled ‡	Control nLight Wired: ‡ (blank) no control nLight Wireless: RIO nLight AIR Radio module without sensor ‡ RES7 nLight AIR PIR integral occupancy sensor with automatic dimming photocell for Networking Capabilities ‡ RES7PDT nLight air microphonics dual technology occupancy sensor with automatic dimming photocell ‡	Individual Control JOT Wireless room control with "Just One Touch" pairing ‡ JOTVTX15 Wireless occupancy sensor with "Just One Touch" pairing ‡

Options			
GLR	Fast-blowing fuse ‡	PWS1856LV	6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit w/low voltage wires ‡
GMF	Slow-blowing fuse ‡	CP	Chicago plenum ‡
PWS1836	6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit	NPLT	Narrow Pallet
PWS1846	6' pre-wire, 3/8" diameter, 18 gauge, 2 circuit	BDP	Factory Installed Ballast Disconnect Plug
PWS1846 PWSLV	Two cables: one 6' pre-wire, 3/8" diameter, 18 gauge, 2 circuits; one 6' pre-wire, 3/8" diameter, 18 gauge ‡	RRL	RELOC®-ready luminaire ‡

NOTE: ‡ indicates option value has ordering restrictions. Please reference the Option Value Ordering Restrictions chart on the next page. Options are sorted alphanumerically.

ELECTRICAL CONTRACTOR TO DETERMINE APPROPRIATE MOUNTING HARDWARE & ACCESSORIES



EPANL

EPANL LED Flat Panel

TYPE T1C

± Option Value Ordering Restrictions	
Option Value	Restriction
347	Not available with SLD, E10WCP, or GTD options.
Dimming	If Step Level Dimming (SLD) or NLIGHT or NLTAIR2 is specified, leave this section blank.
CP	Not available with nLight wired (NLIGHT), nLight wireless (NLTAIR2).
E10WCP	Refer to Emergency Battery Estimated Lumen section for lumen estimation. Test Switch must be remote mounted or installed in an adjacent ceiling tile. When using pre-wire option, use PWS1846 or PWS1846 PWSLV.
EMG	Requires a connection to existing NLIGHT or NLTAIR2 network. Power is provided from separate nLight enabled fixture.
GLR, GMF	Must specify voltage. 120 or 277, with GLR and GMF fusing.
GTD	Not available with JOT, JOTVTX15, sensor options or emergency battery options. Must specify voltage. Requires BSE labeling, voltage specific. Consult factory for options. Example: GTD BSE10.
JOT, JOTVTX15	Not available with NLIGHT, DALI, SLD, GTD, EMG, or NLTAIR2 options.
MIN10	Not available with EZT, NLIGHT or DALI.
Minimum Dimming Level	If Step Level Dimming (SLD) is specified, leave this section blank.
NLTAIR2	Only available with MIN1 minimum dimming level option.
PWS1846 PWSLV	Not available with GTD, nLight wired, nLight wireless, NLIGHT or NLTAIR2.
PWS1856LV	Not available with nLight wired, nLight wireless, NLIGHT, or NLTAIR2.
RES7EM, RES7PDTEM, RIOEM	See UL924 Sequence of Operation chart on page 4.
RRL	For ordering logic consult RRL_2013.
SLD	Not available with with any nLight Interface, Control options, or GTD. When using prewire option use PWS1846.

Tunable White (Select SKUs Only)

Available SKUs:

*2735H0 EPANL 2X2 TUWH PROR 4800LM 80CRI NLT
 *2735H9 EPANL 2X2 TUWH PROR 4800LM 80CRI NLT PWS1836
 *2735HJ EPANL 2X2 TUWH PROR 4800LM 80CRI NLT E10WCP
 *2735HN EPANL 2X2 TUWH PROR 4800LM 80CRI NLT E10WCP PWS1846

Operating Performance:

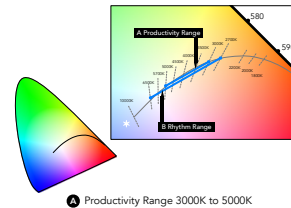
Nomenclature	CCT	Lumens	Efficacy	CRI
EPANL 2X2 TUWH PROR 4800LM 80CRI NLT @ 3000K	3105	4527.53	98.81	80.78
EPANL 2X2 TUWH PROR 4800LM 80CRI NLT @ 4000K	3974	4920.24	127.2	83.85
EPANL 2X2 TUWH PROR 4800LM 80CRI NLT @ 5000K	4925	5004.18	123.41	82.89

Mainstream Dynamic Tunable White with nTune Technology: Tunable white nTune™ is an all-digital light color temperature control within an nLight enabled luminaire. This brings tunable white lighting control into the mainstream with repeatable, consistent results in an economical luminaire form and system already familiar to schools. Designers and facility operators are granted the freedom to tie scenes to specific activities or to complement colors or materials within a visual environment. nTune™ allows color temperature settings through the Productivity Range of 3000K-5000K. Refer to the Programming User's Guide for instructions on customizing to your application with SensorView.



Tunable White GPHD

- **Gamut:** One dimensional Warm-Cool
- **Path:** Direct 3000K to 5000K (Productivity Range)
- **Handle:** Two Natural Language Handles: Intensity and CCT
- **Data:** nLight with nTune technology for both handles of control



Lumen Maintenance:

EPANL	Reported Lumen Maintenance	Forecasted Lumen Maintenance
SE LEDs	L90 @ 41k Hrs / L80 @ >54k Hrs / L70 @ >54k Hrs	L90 @ 41k Hrs / L80 @ 84k Hrs / L70 @ 134k Hrs
HE LEDs	L90 @ 44k Hrs / L80 @ >54k Hrs / L70 @ >54k Hrs	L90 @ 44k Hrs / L80 @ 93k Hrs / L70 @ 148k Hrs



EPANL

EPANL LED Flat Panel

ACCESSORIES

Accessories: Order as separate catalog number.	
DGA14	Drywall grid adapter for 1x4 recessed fixture.
DGA22	Drywall grid adapter for 2x2 recessed fixture.
DGA24	Drywall grid adapter for 2x4 recessed fixture.
PANLEM E10WCP BKT CVR	Field installable kit includes 10 watt battery, bracket and cover ¹
PANLEM BKT CVR	Field installable kit bracket and cover only, 10W battery NOT included ¹
2X2SMKSH	2'x2' Surface Mount Troffer Kit
2X4SMKSH	2'x4' Surface Mount Troffer Kit
1X4SMKSH	1'x4' Surface Mount Troffer Kit
BDP U	Field Installable Ballast Disconnect Plug
PAC 2DNF 36	Panel Air Craft Kit, 2 cables with Y splitter, No Power Feed, 36 inches. Recommended for 1X4 or 2X2 Panel Fixtures only. ²
PAC 2DF 36	Panel Air Craft Kit, 2 cables with Y splitter, with Power Feed, 36 inches. Recommended for 1X4 or 2X2 Panel Fixtures only. ^{2,3}
PAC 4DNF 36	Panel Air Craft Kit, 4 cables, No Power Feed, 36 inches. Recommended for 2X4, 1X4 or 2X2 Panel Fixtures. ²
PAC 4DF 36	Panel Air Craft Kit, 4 cables, with Power Feed, 36 inches. Recommended for 2X4, 1X4 or 2X2 Panel Fixtures. ^{2,3}
PAC 2DNF 72	Panel Air Craft Kit, 2 cables with Y splitter, No Power Feed 72 inches. Recommended for 1X4 or 2X2 Panel Fixtures only. ²
PAC 2DF 72	Panel Air Craft Kit, 2 cables with Y splitter, with Power Feed, 72 inches. Recommended for 1X4 or 2X2 Panel Fixtures only. ^{2,3}
PAC 4DNF 72	Panel Air Craft Kit, 4 cables, No Power Feed, 72 inches. Recommended for 2X4, 1X4 or 2X2 Panel Fixtures. ²
PAC 4DF 72	Panel Air Craft Kit, 4 cables, with Power Feed, 72 inches. Recommended for 2X4, 1X4 or 2X2 Panel Fixtures. ^{2,3}

Emergency Battery Estimated Lumens

Use the formula below to estimate the delivered lumens in emergency mode

$$\text{Estimated Lumens} = 1.25 \times P \times \text{LPW}$$

P = Output power of emergency driver (10W for PS1055CP)

LPW = Lumen per watt rating of the luminaire.

SMKSH Accessory



Notes:

1. Test switch must be remote mounted or installed in an adjacent ceiling tile.
2. See Suspension Kits section below for additional detail.
3. For MVOLT only, not available with 347V

Emergency Battery Pack Options – Field Installable

Battery Model Number	Wattage	Runtime (Minutes)	Lumen Output* @ 120 Lumens/Watt	Other
ILB CP07 2H A	7W	120	840	Storm Shelter / 2 Hour Runtime
ILB CP10 A	10W	90	1200	
ILBLP CP10 HE SD A	10W	90	1200	Title 20, Self Diagnostic
ILBLP CP15 HE SD A	15W	90	1800	Title 20, Self Diagnostic
ILB CP20 HE A	20W	90	2400	Title 20
ILB CP20 HE SD A	20W	90	2400	Title 20, Self Diagnostic

All the above are UL Listed products that are certified for field install external/remote to the fixture.

*Minimum delivered lumen output to assist in product selection for increased fixture mounting height.

The CP10 delivered emergency illumination outperforms legacy 1400 lumen fluorescent emergency ballast.

Please contact us at productsupportemergency@acuitybrands.com for any Emergency Battery related questions.

UL924 Sequence of Operation

For 90 minutes following any complete AC power interruption >200 ms:

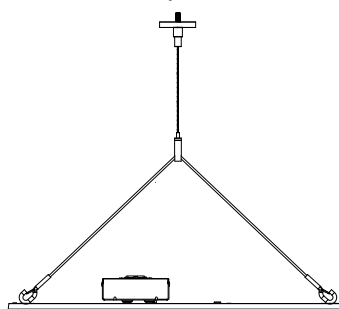
- Digital dimming is commanded to high end trim level.
- Device ignores wireless lighting control commands.

Suspension Kits

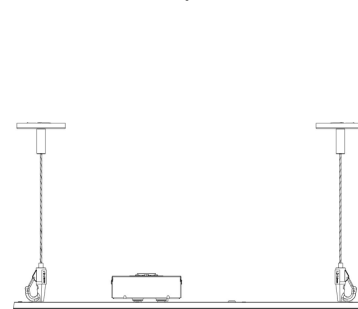
2 drops (1x4)



2 drops (2x2)



4 drops (2x4)



EPANL

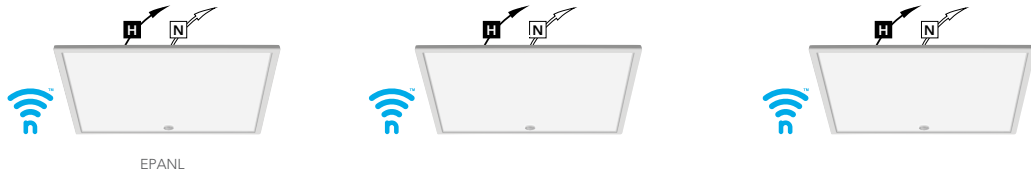
TYPE T1C

EPANL LED Flat Panel

nLight Platform

nLight embedded fixtures offer:	Customers get:
Manual Dimming	Convenience and visual comfort for occupants
Motion Sensing and/or Daylight Harvesting	Energy savings and code compliance
Fixture or Group Level Control	Ability to configure lighting to the space requirements
Flexibility	Ease of fixture moves, adds and changes
Wireless Wall Switch (nLight AIR Only)	Ease and flexibility of placement
Astronomical and Time of Day Scheduling	Energy savings and building security
Scalable Solution	nLight controls to grow with your business
Future-Ready	nLight platform to set foundation for future upgrades and capabilities

nLight Air Wireless

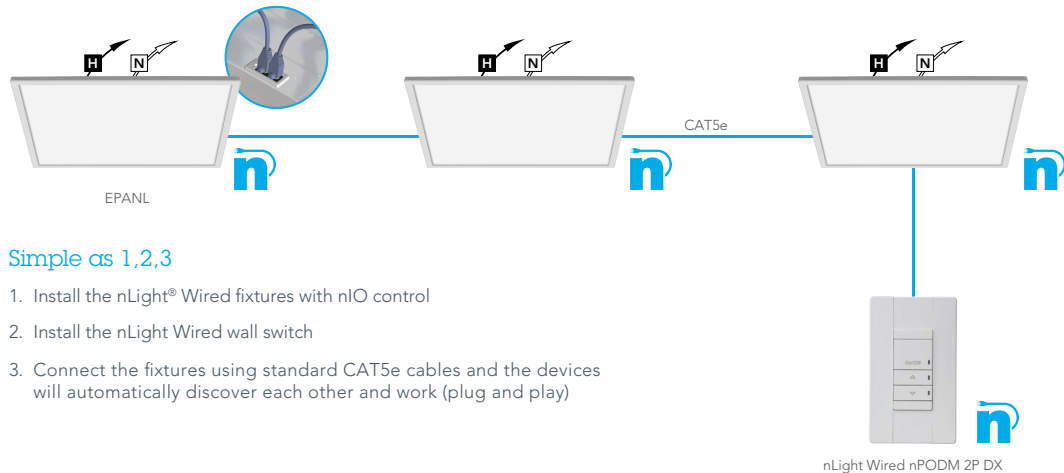


Simple as 1,2,3

1. Install the nLight® AIR fixtures with embedded smart sensor
2. Install the wireless battery-powered wall switch
3. With the CLAIRITY Pro app, pair the fixtures with the wall switch and if desired, customize the sensor settings for the desired outcome



nLight Wired Networking



Simple as 1,2,3

1. Install the nLight® Wired fixtures with nIO control
2. Install the nLight Wired wall switch
3. Connect the fixtures using standard CAT5e cables and the devices will automatically discover each other and work (plug and play)

EPANL LED Flat Panel

TYPE T1C

Controls Accessories

nLight® Wired Control Accessories:

Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlight.

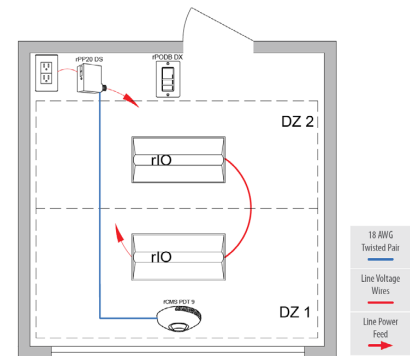
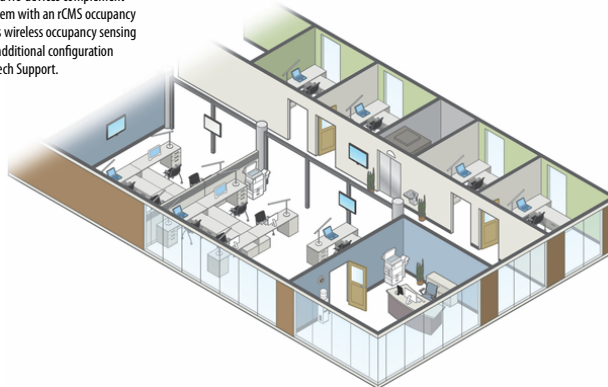
WallPod stations	Model number	Occupancy sensors	Model number
On/Off	nPODMA [Color]	Small motion 360°, ceiling (PIR / dual tech)	nCM 9 RJB / nCM PDT 9 RJB
On/Off & raise/lower	nPODMA DX [Color]	Large motion 360°, ceiling (PIR / dual tech)	nCM10 RJB / nCM PDT 10 RJB
Graphic touchscreen	nPOD TOUCH [Color]	Wall switch with raise/lower	nWSX PDT LV DX [color]
Photo cell controls	Model number	Cat-5 cable (plenum rated)	Model number
Full range dimming	nCM ADCX RJB	10' cable	CATS 10FT J1
		30' cable	CATS 30FT J1

nLight® AIR Control Accessories:

Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlightair.

Wall switches	Model number
On/Off single pole	rPODBA [color] G2
On/Off two pole	rPODB A2P [color] G2
On/Off & raise/lower single pole	rPODBA DX [color] G2
On/Off & raise/lower two pole	rPODBA 2P DX [color] G2

EPANL fixtures with integrated rIO devices complement any small office space. Pair them with an rCMS occupancy sensor and the space now has wireless occupancy sensing and dimming capability. For additional configuration options please consult with Tech Support.



rCMS ¹						Example: RCMS PDT 10 AR G2	
Series / Detection	Power Supply ¹	Occupancy Detection	Lens (Required)	Operating Mode	Generation		
RCMS nLight AIR occupancy and daylight sensor	[blank] Power Supply ordered separately	[blank] PIR Detection PDT Dual Tech PIR/Microphonics	10 Large Motion/ Extended Range 360°	[BLANK] None AR Auxiliary Relay	G2 Generation 2 compatibility		
	PS 150 Standard 150 mA Power Supply		9 Small Motion/ Extended Range 360°				
			6 High Bay 360° Lens				

Notes

¹ RCMS requires low voltage power from either RPP20 DS 24V G2 or PS150.



Sensor Switch
WSX



nLight WIRED
nPOD UNITOUCH



nLight WIRED
nPODMA DX



nLight AIR
rPODBA



EPANL with rES7



rPODBA



RCMS



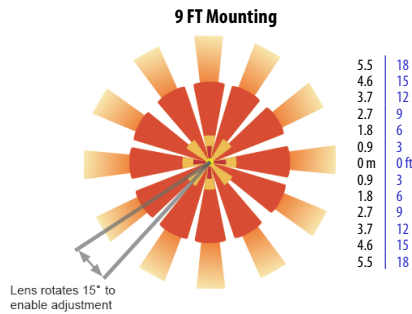
EPANL

EPANL LED Flat Panel

Sensor Coverage Pattern

Mini 360° Lens

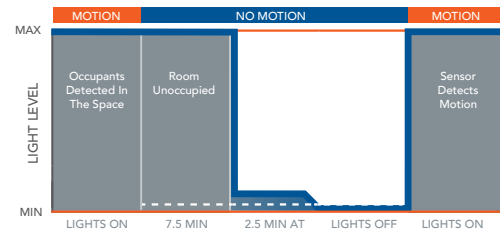
- Recommended for walking motion detection from mounting heights between 8 ft (2.44 m) and 20 ft (6.10 m)
- Initial detection of walking motion along sensor axes at distances of 2x the mounting height up to 15 ft (4.57 m) and
- 1.75x up to 20 ft (6.10 m).
- Provides 12 ft (3.66 m) radial detection of small motion when mounted at 9 ft (2.74 m)
- Initial detection will occur earlier when walking across sensor's field of view than when walking directly at sensor



nLight AIR Wireless

nLight AIR is the ideal solution for retrofit or new construction spaces where adding additional wiring can be labor intensive and nLight AIR is available with or without an integral sensor. The integrated rE57 or rE57PDT smart sensors are part of each luminaire in the nLight AIR network, which can be grouped to control multiple luminaires. The granularity of control with the digital PIR occupancy detection and daylight sensing makes a great solution for any application.

Sequence of Operation (nES7 and Sensor)



*The presetting on the automatic dimming photocell is 10fc (RES7).

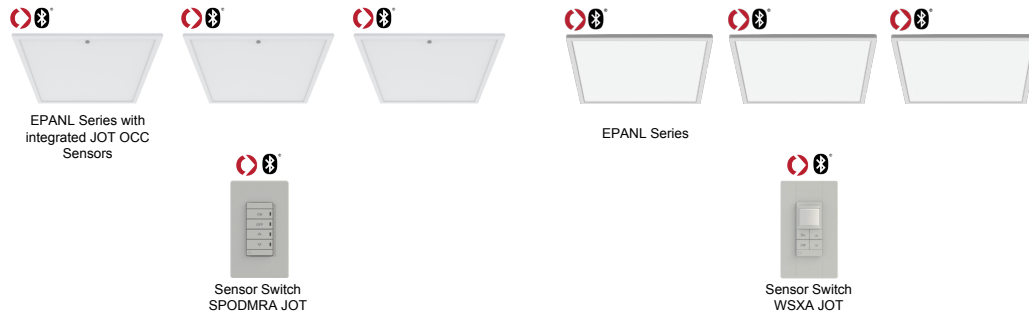
Sensor Switch J0T



Sensor Switch JOT Enabled Wireless Solution

Designed with contractors in mind, the Sensor Switch JOT enabled wireless solution offers a straightforward approach to the installation and pairing of lighting fixtures and controls. Absolutely no 0-10V control wires and no mobile apps are needed with JOT enabled products, allowing for lightning speed installation right out of the box.

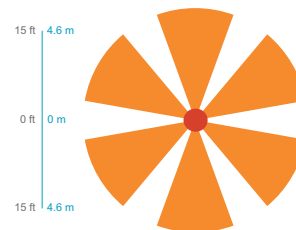
1. **Power:** Install JOT enabled fixtures and controls as instructed.
2. **Pair:** Insert the pairing tool into the pinhole on the wall switch; press and hold any button for 6 seconds.
3. **Play:** Once paired, each fixture will individually dim down to 10% brightness. All products will be fully functional.



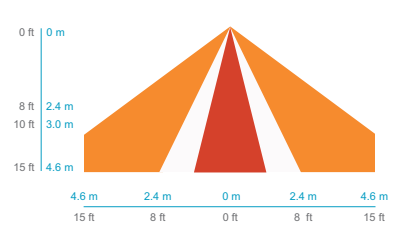
15F - LARGE MOTION EXTENDED RANGE 360

- Optimized full coverage from 8 ft - 15 ft (2.4 m - 4.5 m) mounting heights
- Reliable detection of large motion (e.g. pedestrian walking traffic)
- 1.3 x mounting height equals approximate detection range

TOP VIEW



SIDE VIEW



EPANL

EPANL LED Flat Panel

Performance Data					
Model No.	DLC Classification	Reported Light Output	Reported Wattage	Reported Efficacy (AC)	DLC Product Id
EPANL 1X4 1500LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1511	14	108	P7WQ2HL
EPANL 1X4 1500LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1511	14	108	P7U30VTJ
EPANL 1X4 1500LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1574	14	113	P8VKRLEE
EPANL 1X4 1500LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1574	14	113	P7K7C75SF
EPANL 1X4 1500LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1637	14	117	PJAP0LUK
EPANL 1X4 1500LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1637	14	117	P93PN6HF
EPANL 1X4 1500LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1699	14	122	PJ2LT8RF
EPANL 1X4 1500LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1699	14	122	PMO20WDF
EPANL 1X4 1500LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1419	12	119	P783S2UK
EPANL 1X4 1500LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1419	12	119	P08VAI49
EPANL 1X4 1500LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1457	12	122	PPJ3S90F
EPANL 1X4 1500LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1457	12	122	PKV3IEP
EPANL 1X4 1500LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	1508	12	127	P2590KI9
EPANL 1X4 1500LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	1508	12	127	P66FTD1J
EPANL 1X4 1500LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	1543	12	130	PD3A29J1
EPANL 1X4 1500LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	1543	12	130	PW3538GV
EPANL 1X4 3000LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	2841	27	106	PEYKSSNY
EPANL 1X4 3000LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	2841	27	106	P7W193ZL
EPANL 1X4 3000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	2960	27	110	PBMB5QAS
EPANL 1X4 3000LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	2960	27	110	PT0HAAX5
EPANL 1X4 3000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3078	27	114	PNKUCIA
EPANL 1X4 3000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3078	27	114	PS3ZWBUF
EPANL 1X4 3000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3197	27	119	PMH2SAT
EPANL 1X4 3000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3197	27	119	PFZRHYS
EPANL 1X4 3000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	2771	23	123	PJ1YE30
EPANL 1X4 3000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	2771	23	123	P49S1R0
EPANL 1X4 3000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	2845	23	126	PTUGXVMO
EPANL 1X4 3000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	2845	23	126	P61KCHZV
EPANL 1X4 3000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	2945	23	130	PJYQUJN8
EPANL 1X4 3000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	2945	23	130	PJZRVW5F
EPANL 1X4 3000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3012	23	133	POATZ94T
EPANL 1X4 3000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3012	23	133	PT45WGFZ
EPANL 1X4 4000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	3426	31	111	PSWJLZ98
EPANL 1X4 4000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3963	37	107	P7MFGP4R
EPANL 1X4 4000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3963	37	107	PQHOHMOH
EPANL 1X4 4000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4116	37	111	PY8MM627
EPANL 1X4 4000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4116	37	111	P3XBCGJ0
EPANL 1X4 4000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3667	31	120	PKMNCN1T4
EPANL 1X4 4000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3667	31	120	PDWGL65K
EPANL 1X4 4000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3765	31	123	PJZ17EWI
EPANL 1X4 4000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3765	31	123	P4L0LVRG
EPANL 1X4 4000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3897	31	128	PZGUZR2U
EPANL 1X4 4000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3897	31	128	PY7QZBWI
EPANL 1X4 4000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3985	31	130	PDAKJ8B3
EPANL 1X4 4000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3985	31	130	PELAOSTB
EPANL 1X4 4800LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4633	45	104	PII6VKUP
EPANL 1X4 4800LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4633	45	104	PKJO2BDR
EPANL 1X4 4800LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4807	45	108	P716D3WI
EPANL 1X4 4800LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4807	45	108	PJ87LC64
EPANL 1X4 4800LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4923	45	110	PICJQWGD
EPANL 1X4 4800LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4923	45	110	PZW1PDFZ
EPANL 1X4 4800LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4967	45	111	PQAFPPJ6
EPANL 1X4 4800LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4967	45	111	PCNBZY2M0
EPANL 1X4 4800LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4340	37	117	PU1UIM58
EPANL 1X4 4800LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4340	37	117	PNSWOKZ3
EPANL 1X4 4800LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4456	37	120	P0BHX07V
EPANL 1X4 4800LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4456	37	120	P07FGWK3
EPANL 1X4 4800LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4612	37	124	PHAPQJJS
EPANL 1X4 4800LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4612	37	124	PZ9DDI8L
EPANL 1X4 4800LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4717	37	127	PL0V456F
EPANL 1X4 4800LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4717	37	127	PJIAJOSO
EPANL 1X4 5400LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5156	44	116	PKIBC75K
EPANL 1X4 5400LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5156	44	116	PC2IS9KU
EPANL 1X4 5400LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5272	44	119	PNX0E6ZR
EPANL 1X4 5400LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5272	44	119	PE4NWEQC
EPANL 1X4 5400LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5490	44	124	PF0B5KQD

TYPE T1C

EPANL LED Flat Panel

Performance Data					
Model No.	DLC Classification	Reported Light Output	Reported Wattage	Reported Efficacy (AC)	DLC Product Id
EPANL 1X4 5400LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5490	44	124	PVWWB0JI
EPANL 1X4 5400LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5665	44	128	PEC0GL65
EPANL 1X4 5400LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5665	44	128	P7PAYNFS
EPANL 1X4 6000LM 80CRI 30K [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	5953	55	109	P84A41CZ
EPANL 1X4 6000LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5953	51	117	PL3AU798
EPANL 1X4 6000LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5953	51	117	PCMNH26U
EPANL 1X4 6000LM 80CRI 35K [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	5997	55	110	PWJ6HVP3
EPANL 1X4 6000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5997	51	118	P31GEZNP
EPANL 1X4 6000LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5997	51	118	P9MS2FI2
EPANL 1X4 6000LM 80CRI 40K [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	6171	55	113	PD7JL7CS
EPANL 1X4 6000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	6171	51	121	PEC0ZVXY
EPANL 1X4 6000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	6171	51	121	PRC6VIDH
EPANL 1X4 6000LM 80CRI 50K [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	6240	55	114	P206CKK4
EPANL 1X4 6000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	6240	51	123	PSBGKZ54
EPANL 1X4 6000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	6240	51	123	PEVMDG8B
EPANL 2X2 2000LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1988	19	106	P084CQTR
EPANL 2X2 2000LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1988	19	106	PN6W7230
EPANL 2X2 2000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	2071	19	110	P4AJO61I
EPANL 2X2 2000LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	2071	19	110	P4YZ508D
EPANL 2X2 2000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	2154	19	115	PIQUALNF
EPANL 2X2 2000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	2154	19	115	PULQ3DQ4
EPANL 2X2 2000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	2237	19	119	P167DCJS
EPANL 2X2 2000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	2237	19	119	P1FNCFUQ
EPANL 2X2 2000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1856	16	119	P8MIUS1X
EPANL 2X2 2000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1856	16	119	PRXPVWQJ
EPANL 2X2 2000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1906	16	123	PU253KEZ
EPANL 2X2 2000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1906	16	123	PLNV5ZF6
EPANL 2X2 2000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	1972	16	127	PZSE53JI
EPANL 2X2 2000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	1972	16	127	PZKK2D04
EPANL 2X2 2000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	2017	16	130	PCLAME02
EPANL 2X2 2000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	2017	16	130	PV0MYAQV
EPANL 2X2 3400LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3291	30	109	PNSQ2LMI
EPANL 2X2 3400LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3291	30	109	PU14CBM6
EPANL 2X2 3400LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3428	30	113	PMKTPCS2
EPANL 2X2 3400LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3428	30	113	PB1DW61J
EPANL 2X2 3400LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3566	30	118	PWRHGEH4
EPANL 2X2 3400LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	3566	33	107	PS9YV8OV
EPANL 2X2 3400LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3566	30	118	PG7KB5GU
EPANL 2X2 3400LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3703	30	122	PL6024K5
EPANL 2X2 3400LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3703	30	122	PP79GBQH
EPANL 2X2 3400LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3198	27	121	P25AS4VV
EPANL 2X2 3400LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3198	27	121	PZENR7ML
EPANL 2X2 3400LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3285	27	124	PC28H7F3
EPANL 2X2 3400LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3285	27	124	PGPCX23Z
EPANL 2X2 3400LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3399	27	128	PWGICRAX
EPANL 2X2 3400LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3399	27	128	PZQGNSEP
EPANL 2X2 3400LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3477	27	131	P57KW7H4
EPANL 2X2 3400LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3477	27	131	PDS56JHB
EPANL 2X2 4000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4121	37	110	PSL7HREA
EPANL 2X2 4000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4121	37	110	PP2PR06A
EPANL 2X2 4000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4280	37	114	P94H4XFG
EPANL 2X2 4000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4280	37	114	PFQ0F3LM
EPANL 2X2 4000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3874	33	118	PTN8M36S
EPANL 2X2 4000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3874	33	118	PXW23VVD
EPANL 2X2 4000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3978	33	121	P5661UUU
EPANL 2X2 4000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3978	33	121	PG06EXAT
EPANL 2X2 4000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4117	33	125	PD2JEZV9
EPANL 2X2 4000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4117	33	125	P8BAID21
EPANL 2X2 4000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4211	33	128	P3P7W4AB
EPANL 2X2 4000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4211	33	128	PQCCGU60
EPANL 2X2 4800LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4843	45	109	P00Y8NZ2
EPANL 2X2 4800LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4843	45	109	PB9Y8XNL
EPANL 2X2 4800LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4886	45	110	PW25Y5X9
EPANL 2X2 4800LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4886	45	110	PAAM27H
EPANL 2X2 4800LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4420	36	121	PFYMYFE0
EPANL 2X2 4800LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4420	36	121	PX02EX68
EPANL 2X2 4800LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4539	36	125	PZ0PLMI9
EPANL 2X2 4800LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4539	36	125	PF2L9X2I



EPANL

EPANL LED Flat Panel

Performance Data					
Model No.	DLC Classification	Reported Light Output	Reported Wattage	Reported Efficacy (AC)	DLC Product Id
EPANL 2X2 4800LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4697	36	129	PNQ40WFF
EPANL 2X2 4800LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4697	36	129	P2NS3VB0
EPANL 2X2 4800LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4804	36	132	PG3ZCKUI
EPANL 2X2 4800LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4804	36	132	PND00XI4
EPANL 2X4 3000LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3015	29	106	PGB293WJ
EPANL 2X4 3000LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3015	29	106	PXWRSANS
EPANL 2X4 3000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3141	29	110	PU32L41S
EPANL 2X4 3000LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3141	29	110	PWJKJ91G
EPANL 2X4 3000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3266	29	115	PVIRS0QB
EPANL 2X4 3000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3266	29	115	PP0P99LT
EPANL 2X4 3000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3392	29	119	P4H3UGFQ
EPANL 2X4 3000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3392	29	119	PLI4CPSN
EPANL 2X4 3000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	2943	23	129	PHDEORE3
EPANL 2X4 3000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	2943	23	129	PYUNOTIN
EPANL 2X4 3000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	2986	23	131	P2GQ1ISA
EPANL 2X4 3000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	2986	23	131	PC23010I
EPANL 2X4 3000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3071	23	135	PNWQLGKR
EPANL 2X4 3000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3071	23	135	P3CL956W
EPANL 2X4 3000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3114	23	137	PIIH40FQ
EPANL 2X4 3000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3114	23	137	P609TWNV
EPANL 2X4 3760LMHE 80CRI 40K MIN10 ZT MVOLT NACV	Premium	3984	27	147	PQMBSPAR
EPANL 2X4 4000LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3914	38	104	PLDIMHXG
EPANL 2X4 4000LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3914	38	104	P01K0BJN
EPANL 2X4 4000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4077	38	108	PPTL71HY
EPANL 2X4 4000LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4077	38	108	PRO2E004
EPANL 2X4 4000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4240	38	113	PT1H08CF
EPANL 2X4 4000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4240	38	113	PGSERWDA
EPANL 2X4 4000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4403	38	117	P8TD4A4V
EPANL 2X4 4000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4403	38	117	PTXVJNOI
EPANL 2X4 4000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3874	31	123	P8R62RB3
EPANL 2X4 4000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3874	31	123	P23T82YA
EPANL 2X4 4000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3930	31	125	PIY82204
EPANL 2X4 4000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3930	31	125	PSKVI7RT
EPANL 2X4 4000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4042	31	129	PPU6PYNE
EPANL 2X4 4000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4042	31	129	P9VNDDDS
EPANL 2X4 4000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4098	31	130	PTRH2WMJ
EPANL 2X4 4000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4098	31	130	P55XJ12N
EPANL 2X4 4800LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4817	45	107	PZB2XRG3
EPANL 2X4 4800LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4817	45	107	PHYF1N9C
EPANL 2X4 4800LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4998	45	111	P4PIGUFW
EPANL 2X4 4800LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4998	45	111	PI2A3L85
EPANL 2X4 4800LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5119	45	113	P4SKVRJP
EPANL 2X4 4800LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5119	45	113	P018HM99
EPANL 2X4 4800LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5164	45	114	PG2MHOZE
EPANL 2X4 4800LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	5164	48	107	P70IOAPR
EPANL 2X4 4800LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5164	45	114	PWTSOASQ
EPANL 2X4 4800LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4491	37	120	P3RFGZH6
EPANL 2X4 4800LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4491	37	120	POC36E5U
EPANL 2X4 4800LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4612	37	123	PYK5A8HX
EPANL 2X4 4800LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4612	37	123	PYWZDYOR
EPANL 2X4 4800LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4773	37	127	P47QIRYT
EPANL 2X4 4800LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4773	37	127	PH0QXWON
EPANL 2X4 4800LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4882	37	130	PR3ISII0
EPANL 2X4 4800LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4882	37	130	PKP1XLJT
EPANL 2X4 5000LMHE 80CRI 40K MIN10 ZT MVOLT NACV	Premium	5218	37	141	PL4KIXE5
EPANL 2X4 5400LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5345	49	109	PO568XSR
EPANL 2X4 5400LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5345	49	109	P00696LI
EPANL 2X4 5400LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5546	49	113	PFC1L300
EPANL 2X4 5400LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5546	49	113	PK7Q1VHH
EPANL 2X4 5400LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5679	49	116	PR3K6SHH
EPANL 2X4 5400LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5679	49	116	P8KYWF8W
EPANL 2X4 5400LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5730	49	117	PVKKX9GJ
EPANL 2X4 5400LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5730	49	117	PX1YH6FH
EPANL 2X4 5400LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5302	41	131	P3JOAC0V
EPANL 2X4 5400LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	5302	41	128	PNWXLXM3
EPANL 2X4 5400LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5302	41	131	PARJN9JC
EPANL 2X4 5400LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5421	41	134	P4E4JYPW
EPANL 2X4 5400LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	5421	41	131	PPKAF154

TYPE T1C

EPANL LED Flat Panel

Performance Data					
Model No.	DLC Classification	Reported Light Output	Reported Wattage	Reported Efficacy (AC)	DLC Product Id
EPANL 2X4 5400LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5421	41	134	PBVWKM6
EPANL 2X4 5400LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5645	41	139	PWCONHWW
EPANL 2X4 5400LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	5645	41	137	PZRLJ13L
EPANL 2X4 5400LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5645	41	139	PAHJYVRW
EPANL 2X4 5400LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5825	41	144	PKD67XHY
EPANL 2X4 5400LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	5825	41	141	P36758NK
EPANL 2X4 5400LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5825	41	144	P2LS10S9
EPANL 2X4 5757LMHE 80CRI 40K MIN10 ZT MVOLT NACV	Premium	5776	40	143	P71Q69QD
EPANL 2X4 6000LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6318	50	126	PD2QM1LA
EPANL 2X4 6000LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6318	50	126	P32NF8NU
EPANL 2X4 6000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6364	50	127	PSV30WTC
EPANL 2X4 6000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	6364	55	115	P89SURCD
EPANL 2X4 6000LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6364	50	127	PK0759Q3
EPANL 2X4 6000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6548	50	131	PWWK6LER
EPANL 2X4 6000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6548	50	131	PHICROVH
EPANL 2X4 6000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6622	50	132	PQMLRFRM
EPANL 2X4 6000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6622	50	132	PSF8NN00
EPANL 2X4 6000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5755	43	135	P6JUAFC1
EPANL 2X4 6000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	5755	45	128	PDDV7MOA
EPANL 2X4 6000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5755	43	135	P0181095
EPANL 2X4 6000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5884	43	138	PENZU105
EPANL 2X4 6000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	5884	45	131	PIVHYPP1
EPANL 2X4 6000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5884	43	138	PKFWFCU
EPANL 2X4 6000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6127	43	144	P2GV0FOB
EPANL 2X4 6000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	6127	45	136	PB0A5LE2
EPANL 2X4 6000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6127	43	144	PA04TVD1
EPANL 2X4 6000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6322	43	148	P2ZYBVS5
EPANL 2X4 6000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	6322	45	140	P888TM5U
EPANL 2X4 6000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6322	43	148	PKPSCMGA
EPANL 2X4 6800LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7013	62	113	PW2KT9FQ
EPANL 2X4 6800LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7013	62	113	PBEOWDCQ
EPANL 2X4 6800LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7064	62	114	PW0040LR
EPANL 2X4 6800LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7064	62	114	P7ALFH3K
EPANL 2X4 6800LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7269	62	117	P8FEEBQH
EPANL 2X4 6800LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	7269	65	111	PSLOA6G7
EPANL 2X4 6800LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7269	62	117	PIUM942B
EPANL 2X4 6800LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7351	62	118	PCMKG05N
EPANL 2X4 6800LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7351	62	118	P9AP1VBW
EPANL 2X4 6800LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6450	48	135	PTT9MBX1
EPANL 2X4 6800LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6450	48	135	PNHSDDT2
EPANL 2X4 6800LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6596	48	138	PICAPAMD
EPANL 2X4 6800LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6596	48	138	PHA6TVBP
EPANL 2X4 6800LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6868	48	144	P18UL0J1
EPANL 2X4 6800LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6868	48	144	P7786JMO
EPANL 2X4 6800LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	7086	48	149	PU25XKJQ
EPANL 2X4 6800LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	7086	48	149	PMB46YK
EPANL 2X4 7200LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7388	66	111	P2QK1V0K
EPANL 2X4 7200LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	7388	70	106	PF1518JE
EPANL 2X4 7200LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7388	66	111	P2GTCW3J
EPANL 2X4 7200LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7442	66	112	PCRM0D2R
EPANL 2X4 7200LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	7442	70	107	PKVY7048
EPANL 2X4 7200LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7442	66	112	P41RL2HS
EPANL 2X4 7200LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7657	66	115	PS2AC19A
EPANL 2X4 7200LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	7657	70	110	PBV78YXA
EPANL 2X4 7200LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7657	66	115	PCLJ4VZN
EPANL 2X4 7200LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7744	66	117	PIS28TOX
EPANL 2X4 7200LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	7744	70	111	PSPB7FBG
EPANL 2X4 7200LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7744	66	117	PIRQA8L6
EPANL 2X4 7200LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6792	50	137	PJN0UK7J
EPANL 2X4 7200LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6792	50	137	PW92GBXR
EPANL 2X4 7200LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6945	50	140	PHWEYL0D
EPANL 2X4 7200LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6945	50	140	PXHH12RI
EPANL 2X4 7200LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	7232	50	146	PW3RZAGO
EPANL 2X4 7200LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	7232	50	146	PZY6WXTJ
EPANL 2X4 7200LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	7462	50	151	PPYDM8D6
EPANL 2X4 7200LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	7462	50	151	P7IGKCWE



EPANL

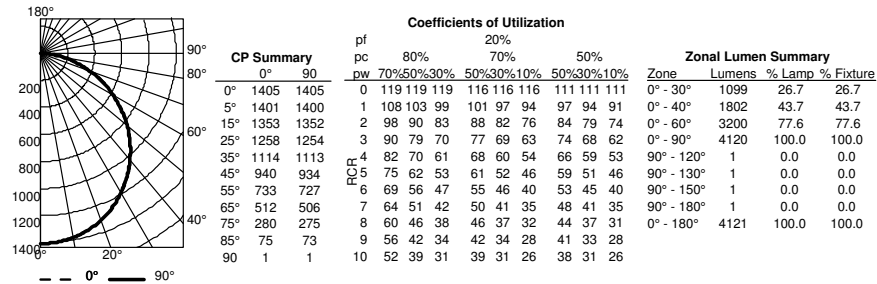
EPANL LED Flat Panel

TYPE T1C

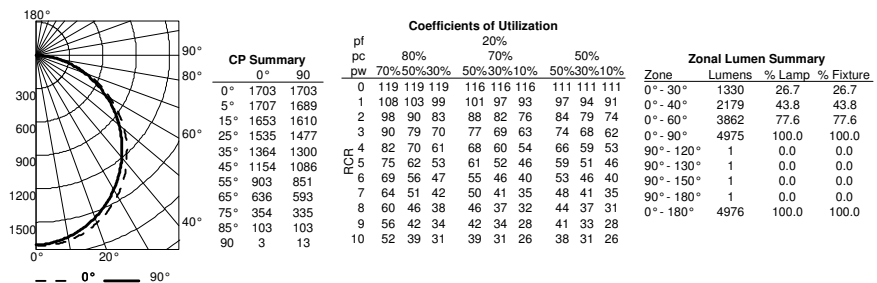
PHOTOMETRICS

Full Photometric data is available on Lithonia.acuitybrands.com

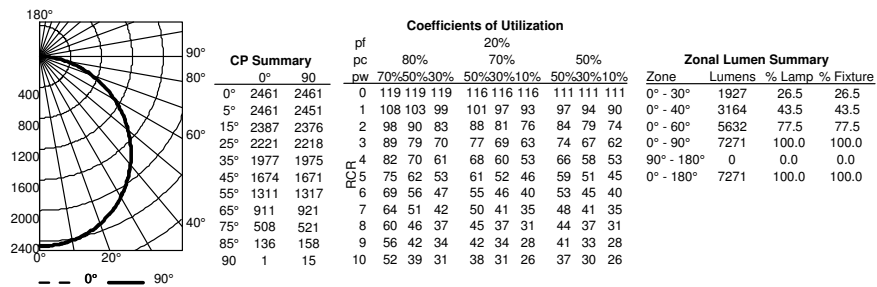
EPANL 2x2 4000LM 80CRI 40K, 4121 delivered lumens.



EPANL 2x4 4800LM 80CRI 40K, 5119 delivered lumens.



EPANL 2x4 6800LM 80CRI 40K, 7269 delivered lumens.

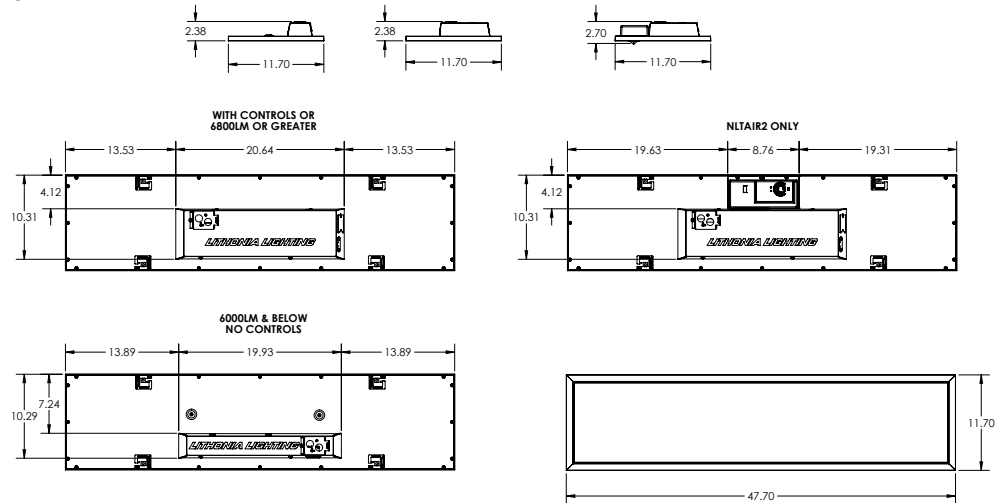


EPANL LED Flat Panel

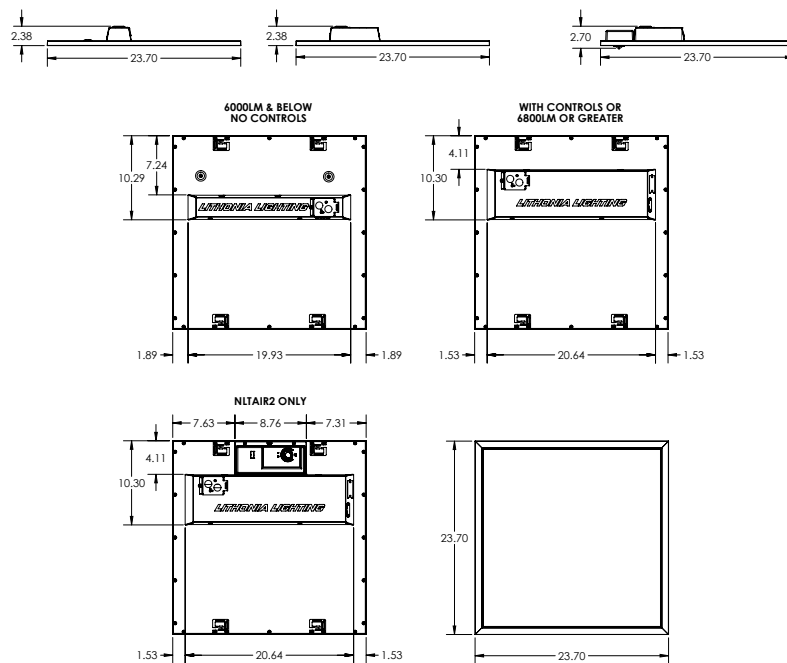
TYPE T1C

DIMENSIONS

1X4 Configurations



2X2 Configurations

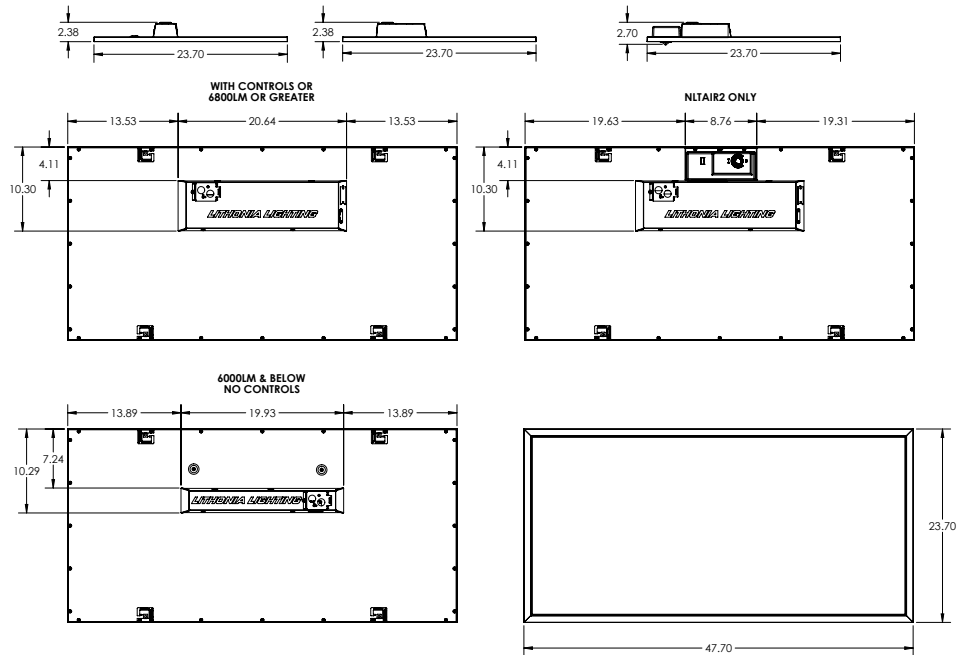


EPANL LED Flat Panel

TYPE T1C

DIMENSIONS (continued)

2X4 Configurations





DIGITAL NAVIGATION

Ordering Tree nLight Platform Sensor Switch JOT Photometrics Performance Data

FEATURES & SPECIFICATIONS

INTENDED USE — The BLT Best-in-Value Low Profile LED luminaire features a popular center basket design that offers a clean, versatile style and volumetric distribution. High efficacy LED light engines deliver energy savings and low maintenance compared to traditional sources. An extensive selection of configurations and options make the BLT the perfect choice for many lighting applications including schools, offices and other commercial spaces, retail, hospitals and healthcare facilities. The low profile BLT design (2-3/8") also makes it an excellent choice for renovation projects.

CONSTRUCTION — Prior to fabrication, BLT components are coated with a proprietary paint blend and die-formed for dimensional consistency.

The BLT reflector is available in both smooth and ribbed finishes. Choose RB from the fixture style section below for a ribbed finish.

End plates contain easy-to-position integral T-bar clips for securely attaching the luminaire to the T-grid. For additional T-grid security, optional screw on T-bar clips are available.

Diffusers are extruded from impact modified acrylic for increased durability.

LED boards and drivers are accessible from the plenum.

OPTICS — Volumetric illumination is achieved by creating an optimal mix of light to walls, partitions and vertical and horizontal work surfaces – rendering the interior space, objects and occupants in a more balanced, complimentary luminous environment. High performance extruded acrylic diffusers conceal LEDs and efficiently deliver light in a volumetric distribution. Four diffuser choices available – curved and square designs with ribbed or a smooth frosted finish.

ELECTRICAL — Long-life LEDs, coupled with high-efficiency drivers, provide superior quantity and quality of illumination for extended service life. 80% LED lumen maintenance at 60,000 hours (L80/60,000). Color Variation within 3-step MacAdam ellipse (3SDCM).

Non-Configurable BLT: Generic 0-10 volt dimming driver. Dims to 10%

Configurable BLT: available in High Efficiency (HE) versions for applications where a lower wattage (over the standard product) is required. The High Efficiency versions deliver >130 LPW and can be specified via the Lumen Package designations in the Ordering Information below.

eldoLED driver options deliver choice of dimming range, and choices for control, while assuring flicker-free, low-current inrush, 89% efficiency and low EMI.

Optional integrated nLight*controls make each luminaire addressable - allowing them to digitally communicate with other nLight enabled controls such as dimmers, switches, occupancy sensors and photocontrols. Connection to nLight is simple. It can be accomplished with integrated nLight AIR wireless r10 and rE57 sensors, or through standard Cat-5 cabling. nLight offers unique plug-and-play convenience as devices and luminaires automatically discover each other and self-commission. nLight AIR is commissioned easily through an intuitive model app.

Lumen Management: Unique lumen management system (option N80) provides on board intelligence that actively manages the LED light source so that constant lumen output is maintained over the system life, preventing the energy waste created by the traditional practice of over-lighting.

Step-level dimming option allows system to be switched to 50% power for compliance with common energy codes while maintaining fixture appearance.

SENSOR — Integrated sensor (individual control): Sensor Switch MSD7ADCX ((Passive infrared (PIR)) or MSDPDT7ADCX ((PIR/Microphonics Dual Tech (PDT))) integrated occupancy sensor/automatic dimming photocell allows the luminaire to power off when the space is unoccupied or enough ambient light is entering the space. See page 4 for more details on the integrated sensor.

Integrated Sensor (nLight Wired Networking): This sensor is nLight-enabled, meaning it has the ability to communicate over an nLight network. When wired, using CAT-5 cabling, with other nLight-enabled sensors, power packs, or WallPods, an nLight control zone is created. Once linked to a Gateway, directly or via a Bridge, the zone becomes capable of remote status monitoring and control via SensorView software. See page 4 for the nLight sensor options.

Integrated Smart Sensor (nLight Air Wireless Platform): The RES7 sensor is nLight AIR enabled, meaning it has the ability to communicate over the wireless nLight control platform. It is available with an automatic dimming photocell, and either a digital PIR or a microphonics (PDT) dual technology occupancy sensor. It pairs to other luminaires and wall switches through our mobile app, CLARITY, which allows for simple sensor adjustment. See page 4 for more details on the Integrated Smart Sensor.

Integrated Wireless Sensor (single room control): Sensor Switch VERTEX JOT or JOTVTX15 luminaire-embedded occupancy and ambient light sensor allows the luminaire to power off when the space is unoccupied or when enough ambient light is entering the space. See page X for more details on the integrated wireless sensor.

INSTALLATION — The BLT's low profile design of only 2-3/8" provides increased installation flexibility especially in restrictive plenum applications. The BLT fits into standard 15/16" and narrow 9/16" T-grid ceiling systems.

Suitable for damp location.

For recessed mounting in hard ceiling applications, Drywall Grid Adapters (DGA) are available as an accessory. See Accessories section.

LISTINGS — CSA Certified to meet U.S. and Canadian standards. IC rated. Tested in accordance with ISO 14644-1; suitable for ISO Class 5-9 positive and negative pressure clean rooms.

DesignLights Consortium® (DLC) Premium qualified product and DLC qualified product. Not all versions of this product may be DLC Premium qualified or DLC qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.

BUY AMERICAN — Product with the BAA option 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. Specifications subject to change without notice.

TYPE T2A

Catalog Number
Notes
Type

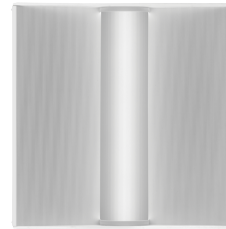
BLT Series LED



ADP Diffuser Option

2BLT2

2' x 2'
LED



Ribbed Reflector Option



Specifications

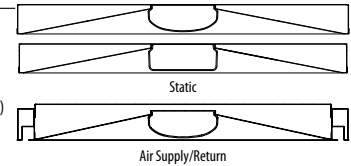
Length: 23-3/4 (60.3)

Width: 23-3/4 (60.3)

Depth: 2-3/8 (6.0)

Depth with Air supply/return: 2-3/4 (6.9)

All dimensions are inches (centimeters) unless otherwise specified.



Embed nLight controls today. Prepare for tomorrow.

Now

- User-friendly install
- Enhanced energy savings
- Code compliance

Tomorrow

- Scalability
- Space configuration
- Future-ready

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

2BLT Volumetric Recessed Lighting 2'x2'

TYPE T2A



A+ Capable options indicated by this color background.

ORDERING INFORMATION

Lead times will vary depending on options selected. Consult with your sales representative.

Example: 2BLT2 33L ADP EZ1 LP835

Series	Fixture Style	Air function	Lumens ‡	Diffuser	Voltage	Driver	Color temperature
2BLT2	2X2 BLT	(blank) Smooth Reflector RB Ribbed Reflector	(blank) Static A Air supply/return ‡	ADP Curved, ribbed ADSM Curved, smooth SDP Square, ribbed SDSM Square, smooth Includes trim rings to match sensed version ADPT Curved, ribbed ADSMT Curved, smooth SDPT Square, ribbed SDSMT Square, smooth	(blank) MVOLT 120 120V 277 277V 347 347V ‡	EZ1 eldoLED dims to 1% (0-10 volt dimming) GZ1 Dims to 1% (0-10V dimming) ‡ GZ10 Dims to 10% (0-10V dimming) ‡ SLD Step-level dimming ‡	LP830 82CRI, 3000 K LP835 82CRI, 3500 K LP840 82CRI, 4000 K LP850 82CRI, 5000 K LP930 90CRI, 3000K LP935 90CRI, 3500K LP940 90CRI, 4000K LP950 90CRI, 5000K

nLight Interface	Control ‡
nLight Wired (blank) no nLight ® interface N80 nLight with 80% lumen management N80EMG nLight with 80% lumen management For use with generator supply EM power ‡ N100 nLight without lumen management N100EMG nLight without lumen management For use with generator supply EM power ‡ nLight Wireless (blank) no nLight ® interface NLTAIR2 nLight AIR Generation 2 enabled ‡	nLight Wired (blank) No sensor control NES7 nLight™ nES 7 PIR integral occupancy sensor ‡ NESPD7 nLight™ nES PDT 7 dual technology integral occupancy control ‡ NES7ADCX nLight™ nES 7 ADCX PIR integral occupancy sensor with automatic dimming photocell ‡ NESPD7ADCX nLight™ nES PDT 7 dual technology integral occupancy sensor with automatic dimming photocell ‡ nLight Wireless RES7 nLight AIR PIR integral occupancy sensor with automatic dimming photocell for Networking Capabilities RES7PDT nLight AIR microphonics dual technology occupancy sensor with automatic dimming photocell RIO nLight AIR radio module without sensor RES7EM nLight AIR PIR integral occupancy sensor with automatic dimming photocell and UL924 Emergency Operation, via power interrupt detection ‡ RES7PDTEM nLight AIR microphonics dual technology occupancy sensor with automatic dimming photocell and UL924 Emergency Operation, via power interrupt detection ‡ RIOEM nLight AIR radio module less sensor, with UL924 Emergency Operation, via power interrupt detection ‡

Standby Mode	Options
NOC NOC Occupancy sensor disabled ‡	BDP Disconnect Plug EL7L 700 lumen battery pack (Noncompliant with CA T20) ‡ EL14L 1400 lumen battery pack (Noncompliant with CA T20) ‡ EL14LSD 1400 lumen battery pack with self-diagnostic testing feature (Noncompliant with CA T20) ‡ E10WLCP EM Self-Diagnostic battery pack 10W Constant Power, Certified in CA Title 20 MAEDBS ‡ CP Chicago plenum ‡ BGTD Bodine Generator Transfer Device ‡ PWS1836 6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit PWS1846 6' pre-wire, 3/8" diameter, 18 gauge, 2 circuit PWS1846 PWSLV Two cables: one 6' pre-wire, 3/8" diameter, 18 gauge, 2 circuits; one 6' pre-wire, 3/8" diameter, 18 gauge ‡ PWS1856LV 6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit w/low voltage wires ‡ GLR Fast-blowing fuse ‡ GMF Slow-blowing fuse ‡ NPLT Narrow pallet RRL RELOC®-ready luminaire ‡ LATC Earthquake clip DWAM Anti-Microbial paint JP28 Job packaging ‡ JP36 Job packaging IPSX Gasketed diffuser compartment to meet IPSX rating ‡ BAA Buy America(n) Act Compliant

NOTE: ‡ indicates option value has ordering restrictions. Please reference the Option Value Ordering Restrictions chart on the next page. Options are sorted alphabetically.

INTEGRAL BATTERY PACKS TO BE PROVIDED FOR LUMINAIRES INDICATED AS "EM" ON LIGHTING PLANS

ELECTRICAL CONTRACTOR TO DETERMINE APPROPRIATE MOUNTING HARDWARE & ACCESSORIES



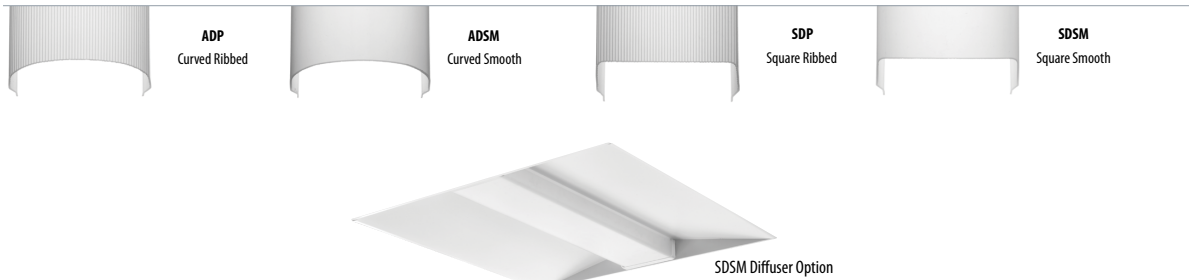
BLT-2X2

TYPE T2A

2BLT Volumetric Recessed Lighting 2'x2'

† Option Value Ordering Restrictions	
Option value	Restriction
347	Not available with SLD, EL7L, EL14L, or E10WLCP options.
A	Not available with RB fixture style, consult factory for air flow data.
BGTD	Not available with JOT, JOTVTX15 sensor options or emergency battery options. Must specify voltage. Requires BSE labeling, voltage specific. Consult factory for options. Example: BGTD BSE10.
Control	Must specify diffuser with trim rings.
CP	Not available with N80, N80EMG, N100, or N100EMG.
GZ1, GZ10	Not available with any Control or Sensor options except JOT & JOTVTX15
EL7L, EL14L, EL14LSD, E10WLCP	When using pre-wire option, use PWS1846 or PWS1846 PWSLV. For more information on the EL14LSD, please see the PSSD2 specification sheet .
GLR, GMF	Must specify voltage. 120 or 277, with GLR and GMF fusing.
IP5X	Not available with air supply/return or Wired Networking (NES_) and Individual Control (MSD_) sensors.
JOT, JOTVTX15	Not available with SLD, nLight, NLTAIR2, NOC, or BGTD options.
JP28	Only available with options: NES7, NESPD7, NES7ADCX, MSD7ADCX, MSDPD7ADCX, RES7, RES7PDT, RIO. Not available when sensor options combined with air supply return option.
Lumens	Approximate lumen output. For high Efficiency, all versions may not achieve 130+ LPW. Refer to photometry on www.acuitybrands.com . Air supply/return option, 90 CRI, and versions with integral sensor trim rings may not achieve 130 LPW.
MSD7ADCX, MSDPD7ADCX	Only available with EZ1 driver option. 0-10v dimming wires not accessible via access plate.
NES7, NESPD7, NES7ADCX, NESPD7ADCX	Requires N80, N80EMG, N100, or N100EMG. Only available with EZ1 driver.
NLTAIR2	Must order with nLight Wireless option from Control section. Only available with EZ1 driver.
NOC	Can only be ordered in conjunction with EZ1, NLTAIR2, RES7/RES7PDT. Occupancy sensor disabled at factory but can be re-enabled upon commissioning.
N80EMG, N100EMG	nLight EMG option requires a connection to existing nLight network. Power is provided from a separate N80 or N100 enabled fixture.
PWS1846 PWSLV, PWS1856LV	Not available with nLIGHT wired network or individual controls
RES7EM, RES7PDTM, RIOEM	See UL924 Sequence of Operation chart on page 3.
RRL_	For ordering logic consult: RRL_2013 .
SLD	Not available with with any nLight Interface or Control options.

Multiple Diffuser Options

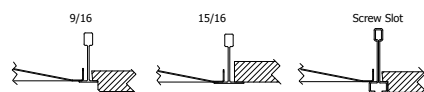


Non-Configurable BLT

Stock/MTO	Catalog Description *	UPC	Lumens	Wattage	LPW	Color Temperature	Voltage	Pallet Qty
Stock	2BLT2 33L ADP LP835	190887529708	3332	26.67	124.92	3500K/82 CRI	120-277	56
	2BLT2 33L ADP LP840	190887529739	3385	26.67	126.91	4000K/82CRI	120-277	56
	2BLT2 33L ADP EL14L LP835	190887529890	3332	26.67	124.92	3500K/82CRI	120-277	56
	2BLT2 33L ADP EL14L LP840	190887529937	3385	26.67	126.91	4000K/82CRI	120-277	56

*Generic 0-10V Dimming to 10%.

MOUNTING DATA	
Ceiling Type	Appropriate Trim Type
Exposed grid tee (1' and 9/16")	G
Concealed grid tee	G
Plaster or plasterboard	G*



*DGA accessory available to provide ceiling trim flange and fixture support for plaster or plasterboard ceiling. Recommended rough-in dimensions for DGA installation is 24-3/4" x 24-3/4" (Tolerance is +1/8", "0").

UL924 Sequence of Operation

For 90 minutes following any complete AC power interruption >200 ms:

- Digital dimming is commanded to high end trim level.
- Device ignores wireless lighting control commands.

2BLT Volumetric Recessed Lighting 2'x2'

Accessories & Replacement Parts

Accessories: Order as separate catalog number.		Replacement Parts: Order as separate catalog number.		
DGA22	Drywall grid adapter for 2x2 recessed fixture	*247WJV	2DBLT24 ADP LENS ASSEMBLY	2 ft. replacement lens
2X2SMKSH PAF	Surface Mount Troffer Kit Post Paint	*249P2P	2DBLT24 SDP LENS ASSEMBLY	2 ft. replacement lens
RK8BDP 2P U	Disconnect Plug (BDP), 2 Pole, Package of 1	*249P2W	2DBLT24 ADSM LENS ASSEMBLY	2 ft. replacement lens
RK8BDP 3P U	Disconnect Plug (BDP), 3 Pole, Package of 1	*249P32	2DBLT24 SDSM LENS ASSEMBLY	2 ft. replacement lens
RK8BDP 2P J10	Disconnect Plug (BDP), 2 Pole, Package of 10	*237LT1	2DBLT24 ADPT LENS ASSEMBLY	2 ft. replacement lens
RK8BDP 2P J40	Disconnect Plug (BDP), 2 Pole, Package of 40	*237LT3	2DBLT24 SDPT LENS ASSEMBLY	2 ft. replacement lens
		*237LT5	2DBLT24 ADSMT LENS ASSEMBLY	2 ft. replacement lens
		*237LT7	2DBLT24 SDSMT LENS ASSEMBLY	2 ft. replacement lens
		*237LT9	2DBLT24 ADPT SENSOR LENS ASSEMBLY	2 ft. replacement lens
		*237M4Y	2DBLT24 SDPT SENSOR LENS ASSEMBLY	2 ft. replacement lens
		*237M57	2DBLT24 ADSMT SENSOR LENS ASSEMBLY	2 ft. replacement lens
		*237M5H	2DBLT24 SDSMT SENSOR LENS ASSEMBLY	2 ft. replacement lens

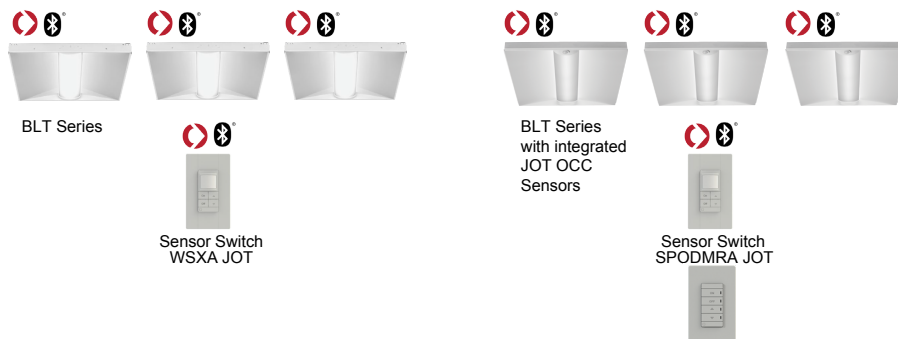
JOT Wireless



Sensor Switch JOT Enabled Wireless Solution

Designed with contractors in mind, the Sensor Switch JOT enabled wireless solution offers a straightforward approach to the installation and pairing of lighting fixtures and controls. Absolutely no 0-10V control wires and no mobile apps are needed with JOT enabled products, allowing for lightning speed installation right out of the box.

- 1. Power:** Install JOT enabled fixtures and controls as instructed.
- 2. Pair:** Insert the pairing tool into the pinhole on the wall switch; press and hold any button for 6 seconds.
- 3. Play:** Once paired, each fixture will individually dim down to 10% brightness. All products will be fully functional.



2BLT Volumetric Recessed Lighting 2'x2'

nLight Platform

nLight embedded fixtures offer:	Customers get:
Manual Dimming	Convenience and visual comfort for occupants
Motion Sensing and/or Daylight Harvesting	Energy savings and code compliance
Fixture or Group Level Control	Ability to configure lighting to the space requirements
Flexibility	Ease of fixture moves, adds and changes
Wireless Wall Switch (nLight AIR Only)	Ease and flexibility of placement
Astronomical and Time of Day Scheduling	Energy savings and building security
Scalable Solution	nLight controls to grow with your business
Future-Ready	nLight platform to set foundation for future upgrades and capabilities

nLight Air Wireless

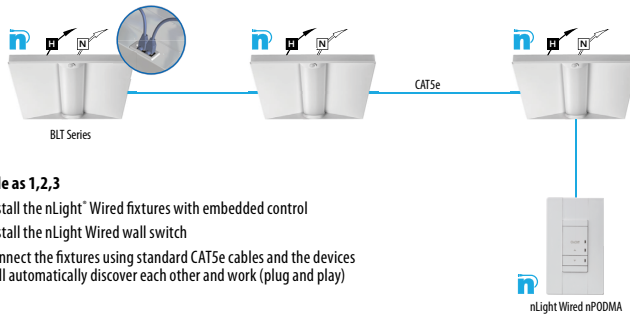


Simple as 1,2,3

1. Install the nLight® AIR fixtures with embedded smart sensor
2. Install the wireless battery-powered wall switch
3. With CLAIRITY app, pair the fixtures with the wall switch and if desired, customize the sensor settings for the desired outcome



nLight Wired Networking



Simple as 1,2,3

1. Install the nLight® Wired fixtures with embedded control
2. Install the nLight Wired wall switch
3. Connect the fixtures using standard CAT5e cables and the devices will automatically discover each other and work (plug and play)

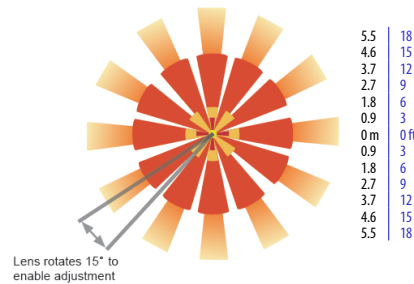
2BLT Volumetric Recessed Lighting 2'x2'

Sensor Options					
Option	Automatic Dimming Photocell	Occupancy Sensing		nLight Wired Networking	nLight AIR Networking
		PIR	PDT		
MSD7ADCX	X	X			
MSDPDT7ADCX	X		X		
NES7		X		X	
NES7ADCX	X	X		X	
NESPDT7			X	X	
NESPDT7ADCX	X		X	X	
RES7	X	X			X
RESPDT7	X	X	X		X

Sensor Coverage Pattern Mini 360° Lens

- Recommended for walking motion detection from mounting heights between 8 ft (2.44 m) and 20 ft (6.10 m)
- Initial detection of walking motion along sensor axes at distances of 2x the mounting height up to 15 ft (4.57 m) and
- 1.75x up to 20 ft (6.10 m).
- Provides 12 ft (3.66 m) radial detection of small motion when mounted at 9 ft (2.74 m)
- Initial detection will occur earlier when walking across sensor's field of view than when walking directly at sensor

9 FT Mounting



Integrated Sensor with Individual Control

The MSD7ADCX PIR occupancy sensor/automatic dimming photocell is ideal for areas without obstructions and where daylight harvesting may be desired. Suggested applications include, but not limited to, hallways, corridors, storage rooms, and breakrooms or other areas where people are typically moving.

The MSDPDT7ADCX PIR/Microphonics Dual Tech occupancy sensor/automatic dimming photocell is ideal for areas with obstructions and where daylight harvesting is desired. Suggested applications include, but not limited to, open offices, private offices, classrooms, public restrooms, and conference rooms.

nLight AIR Wireless

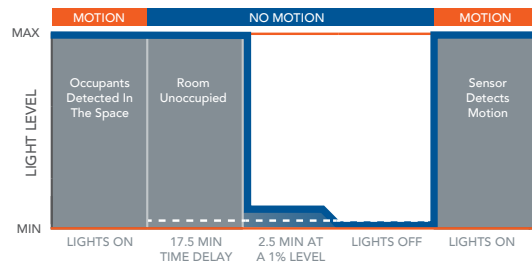
nLight AIR is the ideal solution for retrofit or new construction spaces where adding additional wiring can be labor intensive and nLight AIR is available with or without an integral sensor. The integrated rES7 or rES7PDT smart sensors are part of each luminaire in the nLight AIR network, which can be grouped to control multiple luminaires. The granularity of control with the digital PIR occupancy detection and daylight sensing makes a great solution for any application.

nLight Wired Networking

The nES 7 is ideal for small rooms without obstructions or areas with primarily walking motion. Ideal areas include hallways, corridors, storage rooms, and breakrooms. Additionally, the nES7ADCX includes an integrated photocell, which enables daylight harvesting controls.

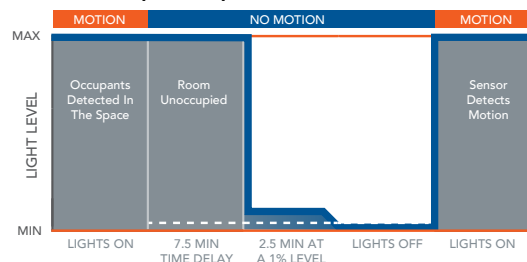
For areas like restrooms, private offices, open offices, conference rooms or any space with obstructions, the nES PDT 7 dual technology sensor is recommended. The nES PDT 7 utilizes both PIR (passive infrared) and Microphonics technologies to detect occupancy. Additionally, the nESPDT7ADCX includes an integrated photocell, which enables daylight harvesting controls which is ideal for areas where windows are present.

Sequence of Operation (MSD7 Sensor)



*The presetting on the automatic dimming photocell is 5fc.

Sequence of Operation (nES7 and rES7 and Sensor)



*The presetting on the automatic dimming photocell is 5fc (NES7) and 10fc (RES7).

2BLT Volumetric Recessed Lighting 2'x2'

Controls Accessories

nLight® Wired Control Accessories:

Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlight.

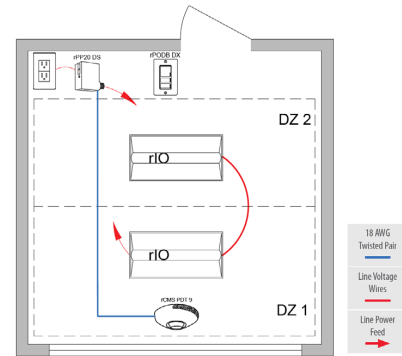
WallPod stations	Model number	Occupancy sensors	Model number
On/Off	nPODMA [Color]	Small motion 360°, ceiling (PIR / dual tech)	nCM 9 RJB / nCM PDT 9 RJB
On/Off & raise/lower	nPODMA DX [Color]	Large motion 360°, ceiling (PIR / dual tech)	nCM10 RJB / nCM PDT 10 RJB
Graphic touchscreen	nPOD TOUCH [Color]	Wall switch with raise/lower	nWSX PDT LV DX [color]
Photocell controls	Model number	Cat-5 cable (plenum rated)	Model number
Full range dimming	nCM ADCX RJB	10' cable	CATS 10FT J1
		30' cable	CATS 30FT J1

nLight® AIR Control Accessories:

Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlightair.

Wall switches	Model number
On/Off single pole	rPODBA [color] G2
On/Off two pole	rPODB A2P [color] G2
On/Off & raise/lower single pole	rPODBA DX [color] G2
On/Off & raise/lower two pole	rPODBA 2P DX [color] G2

BLT fixtures with integrated rIO devices complement any small office space. Pair them with an rCMS occupancy sensor and the space now has wireless occupancy sensing and dimming capability. For additional configuration options please consult with Tech Support.



rCMS ¹				Example: RCMS PDT 10 AR G2		
Series / Detection	Power Supply ¹	Occupancy Detection	Lens (Required)	Operating Mode	Generation	
RCMS nLight AIR occupancy and daylight sensor	[blank] Power Supply ordered separately PS 150 Standard 150 mA Power Supply	[blank] PIR Detection PDT Dual Tech PIR/ Microphonics	10 Large Motion/ Extended Range 360° 9 Small Motion/ Extended Range 360° 6 High Bay 360° Lens	[BLANK] None AR Auxiliary Relay	G2	Generation 2 compatibility

Notes

¹ RCMS requires low voltage power from either RPP20 DS 24V G2 or PS150.



Sensor Switch
WSX



nLight WIRED
nPOD UNITOUCH



nLight WIRED
nPODMA DX



nLight AIR
rPODBA



BLT with rIO



rPODBA

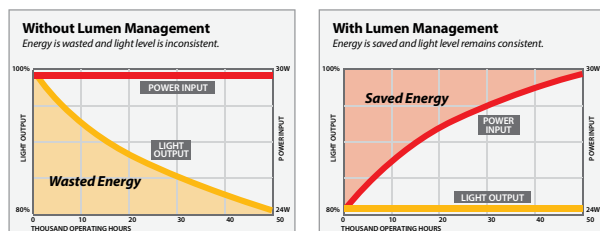


RCMS

2BLT Volumetric Recessed Lighting 2'x2'

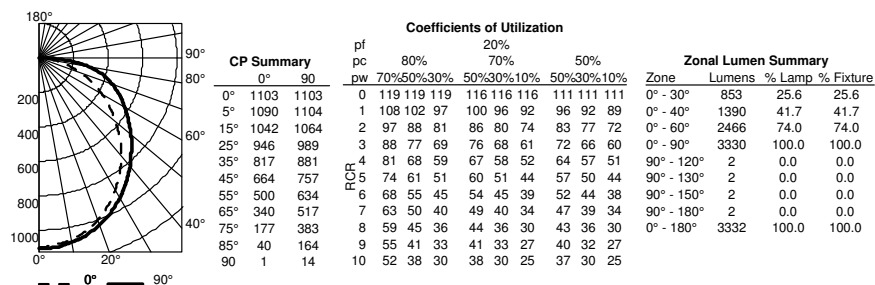
Constant Lumen Management

Enabled by the embedded nLight control, the BLT actively tracks its run-time and manages its light source such that constant lumen output is maintained over the system life. Referred to as lumen management, this feature eliminates the energy waste created by the traditional practice of over-lighting.

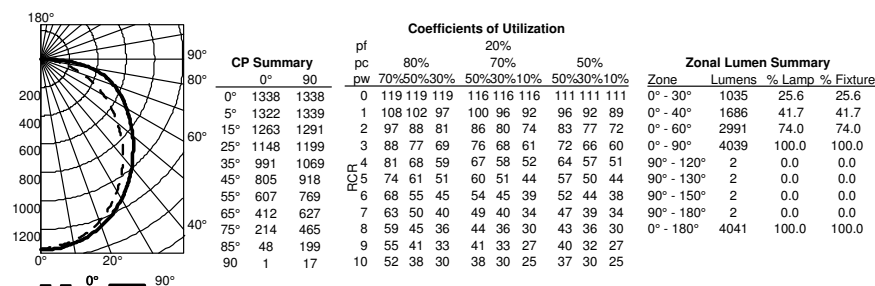


PHOTOMETRICS

2BLT2 33L ADP LP835, 3332 delivered lumens, test no. ISF36900P19, tested in accordance to IESNA LM-79



2BLT2 40L ADP LP835, 4041 delivered lumens, test no. ISF36900P35, tested in accordance to IESNA LM-79



TYPE T2A

2BLT Volumetric Recessed Lighting 2'x2'

Performance Data					
Model Number	Lumens	LPW	Watts	DLC Listing	DLC ID
2BLT2 20L ADP EZ1 (GZ1, GZ10) LP840 [All Options]	2065.45	124.06	16.64	Premium	PM92196A
2BLT2 20L ADP EZ1 (GZ10) LP835 [All Options]	2033	126.58	16.06	Premium	P6445UVD
2BLT2 20L ADP GZ1 LP835 [All Options]	2033	122.11	16.64	standard	PLNK6MX8
2BLT2 20L ADPT EZ1 (GZ10) LP840 [All Options]	2037.91	126.89	16.06	Premium	PYX15QEQ
2BLT2 20L ADPT GZ1 LP835 [All Options]	2005.89	120.49	16.64	standard	P40HQGLB
2BLT2 20L ADPT GZ1 LP840 [All Options]	2037.91	122.41	16.64	standard	PB3HB9AK
2BLT2 33L ADP EZ1 (GZ1, GZ10) LP835 [All Options]	3332	124.92	26.67	Premium	PHSXHE8F
2BLT2 33L ADP EZ1 (GZ1, GZ10) LP840 [All Options]	3385.19	126.91	26.67	Premium	PD18CKQ8
2BLT2 33L ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	3340.05	125.22	26.67	Premium	PF98CZ2H
2BLT2 33L ADPT EZ1 (GZ10) LP835 [All Options]	3287.57	125.14	26.27	Premium	PTKZR9WQ
2BLT2 33L ADPT GZ1 LP835 [All Options]	3287.57	123.25	26.67	standard	PTN5023N
2BLT2 40L ADP EZ1 (GZ1, GZ10) LP835 [All Options]	4041	127.35	31.73	Premium	P1XWW9GV
2BLT2 40L ADP EZ1 (GZ1, GZ10) LP840 [All Options]	4105.51	129.38	31.73	Premium	PHCQ2CQF
2BLT2 40L ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	3987.12	125.65	31.73	Premium	PW6RMMJ4
2BLT2 40L ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	4050.77	127.65	31.73	Premium	PSYYDA8
2BLT2 48L ADP EZ1 (GZ1, GZ10) LP835 [All Options]	4800	109.9	43.67	standard	PJRHR1G
2BLT2 48L ADP EZ1 (GZ1, GZ10) LP840 [All Options]	4876.63	111.66	43.67	standard	P8G93YOK
2BLT2 48L ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	4736	108.44	43.67	standard	PITU3V6X
2BLT2 48L ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	4811.61	110.17	43.67	standard	PSX2XU76

DLC information is subject to change, for the most up-to-date information please refer to www.dlc.org. Above listings do not cover 347v or SLD.

HE Performance Data					
Model Number	Lumens	LPW	Watts	DLC Listing	DLC ID
2BLT2 20LHE ADP EZ1 (GZ1, GZ10) LP835 [All Options]	1948	130.59	14.91	Premium	PUQCZNI
2BLT2 20LHE ADP EZ1 (GZ1, GZ10) LP840 [All Options]	1979.1	132.67	14.91	Premium	PJCZRW21
2BLT2 20LHE ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	1952.71	130.9	14.91	Premium	PLCARF4L
2BLT2 33LHE ADP EZ1 (GZ1, GZ10) LP835 [All Options]	3392	137.3	24.7	Premium	PXXZN9PH
2BLT2 33LHE ADP EZ1 (GZ1, GZ10) LP840 [All Options]	3446.15	139.5	24.7	Premium	PKPIYYRF
2BLT2 33LHE ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	3346.77	135.47	24.7	Premium	PZC8BZSS
2BLT2 33LHE ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	3400.2	137.64	24.7	Premium	PM5G8AFU
2BLT2 40LHE ADP EZ1 (GZ1, GZ10) LP835 [All Options]	4118	133.71	30.79	Premium	PJ55XFFP
2BLT2 40LHE ADP EZ1 (GZ1, GZ10) LP840 [All Options]	4183.74	135.85	30.79	Premium	PEGFPZD
2BLT2 40LHE ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	4063.09	131.93	30.79	Premium	P8E16E9B
2BLT2 40LHE ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	4127.96	134.04	30.79	Premium	PFSSSVG
2BLT2 48LHE ADP EZ1 (GZ1, GZ10) LP835 [All Options]	4845	128	37.85	Premium	P558XUZP
2BLT2 48LHE ADP EZ1 (GZ1, GZ10) LP840 [All Options]	4922.35	130.04	37.85	Premium	P1863H56
2BLT2 48LHE ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	4780.4	126.29	37.85	Premium	PHPTG5M8
2BLT2 48LHE ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	4856.71	128.31	37.85	Premium	PBKN954Z

DLC information is subject to change, for the most up-to-date information please refer to www.dlc.org. Above listings do not cover 347v or SLD.

How to Estimate Delivered Lumens in Emergency Mode

Use the formula below to estimate the delivered lumens in emergency mode

$$\text{Delivered Lumens} = 1.25 \times P \times \text{LPW}$$

P = Output power of emergency driver. P = 10W for E10WLCP option.

LPW = Lumen per watt rating of the luminaire. This information is available on the ABL luminaire spec sheet. LPW = Lumen per watt rating of the luminaire. LPW information available in Performance Data section.



BLT-2X2



DIGITAL NAVIGATION

[Ordering Tree](#) [nLight Platform](#) [Sensor Switch JOT](#) [Photometrics](#) [Performance Data](#)

FEATURES & SPECIFICATIONS

INTENDED USE — The BLT Best-in-Value Low Profile LED luminaire features a popular center basket design that offers a clean, versatile style and volumetric distribution. High efficacy LED light engines deliver energy savings and low maintenance compared to traditional sources. An extensive selection of configurations and options make the BLT the perfect choice for many lighting applications including schools, offices and other commercial spaces, retail, hospitals and healthcare facilities. The low profile BLT design (2-3/8") also makes it an excellent choice for renovation projects.

CONSTRUCTION — Prior to fabrication, BLT components are coated with a proprietary paint blend and die-formed for dimensional consistency.

The BLT reflector is available in both smooth and ribbed finishes. Choose RB from the fixture style section below for a ribbed finish.

End plates contain easy-to-position integral T-bar clips for securely attaching the luminaire to the T-grid. For additional T-grid security, optional screw on T-bar clips are available.

Diffusers are extruded from impact modified acrylic for increased durability.

LED boards and drivers are accessible from the plenum.

OPTICS — Volumetric illumination is achieved by creating an optimal mix of light to walls, partitions and vertical and horizontal work surfaces – rendering the interior space, objects and occupants in a more balanced, complimentary luminous environment. High performance extruded acrylic diffusers conceal LEDs and efficiently deliver light in a volumetric distribution. Four diffuser choices available – curved and square designs with ribbed or a smooth frosted finish.

ELECTRICAL — Long-life LEDs, coupled with high-efficiency drivers, provide superior quantity and quality of illumination for extended service life. 80% LED lumen maintenance at 60,000 hours (L80/60,000). Color Variation within 3-step MacAdam ellipse (3SDCM).

Non-Configurable BLT: Generic 0-10 volt dimming driver. Dims to 10%

Configurable BLT: available in High Efficiency (HE) versions for applications where a lower wattage (over the standard product) is required. The High Efficiency versions deliver >130 LPW and can be specified via the Lumen Package designations in the Ordering Information below.

eldoLED driver options deliver choice of dimming range, and choices for control, while assuring flicker-free, low-current inrush, 89% efficiency and low EMI.

Optional integrated nLight* controls make each luminaire addressable - allowing them to digitally communicate with other nLight enabled controls such as dimmers, switches, occupancy sensors and photocontrols. Connection to nLight is simple. It can be accomplished with integrated nLight AIR wireless r10 and rE57 sensors, or through standard Cat-5 cabling. nLight offers unique plug-and-play convenience as devices and luminaires automatically discover each other and self-commission. nLight AIR is commissioned easily through an intuitive model app.

Lumen Management: Unique lumen management system (option N80) provides on board intelligence that actively manages the LED light source so that constant lumen output is maintained over the system life, preventing the energy waste created by the traditional practice of over-lighting.

Step-level dimming option allows system to be switched to 50% power for compliance with common energy codes while maintaining fixture appearance.

SENSOR — Integrated sensor (individual control): Sensor Switch MSD7ADCX ((Passive infrared (PIR)) or MSDPDT7ADCX ((PIR/Microphonics Dual Tech (PDT))) integrated occupancy sensor/automatic dimming photocell allows the luminaire to power off when the space is unoccupied or enough ambient light is entering the space. See page 4 for more details on the integrated sensor.

Integrated Sensor (nLight Wired Networking): This sensor is nLight-enabled, meaning it has the ability to communicate over an nLight network. When wired, using CAT-5 cabling, with other nLight-enabled sensors, power packs, or WallPods, an nLight control zone is created. Once linked to a Gateway, directly or via a Bridge, the zone becomes capable of remote status monitoring and control via SensorView software. See page 4 for the nLight sensor options.

Integrated Smart Sensor (nLight Air Wireless Platform): The RES7 sensor is nLight AIR enabled, meaning it has the ability to communicate over the wireless nLight control platform. It is available with an automatic dimming photocell, and either a digital PIR or a microphonics (PDT) dual technology occupancy sensor. It pairs to other luminaires and wall switches through our mobile app, CLARITY, which allows for simple sensor adjustment. See page 4 for more details on the Integrated Smart Sensor.

Integrated Wireless Sensor (single room control): Sensor Switch VERTEX JOT or JOTVTX15 luminaire-embedded occupancy and ambient light sensor allows the luminaire to power off when the space is unoccupied or when enough ambient light is entering the space. See page X for more details on the integrated wireless sensor.

INSTALLATION — The BLT's low profile design of only 2-3/8" provides increased installation flexibility especially in restrictive plenum applications. The BLT fits into standard 15/16" and narrow 9/16" T-grid ceiling systems.

Suitable for damp location.

For recessed mounting in hard ceiling applications, Drywall Grid Adapters (DGA) are available as an accessory. See Accessories section.

LISTINGS — CSA Certified to meet U.S. and Canadian standards. IC rated. Tested in accordance with ISO 14644-1; suitable for ISO Class 5-9 positive and negative pressure clean rooms.

Designlights Consortium® (DLC) Premium qualified product and DLC qualified product. Not all versions of this product may be DLC Premium qualified or DLC qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.

BUY AMERICAN — Product with the BAA option 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.

Specifications subject to change without notice.

TYPE T2B

Catalog Number
Notes
Type

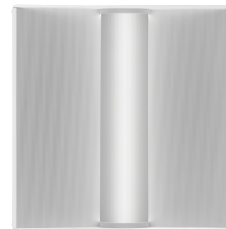
BLT Series LED



ADP Diffuser Option

2BLT2

2' x 2'
LED



Ribbed Reflector Option



Specifications

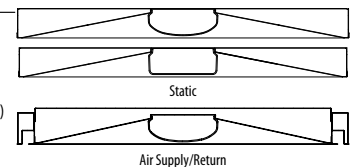
Length: 23-3/4 (60.3)

Width: 23-3/4 (60.3)

Depth: 2-3/8 (6.0)

Depth with Air supply/return: 2-3/4 (6.9)

All dimensions are inches (centimeters) unless otherwise specified.



Embed nLight controls today. Prepare for tomorrow.

Now

- User-friendly install
- Enhanced energy savings
- Code compliance

Tomorrow

- Scalability
- Space configuration
- Future-ready

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

COMMERCIAL INDOOR

BLT-2X2

TYPE T2B

2BLT Volumetric Recessed Lighting 2'x2'



A+ Capable options indicated by this color background.

ORDERING INFORMATION

Lead times will vary depending on options selected. Consult with your sales representative.

Example: 2BLT2 33L ADP EZ1 LP835

Series	Fixture Style	Air function	Lumens ‡		Diffuser	Voltage	Driver	Color temperature
2BLT2	2X2 BLT	(blank) Smooth Reflector RB Ribbed Reflector	(blank) Static A Air supply/return ‡	Standard efficiency ‡ (>125 LPW) 20L 2000 33L 3300 40L 4000 48L 4800 High efficiency ‡ (>130 LPW) 20LHE 2000 33LHE 3300 40LHE 4000 48LHE 4800	ADP Curved, ribbed ADSM Curved, smooth SDP Square, ribbed SDSM Square, smooth Includes trim rings to match sensed version ADPT Curved, ribbed ADSMT Curved, smooth SDPT Square, ribbed SDSMT Square, smooth	(blank) MVOLT 120 120V 277 277V 347 347V ‡	EZ1 eldoLED dims to 1% (0-10 volt dimming) GZ1 Dims to 1% (0-10V dimming) ‡ GZ10 Dims to 10% (0-10V dimming) ‡ SLD Step-level dimming ‡	LP830 82CRI, 3000 K LP835 82CRI, 3500 K LP840 82CRI, 4000 K LP850 82CRI, 5000 K LP930 90CRI, 3000K LP935 90CRI, 3500K LP940 90CRI, 4000K LP950 90CRI, 5000K

nLight Interface	Control ‡
nLight Wired (blank) no nLight ® interface N80 nLight with 80% lumen management N80EMG nLight with 80% lumen management For use with generator supply EM power ‡ N100 nLight without lumen management N100EMG nLight without lumen management For use with generator supply EM power ‡ nLight Wireless (blank) no nLight ® interface NLTAIR2 nLight AIR Generation 2 enabled ‡	nLight Wired (blank) No sensor control NES7 nLight™ nES 7 PIR integral occupancy sensor ‡ NESPD7 nLight™ nES PDT 7 dual technology integral occupancy control ‡ NES7ADCX nLight™ nES 7 ADCX PIR integral occupancy sensor with automatic dimming photocell ‡ NESPD7ADCX nLight™ nES PDT 7 dual technology integral occupancy sensor with automatic dimming photocell ‡ nLight Wireless RES7 nLight AIR PIR integral occupancy sensor with automatic dimming photocell for Networking Capabilities RES7PDT nLight AIR microphonics dual technology occupancy sensor with automatic dimming photocell RIO nLight AIR radio module without sensor RES7EM nLight AIR PIR integral occupancy sensor with automatic dimming photocell and UL924 Emergency Operation, via power interrupt detection ‡ RES7PDTEM nLight AIR microphonics dual technology occupancy sensor with automatic dimming photocell and UL924 Emergency Operation, via power interrupt detection ‡ RIOEM nLight AIR radio module less sensor, with UL924 Emergency Operation, via power interrupt detection ‡

Standy Mode	Options
NOC NOC Occupancy sensor disabled ‡ BDP Disconnect Plug EL7L 700 lumen battery pack (Noncompliant with CA T20) ‡ EL14L 1400 lumen battery pack (Noncompliant with CA T20) ‡ EL14LSD 1400 lumen battery pack with self-diagnostic testing feature (Noncompliant with CA T20) ‡ E10WLCP EM Self-Diagnostic battery pack, 10W Constant Power, Certified in CA Title 20 MAEDBS ‡	CP Chicago plenum ‡ BGTD Bodine Generator Transfer Device ‡ PWS1836 6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit PWS1846 6' pre-wire, 3/8" diameter, 18 gauge, 2 circuit PWS1846 PWSLV Two cables: one 6' pre-wire, 3/8" diameter, 18 gauge, 2 circuits; one 6' pre-wire, 3/8" diameter, 18 gauge ‡ PWS1856LV 6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit w/low voltage wires ‡ GLR Fast-blowing fuse ‡ GMF Slow-blowing fuse ‡ NPLT Narrow pallet RRL RELOC®-ready luminaire ‡ LATC Earthquake clip DWAM Anti-Microbial paint JP28 Job packaging ‡ JP36 Job packaging IPSX Gasketed diffuser compartment to meet IPSX rating ‡ BAA Buy America(n) Act Compliant

NOTE: ‡ indicates option value has ordering restrictions. Please reference the Option Value Ordering Restrictions chart on the next page. Options are sorted alphabetically.

INTEGRAL BATTERY PACKS TO BE PROVIDED FOR LUMINAIRES INDICATED AS "EM" ON LIGHTING PLANS

ELECTRICAL CONTRACTOR TO DETERMINE APPROPRIATE MOUNTING HARDWARE & ACCESSORIES

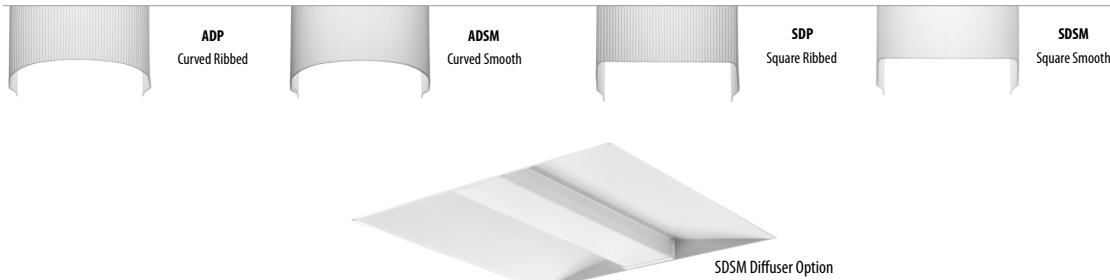


BLT-2X2

2BLT Volumetric Recessed Lighting 2'x2'

† Option Value Ordering Restrictions	
Option value	Restriction
347	Not available with SLD, EL7L, EL14L, or E10WLCP options.
A	Not available with RB fixture style, consult factory for air flow data.
BGTD	Not available with JOT, JOTVTX15 sensor options or emergency battery options. Must specify voltage. Requires BSE labeling, voltage specific. Consult factory for options. Example: BGTD BSE10.
Control	Must specify diffuser with trim rings.
CP	Not available with N80, N80EMG, N100, or N100EMG.
GZ1, GZ10	Not available with any Control or Sensor options except JOT & JOTVTX15
EL7L, EL14L, EL14LSD, E10WLCP	When using pre-wire option, use PWS1846 or PWS1846 PWSLV. For more information on the EL14LSD, please see the PSSD2 specification sheet .
GLR, GMF	Must specify voltage. 120 or 277, with GLR and GMF fusing.
IP5X	Not available with air supply/return or Wired Networking (NES_) and Individual Control (MSD_) sensors.
JOT, JOTVTX15	Not available with SLD, nLight, NLTAIR2, NOC, or BGTD options.
JP28	Only available with options: NES7, NESPD7, NES7ADCX, NESPD7ADCX, MSD7ADCX, MSDPD7ADCX, RES7, RES7PDT, RIO. Not available when sensor options combined with air supply return option.
Lumens	Approximate lumen output. For high Efficiency, all versions may not achieve 130+ LPW. Refer to photometry on www.acuitybrands.com . Air supply/return option, 90 CRI, and versions with integral sensor trim rings may not achieve 130 LPW.
MSD7ADCX, MSDPD7ADCX	Only available with EZ1 driver option. 0-10v dimming wires not accessible via access plate.
NES7, NESPD7, NES7ADCX, NESPD7ADCX	Requires N80, N80EMG, N100, or N100EMG. Only available with EZ1 driver.
NLTAIR2	Must order with nLight Wireless option from Control section. Only available with EZ1 driver.
NOC	Can only be ordered in conjunction with EZ1, NLTAIR2, RES7/RES7PDT. Occupancy sensor disabled at factory but can be re-enabled upon commissioning.
N80EMG, N100EMG	nLight EMG option requires a connection to existing nLight network. Power is provided from a separate N80 or N100 enabled fixture.
PWS1846 PWSLV, PWS1856LV	Not available with nLIGHT wired network or individual controls
RES7EM, RES7PDTM, RIOEM	See UL924 Sequence of Operation chart on page 3.
RRL_	For ordering logic consult: RRL_2013 .
SLD	Not available with with any nLight Interface or Control options.

Multiple Diffuser Options

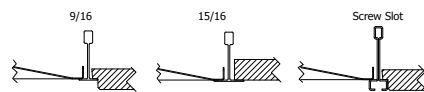


Non-Configurable BLT

Stock/MTO	Catalog Description *	UPC	Lumens	Wattage	LPW	Color Temperature	Voltage	Pallet Qty
Stock	2BLT2 33L ADP LP835	190887529708	3332	26.67	124.92	3500K/82 CRI	120-277	56
	2BLT2 33L ADP LP840	190887529739	3385	26.67	126.91	4000K/82CRI	120-277	56
	2BLT2 33L ADP EL14L LP835	190887529890	3332	26.67	124.92	3500K/82CRI	120-277	56
	2BLT2 33L ADP EL14L LP840	190887529937	3385	26.67	126.91	4000K/82CRI	120-277	56

*Generic 0-10V Dimming to 10%.

MOUNTING DATA	
Ceiling Type	Appropriate Trim Type
Exposed grid tee (1' and 9/16")	G
Concealed grid tee	G
Plaster or plasterboard	G*



*DGA accessory available to provide ceiling trim flange and fixture support for plaster or plasterboard ceiling. Recommended rough-in dimensions for DGA installation is 24-3/4" x 24-3/4" (Tolerance is +1/8", -0").

UL924 Sequence of Operation

For 90 minutes following any complete AC power interruption >200 ms:

- Digital dimming is commanded to high end trim level.
- Device ignores wireless lighting control commands.

2BLT Volumetric Recessed Lighting 2'x2'

Accessories & Replacement Parts

Accessories: Order as separate catalog number.		Replacement Parts: Order as separate catalog number.		
DGA22	Drywall grid adapter for 2x2 recessed fixture	*247WJV	2DBLT24 ADP LENS ASSEMBLY	2 ft. replacement lens
2X2SMKSH PAF	Surface Mount Troffer Kit Post Paint	*249P2P	2DBLT24 SDP LENS ASSEMBLY	2 ft. replacement lens
RK8BDP 2P U	Disconnect Plug (BDP), 2 Pole, Package of 1	*249P2W	2DBLT24 ADSM LENS ASSEMBLY	2 ft. replacement lens
RK8BDP 3P U	Disconnect Plug (BDP), 3 Pole, Package of 1	*249P32	2DBLT24 SDSM LENS ASSEMBLY	2 ft. replacement lens
RK8BDP 2P J10	Disconnect Plug (BDP), 2 Pole, Package of 10	*237LT1	2DBLT24 ADPT LENS ASSEMBLY	2 ft. replacement lens
RK8BDP 2P J40	Disconnect Plug (BDP), 2 Pole, Package of 40	*237LT3	2DBLT24 SDPT LENS ASSEMBLY	2 ft. replacement lens
		*237LT5	2DBLT24 ADSMT LENS ASSEMBLY	2 ft. replacement lens
		*237LT7	2DBLT24 SDSMT LENS ASSEMBLY	2 ft. replacement lens
		*237LT9	2DBLT24 ADPT SENSOR LENS ASSEMBLY	2 ft. replacement lens
		*237M4Y	2DBLT24 SDPT SENSOR LENS ASSEMBLY	2 ft. replacement lens
		*237M57	2DBLT24 ADSMT SENSOR LENS ASSEMBLY	2 ft. replacement lens
		*237M5H	2DBLT24 SDSMT SENSOR LENS ASSEMBLY	2 ft. replacement lens

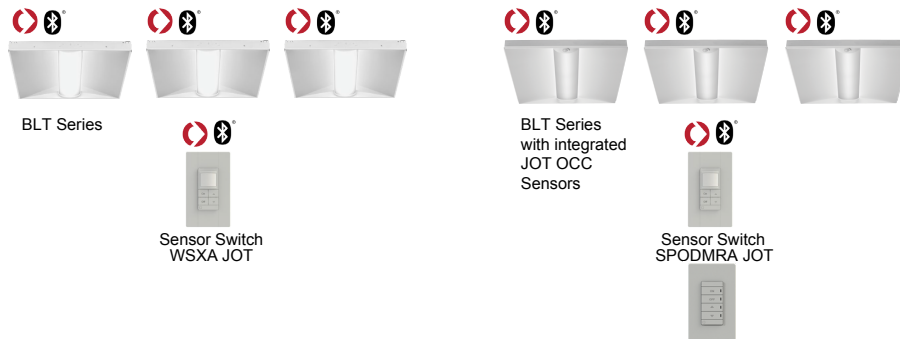
JOT Wireless



Sensor Switch JOT Enabled Wireless Solution

Designed with contractors in mind, the Sensor Switch JOT enabled wireless solution offers a straightforward approach to the installation and pairing of lighting fixtures and controls. Absolutely no 0-10V control wires and no mobile apps are needed with JOT enabled products, allowing for lightning speed installation right out of the box.

- 1. Power:** Install JOT enabled fixtures and controls as instructed.
- 2. Pair:** Insert the pairing tool into the pinhole on the wall switch; press and hold any button for 6 seconds.
- 3. Play:** Once paired, each fixture will individually dim down to 10% brightness. All products will be fully functional.



2BLT Volumetric Recessed Lighting 2'x2'

nLight Platform

nLight embedded fixtures offer:	Customers get:
Manual Dimming	Convenience and visual comfort for occupants
Motion Sensing and/or Daylight Harvesting	Energy savings and code compliance
Fixture or Group Level Control	Ability to configure lighting to the space requirements
Flexibility	Ease of fixture moves, adds and changes
Wireless Wall Switch (nLight AIR Only)	Ease and flexibility of placement
Astronomical and Time of Day Scheduling	Energy savings and building security
Scalable Solution	nLight controls to grow with your business
Future-Ready	nLight platform to set foundation for future upgrades and capabilities

nLight Air Wireless

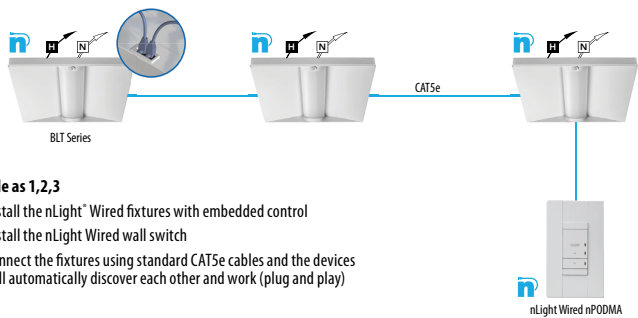


Simple as 1,2,3

1. Install the nLight® AIR fixtures with embedded smart sensor
2. Install the wireless battery-powered wall switch
3. With CLAIRITY app, pair the fixtures with the wall switch and if desired, customize the sensor settings for the desired outcome



nLight Wired Networking



Simple as 1,2,3

1. Install the nLight® Wired fixtures with embedded control
2. Install the nLight Wired wall switch
3. Connect the fixtures using standard CAT5e cables and the devices will automatically discover each other and work (plug and play)

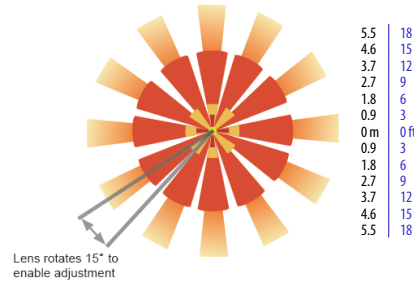
2BLT Volumetric Recessed Lighting 2'x2'

Sensor Options					
Option	Automatic Dimming Photocell	Occupancy Sensing		nLight Wired Networking	nLight AIR Networking
		PIR	PDT		
MSD7ADCX	X	X			
MSDPDT7ADCX	X		X		
NES7		X		X	
NES7ADCX	X	X		X	
NESPD7			X	X	
NESPD7ADCX	X		X	X	
RES7	X	X			X
RESPDT7	X	X	X		X

Sensor Coverage Pattern Mini 360° Lens

- Recommended for walking motion detection from mounting heights between 8 ft (2.44 m) and 20 ft (6.10 m)
- Initial detection of walking motion along sensor axes at distances of 2x the mounting height up to 15 ft (4.57 m) and
- 1.75x up to 20 ft (6.10 m).
- Provides 12 ft (3.66 m) radial detection of small motion when mounted at 9 ft (2.74 m)
- Initial detection will occur earlier when walking across sensor's field of view than when walking directly at sensor

9 FT Mounting



Integrated Sensor with Individual Control

The MSD7ADCX PIR occupancy sensor/automatic dimming photocell is ideal for areas without obstructions and where daylight harvesting may be desired. Suggested applications include, but not limited to, hallways, corridors, storage rooms, and breakrooms or other areas where people are typically moving.

The MSDPDT7ADCX PIR/Microphonics Dual Tech occupancy sensor/automatic dimming photocell is ideal for areas with obstructions and where daylight harvesting is desired. Suggested applications include, but not limited to, open offices, private offices, classrooms, public restrooms, and conference rooms.

nLight AIR Wireless

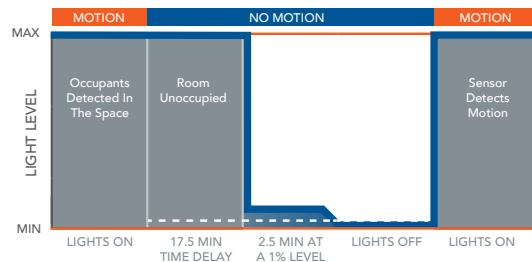
nLight AIR is the ideal solution for retrofit or new construction spaces where adding additional wiring can be labor intensive and nLight AIR is available with or without an integral sensor. The integrated rES7 or rES7PDT smart sensors are part of each luminaire in the nLight AIR network, which can be grouped to control multiple luminaires. The granularity of control with the digital PIR occupancy detection and daylight sensing makes a great solution for any application.

nLight Wired Networking

The nES 7 is ideal for small rooms without obstructions or areas with primarily walking motion. Ideal areas include hallways, corridors, storage rooms, and breakrooms. Additionally, the nES7ADCX includes an integrated photocell, which enables daylight harvesting controls.

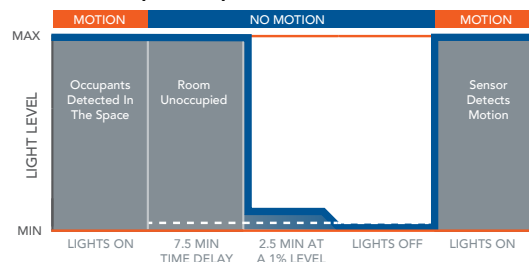
For areas like restrooms, private offices, open offices, conference rooms or any space with obstructions, the nES PDT 7 dual technology sensor is recommended. The nES PDT 7 utilizes both PIR (passive infrared) and Microphonics technologies to detect occupancy. Additionally, the nESPD7ADCX includes an integrated photocell, which enables daylight harvesting controls which is ideal for areas where windows are present.

Sequence of Operation (MSD7 Sensor)



*The presetting on the automatic dimming photocell is 5fc.

Sequence of Operation (nES7 and rES7 and Sensor)



*The presetting on the automatic dimming photocell is 5fc (NES7) and 10fc (RES7).

2BLT Volumetric Recessed Lighting 2'x2'

Controls Accessories

nLight® Wired Control Accessories:

Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlight.

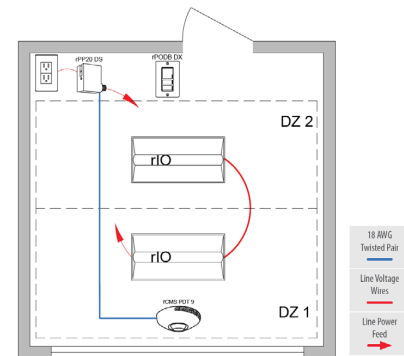
WallPod stations	Model number	Occupancy sensors	Model number
On/Off	nPODMA [Color]	Small motion 360°, ceiling (PIR / dual tech)	nCM 9 RJB / nCM PDT 9 RJB
On/Off & raise/lower	nPODMA DX [Color]	Large motion 360°, ceiling (PIR / dual tech)	nCM10 RJB / nCM PDT 10 RJB
Graphic touchscreen	nPOD TOUCH [Color]	Wall switch with raise/lower	nWSX PDT LV DX [color]
Photocell controls	Model number	Cat-5 cable (plenum rated)	Model number
Full range dimming	nCM ADCX RJB	10' cable	CATS 10FT J1
		30' cable	CATS 30FT J1

nLight® AIR Control Accessories:

Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlightair.

Wall switches	Model number
On/Off single pole	rPODBA [color] G2
On/Off two pole	rPODB A2P [color] G2
On/Off & raise/lower single pole	rPODBA DX [color] G2
On/Off & raise/lower two pole	rPODBA 2P DX [color] G2

BLT fixtures with integrated rIO devices complement any small office space. Pair them with an rCMS occupancy sensor and the space now has wireless occupancy sensing and dimming capability. For additional configuration options please consult with Tech Support.



rCMS ¹				Example: RCMS PDT 10 AR G2		
Series / Detection	Power Supply ¹	Occupancy Detection	Lens (Required)	Operating Mode	Generation	
RCMS nLight AIR occupancy and daylight sensor	[blank] Power Supply ordered separately PS 150 Standard 150 mA Power Supply	[blank] PIR Detection PDT Dual Tech PIR/ Microphonics	10 Large Motion/ Extended Range 360° 9 Small Motion/ Extended Range 360° 6 High Bay 360° Lens	[BLANK] None AR Auxiliary Relay	G2	Generation 2 compatibility

Notes

¹ RCMS requires low voltage power from either RPP20 DS 24V G2 or PS150.



Sensor Switch
WSX



nLight WIRED
nPOD UNITOUCH



nLight WIRED
nPODMA DX



nLight AIR
rPODBA



BLT with rIO



rPODBA

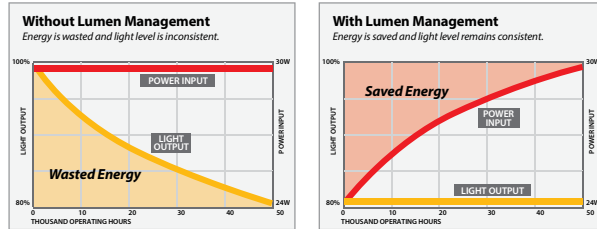


RCMS

2BLT Volumetric Recessed Lighting 2'x2'

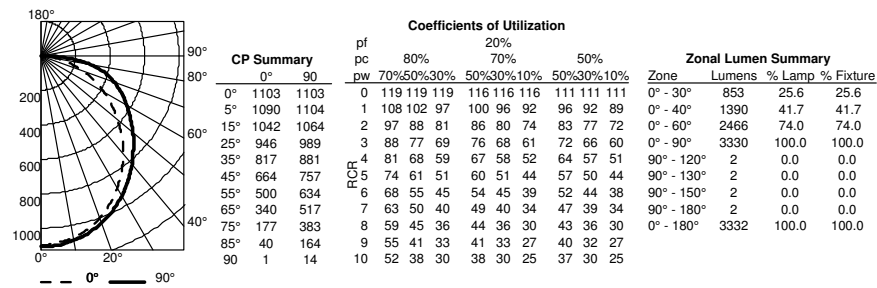
Constant Lumen Management

Enabled by the embedded nLight control, the BLT actively tracks its run-time and manages its light source such that constant lumen output is maintained over the system life. Referred to as lumen management, this feature eliminates the energy waste created by the traditional practice of over-lighting.

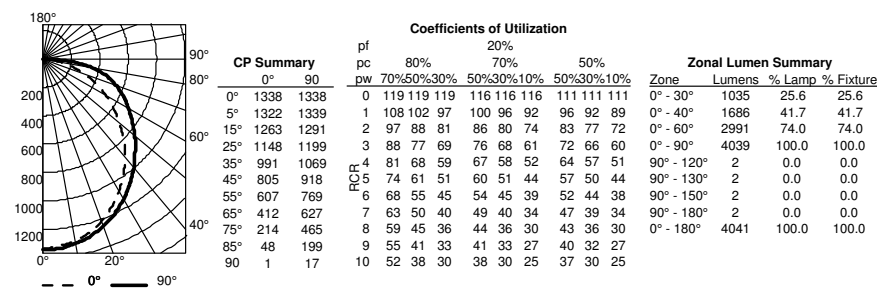


PHOTOMETRICS

2BLT2 33L ADP LP835, 3332 delivered lumens, test no. ISF36900P19, tested in accordance to IESNA LM-79



2BLT2 40L ADP LP835, 4041 delivered lumens, test no. ISF36900P35, tested in accordance to IESNA LM-79



2BLT Volumetric Recessed Lighting 2'x2'

Performance Data					
Model Number	Lumens	LPW	Watts	DLC Listing	DLC ID
2BLT2 20L ADP EZ1 (GZ1, GZ10) LP840 [All Options]	2065.45	124.06	16.64	Premium	PM92196A
2BLT2 20L ADP EZ1 (GZ10) LP835 [All Options]	2033	126.58	16.06	Premium	P6445UVD
2BLT2 20L ADP GZ1 LP835 [All Options]	2033	122.11	16.64	standard	PLNK6MX8
2BLT2 20L ADPT EZ1 (GZ10) LP840 [All Options]	2037.91	126.89	16.06	Premium	PYX15QEQ
2BLT2 20L ADPT GZ1 LP835 [All Options]	2005.89	120.49	16.64	standard	P40HQGLB
2BLT2 20L ADPT GZ1 LP840 [All Options]	2037.91	122.41	16.64	standard	PB3HB9AK
2BLT2 33L ADP EZ1 (GZ1, GZ10) LP835 [All Options]	3332	124.92	26.67	Premium	PHSXHE8F
2BLT2 33L ADP EZ1 (GZ1, GZ10) LP840 [All Options]	3385.19	126.91	26.67	Premium	PD18CKQ8
2BLT2 33L ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	3340.05	125.22	26.67	Premium	PF98CZ2H
2BLT2 33L ADPT EZ1 (GZ10) LP835 [All Options]	3287.57	125.14	26.27	Premium	PTKZR9WQ
2BLT2 33L ADPT GZ1 LP835 [All Options]	3287.57	123.25	26.67	standard	PTN5023N
2BLT2 40L ADP EZ1 (GZ1, GZ10) LP835 [All Options]	4041	127.35	31.73	Premium	P1XWW9GV
2BLT2 40L ADP EZ1 (GZ1, GZ10) LP840 [All Options]	4105.51	129.38	31.73	Premium	PHCQ2CQF
2BLT2 40L ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	3987.12	125.65	31.73	Premium	PW6RMMJ4
2BLT2 40L ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	4050.77	127.65	31.73	Premium	PSYYDA8
2BLT2 48L ADP EZ1 (GZ1, GZ10) LP835 [All Options]	4800	109.9	43.67	standard	PJRHR1R1G
2BLT2 48L ADP EZ1 (GZ1, GZ10) LP840 [All Options]	4876.63	111.66	43.67	standard	P8G93YOK
2BLT2 48L ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	4736	108.44	43.67	standard	PITU3V6X
2BLT2 48L ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	4811.61	110.17	43.67	standard	PSX2XU76

DLC information is subject to change, for the most up-to-date information please refer to www.dlc.org. Above listings do not cover 347v or SLD.

HE Performance Data					
Model Number	Lumens	LPW	Watts	DLC Listing	DLC ID
2BLT2 20LHE ADP EZ1 (GZ1, GZ10) LP835 [All Options]	1948	130.59	14.91	Premium	PUQCZNI
2BLT2 20LHE ADP EZ1 (GZ1, GZ10) LP840 [All Options]	1979.1	132.67	14.91	Premium	PJCZRW21
2BLT2 20LHE ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	1952.71	130.9	14.91	Premium	PLCARF4L
2BLT2 33LHE ADP EZ1 (GZ1, GZ10) LP835 [All Options]	3392	137.3	24.7	Premium	PXXZN9PH
2BLT2 33LHE ADP EZ1 (GZ1, GZ10) LP840 [All Options]	3446.15	139.5	24.7	Premium	PKPIYYRF
2BLT2 33LHE ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	3346.77	135.47	24.7	Premium	PZC8BZSS
2BLT2 33LHE ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	3400.2	137.64	24.7	Premium	PM5G8AFU
2BLT2 40LHE ADP EZ1 (GZ1, GZ10) LP835 [All Options]	4118	133.71	30.79	Premium	PJ55XFFP
2BLT2 40LHE ADP EZ1 (GZ1, GZ10) LP840 [All Options]	4183.74	135.85	30.79	Premium	PEGFHPZD
2BLT2 40LHE ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	4063.09	131.93	30.79	Premium	P8E16E9B
2BLT2 40LHE ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	4127.96	134.04	30.79	Premium	PFSSSSVG
2BLT2 48LHE ADP EZ1 (GZ1, GZ10) LP835 [All Options]	4845	128	37.85	Premium	P558XUZP
2BLT2 48LHE ADP EZ1 (GZ1, GZ10) LP840 [All Options]	4922.35	130.04	37.85	Premium	P1863H56
2BLT2 48LHE ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	4780.4	126.29	37.85	Premium	PHPTG5M8
2BLT2 48LHE ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	4856.71	128.31	37.85	Premium	PBKN954Z

DLC information is subject to change, for the most up-to-date information please refer to www.dlc.org. Above listings do not cover 347v or SLD.

How to Estimate Delivered Lumens in Emergency Mode

Use the formula below to estimate the delivered lumens in emergency mode

$$\text{Delivered Lumens} = 1.25 \times P \times \text{LPW}$$

P = Output power of emergency driver. P = 10W for E10WLCP option.

LPW = Lumen per watt rating of the luminaire. This information is available on the ABL luminaire spec sheet. LPW = Lumen per watt rating of the luminaire. LPW information available in Performance Data section.



DIGITAL NAVIGATION

[Ordering Tree](#) [nLight Platform](#) [Sensor Switch JOT](#) [Photometrics](#) [Performance Data](#) [Drawings](#)

FEATURES & SPECIFICATIONS

INTENDED USE — The EPANL Series LED Edge-Lit Flat Panel provides a fully luminous appearance across the face of the lens. This provides a soft, glare-free solution that is visually comfortable within the space. Suitable for many lighting applications including schools, offices and other commercial spaces, retail, convenience stores, hospitals and healthcare facilities. **Certain airborne contaminants can diminish the integrity of acrylic and/or polycarbonate.** [Click here for Acrylic-Polycarbonate Compatibility table for suitable uses.](#)

CONSTRUCTION — Built to last with an aluminum frame for strength and durability, the seamless frame prevents light leak in the corners. The PMMA light guide plate and lens resists yellowing and transmits light with superior efficacy. The satin white lens provides excellent shielding and fully luminous appearance. EPANL's low-profile design provides increased installation flexibility especially in restricted plenum spaces. The back plate includes integral T-bar clips for installation into 15/16" or 9/16" T-grid ceilings. Fixture may be recessed, suspended, surface box mounted or mounted in a hard-ceiling see accessories section for more information. Fixture may be mounted and wired in continuous rows.

Integrated Sensor (nLight Wired Networking): This sensor is nLight-enabled, meaning it has the ability to communicate over an nLight network. When wired, using CAT-5 cabling, with other nLight-enabled sensors, power packs, or WallPods, an nLight control zone is created. Once linked to a Gateway, directly or via a Bridge, the zone becomes capable of remote status monitoring and control via SensorView software.

Integrated Smart Sensor (nLight Air Wireless Platform): The RES7 sensor is nLight AIR enabled, meaning it has the ability to communicate over the wireless nLight control platform. It is available with an automatic dimming photocell, and either a digital PIR or a microphonics (PDT) dual technology occupancy sensor. It pairs to other luminaires and wall switches through our mobile app, CLAIRITY, which allows for simple sensor adjustment

Integrated Wireless Sensor (single room control): Sensor Switch VERTEX JOT or JOTVTX15 luminaire-embedded occupancy and ambient light sensor allows the luminaire to power off when the space is unoccupied or when enough ambient light is entering the space. See page 7 for more details on the integrated wireless sensor.

ELECTRICAL — Long-life LEDs, coupled with a high-efficiency driver, provide superior illumination for extended service life. See page 3 for detailed lumen maintenance information. 0-10V dimming driver, dims to 1% or 10% and contains non-isolated dimming leads.

LISTINGS — CSA Certified to meet US and Canadian standards. Tested to meet UL1958. Intended for indoor use only. Product is not to be stored in non-climate controlled spaces. DesignLights Consortium® (DLC) Premium qualified product and DLC qualified product. Not all versions of this product may be DLC Premium qualified or DLC qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified. Damp location listed. IC rated. IPSX rated. Long nomenclature, configurable product is rated and certified to meet NSF Splash Zone 2. Tested in accordance with ISO 14644-1; suitable for ISO Class 5-9 positive and negative pressure clean rooms. Suitable for ambient temperatures from 32°F (0°C) to 77°F (25°C).

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. Specifications subject to change without notice.

	Dimensions		
	1x4	2x2	2x4
Length	47.72"	23.70"	47.72"
Width	11.85"	23.70"	23.70"
Depth	2.19"	2.19"	2.19"
Weight	13.9 lbs	7.4 lbs	15.1 lbs

* Base configurations; options may add weight

TYPE T2C

Catalog Number
Notes
Type

EPANL LED

1'x4', 2'x2', and 2'x4'



Embed nLight controls today. Prepare for tomorrow.

Now	Tomorrow
User-friendly install	Scalability
Enhanced energy savings	Space configuration
Code compliance	Future-ready

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.

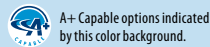
- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® control networks when ordered with drivers marked by a shaded background*
- This luminaire is part of an A+ Certified solution for nLight 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

TYPE T2C

EPANL LED Flat Panel



ORDERING INFORMATION

Example: EPANL 2X4 4000LM 80CRI 35K MIN1 MVOLT E10WCP NLTAIR2 RIO

Series	Width and Length	Lumens	CRI	Color Temperature	Minimum Dimming Level ‡
EPANL LED Flat Panel	1x4 1'x4'	Standard Lumens:	80CRI 80 CRI	30K 3000K 35K 3500K 40K 4000K 50K 5000K	MIN10 Dims to 10% ‡ MIN1 Dims to 1%
		1500LM 1500 Lumens			
		3000LM 3000 Lumens			
		4000LM 4000 Lumens			
		4800LM 4800 Lumens			
		6000LM 6000 Lumens			
	2x2 2'x2'	High Efficiency Lumens:			
		2000LM 2000 Lumens			
		3400LM 3400 Lumens			
		4000LM 4000 Lumens			
	2x4 2'x4'	4800LM 4800 Lumens			
		3000LM 3000 Lumens			
		4000LM 4000 Lumens			
		4800LM 4800 Lumens			
		5400LM 5400 Lumens			
		6000LM 6000 Lumens			
		6800LM 6800 Lumens			
		7200LM 7200 Lumens			

Dimming ‡	Voltage	Step Level Dimming	Emergency Option
ZT Generic 0-10V Dimming	MVOLT 120-277V	(Blank) None	E10WCP EM Self-Diagnostic battery pack, 10W Constant Power, Certified in CA Title 20 MAEDBS ‡
EZT eldoLED 0-10V Dimming	120 120V	SLD Step Level Dimming ‡	GTD Generator Transfer Device ‡
DALI eldoLED DALI	277 277V		EMG for use with NLIGHT or NLTAIR2 on generator supply EM power ‡
	347 347V ‡		

INTEGRAL BATTERY PACKS TO BE PROVIDED FOR LUMINAIRES INDICATED AS "EM" ON LIGHTING PLANS

Control Options		
Control Input	Control	Individual Control
nLight Wired:	nLight Wired: ‡	JOT Wireless room control with "Just One Touch" pairing ‡
NLIGHT nLight enabled, no constant lumen management	(blank) no control	JOTVIX15 Wireless occupancy sensor with "Just One Touch" pairing ‡
CL80 NLIGHT nLight enabled, constant lumen output 80%		
nLight Wireless:	nLight Wireless:	
NLTAIR2 nLight AIR Generation 2 enabled ‡	RIO nLight AIR Radio module without sensor ‡	
	RES7 nLight AIR PIR integral occupancy sensor with automatic dimming photocell for Networking Capabilities ‡	
	RES7PDT nLight air microphonics dual technology occupancy sensor with automatic dimming photocell ‡	

Options	
GLR Fast-blowing fuse ‡	PWS1856LV 6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit w/low voltage wires ‡
GMF Slow-blowing fuse ‡	CP Chicago plenum ‡
PWS1836 6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit	NPLT Narrow Pallet
PWS1846 6' pre-wire, 3/8" diameter, 18 gauge, 2 circuit	BDP Factory Installed Ballast Disconnect Plug
PWS1846 PWSLV Two cables: one 6' pre-wire, 3/8" diameter, 18 gauge, 2 circuits; one 6' pre-wire, 3/8" diameter, 18 gauge ‡	RRL_ RELOC®-ready luminaire ‡

NOTE: ‡ indicates option value has ordering restrictions. Please reference the Option Value Ordering Restrictions chart on the next page. Options are sorted alphanumerically.

ELECTRICAL CONTRACTOR TO DETERMINE APPROPRIATE MOUNTING HARDWARE & ACCESSORIES



EPANL

TYPE T2C

EPANL LED Flat Panel

± Option Value Ordering Restrictions	
Option Value	Restriction
347	Not available with SLD, E10WCP, or GTD options.
Dimming	If Step Level Dimming (SLD) or NLIGHT or NLTAIR2 is specified, leave this section blank.
CP	Not available with nLight wired (NLIGHT), nLight wireless (NLTAIR2).
E10WCP	Refer to Emergency Battery Estimated Lumen section for lumen estimation. Test Switch must be remote mounted or installed in an adjacent ceiling tile. When using pre-wire option, use PWS1846 or PWS1846 PWSLV.
EMG	Requires a connection to existing NLIGHT or NLTAIR2 network. Power is provided from separate nLight enabled fixture.
GLR, GMF	Must specify voltage. 120 or 277, with GLR and GMF fusing.
GTD	Not available with JOT, JOTVTX15, sensor options or emergency battery options. Must specify voltage. Requires BSE labeling, voltage specific. Consult factory for options. Example: GTD BSE10.
JOT, JOTVTX15	Not available with NLIGHT, DALI, SLD, GTD, EMG, or NLTAIR2 options.
MIN10	Not available with EZT, NLIGHT or DALI.
Minimum Dimming Level	If Step Level Dimming (SLD) is specified, leave this section blank.
NLTAIR2	Only available with MIN1 minimum dimming level option.
PWS1846 PWSLV	Not available with GTD, nLight wired, nLight wireless, NLIGHT or NLTAIR2.
PWS1856LV	Not available with nLight wired, nLight wireless, NLIGHT, or NLTAIR2.
RES7EM, RES7PDTEM, RIOEM	See UL924 Sequence of Operation chart on page 4.
RRL	For ordering logic consult RRL_2013.
SLD	Not available with with any nLight Interface, Control options, or GTD. When using prewire option use PWS1846.

Tunable White (Select SKUs Only)

Available SKUs:

*2735H0 EPANL 2X2 TUWH PROR 4800LM 80CRI NLT
 *2735H9 EPANL 2X2 TUWH PROR 4800LM 80CRI NLT PWS1836
 *2735HJ EPANL 2X2 TUWH PROR 4800LM 80CRI NLT E10WCP
 *2735HN EPANL 2X2 TUWH PROR 4800LM 80CRI NLT E10WCP PWS1846

Operating Performance:

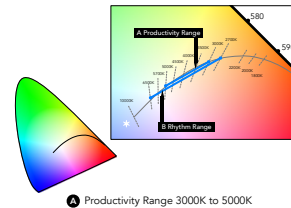
Nomenclature	CCT	Lumens	Efficacy	CRI
EPANL 2X2 TUWH PROR 4800LM 80CRI NLT @ 3000K	3105	4527.53	98.81	80.78
EPANL 2X2 TUWH PROR 4800LM 80CRI NLT @ 4000K	3974	4920.24	127.2	83.85
EPANL 2X2 TUWH PROR 4800LM 80CRI NLT @ 5000K	4925	5004.18	123.41	82.89

Mainstream Dynamic Tunable White with nTune Technology: Tunable white nTune™ is an all-digital light color temperature control within an nLight enabled luminaire. This brings tunable white lighting control into the mainstream with repeatable, consistent results in an economical luminaire form and system already familiar to schools. Designers and facility operators are granted the freedom to tie scenes to specific activities or to complement colors or materials within a visual environment. nTune™ allows color temperature settings through the Productivity Range of 3000K-5000K. Refer to the Programming User's Guide for instructions on customizing to your application with SensorView.



Tunable White GPHD

- Gamut:** One dimensional Warm-Cool
- Path:** Direct 3000K to 5000K (Productivity Range)
- Handle:** Two Natural Language Handles: Intensity and CCT
- Data:** nLight with nTune technology for both handles of control



Lumen Maintenance:

EPANL	Reported Lumen Maintenance	Forecasted Lumen Maintenance
SE LEDs	L90 @ 41k Hrs / L80 @ >54k Hrs / L70 @ >54k Hrs	L90 @ 41k Hrs / L80 @ 84k Hrs / L70 @ 134k Hrs
HE LEDs	L90 @ 44k Hrs / L80 @ >54k Hrs / L70 @ >54k Hrs	L90 @ 44k Hrs / L80 @ 93k Hrs / L70 @ 148k Hrs



EPANL

EPANL LED Flat Panel

ACCESSORIES

Accessories: Order as separate catalog number.	
DGA14	Drywall grid adapter for 1x4 recessed fixture.
DGA22	Drywall grid adapter for 2x2 recessed fixture.
DGA24	Drywall grid adapter for 2x4 recessed fixture.
PANLEM E10WCP BKT CVR	Field installable kit includes 10 watt battery, bracket and cover ¹
PANLEM BKT CVR	Field installable kit bracket and cover only, 10W battery NOT included ¹
2X2SMKSH	2'x2' Surface Mount Troffer Kit
2X4SMKSH	2'x4' Surface Mount Troffer Kit
1X4SMKSH	1'x4' Surface Mount Troffer Kit
BDP U	Field Installable Ballast Disconnect Plug
PAC 2DNF 36	Panel Air Craft Kit, 2 cables with Y splitter, No Power Feed, 36 inches. Recommended for 1X4 or 2X2 Panel Fixtures only. ²
PAC 2DF 36	Panel Air Craft Kit, 2 cables with Y splitter, with Power Feed, 36 inches. Recommended for 1X4 or 2X2 Panel Fixtures only. ^{2,3}
PAC 4DNF 36	Panel Air Craft Kit, 4 cables, No Power Feed, 36 inches. Recommended for 2X4, 1X4 or 2X2 Panel Fixtures. ²
PAC 4DF 36	Panel Air Craft Kit, 4 cables, with Power Feed, 36 inches. Recommended for 2X4, 1X4 or 2X2 Panel Fixtures. ^{2,3}
PAC 2DNF 72	Panel Air Craft Kit, 2 cables with Y splitter, No Power Feed 72 inches. Recommended for 1X4 or 2X2 Panel Fixtures only. ²
PAC 2DF 72	Panel Air Craft Kit, 2 cables with Y splitter, with Power Feed, 72 inches. Recommended for 1X4 or 2X2 Panel Fixtures only. ^{2,3}
PAC 4DNF 72	Panel Air Craft Kit, 4 cables, No Power Feed, 72 inches. Recommended for 2X4, 1X4 or 2X2 Panel Fixtures. ²
PAC 4DF 72	Panel Air Craft Kit, 4 cables, with Power Feed, 72 inches. Recommended for 2X4, 1X4 or 2X2 Panel Fixtures. ^{2,3}

Emergency Battery Estimated Lumens
Use the formula below to estimate the delivered lumens in emergency mode
Estimated Lumens = 1.25 x P x LPW
P = Output power of emergency driver (10W for PS1055CP)
LPW = Lumen per watt rating of the luminaire.

SMKSH Accessory



Notes:

1. Test switch must be remote mounted or installed in an adjacent ceiling tile.
2. See Suspension Kits section below for additional detail.
3. For MVOLT only, not available with 347V

Emergency Battery Pack Options – Field Installable

Battery Model Number	Wattage	Runtime (Minutes)	Lumen Output* @ 120 Lumens/Watt	Other
ILB CP07 2H A	7W	120	840	Storm Shelter / 2 Hour Runtime
ILB CP10 A	10W	90	1200	
ILBLP CP10 HE SD A	10W	90	1200	Title 20, Self Diagnostic
ILBLP CP15 HE SD A	15W	90	1800	Title 20, Self Diagnostic
ILB CP20 HE A	20W	90	2400	Title 20
ILB CP20 HE SD A	20W	90	2400	Title 20, Self Diagnostic

All the above are UL Listed products that are certified for field install external/remote to the fixture.

*Minimum delivered lumen output to assist in product selection for increased fixture mounting height.

The CP10 delivered emergency illumination outperforms legacy 1400 lumen fluorescent emergency ballast.

Please contact us at productsupportemergency@acuitybrands.com for any Emergency Battery related questions.

UL924 Sequence of Operation

For 90 minutes following any complete AC power interruption >200 ms:

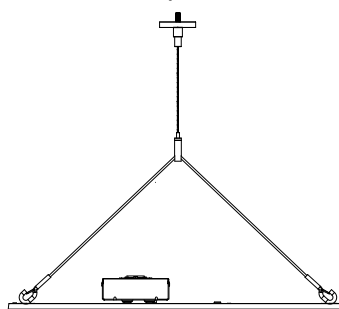
- Digital dimming is commanded to high end trim level.
- Device ignores wireless lighting control commands.

Suspension Kits

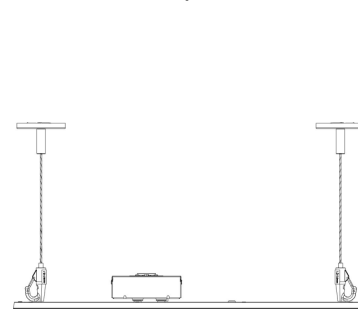
2 drops (1x4)



2 drops (2x2)



4 drops (2x4)



EPANL

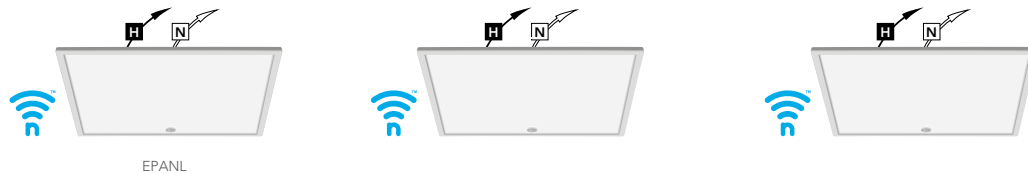
TYPE T2C

EPANL LED Flat Panel

nLight Platform

nLight embedded fixtures offer:	Customers get:
Manual Dimming	Convenience and visual comfort for occupants
Motion Sensing and/or Daylight Harvesting	Energy savings and code compliance
Fixture or Group Level Control	Ability to configure lighting to the space requirements
Flexibility	Ease of fixture moves, adds and changes
Wireless Wall Switch (nLight AIR Only)	Ease and flexibility of placement
Astronomical and Time of Day Scheduling	Energy savings and building security
Scalable Solution	nLight controls to grow with your business
Future-Ready	nLight platform to set foundation for future upgrades and capabilities

nLight Air Wireless

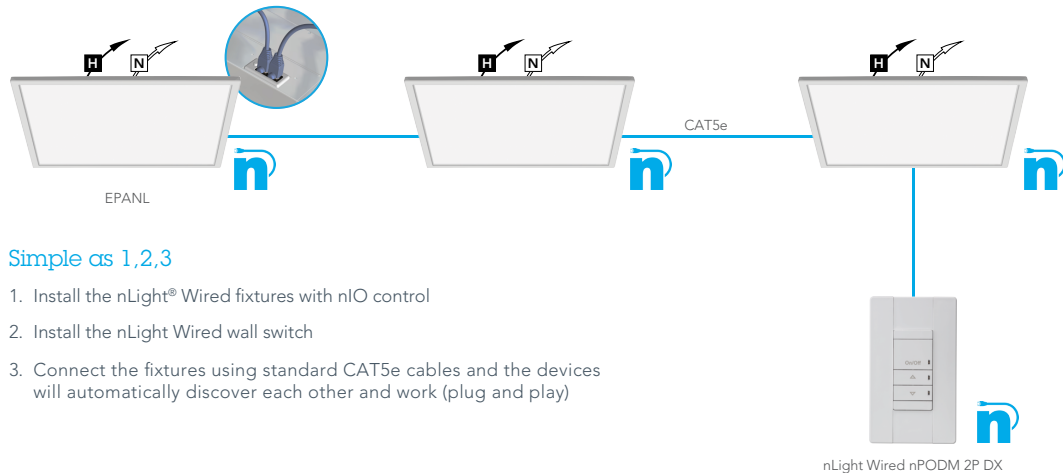


Simple as 1,2,3

1. Install the nLight® AIR fixtures with embedded smart sensor
2. Install the wireless battery-powered wall switch
3. With the CLAIRITY Pro app, pair the fixtures with the wall switch and if desired, customize the sensor settings for the desired outcome



nLight Wired Networking



Simple as 1,2,3

1. Install the nLight® Wired fixtures with nIO control
2. Install the nLight Wired wall switch
3. Connect the fixtures using standard CAT5e cables and the devices will automatically discover each other and work (plug and play)



EPANL

EPANL LED Flat Panel

Controls Accessories

nLight® Wired Control Accessories:

Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlight.

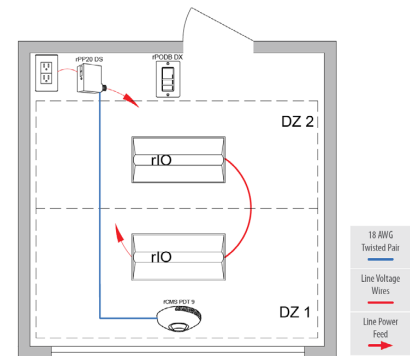
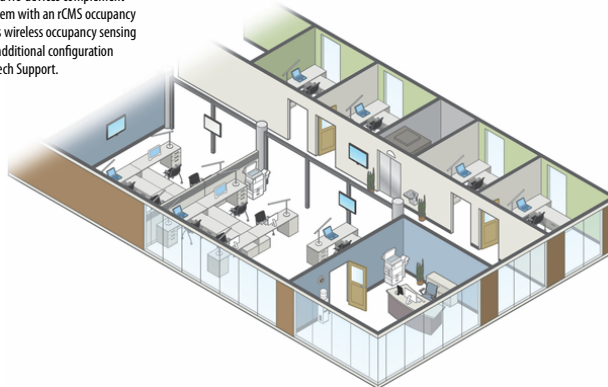
WallPod stations	Model number	Occupancy sensors	Model number
On/Off	nPODMA [Color]	Small motion 360°, ceiling (PIR / dual tech)	nCM 9 RJB / nCM PDT 9 RJB
On/Off & raise/lower	nPODMA DX [Color]	Large motion 360°, ceiling (PIR / dual tech)	nCM10 RJB / nCM PDT 10 RJB
Graphic touchscreen	nPOD TOUCH [Color]	Wall switch with raise/lower	nWSX PDT LV DX [color]
Photocell controls	Model number	Cat-5 cable (plenum rated)	Model number
Full range dimming	nCM ADCX RJB	10' cable	CATS 10FT J1
		30' cable	CATS 30FT J1

nLight® AIR Control Accessories:

Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlightair.

Wall switches	Model number
On/Off single pole	rPODBA [color] G2
On/Off two pole	rPODB A2P [color] G2
On/Off & raise/lower single pole	rPODBA DX [color] G2
On/Off & raise/lower two pole	rPODBA 2P DX [color] G2

EPANL fixtures with integrated rIO devices complement any small office space. Pair them with an rCMS occupancy sensor and the space now has wireless occupancy sensing and dimming capability. For additional configuration options please consult with Tech Support.



rCMS ¹						Example: RCMS PDT 10 AR G2	
Series / Detection	Power Supply ¹	Occupancy Detection	Lens (Required)	Operating Mode	Generation		
RCMS nLight AIR occupancy and daylight sensor	[blank] Power Supply ordered separately	[blank] PIR Detection PDT Dual Tech PIR/Microphonics	10 Large Motion/ Extended Range 360°	[BLANK] None AR Auxiliary Relay	G2 Generation 2 compatibility		
	PS 150 Standard 150 mA Power Supply		9 Small Motion/ Extended Range 360°				
			6 High Bay 360° Lens				

Notes

¹ RCMS requires low voltage power from either RPP20 DS 24V G2 or PS150.



Sensor Switch
WSX



nLight WIRED
nPOD UNITOUCH



nLight WIRED
nPODMA DX



nLight AIR
rPODBA



EPANL with rES7



rPODBA

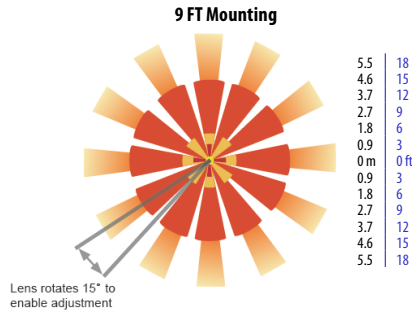


RCMS

EPANL LED Flat Panel

Sensor Coverage Pattern Mini 360° Lens

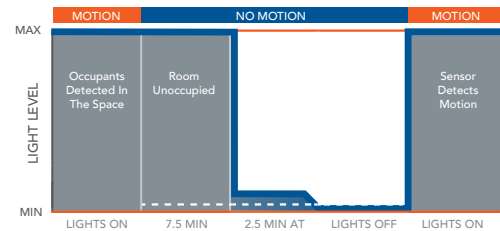
- Recommended for walking motion detection from mounting heights between 8 ft (2.44 m) and 20 ft (6.10 m)
- Initial detection of walking motion along sensor axes at distances of 2x the mounting height up to 15 ft (4.57 m) and
- 1.75x up to 20 ft (6.10 m).
- Provides 12 ft (3.66 m) radial detection of small motion when mounted at 9 ft (2.74 m)
- Initial detection will occur earlier when walking across sensor's field of view than when walking directly at sensor



nLight AIR Wireless

nLight AIR is the ideal solution for retrofit or new construction spaces where adding additional wiring can be labor intensive and nLight AIR is available with or without an integral sensor. The integrated rES7 or rES7PDT smart sensors are part of each luminaire in the nLight AIR network, which can be grouped to control multiple luminaires. The granularity of control with the digital PIR occupancy detection and daylight sensing makes a great solution for any application.

Sequence of Operation (nES7 and Sensor)



*The presetting on the automatic dimming photocell is 10fc (RES7).

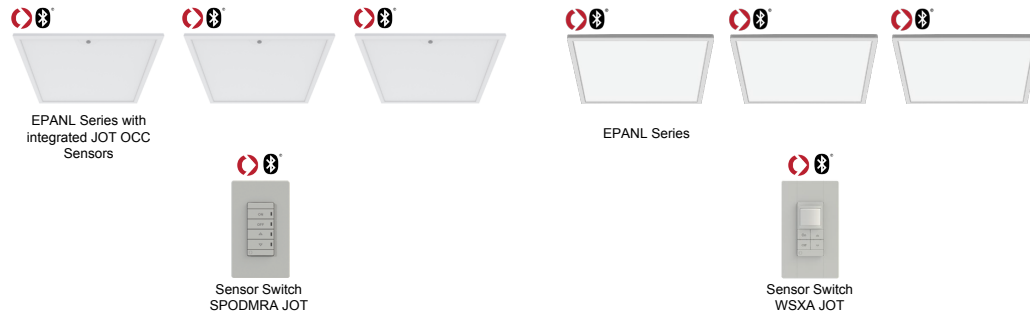
Sensor Switch JOT



Sensor Switch JOT Enabled Wireless Solution

Designed with contractors in mind, the Sensor Switch JOT enabled wireless solution offers a straightforward approach to the installation and pairing of lighting fixtures and controls. Absolutely no 0-10V control wires and no mobile apps are needed with JOT enabled products, allowing for lightning speed installation right out of the box.

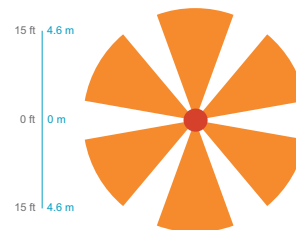
- Power:** Install JOT enabled fixtures and controls as instructed.
- Pair:** Insert the pairing tool into the pinhole on the wall switch; press and hold any button for 6 seconds.
- Play:** Once paired, each fixture will individually dim down to 10% brightness. All products will be fully functional.



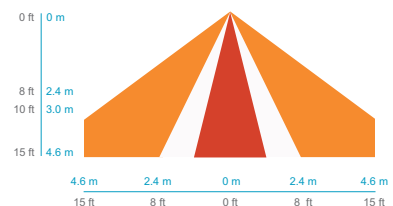
15F - LARGE MOTION EXTENDED RANGE 360

- Optimized full coverage from 8 ft - 15 ft (2.4 m - 4.5 m) mounting heights
- Reliable detection of large motion (e.g. pedestrian walking traffic)
- 1.3 x mounting height equals approximate detection range

TOP VIEW



SIDE VIEW



EPANL LED Flat Panel

Performance Data					
Model No.	DLC Classification	Reported Light Output	Reported Wattage	Reported Efficacy (AC)	DLC Product Id
EPANL 1X4 1500LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1511	14	108	P7WQ2HL
EPANL 1X4 1500LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1511	14	108	P7U30VTJ
EPANL 1X4 1500LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1574	14	113	P8VKRLEE
EPANL 1X4 1500LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1574	14	113	P7K7C5SF
EPANL 1X4 1500LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1637	14	117	PJAP0LUK
EPANL 1X4 1500LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1637	14	117	P93PN6HF
EPANL 1X4 1500LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1699	14	122	PJ2LT8RF
EPANL 1X4 1500LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1699	14	122	PMO20WDF
EPANL 1X4 1500LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1419	12	119	P783S2UK
EPANL 1X4 1500LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1419	12	119	P08VAI49
EPANL 1X4 1500LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1457	12	122	PPJ3S90F
EPANL 1X4 1500LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1457	12	122	PIKV3IEP
EPANL 1X4 1500LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	1508	12	127	P2590KI9
EPANL 1X4 1500LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	1508	12	127	P66FTD1J
EPANL 1X4 1500LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	1543	12	130	PD3A29J1
EPANL 1X4 1500LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	1543	12	130	PW3538GV
EPANL 1X4 3000LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	2841	27	106	PEYKSSNY
EPANL 1X4 3000LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	2841	27	106	P7W193ZL
EPANL 1X4 3000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	2960	27	110	PBMBSQA8
EPANL 1X4 3000LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	2960	27	110	PT0HAA5S
EPANL 1X4 3000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3078	27	114	PNKUCIA
EPANL 1X4 3000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3078	27	114	PS3ZWBUF
EPANL 1X4 3000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3197	27	119	PMH2SAT
EPANL 1X4 3000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3197	27	119	PFZRHYS
EPANL 1X4 3000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	2771	23	123	PJ1YE30
EPANL 1X4 3000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	2771	23	123	P49S1R0
EPANL 1X4 3000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	2845	23	126	PTUGXVMO
EPANL 1X4 3000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	2845	23	126	P61KCHZV
EPANL 1X4 3000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	2945	23	130	PJYUQUN8
EPANL 1X4 3000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	2945	23	130	PJZRVW5F
EPANL 1X4 3000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3012	23	133	P0ATZ94T
EPANL 1X4 3000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3012	23	133	PT45WGFZ
EPANL 1X4 4000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	3426	31	111	PSWJLZ98
EPANL 1X4 4000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3963	37	107	P7MF6P4R
EPANL 1X4 4000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3963	37	107	PQH0HMOH
EPANL 1X4 4000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4116	37	111	PY8MM627
EPANL 1X4 4000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4116	37	111	P3XBCGJ0
EPANL 1X4 4000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3667	31	120	PKMNCN14
EPANL 1X4 4000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3667	31	120	PDWGL65K
EPANL 1X4 4000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3765	31	123	PJZ17EWI
EPANL 1X4 4000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3765	31	123	P4L0LVRG
EPANL 1X4 4000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3897	31	128	PZGUZR2U
EPANL 1X4 4000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3897	31	128	PY7QZBWI
EPANL 1X4 4000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3985	31	130	PDAKJ8B3
EPANL 1X4 4000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3985	31	130	PELAOSTB
EPANL 1X4 4800LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4633	45	104	PII6VKUP
EPANL 1X4 4800LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4633	45	104	PKJ02BDR
EPANL 1X4 4800LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4807	45	108	P716D3WI
EPANL 1X4 4800LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4807	45	108	PJ87LC64
EPANL 1X4 4800LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4923	45	110	PICJQWGD
EPANL 1X4 4800LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4923	45	110	PZW1PDFZ
EPANL 1X4 4800LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4967	45	111	PQAFPPJ6
EPANL 1X4 4800LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4967	45	111	PCNBZY2M0
EPANL 1X4 4800LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4340	37	117	PU1UIM58
EPANL 1X4 4800LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4340	37	117	PNSWOKZ3
EPANL 1X4 4800LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4456	37	120	P0BHX07V
EPANL 1X4 4800LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4456	37	120	P07FGWK3
EPANL 1X4 4800LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4612	37	124	PHAPQJQS
EPANL 1X4 4800LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4612	37	124	PZ9DDI8L
EPANL 1X4 4800LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4717	37	127	PLOV4S6F
EPANL 1X4 4800LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4717	37	127	PJIAJOSO
EPANL 1X4 5400LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5156	44	116	PKIBC75K
EPANL 1X4 5400LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5156	44	116	PC2IS9KU
EPANL 1X4 5400LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5272	44	119	PNX0E6ZR
EPANL 1X4 5400LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5272	44	119	PE4NWEQC
EPANL 1X4 5400LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5490	44	124	PF0B5KQD

TYPE T2C

EPANL LED Flat Panel

Performance Data					
Model No.	DLC Classification	Reported Light Output	Reported Wattage	Reported Efficacy (AC)	DLC Product Id
EPANL 1X4 5400LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5490	44	124	PVWWB0JI
EPANL 1X4 5400LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5665	44	128	PEC0GL65
EPANL 1X4 5400LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5665	44	128	P7PAYNFS
EPANL 1X4 6000LM 80CRI 30K [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	5953	55	109	P84A41CZ
EPANL 1X4 6000LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5953	51	117	PL3AU798
EPANL 1X4 6000LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5953	51	117	PCMNH26U
EPANL 1X4 6000LM 80CRI 35K [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	5997	55	110	PWJ6HVP3
EPANL 1X4 6000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5997	51	118	P31GEZNP
EPANL 1X4 6000LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5997	51	118	P9MS2FI2
EPANL 1X4 6000LM 80CRI 40K [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	6171	55	113	PD7JL7CS
EPANL 1X4 6000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	6171	51	121	PEC0ZVXY
EPANL 1X4 6000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	6171	51	121	PRC6VIDH
EPANL 1X4 6000LM 80CRI 50K [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	6240	55	114	P206CKK4
EPANL 1X4 6000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	6240	51	123	PSBGKZ54
EPANL 1X4 6000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	6240	51	123	PEVMDG8B
EPANL 2X2 2000LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1988	19	106	P084CQTR
EPANL 2X2 2000LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1988	19	106	PN6W7230
EPANL 2X2 2000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	2071	19	110	P4AJO6I1
EPANL 2X2 2000LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	2071	19	110	P4Y2S08D
EPANL 2X2 2000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	2154	19	115	PIQUALNF
EPANL 2X2 2000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	2154	19	115	PULQ3DQ4
EPANL 2X2 2000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	2237	19	119	P167DCJS
EPANL 2X2 2000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	2237	19	119	P1FNCFUQ
EPANL 2X2 2000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1856	16	119	P8MIUS1X
EPANL 2X2 2000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1856	16	119	PRXPVWQJ
EPANL 2X2 2000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1906	16	123	PU253KEZ
EPANL 2X2 2000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1906	16	123	PLNV5ZF6
EPANL 2X2 2000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	1972	16	127	PZSE53JI
EPANL 2X2 2000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	1972	16	127	PZKK2D04
EPANL 2X2 2000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	2017	16	130	PCLAME02
EPANL 2X2 2000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	2017	16	130	PV0MYAQV
EPANL 2X2 3400LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3291	30	109	PNSQ2LMI
EPANL 2X2 3400LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3291	30	109	PU14CBM6
EPANL 2X2 3400LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3428	30	113	PMKTPCS2
EPANL 2X2 3400LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3428	30	113	PB1DW61J
EPANL 2X2 3400LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3566	30	118	PWRHGEH4
EPANL 2X2 3400LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	3566	33	107	PS9Y8BOV
EPANL 2X2 3400LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3566	30	118	PG7KB5GU
EPANL 2X2 3400LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3703	30	122	PL6024K5
EPANL 2X2 3400LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3703	30	122	PP79GBQH
EPANL 2X2 3400LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3198	27	121	P25AS4VV
EPANL 2X2 3400LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3198	27	121	PZENR7ML
EPANL 2X2 3400LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3285	27	124	PC28H7F3
EPANL 2X2 3400LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3285	27	124	PGPCX23Z
EPANL 2X2 3400LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3399	27	128	PWGICRAX
EPANL 2X2 3400LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3399	27	128	PZQGNSEP
EPANL 2X2 3400LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3477	27	131	P57KW7H4
EPANL 2X2 3400LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3477	27	131	PDS56JHB
EPANL 2X2 4000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4121	37	110	P5L7HREA
EPANL 2X2 4000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4121	37	110	PP2PR06A
EPANL 2X2 4000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4280	37	114	P94H4XFG
EPANL 2X2 4000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4280	37	114	PFQ0F3LM
EPANL 2X2 4000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3874	33	118	PTN8M36S
EPANL 2X2 4000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3874	33	118	PXW23VVD
EPANL 2X2 4000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3978	33	121	P5661UJU
EPANL 2X2 4000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3978	33	121	PG06EXAT
EPANL 2X2 4000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4117	33	125	PD2JEZV9
EPANL 2X2 4000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4117	33	125	P8BAID21
EPANL 2X2 4000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4211	33	128	P3P7W4AB
EPANL 2X2 4000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4211	33	128	PQCCGU60
EPANL 2X2 4800LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4843	45	109	P00Y8NZ2
EPANL 2X2 4800LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4843	45	109	PB9Y8XNL
EPANL 2X2 4800LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4886	45	110	PW2SY5X9
EPANL 2X2 4800LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4886	45	110	PAAM27H
EPANL 2X2 4800LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4420	36	121	PFYMYFE0
EPANL 2X2 4800LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4420	36	121	PX02EX68
EPANL 2X2 4800LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4539	36	125	PZ0PLMI9
EPANL 2X2 4800LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4539	36	125	PF2L9X2I



EPANL

EPANL LED Flat Panel

Performance Data					
Model No.	DLC Classification	Reported Light Output	Reported Wattage	Reported Efficacy (AC)	DLC Product Id
EPANL 2X2 4800LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4697	36	129	PNQ40WFF
EPANL 2X2 4800LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4697	36	129	P2NS3VB0
EPANL 2X2 4800LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4804	36	132	PG3ZCKUI
EPANL 2X2 4800LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4804	36	132	PND0DXI4
EPANL 2X4 3000LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3015	29	106	PGB293WJ
EPANL 2X4 3000LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3015	29	106	PXWRSANS
EPANL 2X4 3000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3141	29	110	PU32L41S
EPANL 2X4 3000LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3141	29	110	PWJ9J91G
EPANL 2X4 3000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3266	29	115	PVHS0QB
EPANL 2X4 3000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3266	29	115	PP0P99LT
EPANL 2X4 3000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3392	29	119	P4H3UGFQ
EPANL 2X4 3000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3392	29	119	PLI4CPSN
EPANL 2X4 3000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	2943	23	129	PHDEORE3
EPANL 2X4 3000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	2943	23	129	PYUNOTIN
EPANL 2X4 3000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	2986	23	131	P2GQ1ISA
EPANL 2X4 3000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	2986	23	131	PC23010I
EPANL 2X4 3000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3071	23	135	PNWQLGKR
EPANL 2X4 3000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3071	23	135	P3CL9S6W
EPANL 2X4 3000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3114	23	137	PIIH40FQ
EPANL 2X4 3000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3114	23	137	P609TWNV
EPANL 2X4 3760LMHE 80CRI 40K MIN10 ZT MVOLT NACV	Premium	3984	27	147	PQMBSPAR
EPANL 2X4 4000LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3914	38	104	PLDIMHXG
EPANL 2X4 4000LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3914	38	104	P01K0BJN
EPANL 2X4 4000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4077	38	108	PPTL71HY
EPANL 2X4 4000LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4077	38	108	PRO2E004
EPANL 2X4 4000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4240	38	113	PT1H08CF
EPANL 2X4 4000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4240	38	113	PGSERWDA
EPANL 2X4 4000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4403	38	117	P8TD4A4V
EPANL 2X4 4000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4403	38	117	PTXVJNOI
EPANL 2X4 4000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3874	31	123	P8R62RB3
EPANL 2X4 4000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3874	31	123	P23T82YA
EPANL 2X4 4000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3930	31	125	PIY82204
EPANL 2X4 4000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3930	31	125	PSKVR7RT
EPANL 2X4 4000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4042	31	129	PPU6PYNE
EPANL 2X4 4000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4042	31	129	P9VNDDES
EPANL 2X4 4000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4098	31	130	PTRH2WMJ
EPANL 2X4 4000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4098	31	130	P5SXJ12N
EPANL 2X4 4800LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4817	45	107	PZB2XRG3
EPANL 2X4 4800LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4817	45	107	PHYF1N9C
EPANL 2X4 4800LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4998	45	111	P4PIGUFW
EPANL 2X4 4800LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4998	45	111	PI2A3L85
EPANL 2X4 4800LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5119	45	113	P4SKVRJP
EPANL 2X4 4800LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5119	45	113	P018HM99
EPANL 2X4 4800LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5164	45	114	PG2MHOZE
EPANL 2X4 4800LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	5164	48	107	P70IOAPR
EPANL 2X4 4800LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5164	45	114	PWTSOASQ
EPANL 2X4 4800LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4491	37	120	P3RFGZH6
EPANL 2X4 4800LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4491	37	120	POC36E5U
EPANL 2X4 4800LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4612	37	123	PYK5A8HX
EPANL 2X4 4800LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4612	37	123	PYWZDYOR
EPANL 2X4 4800LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4773	37	127	P47QIRYT
EPANL 2X4 4800LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4773	37	127	PH0QXWON
EPANL 2X4 4800LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4882	37	130	PR3ISII0
EPANL 2X4 4800LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4882	37	130	PKP1XLJT
EPANL 2X4 5000LMHE 80CRI 40K MIN10 ZT MVOLT NACV	Premium	5218	37	141	PL4KIXE5
EPANL 2X4 5400LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5345	49	109	PO568XSR
EPANL 2X4 5400LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5345	49	109	P00696LI
EPANL 2X4 5400LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5546	49	113	PFC1L300
EPANL 2X4 5400LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5546	49	113	PK7Q1VHH
EPANL 2X4 5400LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5679	49	116	PR3K6SHH
EPANL 2X4 5400LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5679	49	116	P8KYWF8J
EPANL 2X4 5400LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5730	49	117	PVKX9GJ
EPANL 2X4 5400LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5730	49	117	PX1YH6FH
EPANL 2X4 5400LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5302	41	131	P3JOAC0V
EPANL 2X4 5400LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	5302	41	128	PNWXLXM3
EPANL 2X4 5400LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5302	41	131	PARJN9JC
EPANL 2X4 5400LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5421	41	134	P4E4JYPW
EPANL 2X4 5400LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	5421	41	131	PPKAF154

EPANL LED Flat Panel

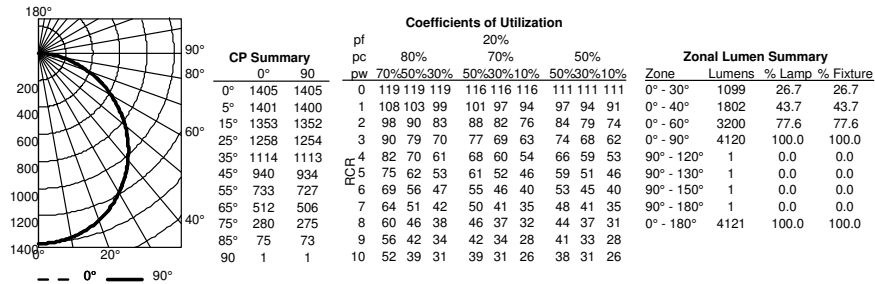
Performance Data					
Model No.	DLC Classification	Reported Light Output	Reported Wattage	Reported Efficacy (AC)	DLC Product Id
EPANL 2X4 5400LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5421	41	134	PBVWKVM6
EPANL 2X4 5400LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5645	41	139	PWCONHWW
EPANL 2X4 5400LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	5645	41	137	PZRLJ13L
EPANL 2X4 5400LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5645	41	139	PAHJYVRW
EPANL 2X4 5400LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5825	41	144	PKDG7XHY
EPANL 2X4 5400LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	5825	41	141	P36758NK
EPANL 2X4 5400LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5825	41	144	P2LSI059
EPANL 2X4 5757LMHE 80CRI 40K MIN10 ZT MVOLT NACV	Premium	5776	40	143	P71Q69QD
EPANL 2X4 6000LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6318	50	126	PD2QM1LA
EPANL 2X4 6000LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6318	50	126	P32NF8NU
EPANL 2X4 6000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6364	50	127	PSV30WTC
EPANL 2X4 6000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	6364	55	115	P89SURCD
EPANL 2X4 6000LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6364	50	127	PK0759Q3
EPANL 2X4 6000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6548	50	131	PWWK6LER
EPANL 2X4 6000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6548	50	131	PHICROVH
EPANL 2X4 6000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6622	50	132	PQMRLFRM
EPANL 2X4 6000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6622	50	132	PSF8NN00
EPANL 2X4 6000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5755	43	135	P6JUAFCI
EPANL 2X4 6000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	5755	45	128	PDDV7MOA
EPANL 2X4 6000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5755	43	135	P0I81Q95
EPANL 2X4 6000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5884	43	138	PENZU105
EPANL 2X4 6000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	5884	45	131	PIVHYPP1
EPANL 2X4 6000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5884	43	138	PKFWFCU
EPANL 2X4 6000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6127	43	144	P2GV0FOB
EPANL 2X4 6000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	6127	45	136	PB0A5LE2
EPANL 2X4 6000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6127	43	144	PA04TVD1
EPANL 2X4 6000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6322	43	148	P2ZYBVS5
EPANL 2X4 6000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	6322	45	140	P888TM5U
EPANL 2X4 6000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6322	43	148	PKPSCMGA
EPANL 2X4 6800LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7013	62	113	PW2TK9FQ
EPANL 2X4 6800LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7013	62	113	PBEOWDCQ
EPANL 2X4 6800LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7064	62	114	PW0040LR
EPANL 2X4 6800LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7064	62	114	P7ALFH3K
EPANL 2X4 6800LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7269	62	117	P8FEEBQH
EPANL 2X4 6800LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	7269	65	111	PSLOA6G7
EPANL 2X4 6800LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7269	62	117	PIUM942B
EPANL 2X4 6800LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7351	62	118	PCMKG05N
EPANL 2X4 6800LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7351	62	118	P9AP1VBW
EPANL 2X4 6800LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6450	48	135	PTT9MBX1
EPANL 2X4 6800LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6450	48	135	PNHSDDT2
EPANL 2X4 6800LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6596	48	138	PICAPAMD
EPANL 2X4 6800LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6596	48	138	PHA6TVBP
EPANL 2X4 6800LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6868	48	144	P18UL0J1
EPANL 2X4 6800LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6868	48	144	P7786JMO
EPANL 2X4 6800LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	7086	48	149	PU25XKJQ
EPANL 2X4 6800LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	7086	48	149	PMB46YK
EPANL 2X4 7200LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7388	66	111	P2QK1V0K
EPANL 2X4 7200LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	7388	70	106	PF1518JE
EPANL 2X4 7200LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7388	66	111	P2GTCW3J
EPANL 2X4 7200LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7442	66	112	PCRM0D2R
EPANL 2X4 7200LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	7442	70	107	PKVY7048
EPANL 2X4 7200LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7442	66	112	P41RL2HS
EPANL 2X4 7200LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7657	66	115	PS2AC19A
EPANL 2X4 7200LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	7657	70	110	PBV78YXA
EPANL 2X4 7200LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7657	66	115	PCLJ4VZN
EPANL 2X4 7200LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7744	66	117	PIS28TOX
EPANL 2X4 7200LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	7744	70	111	PSPB7FBG
EPANL 2X4 7200LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7744	66	117	PIR0A8L6
EPANL 2X4 7200LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6792	50	137	PJN0UK7J
EPANL 2X4 7200LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6792	50	137	PW92GBXR
EPANL 2X4 7200LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6945	50	140	PHWEYL0D
EPANL 2X4 7200LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6945	50	140	PXHH12RI
EPANL 2X4 7200LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	7232	50	146	PW3RZAGO
EPANL 2X4 7200LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	7232	50	146	PZY6WXTJ
EPANL 2X4 7200LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	7462	50	151	PPYDM8D6
EPANL 2X4 7200LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	7462	50	151	P7IGKCWE

EPANL LED Flat Panel

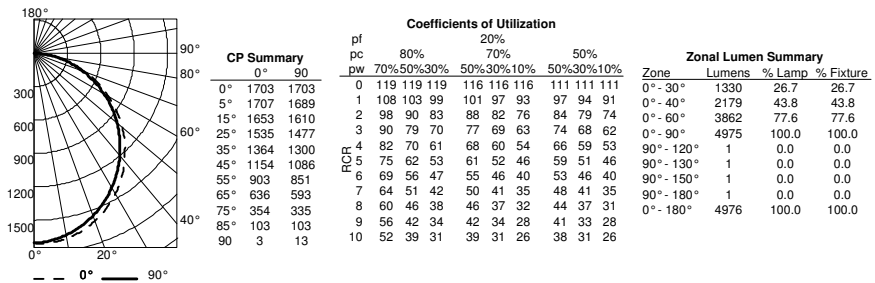
PHOTOMETRICS

Full Photometric data is available on Lithonia.acuitybrands.com

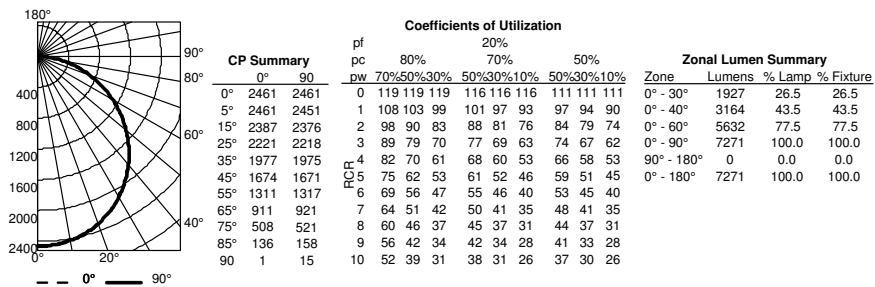
EPANL 2x2 4000LM 80CRI 40K, 4121 delivered lumens.



EPANL 2x4 4800LM 80CRI 40K, 5119 delivered lumens.



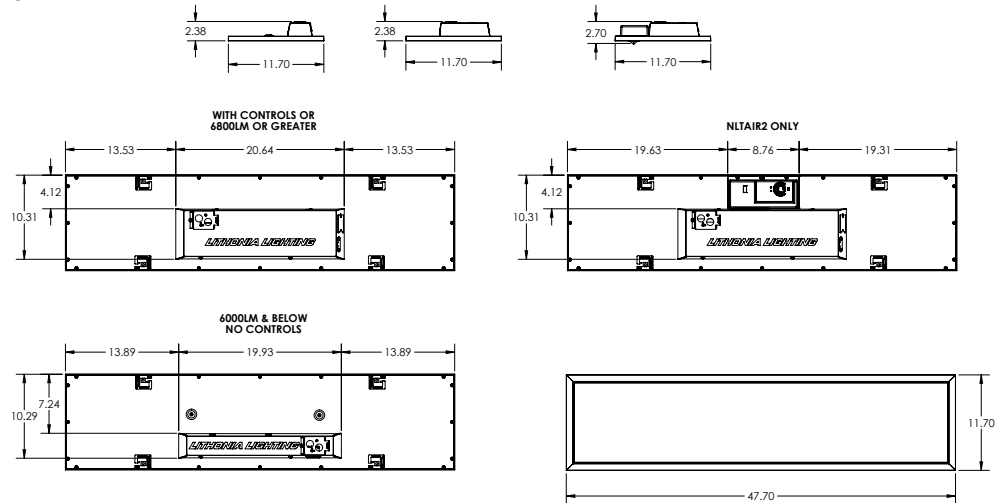
EPANL 2x4 6800LM 80CRI 40K, 7269 delivered lumens.



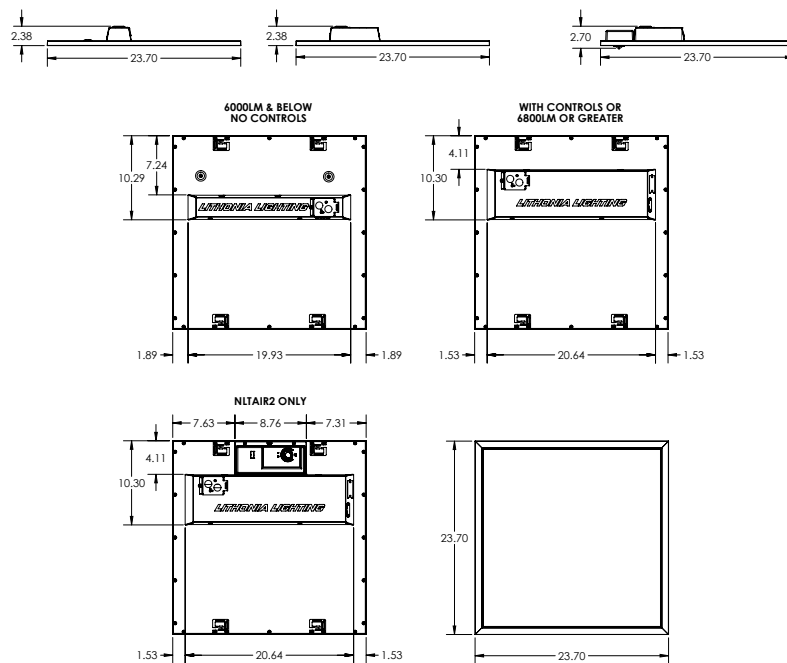
EPANL LED Flat Panel

DIMENSIONS

1X4 Configurations



2X2 Configurations

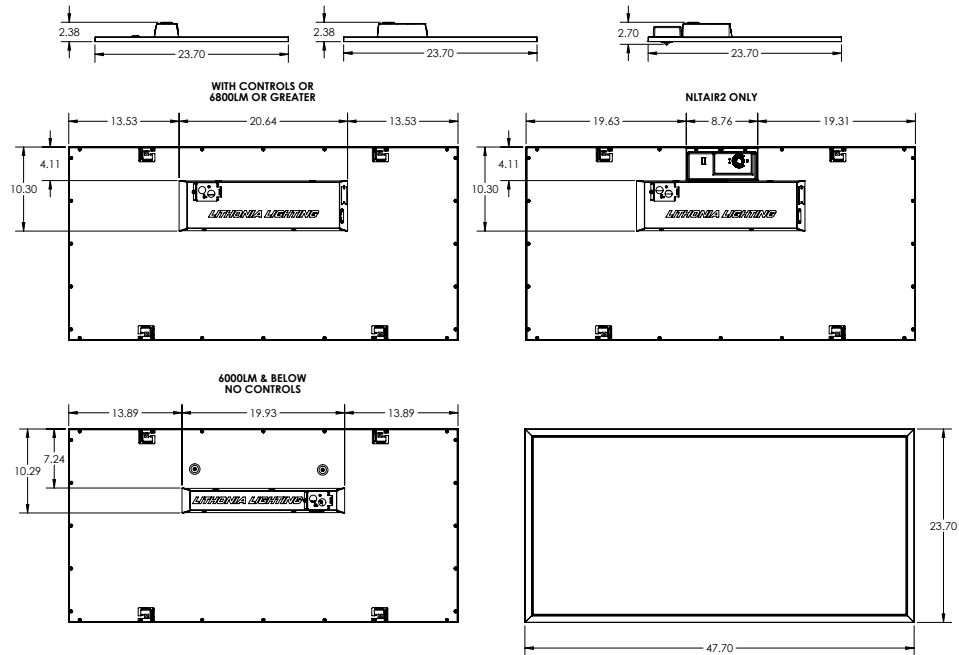


EPANL LED Flat Panel

TYPE T2C

DIMENSIONS (continued)

2X4 Configurations





DIGITAL NAVIGATION

[Ordering Tree](#) [nLight Platform](#) [Sensor Switch JOT](#) [Photometrics](#) [Performance Data](#) [Drawings](#)

FEATURES & SPECIFICATIONS

INTENDED USE — The EPANL Series LED Edge-Lit Flat Panel provides a fully luminous appearance across the face of the lens. This provides a soft, glare-free solution that is visually comfortable within the space. Suitable for many lighting applications including schools, offices and other commercial spaces, retail, convenience stores, hospitals and healthcare facilities. **Certain airborne contaminants can diminish the integrity of acrylic and/or polycarbonate.** [Click here for Acrylic-Polycarbonate Compatibility table for suitable uses.](#)

CONSTRUCTION — Built to last with an aluminum frame for strength and durability, the seamless frame prevents light leak in the corners. The PMMA light guide plate and lens resists yellowing and transmits light with superior efficacy. The satin white lens provides excellent shielding and fully luminous appearance. EPANL's low-profile design provides increased installation flexibility especially in restricted plenum spaces. The back plate includes integral T-bar clips for installation into 15/16" or 9/16" T-grid ceilings. Fixture may be recessed, suspended, surface box mounted or mounted in a hard-ceiling see accessories section for more information. Fixture may be mounted and wired in continuous rows.

Integrated Sensor (nLight Wired Networking): This sensor is nLight-enabled, meaning it has the ability to communicate over an nLight network. When wired, using CAT-5 cabling, with other nLight-enabled sensors, power packs, or WallPods, an nLight control zone is created. Once linked to a Gateway, directly or via a Bridge, the zone becomes capable of remote status monitoring and control via SensorView software.

Integrated Smart Sensor (nLight Air Wireless Platform): The RES7 sensor is nLight AIR enabled, meaning it has the ability to communicate over the wireless nLight control platform. It is available with an automatic dimming photocell, and either a digital PIR or a microphonics (PDT) dual technology occupancy sensor. It pairs to other luminaires and wall switches through our mobile app, CLAIRITY, which allows for simple sensor adjustment

Integrated Wireless Sensor (single room control): Sensor Switch VERTEX JOT or JOTVTX15 luminaire-embedded occupancy and ambient light sensor allows the luminaire to power off when the space is unoccupied or when enough ambient light is entering the space. See page 7 for more details on the integrated wireless sensor.

ELECTRICAL — Long-life LEDs, coupled with a high-efficiency driver, provide superior illumination for extended service life. See page 3 for detailed lumen maintenance information. 0-10V dimming driver, dims to 1% or 10% and contains non-isolated dimming leads.

LISTINGS — CSA Certified to meet US and Canadian standards. Tested to meet UL1958. Intended for indoor use only. Product is not to be stored in non-climate controlled spaces. DesignLights Consortium® (DLC) Premium qualified product and DLC qualified product. Not all versions of this product may be DLC Premium qualified or DLC qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified. Damp location listed. IC rated. IPSX rated. Long nomenclature, configurable product is rated and certified to meet NSF Splash Zone 2. Tested in accordance with ISO 14644-1; suitable for ISO Class 5-9 positive and negative pressure clean rooms. Suitable for ambient temperatures from 32°F (0°C) to 77°F (25°C).

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. Specifications subject to change without notice.

	Dimensions		
	1x4	2x2	2x4
Length	47.72"	23.70"	47.72"
Width	11.85"	23.70"	23.70"
Depth	2.19"	2.19"	2.19"
Weight	13.9 lbs	7.4 lbs	15.1 lbs

* Base configurations; options may add weight

Catalog Number	TYPE T3A
Notes	
Type	

EPANL LED

1'x4', 2'x2', and 2'x4'



Embed nLight controls today. Prepare for tomorrow.

Now	Tomorrow
User-friendly install	Scalability
Enhanced energy savings	Space configuration
Code compliance	Future-ready

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.

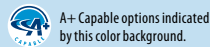
- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® control networks when ordered with drivers marked by a shaded background*
- This luminaire is part of an A+ Certified solution for nLight 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

EPANL LED Flat Panel

TYPE T3A



ORDERING INFORMATION

Example: EPANL 2X4 4000LM 80CRI 35K MIN1 MVOLT E10WCP NLTAIR2 RIO

Series	Width and Length	Lumens	CRI	Color Temperature	Minimum Dimming Level ‡
EPANL LED Flat Panel	1x4' 1'x4'	Standard Lumens:	80CRI 80 CRI	30K 3000K 35K 3500K 40K 4000K 50K 5000K	MIN10 Dims to 10% ‡ MINT Dims to 1%
		1500LM 1500 Lumens			
		3000LM 3000 Lumens			
		4000LM 4000 Lumens			
		4800LM 4800 Lumens			
		6000LM 6000 Lumens			
		High Efficiency Lumens:			
		1500LMHE 1500 Lumens			
		3000LMHE 3000 Lumens			
	2x2' 2'x2'	4000LMHE 4000 Lumens			
		4800LMHE 4800 Lumens			
		6000LMHE 6000 Lumens			
		2000LM 2000 Lumens			
		3400LM 3400 Lumens			
		4000LM 4000 Lumens			
		4800LM 4800 Lumens			
	2x4' 2'x4'	3000LM 3000 Lumens			
		4000LM 4000 Lumens			
		4800LM 4800 Lumens			
		5400LM 5400 Lumens			
		6000LM 6000 Lumens			
		6800LM 6800 Lumens			
		7200LM 7200 Lumens			
		3000LMHE 3000 Lumens			
		4000LMHE 4000 Lumens			

Dimming ‡	Voltage	Step Level Dimming	Emergency Option
ZT Generic 0-10V Dimming	MVOLT 120-277V	(Blank) None	E10WCP EM Self-Diagnostic battery pack, 10W Constant Power, Certified in CA Title 20 MAEDBS ‡
EZT eldoLED 0-10V Dimming	120 120V	SLD Step Level Dimming ‡	GTD Generator Transfer Device ‡
DALI eldoLED DALI	277 277V		EMG for use with NLIGHT or NLTAIR2 on generator supply EM power ‡
	347 347V ‡		

INTEGRAL BATTERY PACKS TO BE PROVIDED FOR LUMINAIRES INDICATED AS "EM" ON LIGHTING PLANS

Control Options		
Control Input nLight Wired: NLIGHT nLight enabled, no constant lumen management CL80 NLIGHT nLight enabled, constant lumen output 80%	Control nLight Wired: ‡ (blank) no control	Individual Control JOT Wireless room control with "Just One Touch" pairing ‡ JOTVIX15 Wireless occupancy sensor with "Just One Touch" pairing ‡
nLight Wireless: NLTAIR2 nLight AIR Generation 2 enabled ‡	nLight Wireless: RIO nLight AIR Radio module without sensor ‡ RES7 nLight AIR PIR integral occupancy sensor with automatic dimming photocell for Networking Capabilities ‡ RES7PDT nLight air microphonics dual technology occupancy sensor with automatic dimming photocell ‡	

Options		
GLR Fast-blowing fuse ‡	PWS1856LV 6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit w/low voltage wires ‡	
GMF Slow-blowing fuse ‡	CP Chicago plenum ‡	
PWS1836 6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit	NPLT Narrow Pallet	
PWS1846 6' pre-wire, 3/8" diameter, 18 gauge, 2 circuit	BDP Factory Installed Ballast Disconnect Plug	
PWS1846 PWSLV Two cables: one 6' pre-wire, 3/8" diameter, 18 gauge, 2 circuits; one 6' pre-wire, 3/8" diameter, 18 gauge ‡	RRL RELOC®-ready luminaire ‡	

NOTE: ‡ indicates option value has ordering restrictions. Please reference the Option Value Ordering Restrictions chart on the next page. Options are sorted alphanumerically.

ELECTRICAL CONTRACTOR TO DETERMINE APPROPRIATE MOUNTING HARDWARE & ACCESSORIES



EPANL

EPANL LED Flat Panel

TYPE T3A

± Option Value Ordering Restrictions	
Option Value	Restriction
347	Not available with SLD, E10WCP, or GTD options.
Dimming	If Step Level Dimming (SLD) or NLIGHT or NLTAIR2 is specified, leave this section blank.
CP	Not available with nLight wired (NLIGHT), nLight wireless (NLTAIR2).
E10WCP	Refer to Emergency Battery Estimated Lumen section for lumen estimation. Test Switch must be remote mounted or installed in an adjacent ceiling tile. When using pre-wire option, use PWS1846 or PWS1846 PWSLV.
EMG	Requires a connection to existing NLIGHT or NLTAIR2 network. Power is provided from separate nLight enabled fixture.
GLR, GMF	Must specify voltage. 120 or 277, with GLR and GMF fusing.
GTD	Not available with JOT, JOTVTX15, sensor options or emergency battery options. Must specify voltage. Requires BSE labeling, voltage specific. Consult factory for options. Example: GTD BSE10.
JOT, JOTVTX15	Not available with NLIGHT, DALI, SLD, GTD, EMG, or NLTAIR2 options.
MIN10	Not available with EZT, NLIGHT or DALI.
Minimum Dimming Level	If Step Level Dimming (SLD) is specified, leave this section blank.
NLTAIR2	Only available with MIN1 minimum dimming level option.
PWS1846 PWSLV	Not available with GTD, nLight wired, nLight wireless, NLIGHT or NLTAIR2.
PWS1856LV	Not available with nLight wired, nLight wireless, NLIGHT, or NLTAIR2.
RES7EM, RES7PDTEM, RIOEM	See UL924 Sequence of Operation chart on page 4.
RRL	For ordering logic consult RRL_2013.
SLD	Not available with with any nLight Interface, Control options, or GTD. When using prewire option use PWS1846.

Tunable White (Select SKUs Only)

Available SKUs:

*2735H0 EPANL 2X2 TUWH PROR 4800LM 80CRI NLT
 *2735H9 EPANL 2X2 TUWH PROR 4800LM 80CRI NLT PWS1836
 *2735HJ EPANL 2X2 TUWH PROR 4800LM 80CRI NLT E10WCP
 *2735HN EPANL 2X2 TUWH PROR 4800LM 80CRI NLT E10WCP PWS1846

Operating Performance:

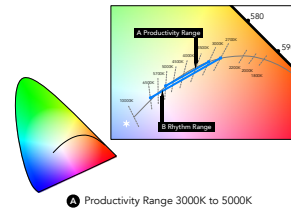
Nomenclature	CCT	Lumens	Efficacy	CRI
EPANL 2X2 TUWH PROR 4800LM 80CRI NLT @ 3000K	3105	4527.53	98.81	80.78
EPANL 2X2 TUWH PROR 4800LM 80CRI NLT @ 4000K	3974	4920.24	127.2	83.85
EPANL 2X2 TUWH PROR 4800LM 80CRI NLT @ 5000K	4925	5004.18	123.41	82.89

Mainstream Dynamic Tunable White with nTune Technology: Tunable white nTune™ is an all-digital light color temperature control within an nLight enabled luminaire. This brings tunable white lighting control into the mainstream with repeatable, consistent results in an economical luminaire form and system already familiar to schools. Designers and facility operators are granted the freedom to tie scenes to specific activities or to complement colors or materials within a visual environment. nTune™ allows color temperature settings through the Productivity Range of 3000K-5000K. Refer to the Programming User's Guide for instructions on customizing to your application with SensorView.



Tunable White GPHD

- **Gamut:** One dimensional Warm-Cool
- **Path:** Direct 3000K to 5000K (Productivity Range)
- **Handle:** Two Natural Language Handles: Intensity and CCT
- **Data:** nLight with nTune technology for both handles of control



Lumen Maintenance:

EPANL	Reported Lumen Maintenance	Forecasted Lumen Maintenance
SE LEDs	L90 @ 41k Hrs / L80 @ >54k Hrs / L70 @ >54k Hrs	L90 @ 41k Hrs / L80 @ 84k Hrs / L70 @ 134k Hrs
HE LEDs	L90 @ 44k Hrs / L80 @ >54k Hrs / L70 @ >54k Hrs	L90 @ 44k Hrs / L80 @ 93k Hrs / L70 @ 148k Hrs

EPANL LED Flat Panel

ACCESSORIES

Accessories: Order as separate catalog number.	
DGA14	Drywall grid adapter for 1x4 recessed fixture.
DGA22	Drywall grid adapter for 2x2 recessed fixture.
DGA24	Drywall grid adapter for 2x4 recessed fixture.
PANLEM E10WCP BKT CVR	Field installable kit includes 10 watt battery, bracket and cover ¹
PANLEM BKT CVR	Field installable kit bracket and cover only, 10W battery NOT included ¹
2X2SMKSH	2'x2' Surface Mount Troffer Kit
2X4SMKSH	2'x4' Surface Mount Troffer Kit
1X4SMKSH	1'x4' Surface Mount Troffer Kit
BDP U	Field Installable Ballast Disconnect Plug
PAC 2DNF 36	Panel Air Craft Kit, 2 cables with Y splitter, No Power Feed, 36 inches. Recommended for 1X4 or 2X2 Panel Fixtures only. ²
PAC 2DF 36	Panel Air Craft Kit, 2 cables with Y splitter, with Power Feed, 36 inches. Recommended for 1X4 or 2X2 Panel Fixtures only. ^{2,3}
PAC 4DNF 36	Panel Air Craft Kit, 4 cables, No Power Feed, 36 inches. Recommended for 2X4, 1X4 or 2X2 Panel Fixtures. ²
PAC 4DF 36	Panel Air Craft Kit, 4 cables, with Power Feed, 36 inches. Recommended for 2X4, 1X4 or 2X2 Panel Fixtures. ^{2,3}
PAC 2DNF 72	Panel Air Craft Kit, 2 cables with Y splitter, No Power Feed 72 inches. Recommended for 1X4 or 2X2 Panel Fixtures only. ²
PAC 2DF 72	Panel Air Craft Kit, 2 cables with Y splitter, with Power Feed, 72 inches. Recommended for 1X4 or 2X2 Panel Fixtures only. ^{2,3}
PAC 4DNF 72	Panel Air Craft Kit, 4 cables, No Power Feed, 72 inches. Recommended for 2X4, 1X4 or 2X2 Panel Fixtures. ²
PAC 4DF 72	Panel Air Craft Kit, 4 cables, with Power Feed, 72 inches. Recommended for 2X4, 1X4 or 2X2 Panel Fixtures. ^{2,3}

Emergency Battery Estimated Lumens
Use the formula below to estimate the delivered lumens in emergency mode
Estimated Lumens = 1.25 x P x LPW
P = Output power of emergency driver (10W for PS1055CP)
LPW = Lumen per watt rating of the luminaire.

SMKSH Accessory



Notes:

1. Test switch must be remote mounted or installed in an adjacent ceiling tile.
2. See Suspension Kits section below for additional detail.
3. For MVOLT only, not available with 347V

Emergency Battery Pack Options – Field Installable

Battery Model Number	Wattage	Runtime (Minutes)	Lumen Output* @ 120 Lumens/Watt	Other
ILB CP07 2H A	7W	120	840	Storm Shelter / 2 Hour Runtime
ILB CP10 A	10W	90	1200	
ILBLP CP10 HE SD A	10W	90	1200	Title 20, Self Diagnostic
ILBLP CP15 HE SD A	15W	90	1800	Title 20, Self Diagnostic
ILB CP20 HE A	20W	90	2400	Title 20
ILB CP20 HE SD A	20W	90	2400	Title 20, Self Diagnostic

All the above are UL Listed products that are certified for field install external/remote to the fixture.

*Minimum delivered lumen output to assist in product selection for increased fixture mounting height.

The CP10 delivered emergency illumination outperforms legacy 1400 lumen fluorescent emergency ballast.

Please contact us at productsupportemergency@acuitybrands.com for any Emergency Battery related questions.

UL924 Sequence of Operation

For 90 minutes following any complete AC power interruption >200 ms:

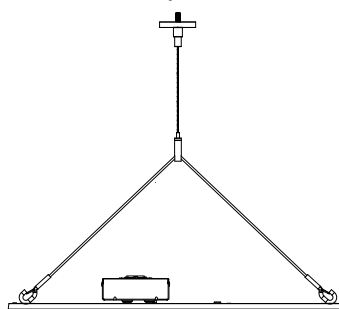
- Digital dimming is commanded to high end trim level.
- Device ignores wireless lighting control commands.

Suspension Kits

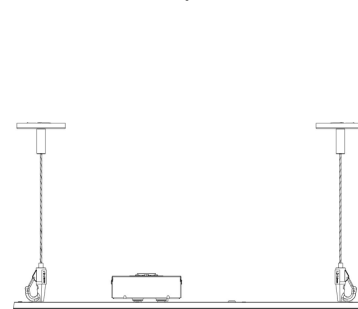
2 drops (1x4)



2 drops (2x2)



4 drops (2x4)



EPANL

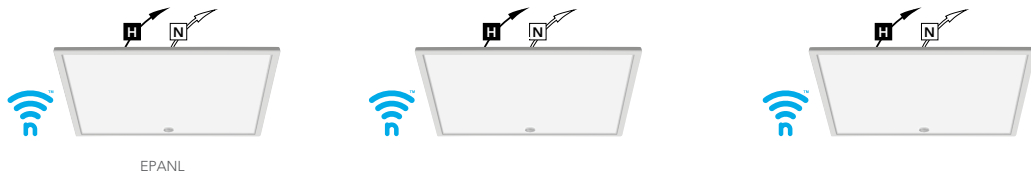
TYPE T3A

EPANL LED Flat Panel

nLight Platform

nLight embedded fixtures offer:	Customers get:
Manual Dimming	Convenience and visual comfort for occupants
Motion Sensing and/or Daylight Harvesting	Energy savings and code compliance
Fixture or Group Level Control	Ability to configure lighting to the space requirements
Flexibility	Ease of fixture moves, adds and changes
Wireless Wall Switch (nLight AIR Only)	Ease and flexibility of placement
Astronomical and Time of Day Scheduling	Energy savings and building security
Scalable Solution	nLight controls to grow with your business
Future-Ready	nLight platform to set foundation for future upgrades and capabilities

nLight Air Wireless

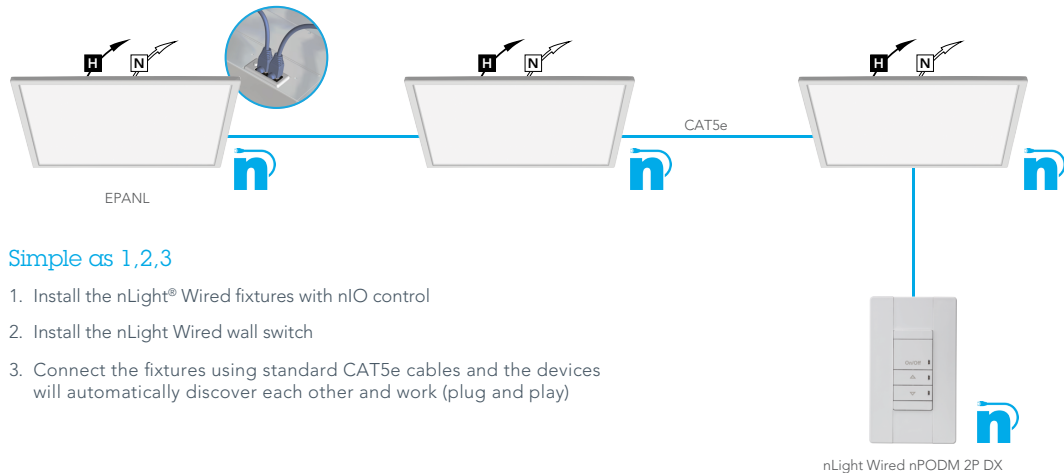


Simple as 1,2,3

1. Install the nLight® AIR fixtures with embedded smart sensor
2. Install the wireless battery-powered wall switch
3. With the CLARITY Pro app, pair the fixtures with the wall switch and if desired, customize the sensor settings for the desired outcome



nLight Wired Networking



Simple as 1,2,3

1. Install the nLight® Wired fixtures with nIO control
2. Install the nLight Wired wall switch
3. Connect the fixtures using standard CAT5e cables and the devices will automatically discover each other and work (plug and play)

EPANL LED Flat Panel

TYPE T3A

Controls Accessories

nLight® Wired Control Accessories:

Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlight.

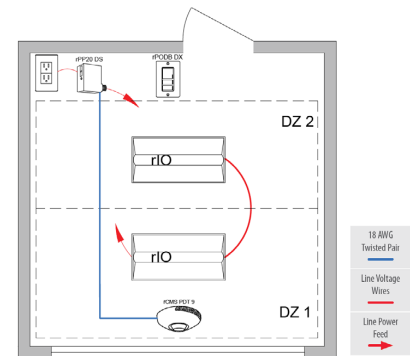
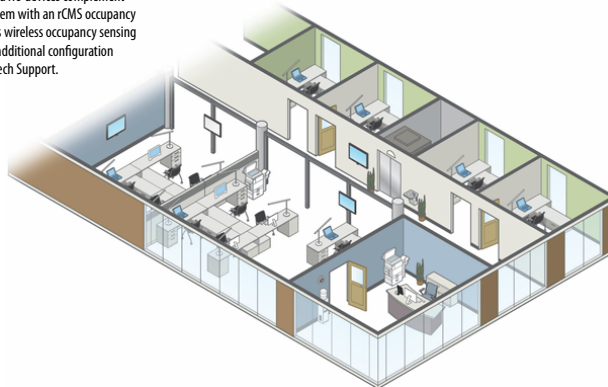
WallPod stations	Model number	Occupancy sensors	Model number
On/Off	nPODMA [Color]	Small motion 360°, ceiling (PIR / dual tech)	nCM 9 RJB / nCM PDT 9 RJB
On/Off & raise/lower	nPODMA DX [Color]	Large motion 360°, ceiling (PIR / dual tech)	nCM10 RJB / nCM PDT 10 RJB
Graphic touchscreen	nPOD TOUCH [Color]	Wall switch with raise/lower	nWSX PDT LV DX [color]
Photozell controls	Model number	Cat-5 cable (plenum rated)	Model number
Full range dimming	nCM ADCX RJB	10' cable	CATS 10FT J1
		30' cable	CATS 30FT J1

nLight® AIR Control Accessories:

Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlightair.

Wall switches	Model number
On/Off single pole	rPODBA [color] G2
On/Off two pole	rPODB A2P [color] G2
On/Off & raise/lower single pole	rPODBA DX [color] G2
On/Off & raise/lower two pole	rPODBA 2P DX [color] G2

EPANL fixtures with integrated rIO devices complement any small office space. Pair them with an rCMS occupancy sensor and the space now has wireless occupancy sensing and dimming capability. For additional configuration options please consult with Tech Support.



rCMS ¹						Example: RCMS PDT 10 AR G2	
Series / Detection	Power Supply ¹	Occupancy Detection	Lens (Required)	Operating Mode	Generation		
RCMS nLight AIR occupancy and daylight sensor	[blank] Power Supply ordered separately	[blank] PIR Detection PDT Dual Tech PIR/Microphonics	10 Large Motion/ Extended Range 360°	[BLANK] None AR Auxiliary Relay	G2 Generation 2 compatibility		
	PS 150 Standard 150 mA Power Supply		9 Small Motion/ Extended Range 360°				
			6 High Bay 360° Lens				

Notes

¹ RCMS requires low voltage power from either RPP20 DS 24V G2 or PS150.



Sensor Switch
WSX



nLight WIRED
nPOD UNITOUCH



nLight WIRED
nPODMA DX



nLight AIR
rPODBA



EPANL with rES7



rPODBA



RCMS

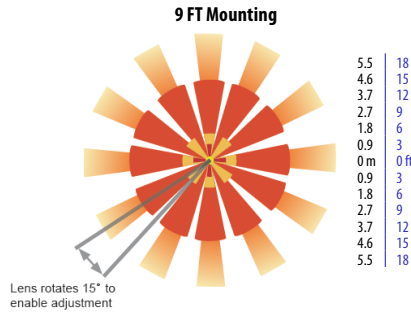


EPANL

EPANL LED Flat Panel

Sensor Coverage Pattern Mini 360° Lens

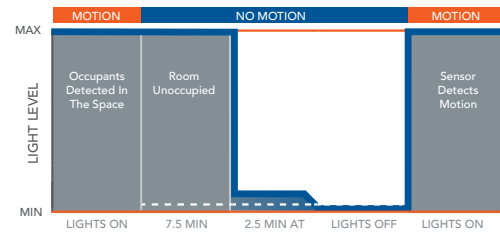
- Recommended for walking motion detection from mounting heights between 8 ft (2.44 m) and 20 ft (6.10 m)
- Initial detection of walking motion along sensor axes at distances of 2x the mounting height up to 15 ft (4.57 m) and
- 1.75x up to 20 ft (6.10 m).
- Provides 12 ft (3.66 m) radial detection of small motion when mounted at 9 ft (2.74 m)
- Initial detection will occur earlier when walking across sensor's field of view than when walking directly at sensor



nLight AIR Wireless

nLight AIR is the ideal solution for retrofit or new construction spaces where adding additional wiring can be labor intensive and nLight AIR is available with or without an integral sensor. The integrated rES7 or rES7PDT smart sensors are part of each luminaire in the nLight AIR network, which can be grouped to control multiple luminaires. The granularity of control with the digital PIR occupancy detection and daylight sensing makes a great solution for any application.

Sequence of Operation (nES7 and Sensor)



*The presetting on the automatic dimming photocell is 10fc (RES7).

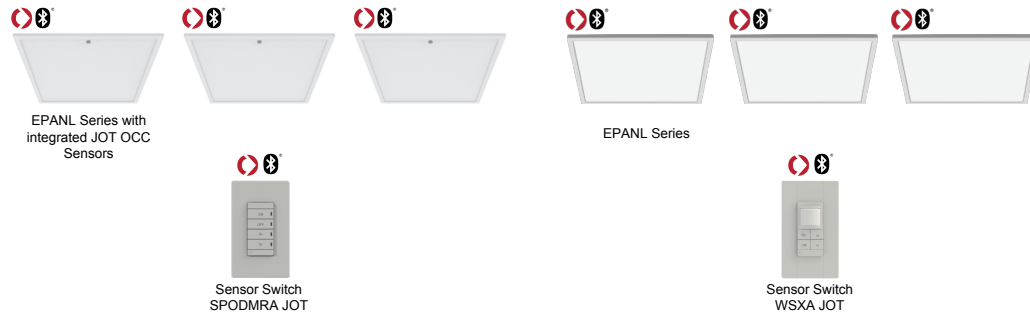
Sensor Switch JOT



Sensor Switch JOT Enabled Wireless Solution

Designed with contractors in mind, the Sensor Switch JOT enabled wireless solution offers a straightforward approach to the installation and pairing of lighting fixtures and controls. Absolutely no 0-10V control wires and no mobile apps are needed with JOT enabled products, allowing for lightning speed installation right out of the box.

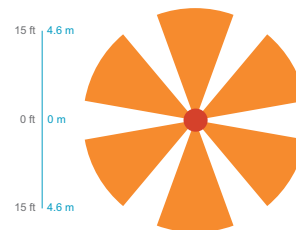
- Power:** Install JOT enabled fixtures and controls as instructed.
- Pair:** Insert the pairing tool into the pinhole on the wall switch; press and hold any button for 6 seconds.
- Play:** Once paired, each fixture will individually dim down to 10% brightness. All products will be fully functional.



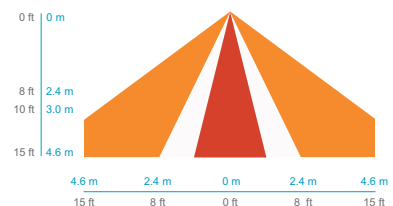
15F - LARGE MOTION EXTENDED RANGE 360

- Optimized full coverage from 8 ft - 15 ft (2.4 m - 4.5 m) mounting heights
- Reliable detection of large motion (e.g. pedestrian walking traffic)
- 1.3 x mounting height equals approximate detection range

TOP VIEW



SIDE VIEW



EPANL LED Flat Panel

Performance Data					
Model No.	DLC Classification	Reported Light Output	Reported Wattage	Reported Efficacy (AC)	DLC Product Id
EPANL 1X4 1500LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1511	14	108	P7WQ2HL
EPANL 1X4 1500LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1511	14	108	P7U30VTJ
EPANL 1X4 1500LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1574	14	113	P8VKRLEE
EPANL 1X4 1500LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1574	14	113	P7KC75SF
EPANL 1X4 1500LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1637	14	117	PJAP0LUK
EPANL 1X4 1500LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1637	14	117	P93PN6HF
EPANL 1X4 1500LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1699	14	122	PJ2LT8RF
EPANL 1X4 1500LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1699	14	122	PMO20WDF
EPANL 1X4 1500LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1419	12	119	P783S2UK
EPANL 1X4 1500LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1419	12	119	P08VAI49
EPANL 1X4 1500LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1457	12	122	PPJ3S90F
EPANL 1X4 1500LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1457	12	122	PKV3IEP
EPANL 1X4 1500LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	1508	12	127	P2590KI9
EPANL 1X4 1500LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	1508	12	127	P66FTD1J
EPANL 1X4 1500LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	1543	12	130	PD3A29J1
EPANL 1X4 1500LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	1543	12	130	PW3538GV
EPANL 1X4 3000LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	2841	27	106	PEYKSSNY
EPANL 1X4 3000LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	2841	27	106	P7W193ZL
EPANL 1X4 3000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	2960	27	110	PBMB5QAS
EPANL 1X4 3000LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	2960	27	110	PT0HAAX5
EPANL 1X4 3000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3078	27	114	PNKUCIA
EPANL 1X4 3000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3078	27	114	PM3ZWBUF
EPANL 1X4 3000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3197	27	119	PMH2SAT
EPANL 1X4 3000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3197	27	119	PFZRHYS
EPANL 1X4 3000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	2771	23	123	PJ1YE30
EPANL 1X4 3000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	2771	23	123	P49S1R0
EPANL 1X4 3000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	2845	23	126	PTUGXVMO
EPANL 1X4 3000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	2845	23	126	P61KCHZV
EPANL 1X4 3000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	2945	23	130	PJYUQUN8
EPANL 1X4 3000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	2945	23	130	PJZRVW5F
EPANL 1X4 3000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3012	23	133	POATZ94T
EPANL 1X4 3000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3012	23	133	PT45WGFZ
EPANL 1X4 4000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	3426	31	111	PSWJLZ98
EPANL 1X4 4000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3963	37	107	P7MFGP4R
EPANL 1X4 4000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3963	37	107	PQH0HMOH
EPANL 1X4 4000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4116	37	111	PY8MM627
EPANL 1X4 4000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4116	37	111	P3XBCGJ0
EPANL 1X4 4000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3667	31	120	PKMNCN1T4
EPANL 1X4 4000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3667	31	120	PDWGL65K
EPANL 1X4 4000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3765	31	123	PJZ17EWI
EPANL 1X4 4000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3765	31	123	P4L0LVRG
EPANL 1X4 4000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3897	31	128	PZGUZR2U
EPANL 1X4 4000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3897	31	128	PY7QZBWI
EPANL 1X4 4000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3985	31	130	PDAKJ8B3
EPANL 1X4 4000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3985	31	130	PELAOSTB
EPANL 1X4 4800LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4633	45	104	PII6VKUP
EPANL 1X4 4800LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4633	45	104	PKJ02BDR
EPANL 1X4 4800LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4807	45	108	P716D3WI
EPANL 1X4 4800LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4807	45	108	PJ87LC64
EPANL 1X4 4800LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4923	45	110	PICJQWGD
EPANL 1X4 4800LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4923	45	110	PZW1PDFZ
EPANL 1X4 4800LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4967	45	111	PQAFPPJ6
EPANL 1X4 4800LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4967	45	111	PCNBZY2M0
EPANL 1X4 4800LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4340	37	117	PU1UIM58
EPANL 1X4 4800LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4340	37	117	PNSWOKZ3
EPANL 1X4 4800LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4456	37	120	P0BHX07V
EPANL 1X4 4800LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4456	37	120	P07FGWK3
EPANL 1X4 4800LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4612	37	124	PHAPQJJS
EPANL 1X4 4800LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4612	37	124	PZ9DDI8L
EPANL 1X4 4800LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4717	37	127	PLOV456F
EPANL 1X4 4800LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4717	37	127	PJIAJOSO
EPANL 1X4 5400LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5156	44	116	PKIBC75K
EPANL 1X4 5400LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5156	44	116	PC2IS9KU
EPANL 1X4 5400LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5272	44	119	PNX0E6ZR
EPANL 1X4 5400LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5272	44	119	PE4NWEQC
EPANL 1X4 5400LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5490	44	124	PF0B5KQD

TYPE T3A

EPANL LED Flat Panel

Performance Data					
Model No.	DLC Classification	Reported Light Output	Reported Wattage	Reported Efficacy (AC)	DLC Product Id
EPANL 1X4 5400LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5490	44	124	PVWWB0JI
EPANL 1X4 5400LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5665	44	128	PEC0GL65
EPANL 1X4 5400LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5665	44	128	P7PAYNFS
EPANL 1X4 6000LM 80CRI 30K [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	5953	55	109	P84A41CZ
EPANL 1X4 6000LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5953	51	117	PL3AU798
EPANL 1X4 6000LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5953	51	117	PCMNH26U
EPANL 1X4 6000LM 80CRI 35K [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	5997	55	110	PWJ6HVP3
EPANL 1X4 6000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5997	51	118	P31GEZNP
EPANL 1X4 6000LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5997	51	118	P9MS2FI2
EPANL 1X4 6000LM 80CRI 40K [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	6171	55	113	PD7JL7CS
EPANL 1X4 6000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	6171	51	121	PEC0ZVXY
EPANL 1X4 6000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	6171	51	121	PRC6VIDH
EPANL 1X4 6000LM 80CRI 50K [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	6240	55	114	P206CKK4
EPANL 1X4 6000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	6240	51	123	PSBGKZ54
EPANL 1X4 6000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	6240	51	123	PEVMDG8B
EPANL 2X2 2000LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1988	19	106	P084CQTR
EPANL 2X2 2000LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1988	19	106	PN6W7230
EPANL 2X2 2000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	2071	19	110	P4AJO6I1
EPANL 2X2 2000LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	2071	19	110	P4Y2S08D
EPANL 2X2 2000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	2154	19	115	P1QUALNF
EPANL 2X2 2000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	2154	19	115	PULQ3DQ4
EPANL 2X2 2000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	2237	19	119	P167DCJS
EPANL 2X2 2000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	2237	19	119	P1FNCFUQ
EPANL 2X2 2000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1856	16	119	P8MIUS1X
EPANL 2X2 2000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1856	16	119	PRXPVWQJ
EPANL 2X2 2000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1906	16	123	PU253KEZ
EPANL 2X2 2000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1906	16	123	PLNV5ZF6
EPANL 2X2 2000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	1972	16	127	PZSE53J1
EPANL 2X2 2000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	1972	16	127	PZKK2D04
EPANL 2X2 2000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	2017	16	130	PCLAME02
EPANL 2X2 2000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	2017	16	130	PV0MYAQV
EPANL 2X2 3400LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3291	30	109	PNSQ2LMI
EPANL 2X2 3400LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3291	30	109	PU14CBM6
EPANL 2X2 3400LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3428	30	113	PMKTPCS2
EPANL 2X2 3400LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3428	30	113	PB1DW61J
EPANL 2X2 3400LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3566	30	118	PWRHGEH4
EPANL 2X2 3400LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	3566	33	107	PS9Y8BOV
EPANL 2X2 3400LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3566	30	118	PG7KB5GU
EPANL 2X2 3400LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3703	30	122	PL6024K5
EPANL 2X2 3400LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3703	30	122	PP79GBQH
EPANL 2X2 3400LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3198	27	121	P25AS4VV
EPANL 2X2 3400LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3198	27	121	PZENR7ML
EPANL 2X2 3400LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3285	27	124	PC28H7F3
EPANL 2X2 3400LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3285	27	124	PGPCX23Z
EPANL 2X2 3400LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3399	27	128	PWGICRAX
EPANL 2X2 3400LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3399	27	128	PZQGNSEP
EPANL 2X2 3400LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3477	27	131	P57KW7H4
EPANL 2X2 3400LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3477	27	131	PDS56JHB
EPANL 2X2 4000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4121	37	110	P5L7HREA
EPANL 2X2 4000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4121	37	110	PP2PR06A
EPANL 2X2 4000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4280	37	114	P94H4XFG
EPANL 2X2 4000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4280	37	114	PFQ0F3LM
EPANL 2X2 4000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3874	33	118	PTN8M365
EPANL 2X2 4000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3874	33	118	PXW23VVD
EPANL 2X2 4000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3978	33	121	P5661UUU
EPANL 2X2 4000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3978	33	121	PG06EXAT
EPANL 2X2 4000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4117	33	125	PD2JEZV9
EPANL 2X2 4000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4117	33	125	P8BAID21
EPANL 2X2 4000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4211	33	128	P3P7W4AB
EPANL 2X2 4000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4211	33	128	PQCCGU60
EPANL 2X2 4800LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4843	45	109	P00Y8NZ2
EPANL 2X2 4800LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4843	45	109	PB9Y8XNL
EPANL 2X2 4800LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4886	45	110	PW25Y5X9
EPANL 2X2 4800LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4886	45	110	PAAM27H
EPANL 2X2 4800LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4420	36	121	PFYMYFE0
EPANL 2X2 4800LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4420	36	121	PX02EX68
EPANL 2X2 4800LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4539	36	125	PZ0PLMI9
EPANL 2X2 4800LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4539	36	125	PF2L9X2I



EPANL

EPANL LED Flat Panel

Performance Data					
Model No.	DLC Classification	Reported Light Output	Reported Wattage	Reported Efficacy (AC)	DLC Product Id
EPANL 2X2 4800LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4697	36	129	PNQ40WFF
EPANL 2X2 4800LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4697	36	129	P2NS3VB0
EPANL 2X2 4800LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4804	36	132	PG3ZCKUI
EPANL 2X2 4800LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4804	36	132	PND0X0I4
EPANL 2X4 3000LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3015	29	106	PGB293WJ
EPANL 2X4 3000LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3015	29	106	PXWRSANS
EPANL 2X4 3000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3141	29	110	PU32L41S
EPANL 2X4 3000LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3141	29	110	PWJKJ91G
EPANL 2X4 3000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3266	29	115	PVIRS0QB
EPANL 2X4 3000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3266	29	115	PP0P99LT
EPANL 2X4 3000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3392	29	119	P4H3UGFQ
EPANL 2X4 3000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3392	29	119	PLI4CPSN
EPANL 2X4 3000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	2943	23	129	PHDEORE3
EPANL 2X4 3000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	2943	23	129	PYUNOTIN
EPANL 2X4 3000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	2986	23	131	P2GQ1ISA
EPANL 2X4 3000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	2986	23	131	PC23010I
EPANL 2X4 3000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3071	23	135	PNWQLGKR
EPANL 2X4 3000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3071	23	135	P3CL956W
EPANL 2X4 3000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3114	23	137	PIIH40FQ
EPANL 2X4 3000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3114	23	137	P609TWNV
EPANL 2X4 3760LMHE 80CRI 40K MIN10 ZT MVOLT NACV	Premium	3984	27	147	PQMBSPAR
EPANL 2X4 4000LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3914	38	104	PLDIMHXG
EPANL 2X4 4000LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3914	38	104	P01K0BJN
EPANL 2X4 4000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4077	38	108	PPTL71HY
EPANL 2X4 4000LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4077	38	108	PRO2E004
EPANL 2X4 4000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4240	38	113	PT1H08CF
EPANL 2X4 4000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4240	38	113	PGSERWDA
EPANL 2X4 4000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4403	38	117	P8TD4A4V
EPANL 2X4 4000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4403	38	117	PTXVJNOI
EPANL 2X4 4000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3874	31	123	P8R62RB3
EPANL 2X4 4000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3874	31	123	P23T82YA
EPANL 2X4 4000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3930	31	125	PIY82204
EPANL 2X4 4000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3930	31	125	PSKVI7RT
EPANL 2X4 4000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4042	31	129	PPU6PYNE
EPANL 2X4 4000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4042	31	129	P9VND0DS
EPANL 2X4 4000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4098	31	130	PTRH2WMJ
EPANL 2X4 4000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4098	31	130	P55XJ12N
EPANL 2X4 4800LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4817	45	107	PZB2XRG3
EPANL 2X4 4800LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4817	45	107	PHYF1N9C
EPANL 2X4 4800LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4998	45	111	P4PIQJFW
EPANL 2X4 4800LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4998	45	111	PI2A3L85
EPANL 2X4 4800LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5119	45	113	P4SKVRJP
EPANL 2X4 4800LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5119	45	113	P018HM99
EPANL 2X4 4800LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5164	45	114	PG2MHOZE
EPANL 2X4 4800LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	5164	48	107	P70IOAPR
EPANL 2X4 4800LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5164	45	114	PWTSOASQ
EPANL 2X4 4800LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4491	37	120	P3RFGZH6
EPANL 2X4 4800LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4491	37	120	POC36E5U
EPANL 2X4 4800LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4612	37	123	PYK5A8HX
EPANL 2X4 4800LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4612	37	123	PYWZDYOR
EPANL 2X4 4800LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4773	37	127	P47QIRYT
EPANL 2X4 4800LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4773	37	127	PH0QXWON
EPANL 2X4 4800LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4882	37	130	PR3ISII0
EPANL 2X4 4800LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4882	37	130	PKP1XLJT
EPANL 2X4 5000LMHE 80CRI 40K MIN10 ZT MVOLT NACV	Premium	5218	37	141	PL4KIXE5
EPANL 2X4 5400LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5345	49	109	PO568XSR
EPANL 2X4 5400LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5345	49	109	P00696L1
EPANL 2X4 5400LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5546	49	113	PFC1L300
EPANL 2X4 5400LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5546	49	113	PK7Q1VHH
EPANL 2X4 5400LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5679	49	116	PR3K6SHH
EPANL 2X4 5400LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5679	49	116	P8KYWF8W
EPANL 2X4 5400LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5730	49	117	PVKKX9GJ
EPANL 2X4 5400LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5730	49	117	PX1YH6FH
EPANL 2X4 5400LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5302	41	131	P3JOAC0V
EPANL 2X4 5400LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	5302	41	128	PNWXLXM3
EPANL 2X4 5400LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5302	41	131	PARJN9JC
EPANL 2X4 5400LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5421	41	134	P4E4JYPW
EPANL 2X4 5400LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	5421	41	131	PPKAF154

TYPE T3A

EPANL LED Flat Panel

Performance Data					
Model No.	DLC Classification	Reported Light Output	Reported Wattage	Reported Efficacy (AC)	DLC Product Id
EPANL 2X4 5400LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5421	41	134	PBVWKVM6
EPANL 2X4 5400LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5645	41	139	PWCONHWW
EPANL 2X4 5400LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	5645	41	137	PZRLJ13L
EPANL 2X4 5400LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5645	41	139	PAHJYVRW
EPANL 2X4 5400LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5825	41	144	PKDG7XHY
EPANL 2X4 5400LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	5825	41	141	P36758NK
EPANL 2X4 5400LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5825	41	144	P2LSI059
EPANL 2X4 5757LMHE 80CRI 40K MIN10 ZT MVOLT NACV	Premium	5776	40	143	P71Q69QD
EPANL 2X4 6000LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6318	50	126	PD2QM1LA
EPANL 2X4 6000LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6318	50	126	P32NF8NU
EPANL 2X4 6000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6364	50	127	PSV30WTC
EPANL 2X4 6000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	6364	55	115	P89SURCD
EPANL 2X4 6000LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6364	50	127	PK0759Q3
EPANL 2X4 6000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6548	50	131	PWWK6LER
EPANL 2X4 6000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6548	50	131	PHICROVH
EPANL 2X4 6000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6622	50	132	PQMLRFRM
EPANL 2X4 6000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6622	50	132	PSF8NN00
EPANL 2X4 6000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5755	43	135	P6JUAFCI
EPANL 2X4 6000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	5755	45	128	PDDV7MOA
EPANL 2X4 6000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5755	43	135	P0J81Q95
EPANL 2X4 6000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5884	43	138	PENZU105
EPANL 2X4 6000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	5884	45	131	PIVHYPP1
EPANL 2X4 6000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5884	43	138	PKFWFCU
EPANL 2X4 6000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6127	43	144	P2GV0FOB
EPANL 2X4 6000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	6127	45	136	PB0A5LE2
EPANL 2X4 6000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6127	43	144	PA04TVD1
EPANL 2X4 6000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6322	43	148	P2ZYBVS5
EPANL 2X4 6000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	6322	45	140	P888TM5U
EPANL 2X4 6000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6322	43	148	PKPSCMGA
EPANL 2X4 6800LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7013	62	113	PW2KT9FQ
EPANL 2X4 6800LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7013	62	113	PBEOWDCQ
EPANL 2X4 6800LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7064	62	114	PW0040LR
EPANL 2X4 6800LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7064	62	114	P7ALFH3K
EPANL 2X4 6800LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7269	62	117	P8FE8BQH
EPANL 2X4 6800LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	7269	65	111	PSLOA6G7
EPANL 2X4 6800LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7269	62	117	PIUM942B
EPANL 2X4 6800LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7351	62	118	PCMKG05N
EPANL 2X4 6800LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7351	62	118	P9AP1VBW
EPANL 2X4 6800LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6450	48	135	PTT9MBX1
EPANL 2X4 6800LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6450	48	135	PNHSDDT2
EPANL 2X4 6800LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6596	48	138	PICAPAMD
EPANL 2X4 6800LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6596	48	138	PHA6TVBP
EPANL 2X4 6800LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6868	48	144	P18UL0J1
EPANL 2X4 6800LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6868	48	144	P7786JMO
EPANL 2X4 6800LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	7086	48	149	PU25XKJQ
EPANL 2X4 6800LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	7086	48	149	PMB46YK
EPANL 2X4 7200LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7388	66	111	P2QK1V0K
EPANL 2X4 7200LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	7388	70	106	PF1518JE
EPANL 2X4 7200LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7388	66	111	P2GTCW3J
EPANL 2X4 7200LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7442	66	112	PCRM0D2R
EPANL 2X4 7200LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	7442	70	107	PKYV7048
EPANL 2X4 7200LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7442	66	112	P41RL2HS
EPANL 2X4 7200LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7657	66	115	PS2AC19A
EPANL 2X4 7200LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	7657	70	110	PBV78YXA
EPANL 2X4 7200LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7657	66	115	PCLJ4VZN
EPANL 2X4 7200LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7744	66	117	PIS28TOX
EPANL 2X4 7200LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	7744	70	111	PSPB7FBG
EPANL 2X4 7200LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7744	66	117	PIR0A8L6
EPANL 2X4 7200LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6792	50	137	PJN0UK7J
EPANL 2X4 7200LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6792	50	137	PW92GBXR
EPANL 2X4 7200LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6945	50	140	PHWEYL0D
EPANL 2X4 7200LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6945	50	140	PXHH12RI
EPANL 2X4 7200LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	7232	50	146	PW3RZAGO
EPANL 2X4 7200LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	7232	50	146	PZY6WXTJ
EPANL 2X4 7200LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	7462	50	151	PPYDM8D6
EPANL 2X4 7200LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	7462	50	151	P7IGKCWE



EPANL

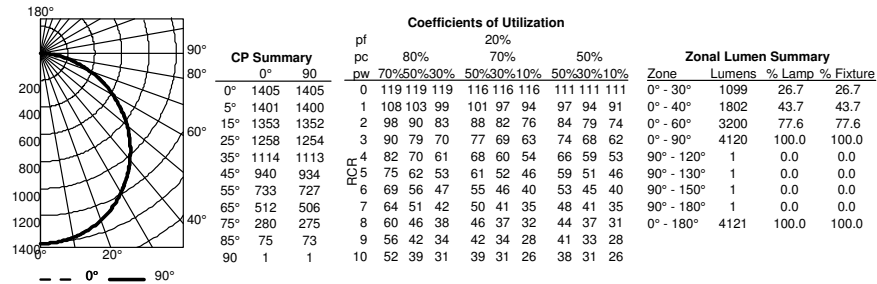
EPANL LED Flat Panel

TYPE T3A

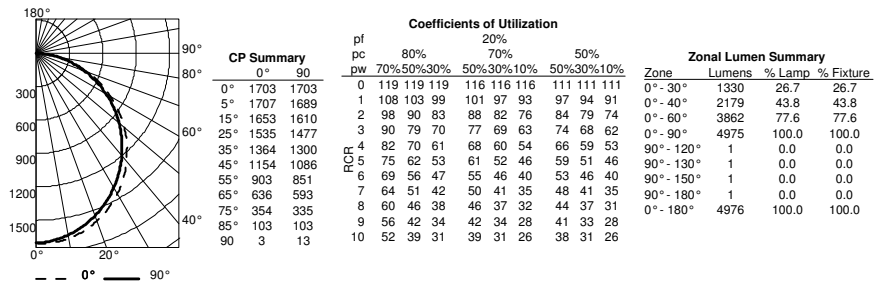
PHOTOMETRICS

Full Photometric data is available on Lithonia.acuitybrands.com

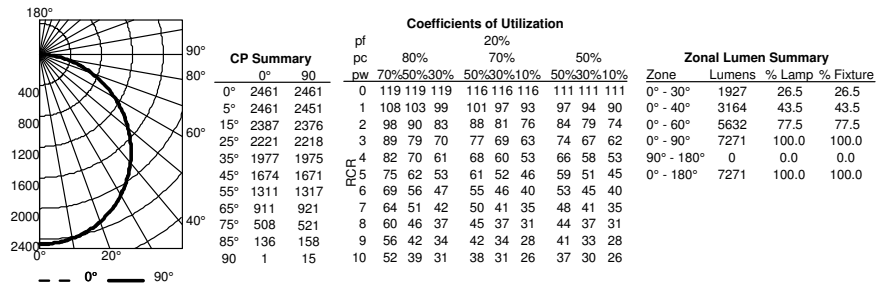
EPANL 2x2 4000LM 80CRI 40K, 4121 delivered lumens.



EPANL 2x4 4800LM 80CRI 40K, 5119 delivered lumens.



EPANL 2x4 6800LM 80CRI 40K, 7269 delivered lumens.

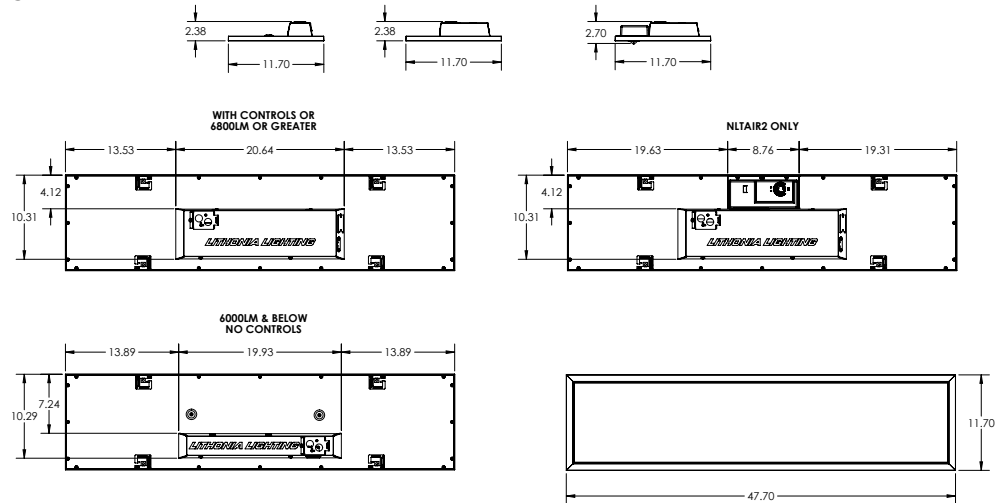


EPANL LED Flat Panel

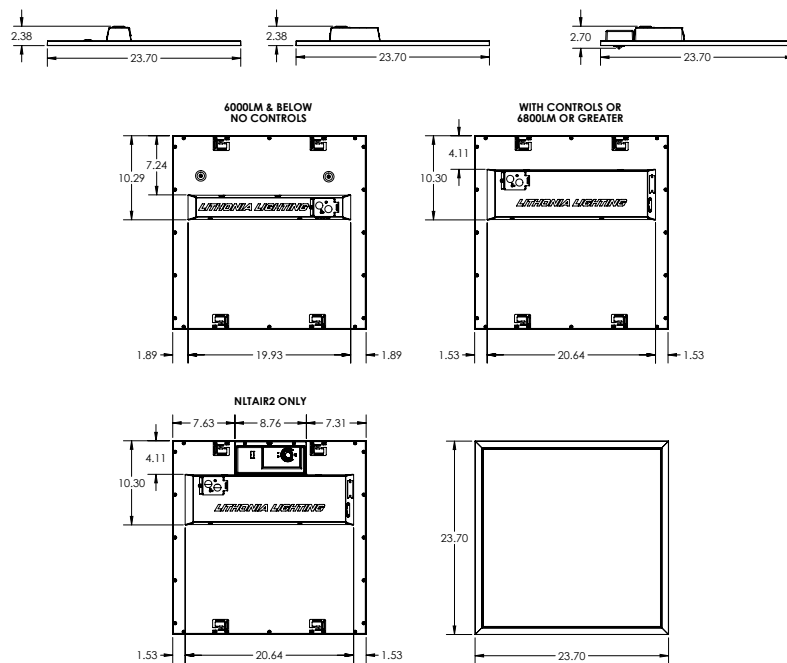
TYPE T3A

DIMENSIONS

1X4 Configurations



2X2 Configurations

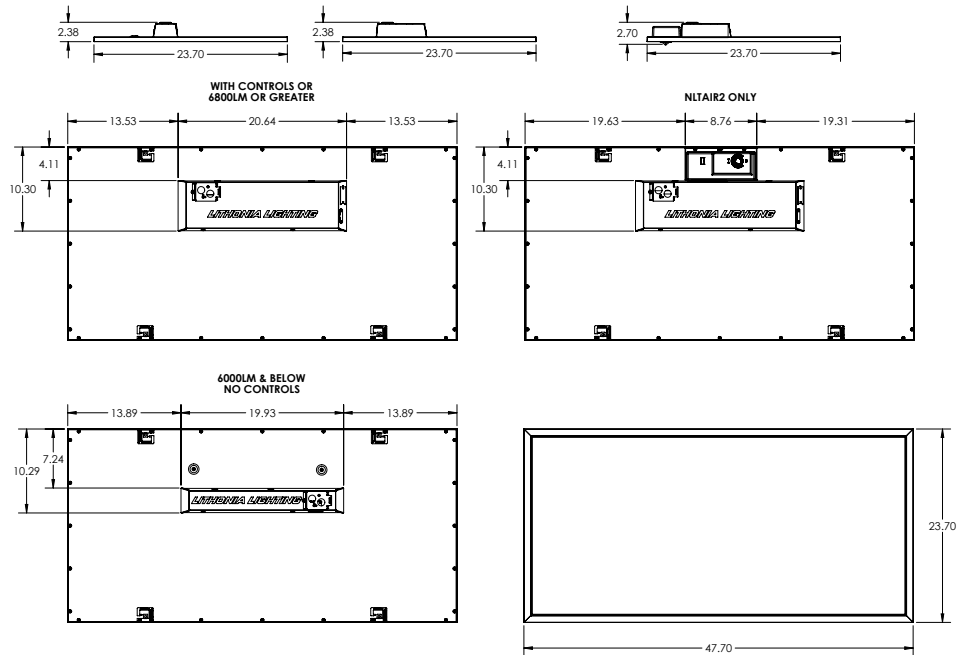


EPANL LED Flat Panel

TYPE T3A

DIMENSIONS (continued)

2X4 Configurations





DIGITAL NAVIGATION

[Ordering Tree](#) [nLight Platform](#) [Sensor Switch JOT](#) [Photometrics](#) [Performance Data](#) [Drawings](#)

FEATURES & SPECIFICATIONS

INTENDED USE — The EPANL Series LED Edge-Lit Flat Panel provides a fully luminous appearance across the face of the lens. This provides a soft, glare-free solution that is visually comfortable within the space. Suitable for many lighting applications including schools, offices and other commercial spaces, retail, convenience stores, hospitals and healthcare facilities. **Certain airborne contaminants can diminish the integrity of acrylic and/or polycarbonate.** [Click here for Acrylic-Polycarbonate Compatibility table for suitable uses.](#)

CONSTRUCTION — Built to last with an aluminum frame for strength and durability, the seamless frame prevents light leak in the corners. The PMMA light guide plate and lens resists yellowing and transmits light with superior efficacy. The satin white lens provides excellent shielding and fully luminous appearance. EPANL's low-profile design provides increased installation flexibility especially in restricted plenum spaces. The back plate includes integral T-bar clips for installation into 15/16" or 9/16" T-grid ceilings. Fixture may be recessed, suspended, surface box mounted or mounted in a hard-ceiling see accessories section for more information. Fixture may be mounted and wired in continuous rows.

Integrated Sensor (nLight Wired Networking): This sensor is nLight-enabled, meaning it has the ability to communicate over an nLight network. When wired, using CAT-5 cabling, with other nLight-enabled sensors, power packs, or WallPods, an nLight control zone is created. Once linked to a Gateway, directly or via a Bridge, the zone becomes capable of remote status monitoring and control via SensorView software.

Integrated Smart Sensor (nLight Air Wireless Platform): The RES7 sensor is nLight AIR enabled, meaning it has the ability to communicate over the wireless nLight control platform. It is available with an automatic dimming photocell, and either a digital PIR or a microphonics (PDT) dual technology occupancy sensor. It pairs to other luminaires and wall switches through our mobile app, CLAIRITY, which allows for simple sensor adjustment

Integrated Wireless Sensor (single room control): Sensor Switch VERTEX JOT or JOTVTX15 luminaire-embedded occupancy and ambient light sensor allows the luminaire to power off when the space is unoccupied or when enough ambient light is entering the space. See page 7 for more details on the integrated wireless sensor.

ELECTRICAL — Long-life LEDs, coupled with a high-efficiency driver, provide superior illumination for extended service life. See page 3 for detailed lumen maintenance information. 0-10V dimming driver, dims to 1% or 10% and contains non-isolated dimming leads.

LISTINGS — CSA Certified to meet US and Canadian standards. Tested to meet UL1958. Intended for indoor use only. Product is not to be stored in non-climate controlled spaces. DesignLights Consortium® (DLC) Premium qualified product and DLC qualified product. Not all versions of this product may be DLC Premium qualified or DLC qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified. Damp location listed. IC rated. IPSX rated. Long nomenclature, configurable product is rated and certified to meet NSF Splash Zone 2. Tested in accordance with ISO 14644-1; suitable for ISO Class 5-9 positive and negative pressure clean rooms. Suitable for ambient temperatures from 32°F (0°C) to 77°F (25°C).

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. Specifications subject to change without notice.

	Dimensions		
	1x4	2x2	2x4
Length	47.72"	23.70"	47.72"
Width	11.85"	23.70"	23.70"
Depth	2.19"	2.19"	2.19"
Weight	13.9 lbs	7.4 lbs	15.1 lbs

* Base configurations; options may add weight

Catalog Number	TYPE T3B
Notes	
Type	

EPANL LED

1'x4', 2'x2', and 2'x4'



Embed nLight controls today. Prepare for tomorrow.

Now	Tomorrow
User-friendly install	Scalability
Enhanced energy savings	Space configuration
Code compliance	Future-ready

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.

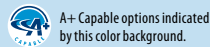
- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® control networks when ordered with drivers marked by a shaded background*
- This luminaire is part of an A+ Certified solution for nLight 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

EPANL LED Flat Panel

TYPE T3B



ORDERING INFORMATION

Example: EPANL 2X4 4000LM 80CRI 35K MIN1 MVOLT E10WCP NLTAIR2 RIO

Series	Width and Length	Lumens	CRI	Color Temperature	Minimum Dimming Level ‡
EPANL LED Flat Panel	1x4' 1'x4'	Standard Lumens:	80CRI 80 CRI	30K 3000K 35K 3500K 40K 4000K 50K 5000K	MIN10 Dims to 10% ‡ MIN1 Dims to 1%
		1500LM 1500 Lumens			
		3000LM 3000 Lumens			
		4000LM 4000 Lumens			
		4800LM 4800 Lumens			
		6000LM 6000 Lumens			
	2x2' 2'x2'	High Efficiency Lumens:			
		1500LMHE 1500 Lumens			
		3000LMHE 3000 Lumens			
		4000LMHE 4000 Lumens			
	2x4' 2'x4'	2000LM 2000 Lumens	80CRI 80 CRI	30K 3000K 35K 3500K 40K 4000K 50K 5000K	MIN10 Dims to 10% ‡ MIN1 Dims to 1%
		3400LM 3400 Lumens			
		4000LM 4000 Lumens			
		4800LM 4800 Lumens			
		6000LM 6000 Lumens			
	2x4' 2'x4'	2000LMHE 2000 Lumens			
		3400LMHE 3400 Lumens			
		4000LMHE 4000 Lumens			
		4800LMHE 4800 Lumens			
	2x4' 2'x4'	3000LM 3000 Lumens	80CRI 80 CRI	30K 3000K 35K 3500K 40K 4000K 50K 5000K	MIN10 Dims to 10% ‡ MIN1 Dims to 1%
		4000LM 4000 Lumens			
		4800LM 4800 Lumens			
		5400LM 5400 Lumens			
		6000LM 6000 Lumens			
	2x4' 2'x4'	6800LM 6800 Lumens			
		7200LM 7200 Lumens			
		3000LMHE 3000 Lumens			
		4000LMHE 4000 Lumens			

Dimming ‡	Voltage	Step Level Dimming	Emergency Option
ZT Generic 0-10V Dimming	MVOLT 120-277V	(Blank) None	E10WCP EM Self-Diagnostic battery pack, 10W Constant Power, Certified in CA Title 20 MAEDBS ‡
EZT eldoLED 0-10V Dimming	120 120V	SLD Step Level Dimming ‡	GTD Generator Transfer Device ‡
DALI eldoLED DALI	277 277V		EMG for use with NLIGHT or NLTAIR2 on generator supply EM power ‡
	347 347V ‡		

INTEGRAL BATTERY PACKS TO BE PROVIDED FOR LUMINAIRES INDICATED AS "EM" ON LIGHTING PLANS

Control Options			
Control Input		Control	Individual Control
nLight Wired:		nLight Wired: ‡	JOT Wireless room control with "Just One Touch" pairing ‡
NLIGHT nLight enabled, no constant lumen management		(blank) no control	JOTVIX15 Wireless occupancy sensor with "Just One Touch" pairing ‡
CL80 NLIGHT nLight enabled, constant lumen output 80%			
nLight Wireless:		nLight Wireless:	
NLTAIR2 nLight AIR Generation 2 enabled ‡		RIO nLight AIR Radio module without sensor ‡	
		RES7 nLight AIR PIR integral occupancy sensor with automatic dimming photocell for Networking Capabilities ‡	
		RES7PDT nLight air microphonics dual technology occupancy sensor with automatic dimming photocell ‡	

Options			
GLR Fast-blowing fuse ‡	PWS1856LV 6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit w/low voltage wires ‡	CP Chicago plenum ‡	
GMF Slow-blowing fuse ‡		NPLT Narrow Pallet	
PWS1836 6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit		BDP Factory Installed Ballast Disconnect Plug	
PWS1846 6' pre-wire, 3/8" diameter, 18 gauge, 2 circuit		RRL RELOC®-ready luminaire ‡	
PWS1846 PWSLV Two cables: one 6' pre-wire, 3/8" diameter, 18 gauge, 2 circuits; one 6' pre-wire, 3/8" diameter, 18 gauge ‡			

NOTE: ‡ indicates option value has ordering restrictions. Please reference the Option Value Ordering Restrictions chart on the next page. Options are sorted alphanumerically.

ELECTRICAL CONTRACTOR TO DETERMINE APPROPRIATE MOUNTING HARDWARE & ACCESSORIES



EPANL

EPANL LED Flat Panel

TYPE T3B

± Option Value Ordering Restrictions	
Option Value	Restriction
347	Not available with SLD, E10WCP, or GTD options.
Dimming	If Step Level Dimming (SLD) or NLIGHT or NLTAIR2 is specified, leave this section blank.
CP	Not available with nLight wired (NLIGHT), nLight wireless (NLTAIR2).
E10WCP	Refer to Emergency Battery Estimated Lumen section for lumen estimation. Test Switch must be remote mounted or installed in an adjacent ceiling tile. When using pre-wire option, use PWS1846 or PWS1846 PWSLV.
EMG	Requires a connection to existing NLIGHT or NLTAIR2 network. Power is provided from separate nLight enabled fixture.
GLR, GMF	Must specify voltage. 120 or 277, with GLR and GMF fusing.
GTD	Not available with JOT, JOTVTX15, sensor options or emergency battery options. Must specify voltage. Requires BSE labeling, voltage specific. Consult factory for options. Example: GTD BSE10.
JOT, JOTVTX15	Not available with NLIGHT, DALI, SLD, GTD, EMG, or NLTAIR2 options.
MIN10	Not available with EZT, NLIGHT or DALI.
Minimum Dimming Level	If Step Level Dimming (SLD) is specified, leave this section blank.
NLTAIR2	Only available with MIN1 minimum dimming level option.
PWS1846 PWSLV	Not available with GTD, nLight wired, nLight wireless, NLIGHT or NLTAIR2.
PWS1856LV	Not available with nLight wired, nLight wireless, NLIGHT, or NLTAIR2.
RES7EM, RES7PDTEM, RIOEM	See UL924 Sequence of Operation chart on page 4.
RRL	For ordering logic consult RRL_2013.
SLD	Not available with with any nLight Interface, Control options, or GTD. When using prewire option use PWS1846.

Tunable White (Select SKUs Only)

Available SKUs:

*2735H0 EPANL 2X2 TUWH PROR 4800LM 80CRI NLT
 *2735H9 EPANL 2X2 TUWH PROR 4800LM 80CRI NLT PWS1836
 *2735HJ EPANL 2X2 TUWH PROR 4800LM 80CRI NLT E10WCP
 *2735HN EPANL 2X2 TUWH PROR 4800LM 80CRI NLT E10WCP PWS1846

Operating Performance:

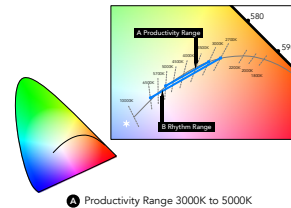
Nomenclature	CCT	Lumens	Efficacy	CRI
EPANL 2X2 TUWH PROR 4800LM 80CRI NLT @ 3000K	3105	4527.53	98.81	80.78
EPANL 2X2 TUWH PROR 4800LM 80CRI NLT @ 4000K	3974	4920.24	127.2	83.85
EPANL 2X2 TUWH PROR 4800LM 80CRI NLT @ 5000K	4925	5004.18	123.41	82.89

Mainstream Dynamic Tunable White with nTune Technology: Tunable white nTune™ is an all-digital light color temperature control within an nLight enabled luminaire. This brings tunable white lighting control into the mainstream with repeatable, consistent results in an economical luminaire form and system already familiar to schools. Designers and facility operators are granted the freedom to tie scenes to specific activities or to complement colors or materials within a visual environment. nTune™ allows color temperature settings through the Productivity Range of 3000K-5000K. Refer to the Programming User's Guide for instructions on customizing to your application with SensorView.



Tunable White GPHD

- Gamut:** One dimensional Warm-Cool
- Path:** Direct 3000K to 5000K (Productivity Range)
- Handle:** Two Natural Language Handles: Intensity and CCT
- Data:** nLight with nTune technology for both handles of control



Lumen Maintenance:

EPANL	Reported Lumen Maintenance	Forecasted Lumen Maintenance
SE LEDs	L90 @ 41k Hrs / L80 @ >54k Hrs / L70 @ >54k Hrs	L90 @ 41k Hrs / L80 @ 84k Hrs / L70 @ 134k Hrs
HE LEDs	L90 @ 44k Hrs / L80 @ >54k Hrs / L70 @ >54k Hrs	L90 @ 44k Hrs / L80 @ 93k Hrs / L70 @ 148k Hrs

EPANL LED Flat Panel

ACCESSORIES

Accessories: Order as separate catalog number.	
DGA14	Drywall grid adapter for 1x4 recessed fixture.
DGA22	Drywall grid adapter for 2x2 recessed fixture.
DGA24	Drywall grid adapter for 2x4 recessed fixture.
PANLEM E10WCP BKT CVR	Field installable kit includes 10 watt battery, bracket and cover ¹
PANLEM BKT CVR	Field installable kit bracket and cover only, 10W battery NOT included ¹
2X2SMKSH	2'x2' Surface Mount Troffer Kit
2X4SMKSH	2'x4' Surface Mount Troffer Kit
1X4SMKSH	1'x4' Surface Mount Troffer Kit
BDP U	Field Installable Ballast Disconnect Plug
PAC 2DNF 36	Panel Air Craft Kit, 2 cables with Y splitter, No Power Feed, 36 inches. Recommended for 1X4 or 2X2 Panel Fixtures only. ²
PAC 2DF 36	Panel Air Craft Kit, 2 cables with Y splitter, with Power Feed, 36 inches. Recommended for 1X4 or 2X2 Panel Fixtures only. ^{2,3}
PAC 4DNF 36	Panel Air Craft Kit, 4 cables, No Power Feed, 36 inches. Recommended for 2X4, 1X4 or 2X2 Panel Fixtures. ²
PAC 4DF 36	Panel Air Craft Kit, 4 cables, with Power Feed, 36 inches. Recommended for 2X4, 1X4 or 2X2 Panel Fixtures. ^{2,3}
PAC 2DNF 72	Panel Air Craft Kit, 2 cables with Y splitter, No Power Feed 72 inches. Recommended for 1X4 or 2X2 Panel Fixtures only. ²
PAC 2DF 72	Panel Air Craft Kit, 2 cables with Y splitter, with Power Feed, 72 inches. Recommended for 1X4 or 2X2 Panel Fixtures only. ^{2,3}
PAC 4DNF 72	Panel Air Craft Kit, 4 cables, No Power Feed, 72 inches. Recommended for 2X4, 1X4 or 2X2 Panel Fixtures. ²
PAC 4DF 72	Panel Air Craft Kit, 4 cables, with Power Feed, 72 inches. Recommended for 2X4, 1X4 or 2X2 Panel Fixtures. ^{2,3}

Emergency Battery Estimated Lumens
Use the formula below to estimate the delivered lumens in emergency mode
Estimated Lumens = 1.25 x P x LPW
P = Output power of emergency driver (10W for PS1055CP)
LPW = Lumen per watt rating of the luminaire.

SMKSH Accessory



Notes:

1. Test switch must be remote mounted or installed in an adjacent ceiling tile.
2. See Suspension Kits section below for additional detail.
3. For MVOLT only, not available with 347V

Emergency Battery Pack Options – Field Installable

Battery Model Number	Wattage	Runtime (Minutes)	Lumen Output* @ 120 Lumens/Watt	Other
ILB CP07 2H A	7W	120	840	Storm Shelter / 2 Hour Runtime
ILB CP10 A	10W	90	1200	
ILBLP CP10 HE SD A	10W	90	1200	Title 20, Self Diagnostic
ILBLP CP15 HE SD A	15W	90	1800	Title 20, Self Diagnostic
ILB CP20 HE A	20W	90	2400	Title 20
ILB CP20 HE SD A	20W	90	2400	Title 20, Self Diagnostic

All the above are UL Listed products that are certified for field install external/remote to the fixture.

*Minimum delivered lumen output to assist in product selection for increased fixture mounting height.

The CP10 delivered emergency illumination outperforms legacy 1400 lumen fluorescent emergency ballast.

Please contact us at productsupportemergency@acuitybrands.com for any Emergency Battery related questions.

UL924 Sequence of Operation

For 90 minutes following any complete AC power interruption >200 ms:

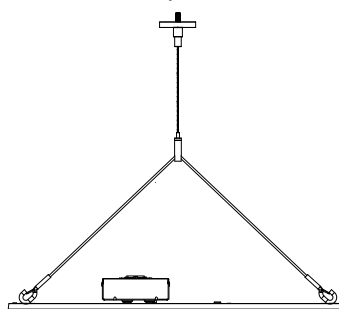
- Digital dimming is commanded to high end trim level.
- Device ignores wireless lighting control commands.

Suspension Kits

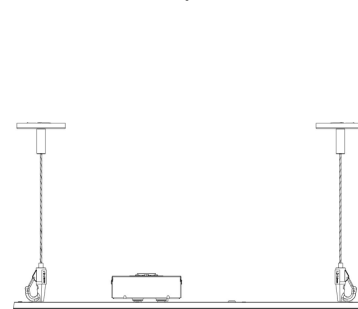
2 drops (1x4)



2 drops (2x2)



4 drops (2x4)



EPANL

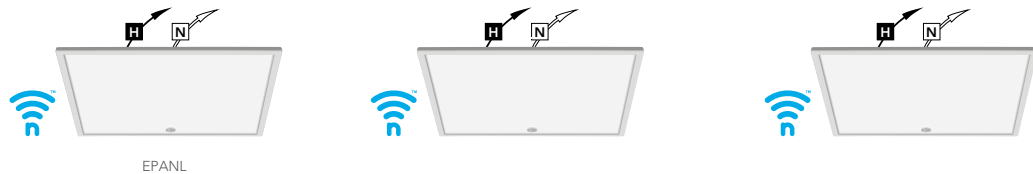
TYPE T3B

EPANL LED Flat Panel

nLight Platform

nLight embedded fixtures offer:	Customers get:
Manual Dimming	Convenience and visual comfort for occupants
Motion Sensing and/or Daylight Harvesting	Energy savings and code compliance
Fixture or Group Level Control	Ability to configure lighting to the space requirements
Flexibility	Ease of fixture moves, adds and changes
Wireless Wall Switch (nLight AIR Only)	Ease and flexibility of placement
Astronomical and Time of Day Scheduling	Energy savings and building security
Scalable Solution	nLight controls to grow with your business
Future-Ready	nLight platform to set foundation for future upgrades and capabilities

nLight Air Wireless

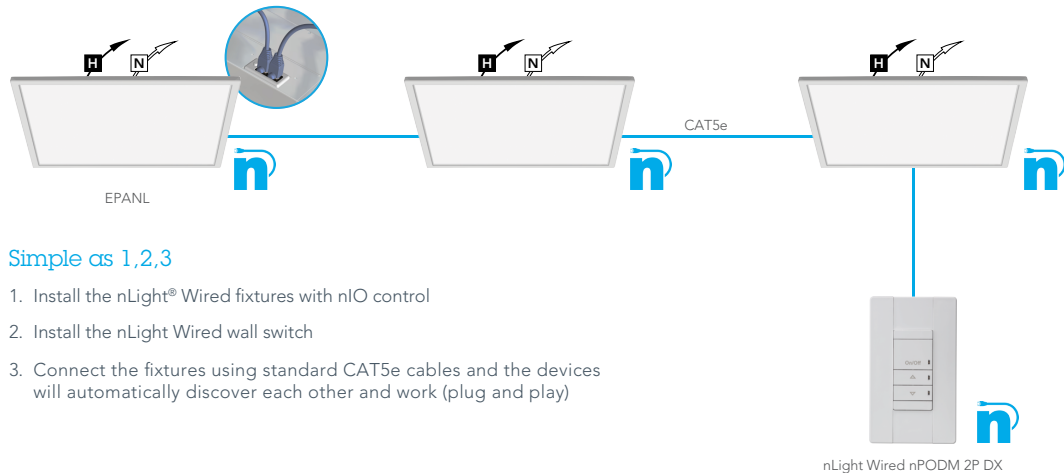


Simple as 1,2,3

1. Install the nLight® AIR fixtures with embedded smart sensor
2. Install the wireless battery-powered wall switch
3. With the CLAIRITY Pro app, pair the fixtures with the wall switch and if desired, customize the sensor settings for the desired outcome



nLight Wired Networking



Simple as 1,2,3

1. Install the nLight® Wired fixtures with nIO control
2. Install the nLight Wired wall switch
3. Connect the fixtures using standard CAT5e cables and the devices will automatically discover each other and work (plug and play)



EPANL

EPANL LED Flat Panel

TYPE T3B

Controls Accessories

nLight® Wired Control Accessories:

Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlight.

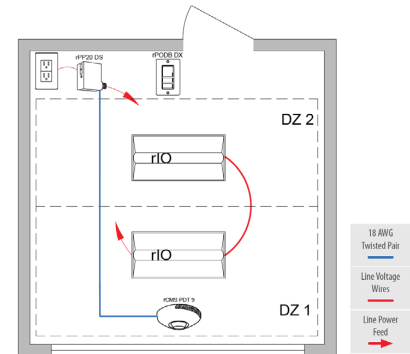
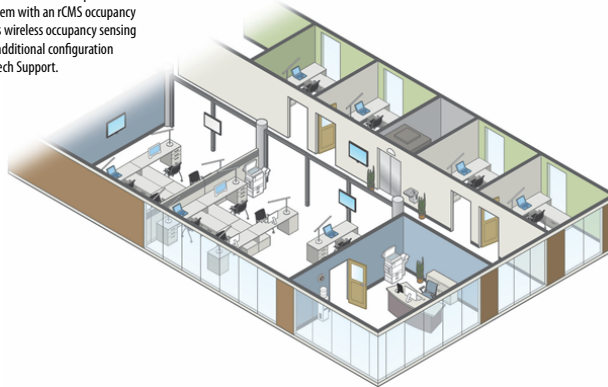
WallPod stations	Model number	Occupancy sensors	Model number
On/Off	nPODMA [Color]	Small motion 360°, ceiling (PIR / dual tech)	nCM 9 RJB / nCM PDT 9 RJB
On/Off & raise/lower	nPODMA DX [Color]	Large motion 360°, ceiling (PIR / dual tech)	nCM10 RJB / nCM PDT 10 RJB
Graphic touchscreen	nPOD TOUCH [Color]	Wall switch with raise/lower	nWSX PDT LV DX [color]
Photo cell controls	Model number	Cat-5 cable (plenum rated)	Model number
Full range dimming	nCM ADCX RJB	10' cable	CATS 10FT J1
		30' cable	CATS 30FT J1

nLight® AIR Control Accessories:

Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlightair.

Wall switches	Model number
On/Off single pole	rPODBA [color] G2
On/Off two pole	rPODB A2P [color] G2
On/Off & raise/lower single pole	rPODBA DX [color] G2
On/Off & raise/lower two pole	rPODBA 2P DX [color] G2

EPANL fixtures with integrated rIO devices complement any small office space. Pair them with an rCMS occupancy sensor and the space now has wireless occupancy sensing and dimming capability. For additional configuration options please consult with Tech Support.



rCMS ¹						Example: RCMS PDT 10 AR G2	
Series / Detection	Power Supply ¹	Occupancy Detection	Lens (Required)	Operating Mode	Generation		
RCMS nLight AIR occupancy and daylight sensor	[blank] Power Supply ordered separately PS 150 Standard 150 mA Power Supply	[blank] PIR Detection PDT Dual Tech PIR/Microphonics	10 Large Motion/ Extended Range 360° 9 Small Motion/ Extended Range 360° 6 High Bay 360° Lens	[BLANK] None AR Auxiliary Relay	G2 Generation 2 compatibility		

Notes

¹ RCMS requires low voltage power from either RPP20 DS 24V G2 or PS150.



Sensor Switch
WSX



nLight WIRED
nPOD UNITOUCH



nLight WIRED
nPODMA DX



nLight AIR
rPODBA



EPANL with rES7



rPODBA



RCMS



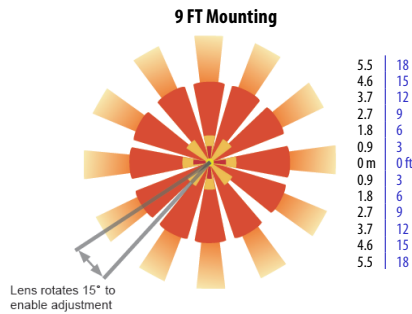
EPANL

EPANL LED Flat Panel

Sensor Coverage Pattern

Mini 360° Lens

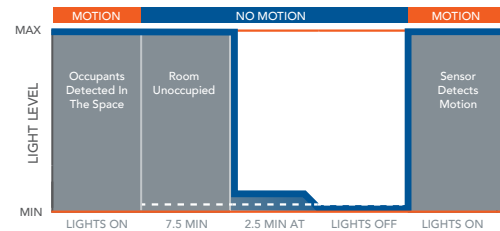
- Recommended for walking motion detection from mounting heights between 8 ft (2.44 m) and 20 ft (6.10 m)
- Initial detection of walking motion along sensor axes at distances of 2x the mounting height up to 15 ft (4.57 m) and 1.75x up to 20 ft (6.10 m).
- Provides 12 ft (3.66 m) radial detection of small motion when mounted at 9 ft (2.74 m)
- Initial detection will occur earlier when walking across sensor's field of view than when walking directly at sensor



nLight AIR Wireless

nLight AIR is the ideal solution for retrofit or new construction spaces where adding additional wiring can be labor intensive and nLight AIR is available with or without an integral sensor. The integrated rE57 or rE57PDT smart sensors are part of each luminaire in the nLight AIR network, which can be grouped to control multiple luminaires. The granularity of control with the digital PIR occupancy detection and daylight sensing makes a great solution for any application.

Sequence of Operation (nES7 and Sensor)



*The presetting on the automatic dimming photocell is 10fc (RES7).

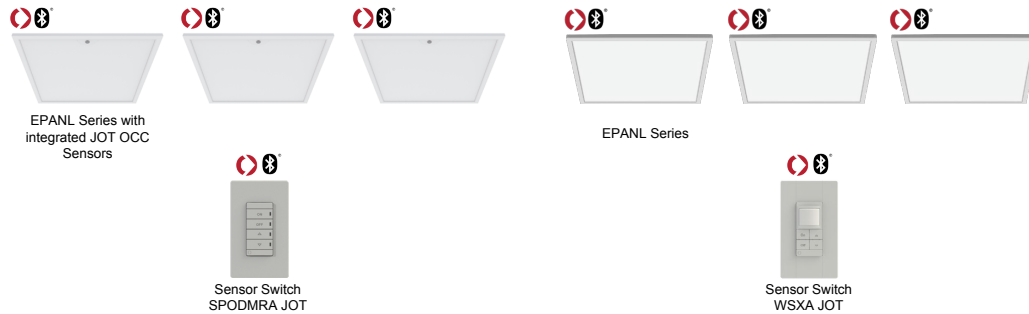
Sensor Switch J0T



Sensor Switch JOT Enabled Wireless Solution

Designed with contractors in mind, the Sensor Switch JOT enabled wireless solution offers a straightforward approach to the installation and pairing of lighting fixtures and controls. Absolutely no 0-10V control wires and no mobile apps are needed with JOT enabled products, allowing for lightning speed installation right out of the box.

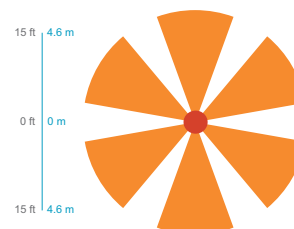
1. **Power:** Install JOT enabled fixtures and controls as instructed.
2. **Pair:** Insert the pairing tool into the pinhole on the wall switch; press and hold any button for 6 seconds.
3. **Play:** Once paired, each fixture will individually dim down to 10% brightness. All products will be fully functional.



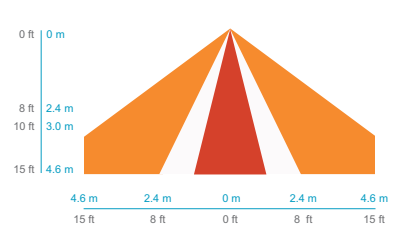
15F - LARGE MOTION EXTENDED RANGE 360

- Optimized full coverage from 8 ft - 15 ft (2.4 m - 4.5 m) mounting heights
- Reliable detection of large motion (e.g. pedestrian walking traffic)
- 1.3 x mounting height equals approximate detection range

TOP VIEW



SIDE VIEW



EPANL

EPANL LED Flat Panel

Performance Data					
Model No.	DLC Classification	Reported Light Output	Reported Wattage	Reported Efficacy (AC)	DLC Product Id
EPANL 1X4 1500LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1511	14	108	P7WQ2HL
EPANL 1X4 1500LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1511	14	108	P7U30VTJ
EPANL 1X4 1500LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1574	14	113	P8VKRLEE
EPANL 1X4 1500LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1574	14	113	P7KC75SF
EPANL 1X4 1500LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1637	14	117	PJAP0LUK
EPANL 1X4 1500LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1637	14	117	P93PN6HF
EPANL 1X4 1500LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1699	14	122	PJ2LT8RF
EPANL 1X4 1500LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1699	14	122	PMO20WDF
EPANL 1X4 1500LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1419	12	119	P783S2UK
EPANL 1X4 1500LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1419	12	119	P08VAI49
EPANL 1X4 1500LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1457	12	122	PPJ3S90F
EPANL 1X4 1500LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1457	12	122	PKV3IEP
EPANL 1X4 1500LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	1508	12	127	P2590KI9
EPANL 1X4 1500LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	1508	12	127	P66FTD1J
EPANL 1X4 1500LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	1543	12	130	PD3A29J1
EPANL 1X4 1500LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	1543	12	130	PW3538GV
EPANL 1X4 3000LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	2841	27	106	PEYKSSNY
EPANL 1X4 3000LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	2841	27	106	P7W193ZL
EPANL 1X4 3000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	2960	27	110	PBMB5QAS
EPANL 1X4 3000LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	2960	27	110	PT0HAAX5
EPANL 1X4 3000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3078	27	114	PNKUCIA
EPANL 1X4 3000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3078	27	114	PM3ZWBUF
EPANL 1X4 3000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3197	27	119	PMH2SAT
EPANL 1X4 3000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3197	27	119	PFZRHYS
EPANL 1X4 3000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	2771	23	123	PJ1YE30
EPANL 1X4 3000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	2771	23	123	P49S1R0
EPANL 1X4 3000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	2845	23	126	PTUGXVMO
EPANL 1X4 3000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	2845	23	126	P61KCHZV
EPANL 1X4 3000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	2945	23	130	PJYUQUN8
EPANL 1X4 3000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	2945	23	130	PJZRVW5F
EPANL 1X4 3000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3012	23	133	P0ATZ94T
EPANL 1X4 3000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3012	23	133	PT45WGFZ
EPANL 1X4 4000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	3426	31	111	PSWJLZ98
EPANL 1X4 4000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3963	37	107	P7MF6P4R
EPANL 1X4 4000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3963	37	107	PQH0HMOH
EPANL 1X4 4000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4116	37	111	PY8MM627
EPANL 1X4 4000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4116	37	111	P3XBCGJ0
EPANL 1X4 4000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3667	31	120	PKMNCN14
EPANL 1X4 4000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3667	31	120	PDWGL65K
EPANL 1X4 4000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3765	31	123	PJZ17EWI
EPANL 1X4 4000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3765	31	123	P4L0LVRG
EPANL 1X4 4000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3897	31	128	PZGUZR2U
EPANL 1X4 4000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3897	31	128	PY7QZBWI
EPANL 1X4 4000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3985	31	130	PDAKJ8B3
EPANL 1X4 4000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3985	31	130	PELAOSTB
EPANL 1X4 4800LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4633	45	104	PII6VKUP
EPANL 1X4 4800LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4633	45	104	PKJ02BDR
EPANL 1X4 4800LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4807	45	108	P716D3WI
EPANL 1X4 4800LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4807	45	108	PJ87LC64
EPANL 1X4 4800LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4923	45	110	PICJQWGD
EPANL 1X4 4800LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4923	45	110	PZW1PDFZ
EPANL 1X4 4800LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4967	45	111	PQAFPPJ6
EPANL 1X4 4800LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4967	45	111	PCNBZY2M0
EPANL 1X4 4800LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4340	37	117	PU1UIM58
EPANL 1X4 4800LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4340	37	117	PNSWOKZ3
EPANL 1X4 4800LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4456	37	120	P0BHX07V
EPANL 1X4 4800LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4456	37	120	P07FGWK3
EPANL 1X4 4800LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4612	37	124	PHAPQJJS
EPANL 1X4 4800LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4612	37	124	PZ9DDI8L
EPANL 1X4 4800LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4717	37	127	PL0V4S6F
EPANL 1X4 4800LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4717	37	127	PJIAJOSO
EPANL 1X4 5400LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5156	44	116	PKIBC75K
EPANL 1X4 5400LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5156	44	116	PC2IS9KU
EPANL 1X4 5400LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5272	44	119	PNX0E6ZR
EPANL 1X4 5400LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5272	44	119	PE4NWEQC
EPANL 1X4 5400LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5490	44	124	PF0B5KQD

TYPE T3B

EPANL LED Flat Panel

Performance Data					
Model No.	DLC Classification	Reported Light Output	Reported Wattage	Reported Efficacy (AC)	DLC Product Id
EPANL 1X4 5400LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5490	44	124	PVWWB0JI
EPANL 1X4 5400LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5665	44	128	PEC0GL65
EPANL 1X4 5400LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5665	44	128	P7PAYNFS
EPANL 1X4 6000LM 80CRI 30K [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	5953	55	109	P84A41CZ
EPANL 1X4 6000LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5953	51	117	PL3AU798
EPANL 1X4 6000LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5953	51	117	PCMNH26U
EPANL 1X4 6000LM 80CRI 35K [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	5997	55	110	PWJ6HVP3
EPANL 1X4 6000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5997	51	118	P31GEZNP
EPANL 1X4 6000LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5997	51	118	P9MS2F1Z
EPANL 1X4 6000LM 80CRI 40K [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	6171	55	113	PD7JL7CS
EPANL 1X4 6000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	6171	51	121	PEC0ZVXY
EPANL 1X4 6000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	6171	51	121	PRC6VIDH
EPANL 1X4 6000LM 80CRI 50K [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	6240	55	114	P206CKK4
EPANL 1X4 6000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	6240	51	123	PSBGKZ54
EPANL 1X4 6000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	6240	51	123	PEVMDG8B
EPANL 2X2 2000LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1988	19	106	P084CQTR
EPANL 2X2 2000LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1988	19	106	PN6W7230
EPANL 2X2 2000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	2071	19	110	P4AJO61I
EPANL 2X2 2000LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	2071	19	110	P4Y2S08D
EPANL 2X2 2000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	2154	19	115	PIQUALNF
EPANL 2X2 2000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	2154	19	115	PULQ3DQ4
EPANL 2X2 2000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	2237	19	119	P167DCJS
EPANL 2X2 2000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	2237	19	119	P1FNCFUQ
EPANL 2X2 2000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1856	16	119	P8MIUS1X
EPANL 2X2 2000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1856	16	119	PRXPVWQJ
EPANL 2X2 2000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1906	16	123	PU253KEZ
EPANL 2X2 2000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1906	16	123	PLNV5ZF6
EPANL 2X2 2000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	1972	16	127	PZSE53UJ
EPANL 2X2 2000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	1972	16	127	PZKK2D04
EPANL 2X2 2000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	2017	16	130	PCLAME02
EPANL 2X2 2000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	2017	16	130	PV0MYAQV
EPANL 2X2 3400LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3291	30	109	PNSQ2LMI
EPANL 2X2 3400LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3291	30	109	PU14CBM6
EPANL 2X2 3400LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3428	30	113	PMKTPCS2
EPANL 2X2 3400LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3428	30	113	PB1DW61J
EPANL 2X2 3400LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3566	30	118	PWRHGEH4
EPANL 2X2 3400LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	3566	33	107	PS9Y8BOV
EPANL 2X2 3400LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3566	30	118	PG7KB5GU
EPANL 2X2 3400LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3703	30	122	PL6024K5
EPANL 2X2 3400LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3703	30	122	PP79GBQH
EPANL 2X2 3400LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3198	27	121	P25AS4VV
EPANL 2X2 3400LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3198	27	121	PZENR7ML
EPANL 2X2 3400LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3285	27	124	PC28H7F3
EPANL 2X2 3400LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3285	27	124	PGPCX23Z
EPANL 2X2 3400LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3399	27	128	PWGICRAX
EPANL 2X2 3400LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3399	27	128	PZQGNSEP
EPANL 2X2 3400LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3477	27	131	P57KW7H4
EPANL 2X2 3400LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3477	27	131	PDS56JHB
EPANL 2X2 4000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4121	37	110	P5L7HREA
EPANL 2X2 4000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4121	37	110	PP2PR06A
EPANL 2X2 4000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4280	37	114	P94H4XFG
EPANL 2X2 4000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4280	37	114	PFQ0F3LM
EPANL 2X2 4000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3874	33	118	PTN8M36S
EPANL 2X2 4000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3874	33	118	PXW23VVD
EPANL 2X2 4000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3978	33	121	P5661UJU
EPANL 2X2 4000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3978	33	121	PG06EXAT
EPANL 2X2 4000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4117	33	125	PD2JEZV9
EPANL 2X2 4000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4117	33	125	P8BAID21
EPANL 2X2 4000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4211	33	128	P3P7W4AB
EPANL 2X2 4000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4211	33	128	PQCCGU60
EPANL 2X2 4800LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4843	45	109	P00Y8NZ2
EPANL 2X2 4800LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4843	45	109	PB9Y8XNL
EPANL 2X2 4800LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4886	45	110	PW25Y5X9
EPANL 2X2 4800LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4886	45	110	PAAAM27H
EPANL 2X2 4800LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4420	36	121	PFYMYFE0
EPANL 2X2 4800LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4420	36	121	PX02EX68
EPANL 2X2 4800LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4539	36	125	PZ0PLMI9
EPANL 2X2 4800LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4539	36	125	PF2L9X2I



EPANL

EPANL LED Flat Panel

Performance Data					
Model No.	DLC Classification	Reported Light Output	Reported Wattage	Reported Efficacy (AC)	DLC Product Id
EPANL 2X2 4800LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4697	36	129	PNQ40WFF
EPANL 2X2 4800LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4697	36	129	P2NS3VB0
EPANL 2X2 4800LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4804	36	132	PG3ZCKUI
EPANL 2X2 4800LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4804	36	132	PND0X0I4
EPANL 2X4 3000LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3015	29	106	PGB293WJ
EPANL 2X4 3000LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3015	29	106	PXWRSANS
EPANL 2X4 3000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3141	29	110	PU32L41S
EPANL 2X4 3000LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3141	29	110	PWJ9J91G
EPANL 2X4 3000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3266	29	115	PVIRS0QB
EPANL 2X4 3000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3266	29	115	PP0P99LT
EPANL 2X4 3000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3392	29	119	P4H3UGFQ
EPANL 2X4 3000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3392	29	119	PLI4CPSN
EPANL 2X4 3000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	2943	23	129	PHDEORE3
EPANL 2X4 3000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	2943	23	129	PYUNOTIN
EPANL 2X4 3000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	2986	23	131	P2GQ1ISA
EPANL 2X4 3000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	2986	23	131	PC23010I
EPANL 2X4 3000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3071	23	135	PNWQLGKR
EPANL 2X4 3000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3071	23	135	P3CL956W
EPANL 2X4 3000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3114	23	137	PIIH40FQ
EPANL 2X4 3000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3114	23	137	P609TWNV
EPANL 2X4 3760LMHE 80CRI 40K MIN10 ZT MVOLT NACV	Premium	3984	27	147	PQMBSPAR
EPANL 2X4 4000LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3914	38	104	PLDIMHXG
EPANL 2X4 4000LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3914	38	104	P01K0BJN
EPANL 2X4 4000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4077	38	108	PPTL71HY
EPANL 2X4 4000LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4077	38	108	PRO2E004
EPANL 2X4 4000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4240	38	113	PT1H08CF
EPANL 2X4 4000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4240	38	113	PGSERWDA
EPANL 2X4 4000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4403	38	117	P8TD4A4V
EPANL 2X4 4000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4403	38	117	PTXVJNOI
EPANL 2X4 4000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3874	31	123	P8R62RB3
EPANL 2X4 4000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3874	31	123	P23T82YA
EPANL 2X4 4000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3930	31	125	PIY82204
EPANL 2X4 4000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3930	31	125	PSKVI7RT
EPANL 2X4 4000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4042	31	129	PPU6PYNE
EPANL 2X4 4000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4042	31	129	P9VND0DS
EPANL 2X4 4000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4098	31	130	PTRH2WMJ
EPANL 2X4 4000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4098	31	130	P55XJ12N
EPANL 2X4 4800LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4817	45	107	PZB2XRG3
EPANL 2X4 4800LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4817	45	107	PHYF1N9C
EPANL 2X4 4800LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4998	45	111	P4PIGUFW
EPANL 2X4 4800LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4998	45	111	PI2A3L85
EPANL 2X4 4800LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5119	45	113	P4SKVRJP
EPANL 2X4 4800LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5119	45	113	P018HM99
EPANL 2X4 4800LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5164	45	114	PG2MHOZE
EPANL 2X4 4800LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	5164	48	107	P70IOAPR
EPANL 2X4 4800LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5164	45	114	PWTSOASQ
EPANL 2X4 4800LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4491	37	120	P3RFGZH6
EPANL 2X4 4800LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4491	37	120	POC36E5U
EPANL 2X4 4800LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4612	37	123	PYK5A8HX
EPANL 2X4 4800LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4612	37	123	PYWZDYOR
EPANL 2X4 4800LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4773	37	127	P47QIRYT
EPANL 2X4 4800LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4773	37	127	PH0QXWON
EPANL 2X4 4800LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4882	37	130	PR3ISII0
EPANL 2X4 4800LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4882	37	130	PKP1XLJT
EPANL 2X4 5000LMHE 80CRI 40K MIN10 ZT MVOLT NACV	Premium	5218	37	141	PL4KIXE5
EPANL 2X4 5400LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5345	49	109	PO568XSR
EPANL 2X4 5400LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5345	49	109	P00696L1
EPANL 2X4 5400LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5546	49	113	PFC1L300
EPANL 2X4 5400LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5546	49	113	PK7Q1VHH
EPANL 2X4 5400LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5679	49	116	PR3K6SHH
EPANL 2X4 5400LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5679	49	116	P8KYWF8W
EPANL 2X4 5400LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5730	49	117	PVKX9GJ
EPANL 2X4 5400LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5730	49	117	PX1YH6FH
EPANL 2X4 5400LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5302	41	131	P3JOAC0V
EPANL 2X4 5400LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	5302	41	128	PNWXLXM3
EPANL 2X4 5400LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5302	41	131	PARJN9JC
EPANL 2X4 5400LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5421	41	134	P4E4JYPW
EPANL 2X4 5400LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	5421	41	131	PPKAF154

TYPE T3B

EPANL LED Flat Panel

Performance Data					
Model No.	DLC Classification	Reported Light Output	Reported Wattage	Reported Efficacy (AC)	DLC Product Id
EPANL 2X4 5400LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5421	41	134	PBVWKVM6
EPANL 2X4 5400LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5645	41	139	PWCONHWW
EPANL 2X4 5400LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	5645	41	137	PZRLJ13L
EPANL 2X4 5400LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5645	41	139	PAHJYVRW
EPANL 2X4 5400LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5825	41	144	PKDG7XHY
EPANL 2X4 5400LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	5825	41	141	P36758NK
EPANL 2X4 5400LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5825	41	144	P2LS10S9
EPANL 2X4 5757LMHE 80CRI 40K MIN10 ZT MVOLT NACV	Premium	5776	40	143	P71Q69QD
EPANL 2X4 6000LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6318	50	126	PD2QM1LA
EPANL 2X4 6000LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6318	50	126	P32NF8NU
EPANL 2X4 6000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6364	50	127	PSV30WTC
EPANL 2X4 6000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	6364	55	115	P89SURCD
EPANL 2X4 6000LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6364	50	127	PK0759Q3
EPANL 2X4 6000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6548	50	131	PWWK6LER
EPANL 2X4 6000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6548	50	131	PHICROVH
EPANL 2X4 6000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6622	50	132	PQMLRFRM
EPANL 2X4 6000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6622	50	132	PSF8NN00
EPANL 2X4 6000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5755	43	135	P6JUAFC1
EPANL 2X4 6000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	5755	45	128	PDDV7MOA
EPANL 2X4 6000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5755	43	135	P0181095
EPANL 2X4 6000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5884	43	138	PENZU105
EPANL 2X4 6000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	5884	45	131	PIVHYPP1
EPANL 2X4 6000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5884	43	138	PKFWFCU
EPANL 2X4 6000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6127	43	144	P2GV0FOB
EPANL 2X4 6000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	6127	45	136	PB0A5LE2
EPANL 2X4 6000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6127	43	144	PA04TVD1
EPANL 2X4 6000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6322	43	148	PZ2YBVS5
EPANL 2X4 6000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	6322	45	140	P888TM5U
EPANL 2X4 6000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6322	43	148	PKPSCMGA
EPANL 2X4 6800LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7013	62	113	PW2KT9FQ
EPANL 2X4 6800LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7013	62	113	PBEOWDCQ
EPANL 2X4 6800LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7064	62	114	PW0040LR
EPANL 2X4 6800LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7064	62	114	P7ALFH3K
EPANL 2X4 6800LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7269	62	117	P8FE8BQH
EPANL 2X4 6800LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	7269	65	111	PSLOA6G7
EPANL 2X4 6800LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7269	62	117	PIUM942B
EPANL 2X4 6800LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7351	62	118	PCMKG05N
EPANL 2X4 6800LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7351	62	118	P9AP1VBW
EPANL 2X4 6800LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6450	48	135	PTT9MBX1
EPANL 2X4 6800LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6450	48	135	PNHSDDT2
EPANL 2X4 6800LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6596	48	138	PICAPAMD
EPANL 2X4 6800LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6596	48	138	PHA6TVBP
EPANL 2X4 6800LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6868	48	144	P18UL0J1
EPANL 2X4 6800LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6868	48	144	P7786JMO
EPANL 2X4 6800LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	7086	48	149	PU25XKJQ
EPANL 2X4 6800LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	7086	48	149	PMB46YK
EPANL 2X4 7200LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7388	66	111	P2QK1V0K
EPANL 2X4 7200LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	7388	70	106	PF1518JE
EPANL 2X4 7200LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7388	66	111	P2GTCW3J
EPANL 2X4 7200LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7442	66	112	PCRM0D2R
EPANL 2X4 7200LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	7442	70	107	PKYV7048
EPANL 2X4 7200LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7442	66	112	P41RL2HS
EPANL 2X4 7200LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7657	66	115	PS2AC19A
EPANL 2X4 7200LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	7657	70	110	PBV78YXA
EPANL 2X4 7200LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7657	66	115	PCLJ4VZN
EPANL 2X4 7200LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7744	66	117	PIS28TOX
EPANL 2X4 7200LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	7744	70	111	PSPB7FBG
EPANL 2X4 7200LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7744	66	117	PIRQ08L6
EPANL 2X4 7200LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6792	50	137	PJN0UK7J
EPANL 2X4 7200LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6792	50	137	PW92GBXR
EPANL 2X4 7200LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6945	50	140	PHWEYL0D
EPANL 2X4 7200LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6945	50	140	PXHH12RI
EPANL 2X4 7200LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	7232	50	146	PW3RZAGO
EPANL 2X4 7200LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	7232	50	146	PZY6WXTJ
EPANL 2X4 7200LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	7462	50	151	PPYDM8D6
EPANL 2X4 7200LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	7462	50	151	P71GKCWE



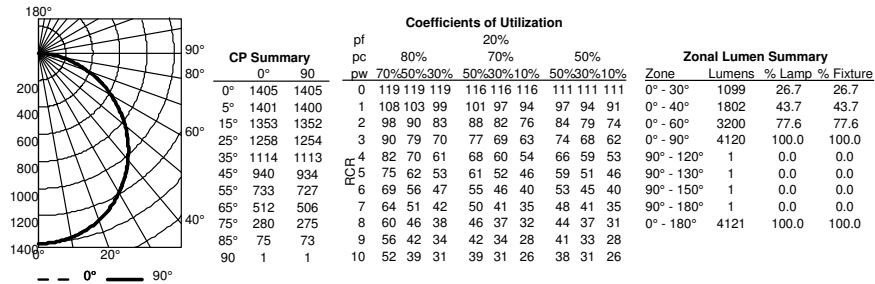
EPANL

EPANL LED Flat Panel

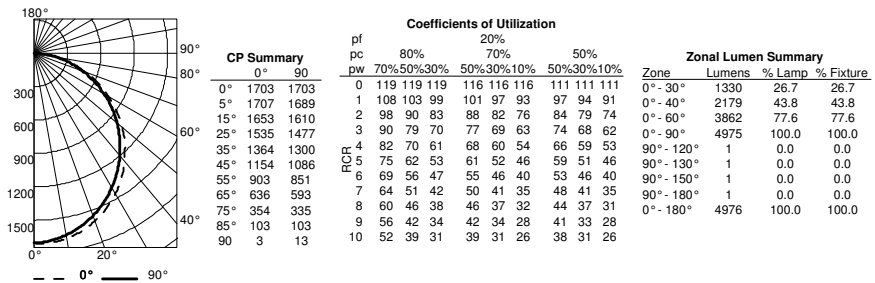
PHOTOMETRICS

Full Photometric data is available on Lithonia.acuitybrands.com

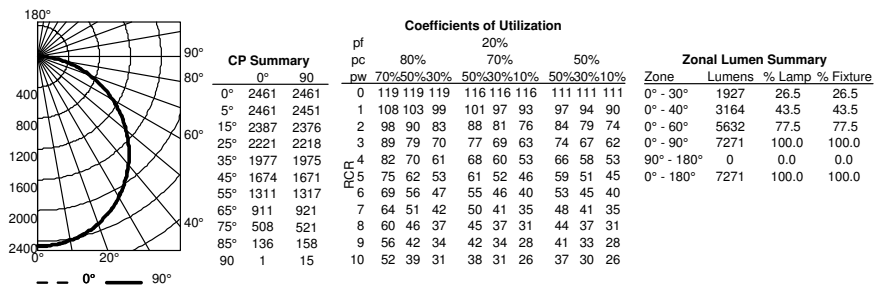
EPANL 2x2 4000LM 80CRI 40K, 4121 delivered lumens.



EPANL 2x4 4800LM 80CRI 40K, 5119 delivered lumens.



EPANL 2x4 6800LM 80CRI 40K, 7269 delivered lumens.

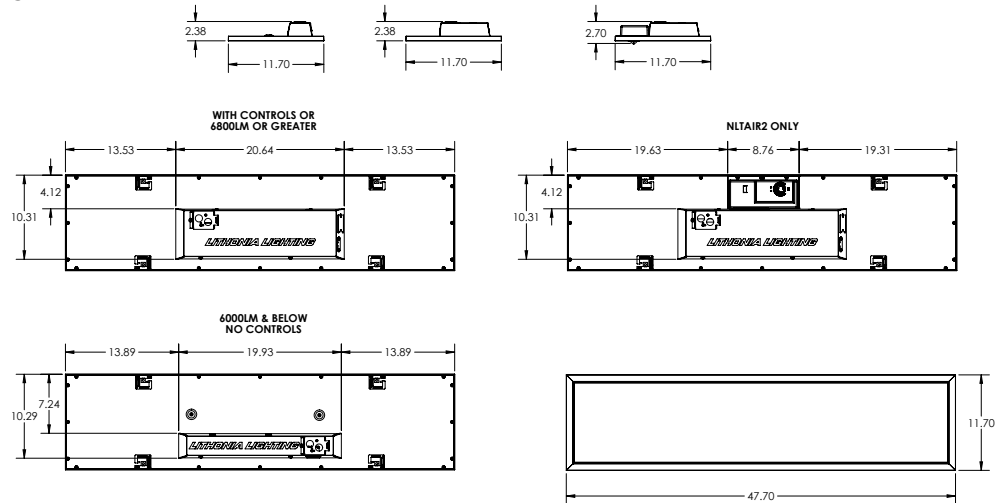


EPANL LED Flat Panel

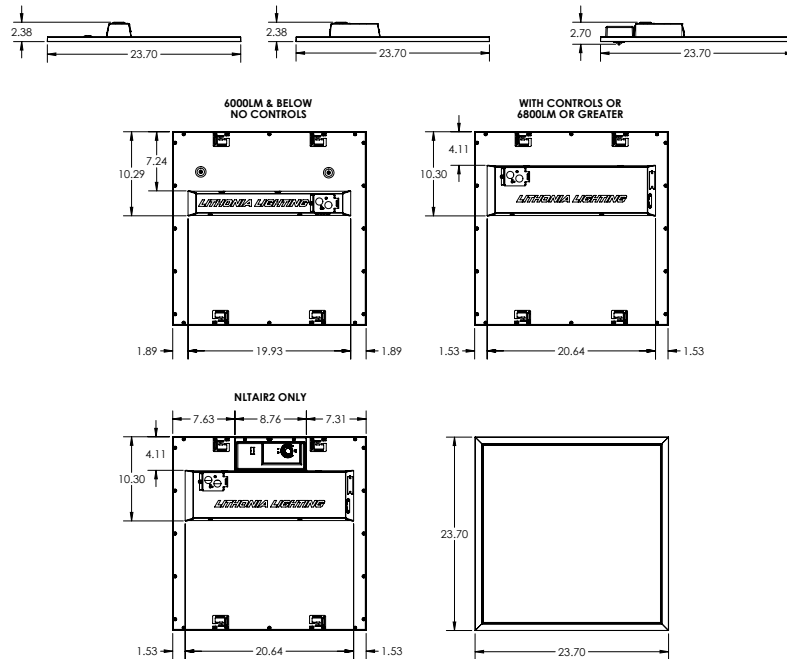
TYPE T3B

DIMENSIONS

1X4 Configurations



2X2 Configurations

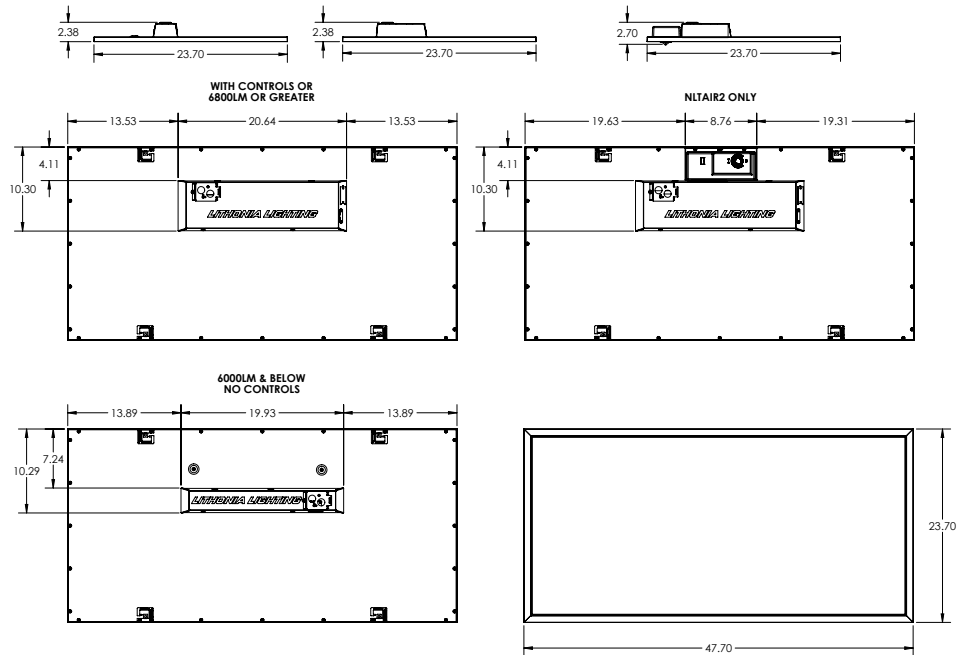


EPANL LED Flat Panel

TYPE T3B

DIMENSIONS (continued)

2X4 Configurations





FEATURES & SPECIFICATIONS

INTENDED USE

Provides task or accent lighting in commercial, retail, hospitality and residential applications. Ideal for use under and over cabinets, display cases, task lighting, office lighting, coves and utility/work areas.

CONSTRUCTION

Low profile design, with on/off rocker switch. Can be direct wired or powered by 5' cord-and-plug (not included). Connect up to 354 watts of fixtures with 13" connector cord or 1-7/8" end row connector (Included). Rugged low profile aluminum housing, available in either white finish. Swivel head allows light to be directed to desired area.

ELECTRICAL

Long-life LEDs, coupled with a high-efficiency driver, provide extended service life. Fixture is rated to deliver L70 performance at 50,000 hours and operates at 120 volts, 60Hz. Minimum starting temp -20F. Can direct-wire through rear access plate/knockout by utilizing the included Romex connector or by utilizing the optional UCD JB Junction/Splice box (sold separately).

Works with most standard incandescent dimmers (see list of approved dimmers).

INSTALLATION

All mounting hardware included.

LISTINGS

UL listed to US and Canadian safety standards. ENERGY STAR® certified product (for 3000K and 4000K only) and Title 24 qualified. **Listed for damp locations.**

WARRANTY

5-year limited warranty. Complete warranty terms located at:
www.acuitybrands.com/support/customer-support/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. Specifications subject to change without notice.

SPECIFICATIONS	12"	18"	24"
Lumens (3000K):	413	585	740
Watts (3000K):	7.3	9.7	12.5
Lumens per watt:	57	60	59
Length:	12.12 (30.8)	18.06 (45.9)	24.12 (61.3)
Width:	3.63 (9.2)	3.63 (9.2)	3.63 (9.2)
Height:	1 (2.54)	1 (2.54)	1 (2.54)
Weight:	.95 (.43)	1.2 (.54)	1.45 (.66)

All dimensions are inches (millimeters) unless otherwise indicated. Weights are pounds (kilograms).

Catalog Number	TYPE UC
Notes	
Type	

Indoor General Purpose

UCLD LED Linkable Cabinet Light

Linkable



ORDERING INFORMATION

For shortest lead times, configure products using **bolded options**.

Example: UCLD 12IN 30K 90CRI SWR WH

Series	Length	Color temperature	CRI	Options	Finish
UCLD Premium LED Undercabinet	12IN 1' Nominal 18IN ² 1.5' Nominal 24IN ³ 2' Nominal	30K 3000K	90CRI >90	SWR On/off Rocker Switch	WH White BN Brushed Nickel BZ Bronze

Accessories: Order as separate catalog number.	
UC 5FT POWERCORD WH M6 ¹	White 5' cord and plug
UC 5FT POWERCORD BL M6 ¹	Black 5' cord and plug
UCD JB	White Junction/Splice box - allows for quick and easy direct wiring
UCD JB BL	Black Junction/Splice box - allows for quick and easy direct wiring
UC ERC	White 1-7/8" row connector for end-to-end connections (1 included with each WH fixture)
UC ERC24	White 24" connector cord for longer length connections between fixtures or splice box (required for splice box to first fixture)
UC ERC24 BL	Black 24" connector cord for longer length connections between fixtures or splice box (required for splice box to first fixture)
UC PIR M12	On/Off Motion Sensor

ELECTRICAL CONTRACTOR TO DETERMINE LENGTHS NEEDED FOR EACH LOCATION

ELECTRICAL CONTRACTOR TO DETERMINE APPROPRIATE MOUNTING HARDWARE & ACCESSORIES

Notes

- Can be ordered in any qty.
- 18in available in BN or BZ only.
- 24in available in BZ only.

DECORATIVE INDOOR

UCLD

UCLD LED Cabinet Light

TYPE UC

LED

lighting facts

A Program of the U.S. DOE

Lithonia Lighting

Light Output (Lumens)	413
Watts	7.29
Lumens per Watt (Efficacy)	56.69

Color Accuracy	94
Color Rendering Index (CRI)	

Light Color

Correlated Color Temperature (CCT)

3000 (Bright White)

Warm White

Bright White

Daylight

2700K

3000K

4500K

6500K

All results are according to IESNA LM-79-2008: Approved Method for the Electrical and Photometric Testing of Solid-State Lighting. The U.S. Department of Energy (DOE) verifies product test data and results.

Visit www.lightingfacts.com for the Label Reference Guide.

Registration Number: NJSM-VJ8RU4 (2/24/2016)
Model Number: UCLD 12IN 30K 90CRI
Type: Luminaire - Directional

LED

lighting facts

A Program of the U.S. DOE

Lithonia Lighting

Light Output (Lumens)	584
Watts	9.74
Lumens per Watt (Efficacy)	60.04

Color Accuracy	94
Color Rendering Index (CRI)	

Light Color

Correlated Color Temperature (CCT)

3000 (Bright White)

Warm White

Bright White

Daylight

2700K

3000K

4500K

6500K

All results are according to IESNA LM-79-2008: Approved Method for the Electrical and Photometric Testing of Solid-State Lighting. The U.S. Department of Energy (DOE) verifies product test data and results.

Visit www.lightingfacts.com for the Label Reference Guide.

Registration Number: NJSM-K4Z7L8 (2/24/2016)
Model Number: UCLD 18IN 30K 90CRI
Type: Luminaire - Directional

LED

lighting facts

A Program of the U.S. DOE

Lithonia Lighting

Light Output (Lumens)	740
Watts	12.56
Lumens per Watt (Efficacy)	58.92

Color Accuracy	94
Color Rendering Index (CRI)	

Light Color

Correlated Color Temperature (CCT)

3000 (Bright White)

Warm White

Bright White

Daylight

2700K

3000K

4500K

6500K

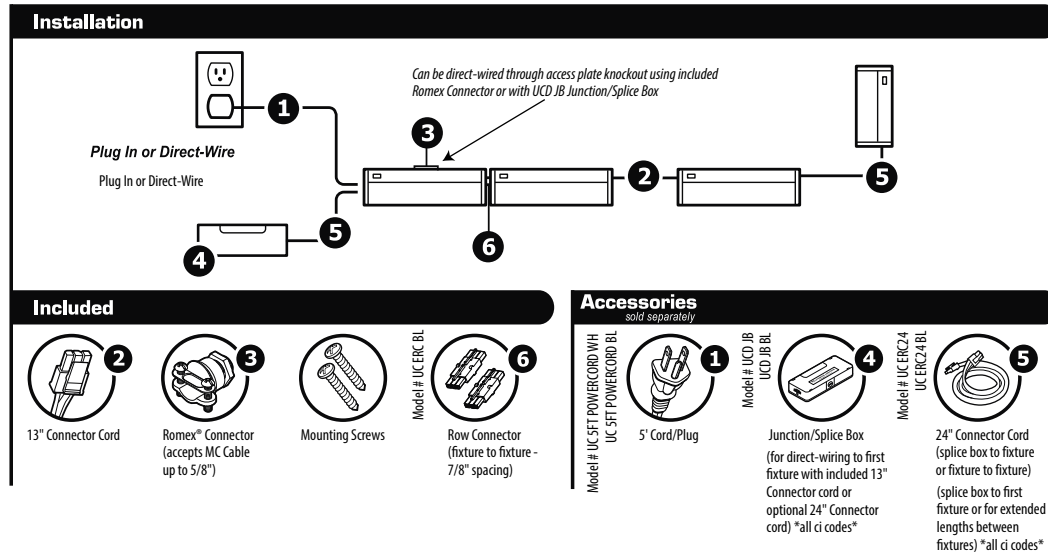
All results are according to IESNA LM-79-2008: Approved Method for the Electrical and Photometric Testing of Solid-State Lighting. The U.S. Department of Energy (DOE) verifies product test data and results.

Visit www.lightingfacts.com for the Label Reference Guide.

Registration Number: NJSM-QDWCI4 (2/24/2016)
Model Number: UCLD 24IN 30K 90CRI
Type: Luminaire - Directional

UCLD LED Cabinet Light

TYPE UC



COMPATIBLE DIMMERS

The UCLD is designed to operate with most standard Triac Based dimmers and is not compatible with 0-10v dimming systems. The following is a list of dimmers tested and does not imply any guarantee or warranty of compatibility with a particular application. Unlisted dimmers do not imply non-compatibility.

Manufacturer	Part number(s)
Lutron	DVELV-300P 300P SELV NTELV-300P
Pass & Seymour	HCL453PTCCCV6
SensorSwitch	nSP5 PCD 2W nSP5 PCDELV 120



FEATURES & SPECIFICATIONS

INTENDED USE

Provides an LED lighting platform to deliver general or task lighting for residential and light commercial applications. Light engine delivers long life and excellent color to ensure a quality, low-maintenance light installation. Ideal for use in bathrooms, lavatories, hallways, corridors, stairways, utility areas and more.

CONSTRUCTION

The Traditional Round Vanity is constructed of an acrylic diffuser with housings available in brushed nickel finish. The white acrylic diffuser provides even illumination and softens the appearance of the LEDs for improved aesthetics.

OPTICS

2' produces 1300 lumens, 3' produces 1900 lumens, and 4' produces 2500 lumens at 3000K with 50,000 hours of life.

Extruded acrylic diffuser is of highly transmissive material to minimize LED image and provides high-angle brightness control.

ELECTRICAL

Long-life LEDs, coupled with a multivolt driver, provide extended service life. Standard input = 18 watts, (2'); 26 watts, (3'). Fixture is rated to deliver L70 performance at 50,000 hours and operates at 120-277 volts.

Use with non-dimmable switches only.

LISTINGS

UL Listed to US and Canadian safety standards. Listed for damp locations. ‡ ENERGY STAR® certified.

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.

Specifications subject to change without notice.

TYPE W1

Catalog
Number

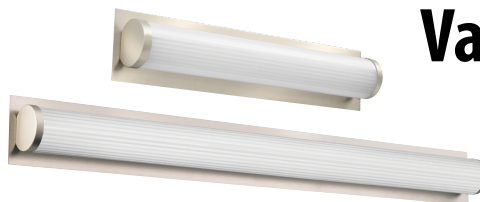
Notes


Type

Decorative Indoor

Traditional Round Vanity

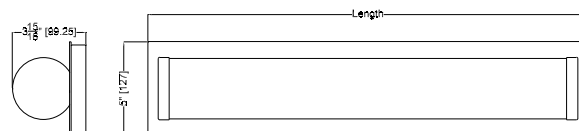
VANITY LED



ADA 
U.S. PATENT PENDING

SPECIFICATIONS	2FT	3FT
Length:	23-7/16 (595)	35-1/4 (895)
Weight:	7 (3.2)	9.7 (4.4)
3000K Lumens (LPW)	1363 (75)	2009 (77)

All dimensions are inches (millimeters) unless otherwise indicated. Weights are pounds (kilograms).



ORDERING INFORMATION

For shortest lead times, configure product using **bolded options**.

Example: FMVTRL 36IN MVOLT 30K 90CRI BN

Series	Length	Voltage	Color temperature	CRI	Finish
FMVTRL Traditional Round Vanity	24IN ‡ 2' Nominal 36IN 3' Nominal	MVOLT MVOLT (120V-277V)	30K 3000 K	90CRI >90	BN Brushed Nickel

‡ Only these configurations are ENERGY STAR certified.

**ELECTRICAL CONTRACTOR TO DETERMINE
APPROPRIATE MOUNTING HARDWARE & ACCESSORIES**

DECORATIVE INDOOR

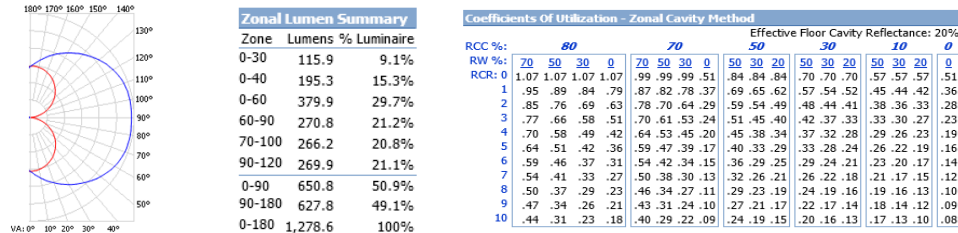
FMVTRL

LED Vanity Traditional Round

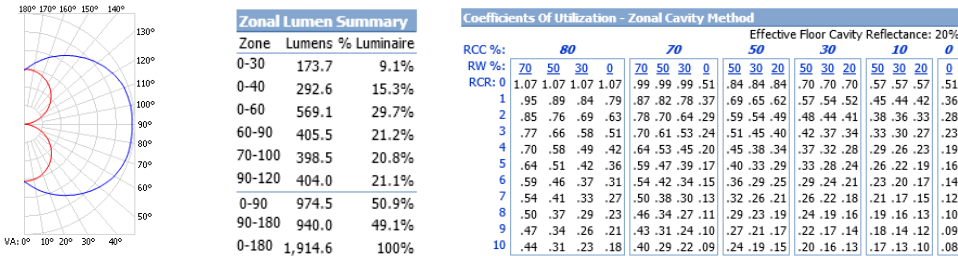
PHOTOMETRICS

Distribution Curve	Distribution Data	Output Data	Coefficient of Utilization	Illuminance Data at 30" Above Floor for a Single Luminaire
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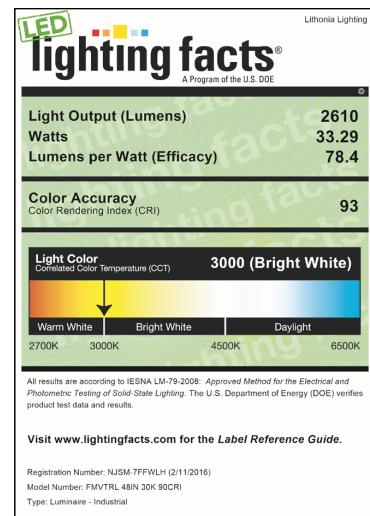
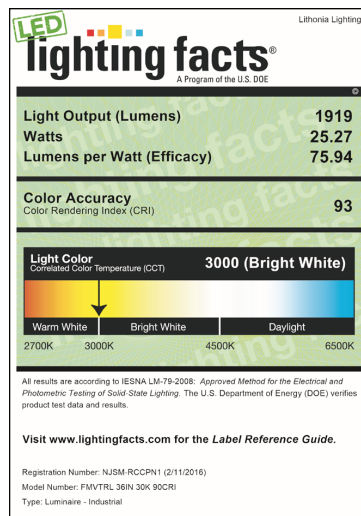
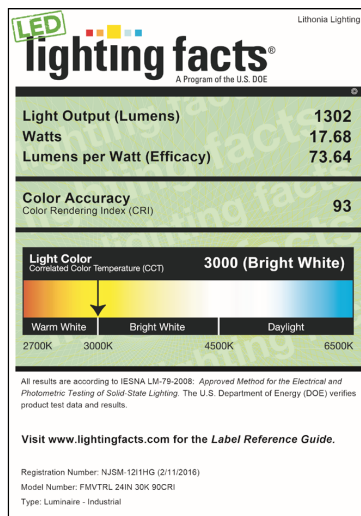
FMVTRL 24IN, 3000K LEDs, input watts:16.66, delivered lumens: 1278.6, LM/W=77, test no. LTL29645MP2, tested in accordance with IESNA LM79-80



FMVTRL 36IN, 3000K LEDs, input watts:24.99, delivered lumens: 1914.6, LM/W=77, test no. LTL29645MP3, tested in accordance with IESNA LM79-80



LIGHTING FACTS





FEATURES & SPECIFICATIONS

INTENDED USE — The LEM08 emergency LED driver enables the lighting fixture to deliver a minimum of 90 minutes illumination during a loss of normal AC power. It is cUL Listed for factory or field installation with indoor, damp location luminaires utilizing 20-50VDC output voltage.

CONSTRUCTION

UL rated, painted steel enclosure (white)
Flexible metallic conduit

PERFORMANCE — When normal AC power fails, the LEM08 immediately drives the LED load at reduced light output for a minimum of 90 minutes. When AC power is present, the emergency LED driver ensures the sealed, maintenance-free, high-temperature nickel-cadmium batteries are fully charged within 24 hours after a discharge and remains fully charged until the next loss of AC power. The included test switch/pilot light provides visual and manual means of monitoring the system operation.

ELECTRICAL

Multi-volt capability – 120V thru 277V; 50/60hz
Output Voltage – 20-50VDC
Initial Output Power – 8 watts
Maximum AC input – 95mA

INSTALLATION — Available for integral mounting (no metal conduit) or with dual metal conduit for mounting inside or outside of wireway. One 1/2" hole in fixture channel permits mounting test switch/pilot light behind fixture lens

Unit wires two ways: on a night light circuit (permanently energized) or on a switchable circuit (un-switched circuit to battery charger and switched circuit to the fixture driver.)

Ambient temp rating 0°C to 50°C (32°F to 122°F)

Polarized test switch/pilot light assembly
Standardized mounting centers

LISTINGS — cUL Listed. Meets UL 924, NFPA 101 (current Life Safety Code), NEC and OSHA illumination standards.

UL 1310 Certified, Output Class 2 Compliant

UL Listed for installation in damp location, recessed type IC fixtures.

Meets CA Title 20 requirements. Registered in the Modernized Appliance Efficiency Database System (MAEDBS) as a small battery charger.

WARRANTY — 3-year limited warranty. Complete warranty terms located at www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx

Note: Actual performance may differ as a result of end-user environment and application. Specifications subject to change without notice.

TYPE W1

Catalog Number
Notes
Type

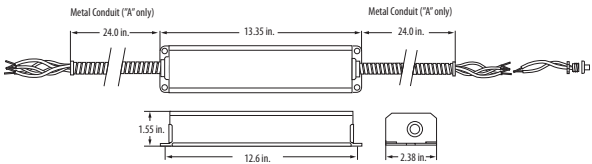
ELECTRICAL CONTRACTOR ORDER & INSTALL LED EMERGENCY BATTERY BACKUP DRIVERS FOR TYPE W1 LUMINAIRES DESIGNATED AS "EM"

LEM08

LED Emergency Battery Backup



MOUNTING
All dimensions are in inches.
Enclosure Length: 13.35"
Width: 2.38"
Height: 1.55"
Shipping weight: 3.4 lbs (1.54 kg) (with metal conduit)
2.8 lbs (1.27 kg) (no metal conduit)



ELECTRICAL CONTRACTOR TO DETERMINE APPROPRIATE OPTION AND MOUNTING HARDWARE & ACCESSORIES NEEDED.

ORDERING INFORMATION

Lead times will vary depending on options selected. Consult with your sales representative.

Example: LEM08 A

LEM08	
Series	Options
LEM08	LED emergency battery pack, 8W 20-50VDC
	A Dual metal conduit (24" length each)
	B Integral (no metal conduit)

TYPE W1

LEM08 Emergency LED Driver

SPECIFICATIONS

BATTERY				
Sealed Nickel-Cadmium				
Voltage	Typical Shelf Life ¹	Typical Life ¹	Maintenance ²	Temperature Rating ³
6.0V	3 years	7-10 years	none	0° C to 50° C (32° F to 122° F)

Notes

- ¹ At 77°F ambient temperature, charge/discharge cycles and prolonged full discharge may reduce useful life.
- ² All life safety equipment, including emergency lighting for path of egress must be tested in accordance with all National Fire Protection Associate (NFPA) and local codes. Failure to perform the required testing could jeopardize the safety of occupants and will void all warranties.
- ³ Ambient temperature range where unit will provide capacity for 90 minutes. Higher and lower temperatures affect life and capacity.



LEM08



FEATURES & SPECIFICATIONS

INTENDED USE

Provides an LED lighting platform to deliver general or task lighting for residential and light commercial applications. Light engine delivers long life and excellent color to ensure a quality, low-maintenance light installation. Ideal for use in bathrooms, lavatories, hallways, corridors, stairways, utility areas and more.

CONSTRUCTION

The Traditional Square Vanity is constructed of an acrylic diffuser with housings available in brushed nickel. The white acrylic diffuser provides even illumination and softens the appearance of the LEDs for improved aesthetics.

OPTICS

2' produces 1300 lumens, 3' produces 1900 lumens, and 4' produces 2500 lumens at 3000K with 50,000 hours of life.

Extruded acrylic diffuser is of highly transmissive material to minimize LED image and provides high-angle brightness control.

ELECTRICAL

Long-life LEDs, coupled with a multivolt driver, provide extended service life. Standard input = 9.5 watts, (2'); 26 watts, (3'); 34 watts, (4'). Fixture is rated to deliver L70 performance at 50,000 hours and operates at 120-277 volts.

Use with non-dimmable switches only.

LISTINGS

UL Listed to US and Canadian safety standards. Listed for damp locations. ENERGY STAR® certified.

WARRANTY

5-year limited warranty. Complete warranty terms located at

www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx

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.

Specifications subject to change without notice.

Catalog
Number

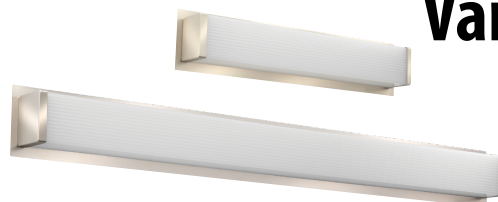
TYPE W2

Notes

Type

Decorative Indoor

Traditional Square Vanity



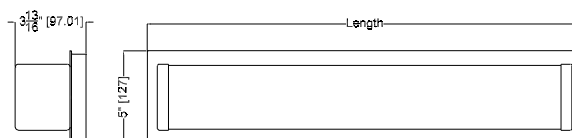
VANITY LED

ADA
U.S. PATENT PENDING



SPECIFICATIONS	2FT	3FT	4FT
Length:	23-7/16 (595)	35-1/4 (895)	47-1/16 (1195)
Weight:	7.3 (3.3)	10 (4.5)	12.7 (5.8)
3000K Lumens (LPW)	1302 (72)	1919 (73)	2551 (75)
4000K Lumens (LPW)	1373 (76)	2024 (77)	2689 (79)

All dimensions are inches (millimeters) unless otherwise indicated. Weights are pounds (kilograms).



ORDERING INFORMATION

For shortest lead times, configure product using **bolded options**.

Example: FMVTSL 36IN MVOLT 30K 90CRI BN

Series	Length	Voltage	Color temperature	CRI	Finish
FMVTSL Traditional Square Vanity	24IN 2' Nominal 36IN 3' Nominal 48IN 4' Nominal	MVOLT MVOLT (120V-277V)	30K 3000 K	90CRI >90	BN Brushed Nickel

ELECTRICAL CONTRACTOR TO DETERMINE
APPROPRIATE MOUNTING HARDWARE & ACCESSORIES

DECORATIVE INDOOR

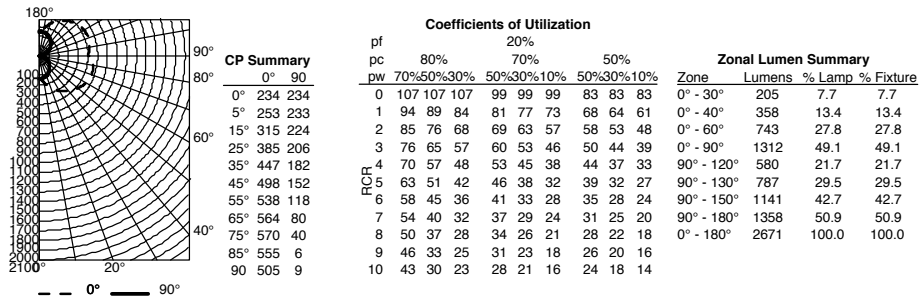
FMVTSL

LED Vanity Traditional Square


PHOTOMETRICS

Distribution Curve	Distribution Data	Output Data	Coefficient of Utilization	Illuminance Data at 30" Above Floor for a Single Luminaire
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FMTSL 48IN, 3000K LEDs, input watts: 33.3, delivered lumens: 2,671, LM/W=80, test no. LTL29644M, tested in accordance with IESNA LM 79-80.



LIGHTING FACTS



Lithonia Lighting

Light Output (Lumens)

1363

Watts

17.68

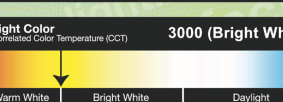
Lumens per Watt (Efficacy)

77.09

Color Accuracy

93

Color Rendering Index (CRI)




All results are according to IESNA LM-79-2008: *Approved Method for the Electrical and Photometric Testing of Solid-State Lighting*. The U.S. Department of Energy (DOE) verifies product test data and results.

Visit www.lightingfacts.com for the **Label Reference Guide**.

Registration Number: NJ5M-SQHX3A (2/11/2016)

Model Number: FMVTSL 24IN 30K 90CRI

Type: Luminaire - Industrial



lighting facts[®]

A Program of the U.S. DOE

Light Output (Lumens) **2009**

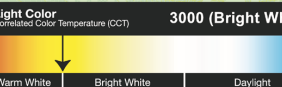
Watts **25.27**

Lumens per Watt (Efficacy) **79.5**

Color Accuracy

Color Rendering Index (CRI) **93**

Light Color
Correlated Color Temperature (CCT) **3000 (Bright White)**



2700K 3000K 4500K 6500K

Warm White Bright White Daylight


All results are based on IESNA LM-79-2008: *Approved Method for the Electrical and Photometric Testing of Solid-State Lighting*. The U.S. Department of Energy (DOE) verifies product test data and results.

Visit www.lightingfacts.com for the Label Reference Guide.

Registration Number: NJSM-00U4FZ (2/11/2016)

Model Number: FMVTL3 36IN 30K 90CRI

Type: Luminaire - Industrial



Lighting facts[®]

A Program of the U.S. DOE

Light Output (Lumens) 2613

Watts 33.3


Lumens per Watt (Efficacy) 78.47

Color Accuracy 93

Color Rendering Index (CRI)

Light Color 3000 (Bright White)

Correlated Color Temperature (CCT)



2700K 3000K 4500K 6500K

Warm White Bright White Daylight

All results are according to: IESNA LM-79-2008 - Approved Method for the Electrical and Photometric Testing of Solid-State Lighting. The U.S. Department of Energy (DOE) verifies product test data and results.

Visit www.lightingfacts.com for the **Label Reference Guide**.

Registration Number: NJSB-3BXJF8 (2/11/2016)

Model Number: FMYTSL 48IN 30K 90CRI

Type: Luminaire - Industrial



FEATURES & SPECIFICATIONS

INTENDED USE — Suitable for architectural applications where aesthetics and superior performance are required.

CONSTRUCTION — High-polish, injection-molded virgin acrylic panel, ultrasonically welded to eliminate visible hardware. Graduated depth of molded letters provides uniform light distribution on graphics. Standard housing finish is brushed aluminum.

Precision-molded, textured letters — 6" high with 3/4" stroke, with 100 ft viewing distance rating, based upon UL924 standard. Chevron indicator direction must be specified.

Recessed rough-in section constructed of 20-gauge, die-formed galvanized steel. Extruded aluminum housing trim mounts flush onto wall or ceiling.

Mounting canopy for top mount is constructed of extruded aluminum housing to match housing finish.

OPTICS — LEDs mounted on printed circuit board. The typical life of the exit LED lamp is 10 years.

Low energy consumption — EL N operation: only 2.3W for 120V single-face red sign; 1.7W for 120V single-face green sign. Non-emergency operation: only 1.5W for 120V single-face red sign; 1.2W for 120V single-face green sign.

ELECTRICAL — Dual voltage input capability (120/277V).

Sealed, maintenance-free nickel cadmium battery delivers 90 minutes capacity to lamp. Constant-current series charger, 24-hour recharge after 90-minute discharge.

Polarized battery connector simplifies installation and maintenance; prevents charger damage due to improper connection.

INSTALLATION — Recessed mount — rough-in section for back, ceiling or end mounting. Fits into minimum wall or ceiling opening 13-5/8" L x 4-1/2" W x 3-1/8" D.

Adjustable T-bar hangers adapt mounting tray for mounting in suspended ceilings or variable-size framed openings. Trim ring has 3/4" variable depth adjustment to ensure flush fit against surface of wall or ceiling.

Plug-in wire connections and self-captive mounting screws for mounting panel/trim to rough-in section.

Top Mount (TM) — low-profile mounting canopy attaches exit to J-box. No rough-in section required.

LISTINGS — UL listed. Non-IC recessed mounting. Meets UL 924, NFPA 101 (current Life Safety Code), NEC, FCC Title 47, Part 15, Subpart B and OSHA illumination standards, and State of Minnesota requirements for less than 20W energy consumption.

Catalog
Number

TYPE X1

Notes

Type

PRECISE[®]
COLLECTION

Edge-Lit Exits

LRP

LED LAMPS



WARRANTY — 5-year limited warranty, including lamps. 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. Specifications subject to change without notice.

† Exit Signs Certified in the CA Title 20 Appliance Efficiency Database.

ORDERING INFORMATION

For shortest lead times, configure products using **bolded options**.

Example: LRP 1 RMR LA 120/277 EL N

LRP									
Family	Housing color	Number of faces	Letters/background		Directional indicators ²		Input voltage		
LRP LED	(blank) Brushed aluminum	1 Single face	RW	Red on white	(blank)	None	120/277 Dual voltage		
	W White	2 Double face	RC	Red on clear (single face only)	LA	Left ³			
	B Black		RMR	Red on mirror (simulates mirrored background for double-face exits)	RA	Right ³			
	BZ Bronze				LRA	Left and right			
	BS Polished Brass ¹		GW	Green on white	DA	Double face ⁴			
	U Unfinished		GC	Green on clear (single face only)					
			GMR	Green on mirror (simulates mirrored background for double-face exits)					
Emergency operation		Mounting		Item type		Options ⁷			
(blank) AC only	(blank) Ceiling or back mount	(blank) Complete exit panel and rough-in section ⁷	FI Fire alarm interface ⁸						
EL N Nickel cadmium battery	EM Recessed end mount	PNL Panel assembly only	F Flashing emergency operation (one flash/second) ^{8,9}						
X2 Lamp boards wired on two separate circuits (specify 120V or 277V) ⁵	TM Top mount ⁶						ORDER APPROPRIATE INDICATORS		

ORDER APPROPRIATE INDICATORS FOR EACH LOCATION AS SHOWN ON LIGHTING PLANS

Accessories: Order as separate items.

ELA R LRIS 120/277 EL N	Single-face, red LED emergency rough-in section ^{7,10}
ELA G LRIS 120/277 EL N	Single-face, green LED emergency rough-in section ^{7,10}
ELA R 2LRIS 120/277 EL N	Double-face, red LED emergency rough-in section ^{7,10}
ELA G 2LRIS 120/277 EL N	Double-face, green LED emergency rough-in section ^{7,10}
ELA LCRIS	LED rough-in section (supplied standard with recessed exit unless PNL suffix is specified; order ELA LCRIS only if needed for early installation). Available AC only with no options. ¹⁰
ELA LRIS 277 X2	LED rough-in section (supplied standard with recessed exit unless PNL suffix is specified; order ELA LRIS 277 X2 only if needed for early installation). ^{7,10}
ELA LRIS 120 X2	LED rough-in section (supplied standard with recessed exit unless PNL suffix is specified; order ELA LRIS 120 X2 only if needed for early installation). ^{7,10}
ELA US12	12" pendant-mount kit (Top mount exits only). Mounting canopy is brushed aluminum. To order white or black canopy, add W or B to catalog number. Example: ELA W US12. To order 24" or 36" lengths, add 24 or 36 to catalog number. Example: ELA US24. See spec sheet ELA-StemKits .

Notes

- Not available with EM option.
- See chart on back for more information.
- Only available with single face.
- Only available with double face.
- Not available with top mount exits (TM) or EL N operation.
- No Rough-In section required. Attaches directly to J-box. Only available with AC operation.
- When ordering recessed rough-in separately, all options must be included with rough-in nomenclature. Example: ELA LRIS 277 X2 F.
- Choice of F or FI, not available with both. Not available with top mount exits.
- Must select EL N option.
- Rough-in supplied standard with exit unless PNL suffix is specified. Order separately only if needed for early installation.

ELECTRICAL CONTRACTOR TO DETERMINE APPROPRIATE MOUNTING HARDWARE & ACCESSORIES

EMERGENCY

LRP

LRP Precise® LED Exit Signs

TYPE X1

SPECIFICATIONS

ELECTRICAL EMERGENCY

Primary Circuit

Type	Typical LED life ¹	Supply voltage	Number of faces	Input watts	Max. amps
Red	10 years	120	1	2.3	.093
		277	1	2.7	.095
Red	10 years	120	2	3.2	.084
		277	2	3.9	.094
Green	10 years	120	1	1.7	.07
		277	1	1.9	.07
Green	10 years	120	2	3.7	.14
		277	2	3.8	.14

ELECTRICAL AC ONLY

Primary Circuit

Type	Typical LED life ¹	Supply voltage	Number of faces	Input watts	Max. amps
Red	10 years	120	1	1.5	.087
		277	1	1.8	.089
		347	1	2.2	.107
Red	10 years	120	2	3.1	.178
		277	2	3.4	.180
		347	2	4.1	.220
Green	10 years	120	1	1.2	.064
		277	1	1.3	.062
Green	10 years	120	2	2.0	.06
		277	2	2.3	.06

BATTERY

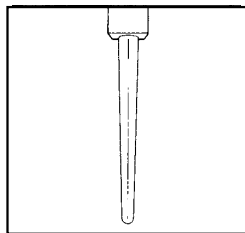
Sealed Nickel-Cadmium

Typical shelf life ²	Typical life ²	Maintenance ³	Temperature range ⁴
3 yrs.	7-9 yrs.	none	32°-100°F (0°-38°C)

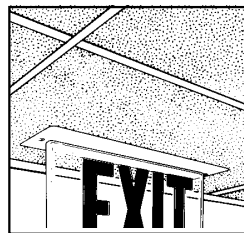
Notes

- Based on continuous operation. The typical life of the exit LED lamp is 10 years.
- At 77°F (25°C).
- All life safety equipment, including emergency lighting for path of egress must be maintained, serviced, and tested in accordance with all National Fire Protection Association (NFPA) and local codes. Failure to perform the required maintenance, service, or testing could jeopardize the safety of occupants and will void all warranties.
- Optimum ambient temperature range where unit will provide capacity for 90 minutes. Higher and lower temperatures affect life and capacity.

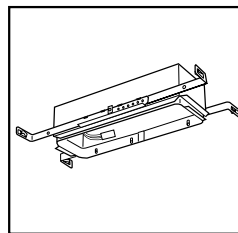
KEY FEATURES



Unique wedge-shaped panel design concentrates light for uniform letter illumination.



Trim fits flush against wall or ceiling for clean, attractive appearance.



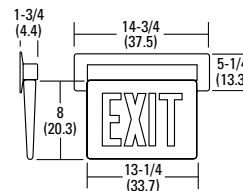
Small rough-in section.
Emergency operation: contains battery and charger board.
Non-emergency: rough-in section is empty.

MOUNTING

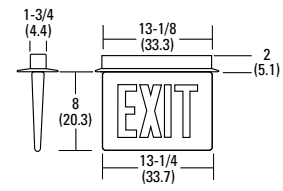
All dimensions are in inches (centimeters).

Shipping weight for panel: 5 lbs. (2.3 kgs.)

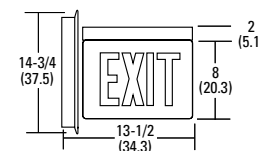
Shipping weight for rough-in section: 5.8 lbs. (2.6 kgs.)



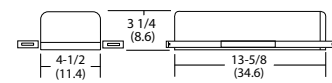
Back Mount (recessed)



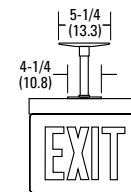
Ceiling Mount (recessed)



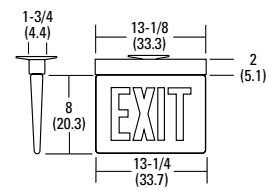
End Mount (recessed)



Rough-In Section



With Pendant Mounting kit (TM mounting only)



Top Mount (AC only operation)

Directional Indicators

Specification (add to catalog number)	Graphics	
	Back	Front
LA		
RA		
LRA (single face)		
DA		
LRA (double face)		



FEATURES & SPECIFICATIONS

INTENDED USE — Suitable for architectural applications where aesthetics and superior performance are required.

CONSTRUCTION — High-polish, injection-molded virgin acrylic panel, ultrasonically welded to eliminate visible hardware. Graduated depth of molded letters provides uniform light distribution on graphics. Standard housing finish is brushed aluminum.

Precision-molded, textured letters — 6" high with 3/4" stroke, with 100 ft viewing distance rating, based upon UL924 standard. Chevron indicator direction must be specified.

Recessed rough-in section constructed of 20-gauge, die-formed galvanized steel. Extruded aluminum housing trim mounts flush onto wall or ceiling.

Mounting canopy for top mount is constructed of extruded aluminum housing to match housing finish.

OPTICS — LEDs mounted on printed circuit board. The typical life of the exit LED lamp is 10 years.

Low energy consumption — EL N operation: only 2.3W for 120V single-face red sign; 1.7W for 120V single-face green sign. Non-emergency operation: only 1.5W for 120V single-face red sign; 1.2W for 120V single-face green sign.

ELECTRICAL — Dual voltage input capability (120/277V).

Sealed, maintenance-free nickel cadmium battery delivers 90 minutes capacity to lamp. Constant-current series charger, 24-hour recharge after 90-minute discharge.

Polarized battery connector simplifies installation and maintenance; prevents charger damage due to improper connection.

INSTALLATION — Recessed mount — rough-in section for back, ceiling or end mounting. Fits into minimum wall or ceiling opening 13-5/8" L x 4-1/2" W x 3-1/8" D.

Adjustable T-bar hangers adapt mounting tray for mounting in suspended ceilings or variable-size framed openings. Trim ring has 3/4" variable depth adjustment to ensure flush fit against surface of wall or ceiling.

Plug-in wire connections and self-captive mounting screws for mounting panel/trim to rough-in section.

Top Mount (TM) — low-profile mounting canopy attaches exit to J-box. No rough-in section required.

LISTINGS — UL listed. Non-IC recessed mounting. Meets UL 924, NFPA 101 (current Life Safety Code), NEC, FCC Title 47, Part 15, Subpart B and OSHA illumination standards, and State of Minnesota requirements for less than 20W energy consumption.

Catalog
Number

TYPE X2

Notes

Type

PRECISE[®]
COLLECTION

Edge-Lit Exits

LRP

LED LAMPS



WARRANTY — 5-year limited warranty, including lamps. 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.

Specifications subject to change without notice.

† Exit Signs Certified in the CA Title 20 Appliance Efficiency Database.

ORDERING INFORMATION

For shortest lead times, configure products using **bolded options**.

Example: LRP 1 RMR LA 120/277 EL N

LRP						
Family	Housing color	Number of faces	Letters/background		Directional indicators ²	Input voltage
LRP LED	(blank) Brushed aluminum	1 Single face	RW	Red on white	(blank) None	120/277 Dual voltage
	W White	2 Double face	RC	Red on clear (single face only)	LA Left ³	
	B Black		RMR	Red on mirror (simulates mirrored background for double-face exits)	RA Right ³	
	BZ Bronze		GW	Green on white	LRA Left and right	
	BS Polished Brass ¹		GC	Green on clear (single face only)	DA Double face ⁴	
	U Unfinished		GMR	Green on mirror (simulates mirrored background for double-face exits)		
Emergency operation		Mounting	Item type		Options ⁷	
(blank) AC only	(blank) Ceiling or back mount	(blank) Complete exit panel and rough-in section ⁷	(blank)		FI	Fire alarm interface ⁸
EL N Nickel cadmium battery	EM Recessed end mount	PNL Panel assembly only			F	Flashing emergency operation (one flash/second) ^{8,9}
X2 Lamp boards wired on two separate circuits (specify 120V or 277V) ⁵	TM Top mount ⁶					

ORDER APPROPRIATE INDICATORS FOR EACH OPTION AND SHOW:

ORDER APPROPRIATE INDICATORS FOR EACH LOCATION AS SHOWN ON LIGHTING PLANS

Accessories: Order as separate items.

ELA R LRIS 120/277 EL N	Single-face, red LED emergency rough-in section ^{7,10}
ELA G LRIS 120/277 EL N	Single-face, green LED emergency rough-in section ^{7,10}
ELA R 2LRIS 120/277 EL N	Double-face, red LED emergency rough-in section ^{7,10}
ELA G 2LRIS 120/277 EL N	Double-face, green LED emergency rough-in section ^{7,10}
ELA LCRIS	LED rough-in section (supplied standard with recessed exit unless PNL suffix is specified; order ELA LCRIS only if needed for early installation). Available AC only with no options. ¹⁰
ELA LRIS 277 X2	LED rough-in section (supplied standard with recessed exit unless PNL suffix is specified; order ELA LRIS 277 X2 only if needed for early installation). ^{7,10}
ELA LRIS 120 X2	LED rough-in section (supplied standard with recessed exit unless PNL suffix is specified; order ELA LRIS 120 X2 only if needed for early installation). ^{7,10}
ELA US12	12" pendant-mount kit (Top mount exits only). Mounting canopy is brushed aluminum. To order white or black canopy, add W or B to catalog number. Example: ELA W US12. To order 24" or 36" lengths, add 24 or 36 to catalog number. Example: ELA US24. See spec sheet ELA-StemKits .

Notes

- Not available with EM option.
- See chart on back for more information.
- Only available with single face.
- Only available with double face.
- Not available with top mount exits (TM) or EL N operation.
- No Rough-In section required. Attaches directly to J-box. Only available with AC operation.
- When ordering recessed rough-in separately, all options must be included with rough-in nomenclature. Example: ELA LRIS 277 X2 F.
- Choice of F or FI, not available with both. Not available with top mount exits.
- Must select EL N option.
- Rough-in supplied standard with exit unless PNL suffix is specified. Order separately only if needed for early installation.

ELECTRICAL CONTRACTOR TO DETERMINE APPROPRIATE MOUNTING HARDWARE & ACCESSORIES

EMERGENCY

LRP

LRP Precise® LED Exit Signs

TYPE X2

SPECIFICATIONS

ELECTRICAL EMERGENCY

Primary Circuit

Type	Typical LED life ¹	Supply voltage	Number of faces	Input watts	Max. amps
Red	10 years	120	1	2.3	.093
		277	1	2.7	.095
Red	10 years	120	2	3.2	.084
		277	2	3.9	.094
Green	10 years	120	1	1.7	.07
		277	1	1.9	.07
Green	10 years	120	2	3.7	.14
		277	2	3.8	.14

ELECTRICAL AC ONLY

Primary Circuit

Type	Typical LED life ¹	Supply voltage	Number of faces	Input watts	Max. amps
Red	10 years	120	1	1.5	.087
		277	1	1.8	.089
		347	1	2.2	.107
Red	10 years	120	2	3.1	.178
		277	2	3.4	.180
		347	2	4.1	.220
Green	10 years	120	1	1.2	.064
		277	1	1.3	.062
Green	10 years	120	2	2.0	.06
		277	2	2.3	.06

BATTERY

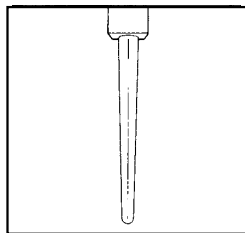
Sealed Nickel-Cadmium

Typical shelf life ²	Typical life ²	Maintenance ³	Temperature range ⁴
3 yrs.	7-9 yrs.	none	32°-100°F (0°-38°C)

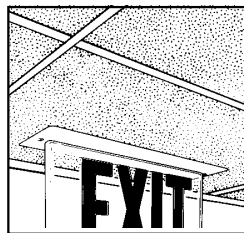
Notes

- Based on continuous operation. The typical life of the exit LED lamp is 10 years.
- At 77°F (25°C).
- All life safety equipment, including emergency lighting for path of egress must be maintained, serviced, and tested in accordance with all National Fire Protection Association (NFPA) and local codes. Failure to perform the required maintenance, service, or testing could jeopardize the safety of occupants and will void all warranties.
- Optimum ambient temperature range where unit will provide capacity for 90 minutes. Higher and lower temperatures affect life and capacity.

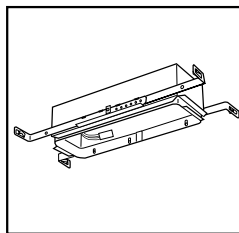
KEY FEATURES



Unique wedge-shaped panel design concentrates light for uniform letter illumination.



Trim fits flush against wall or ceiling for clean, attractive appearance.



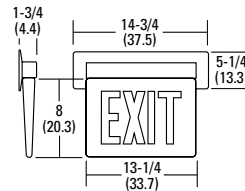
Small rough-in section.
Emergency operation: contains battery and charger board.
Non-emergency: rough-in section is empty.

MOUNTING

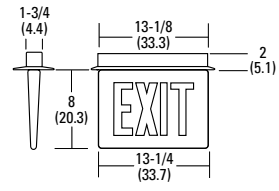
All dimensions are in inches (centimeters).

Shipping weight for panel: 5 lbs. (2.3 kgs.)

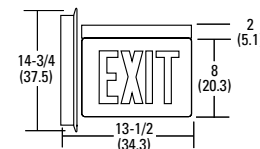
Shipping weight for rough-in section: 5.8 lbs. (2.6 kgs.)



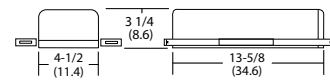
Back Mount (recessed)



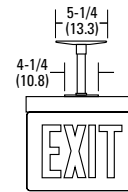
Ceiling Mount (recessed)



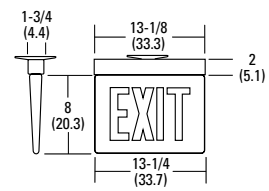
End Mount (recessed)



Rough-In Section



With Pendant Mounting kit (TM mounting only)



Top Mount (AC only operation)

Directional Indicators

Specification (add to catalog number)	Graphics	
	Back	Front
LA		
RA		
LRA (single face)		
DA		
LRA (double face)		



DIGITAL NAVIGATION

[Ordering Tree](#) [nLight Platform](#) [Sensor Switch JOT](#) [Photometrics](#) [Performance Data](#) [Drawings](#)

FEATURES & SPECIFICATIONS

INTENDED USE — The EPANL Series LED Edge-Lit Flat Panel provides a fully luminous appearance across the face of the lens. This provides a soft, glare-free solution that is visually comfortable within the space. Suitable for many lighting applications including schools, offices and other commercial spaces, retail, convenience stores, hospitals and healthcare facilities. **Certain airborne contaminants can diminish the integrity of acrylic and/or polycarbonate.** [Click here for Acrylic-Polycarbonate Compatibility table for suitable uses.](#)

CONSTRUCTION — Built to last with an aluminum frame for strength and durability, the seamless frame prevents light leak in the corners. The PMMA light guide plate and lens resists yellowing and transmits light with superior efficacy. The satin white lens provides excellent shielding and fully luminous appearance. EPANL's low-profile design provides increased installation flexibility especially in restricted plenum spaces. The back plate includes integral T-bar clips for installation into 15/16" or 9/16" T-grid ceilings. Fixture may be recessed, suspended, surface box mounted or mounted in a hard-ceiling see accessories section for more information. Fixture may be mounted and wired in continuous rows.

Integrated Sensor (nLight Wired Networking): This sensor is nLight-enabled, meaning it has the ability to communicate over an nLight network. When wired, using CAT-5 cabling, with other nLight-enabled sensors, power packs, or WallPods, an nLight control zone is created. Once linked to a Gateway, directly or via a Bridge, the zone becomes capable of remote status monitoring and control via SensorView software.

Integrated Smart Sensor (nLight Air Wireless Platform): The RES7 sensor is nLight AIR enabled, meaning it has the ability to communicate over the wireless nLight control platform. It is available with an automatic dimming photocell, and either a digital PIR or a microphonics (PDT) dual technology occupancy sensor. It pairs to other luminaires and wall switches through our mobile app, CLAIRITY, which allows for simple sensor adjustment.

Integrated Wireless Sensor (single room control): Sensor Switch VERTEX JOT or JOTVTX15 luminaire-embedded occupancy and ambient light sensor allows the luminaire to power off when the space is unoccupied or when enough ambient light is entering the space. See page 7 for more details on the integrated wireless sensor.

ELECTRICAL — Long-life LEDs, coupled with a high-efficiency driver, provide superior illumination for extended service life. See page 3 for detailed lumen maintenance information. 0-10V dimming driver, dims to 1% or 10% and contains non-isolated dimming leads.

LISTINGS — CSA Certified to meet US and Canadian standards. Tested to meet UL1958. Intended for indoor use only. Product is not to be stored in non-climate controlled spaces. DesignLights Consortium® (DLC) Premium qualified product and DLC qualified product. Not all versions of this product may be DLC Premium qualified or DLC qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified. Damp location listed. IC rated. IPSX rated. Long nomenclature, configurable product is rated and certified to meet NSF Splash Zone 2. Tested in accordance with ISO 14644-1; suitable for ISO Class 5-9 positive and negative pressure clean rooms. Suitable for ambient temperatures from 32°F (0°C) to 77°F (25°C).

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. Specifications subject to change without notice.

Dimensions

	1x4	2x2	2x4
Length	47.72"	23.70"	47.72"
Width	11.85"	23.70"	23.70"
Depth	2.19"	2.19"	2.19"
Weight	13.9 lbs	7.4 lbs	15.1 lbs

* Base configurations; options may add weight

TYPE T2D

Catalog Number
Notes
Type

EPANL LED

1'x4', 2'x2', and 2'x4'



Embed nLight controls today. Prepare for tomorrow.

Now

- User-friendly install
- Enhanced energy savings
- Code compliance

Tomorrow

- Scalability
- Space configuration
- Future-ready

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

TYPE T2D

EPANL LED Flat Panel



A+ Capable options indicated
by this color background.

ORDERING INFORMATION

Example: EPANL 2X4 4000LM 80CRI 35K MIN1 MVOLT E10WCP NLTAIR2 RIO

Series	Width and Length	Lumens				CRI	Color Temperature	Minimum Dimming Level ‡
EPANL LED Flat Panel	1x4 1'x4'	Standard Lumens:		High Efficiency Lumens:		80CRI 80 CRI	30K 3000K	MIN10 Dims to 10% ‡
		1500LM 1500 Lumens	1500LMHE 1500 Lumens	35K 3500K	MIN1 Dims to 1%			
		3000LM 3000 Lumens	3000LMHE 3000 Lumens					
		4000LM 4000 Lumens	4000LMHE 4000 Lumens					
		4800LM 4800 Lumens	4800LMHE 4800 Lumens					
		6000LM 6000 Lumens	6000LMHE 6000 Lumens					
	2x2 2'x2'	2000LM 2000 Lumens	2000LMHE 2000 Lumens					
		3400LM 3400 Lumens	3400LMHE 3400 Lumens					
		4000LM 4000 Lumens	4000LMHE 4000 Lumens					
		4800LM 4800 Lumens	4800LMHE 4800 Lumens					
	2x4 2'x4'	3000LM 3000 Lumens	3000LMHE 3000 Lumens					
		4000LM 4000 Lumens	4000LMHE 4000 Lumens					
		4800LM 4800 Lumens	4800LMHE 4800 Lumens					
		5400LM 5400 Lumens	5400LMHE 5400 Lumens					
		6000LM 6000 Lumens	6000LMHE 6000 Lumens					
		6800LM 6800 Lumens	6800LMHE 6800 Lumens					
		7200LM 7200 Lumens	7200LMHE 7200 Lumens					

Dimming ‡	Voltage	Step Level Dimming	Emergency Option
ZT Generic 0-10V Dimming	MVOLT 120-277V	(Blank) None	E10WCP EM Self-Diagnostic battery pack, 10W Constant Power, Certified in CA Title 20 MAEDBS ‡
EZT eldoLED 0-10V Dimming	120 120V	SLD Step Level Dimming ‡	GTD Generator Transfer Device ‡
DALI eldoLED DALI	277 277V		EMG for use with NLIGHT or NLTAIR2 on generator supply EM power ‡
	347 347V ‡		

INTEGRAL BATTERY PACKS TO BE PROVIDED FOR
LUMINAIRES INDICATED AS "EM" ON LIGHTING PLANS

Control Options		
Control Input nLight Wired: NLIGHT nLight enabled, no constant lumen management CL80 NLIGHT nLight enabled, constant lumen output 80%	Control nLight Wired: ‡ (blank) no control	Individual Control JOT Wireless room control with "Just One Touch" pairing ‡ JOTVIX15 Wireless occupancy sensor with "Just One Touch" pairing ‡
nLight Wireless: NLTAIR2 nLight AIR Generation 2 enabled ‡	nLight Wireless: RIO nLight AIR Radio module without sensor ‡ RES7 nLight AIR PIR integral occupancy sensor with automatic dimming photocell for Networking Capabilities ‡ RES7PDT nLight air microphonics dual technology occupancy sensor with automatic dimming photocell ‡	

Options	
GLR Fast-blowing fuse ‡	PWS1856LV 6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit w/low voltage wires ‡
GMF Slow-blowing fuse ‡	CP Chicago plenum ‡
PWS1836 6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit	NPLT Narrow Pallet
PWS1846 6' pre-wire, 3/8" diameter, 18 gauge, 2 circuit	BDP Factory Installed Ballast Disconnect Plug
PWS1846 PWSLV Two cables: one 6' pre-wire, 3/8" diameter, 18 gauge, 2 circuits; one 6' pre-wire, 3/8" diameter, 18 gauge ‡	RRL RELOC®-ready luminaire ‡

NOTE: ‡ indicates option value has ordering restrictions. Please reference the Option Value Ordering Restrictions chart on the next page. Options are sorted alphanumerically.

ELECTRICAL CONTRACTOR TO DETERMINE
APPROPRIATE MOUNTING HARDWARE & ACCESSORIES



EPANL

TYPE T2D

EPANL LED Flat Panel

± Option Value Ordering Restrictions	
Option Value	Restriction
347	Not available with SLD, E10WCP, or GTD options.
Dimming	If Step Level Dimming (SLD) or NLIGHT or NLTAIR2 is specified, leave this section blank.
CP	Not available with nLight wired (NLIGHT), nLight wireless (NLTAIR2).
E10WCP	Refer to Emergency Battery Estimated Lumen section for lumen estimation. Test Switch must be remote mounted or installed in an adjacent ceiling tile. When using pre-wire option, use PWS1846 or PWS1846 PWSLV.
EMG	Requires a connection to existing NLIGHT or NLTAIR2 network. Power is provided from separate nLight enabled fixture.
GLR, GMF	Must specify voltage. 120 or 277, with GLR and GMF fusing.
GTD	Not available with JOT, JOTVTX15, sensor options or emergency battery options. Must specify voltage. Requires BSE labeling, voltage specific. Consult factory for options. Example: GTD BSE10.
JOT, JOTVTX15	Not available with NLIGHT, DALI, SLD, GTD, EMG, or NLTAIR2 options.
MIN10	Not available with EZT, NLIGHT or DALI.
Minimum Dimming Level	If Step Level Dimming (SLD) is specified, leave this section blank.
NLTAIR2	Only available with MIN1 minimum dimming level option.
PWS1846 PWSLV	Not available with GTD, nLight wired, nLight wireless, NLIGHT or NLTAIR2.
PWS1856LV	Not available with nLight wired, nLight wireless, NLIGHT, or NLTAIR2.
RES7EM, RES7PDTEM, RIOEM	See UL924 Sequence of Operation chart on page 4.
RRL	For ordering logic consult RRL_2013.
SLD	Not available with with any nLight Interface, Control options, or GTD. When using prewire option use PWS1846.

Tunable White (Select SKUs Only)

Available SKUs:

*2735H0 EPANL 2X2 TUWH PROR 4800LM 80CRI NLT
 *2735H9 EPANL 2X2 TUWH PROR 4800LM 80CRI NLT PWS1836
 *2735HJ EPANL 2X2 TUWH PROR 4800LM 80CRI NLT E10WCP
 *2735HN EPANL 2X2 TUWH PROR 4800LM 80CRI NLT E10WCP PWS1846

Operating Performance:

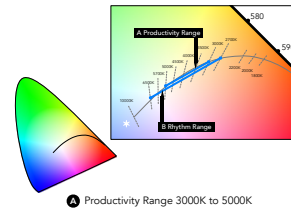
Nomenclature	CCT	Lumens	Efficacy	CRI
EPANL 2X2 TUWH PROR 4800LM 80CRI NLT @ 3000K	3105	4527.53	98.81	80.78
EPANL 2X2 TUWH PROR 4800LM 80CRI NLT @ 4000K	3974	4920.24	127.2	83.85
EPANL 2X2 TUWH PROR 4800LM 80CRI NLT @ 5000K	4925	5004.18	123.41	82.89

Mainstream Dynamic Tunable White with nTune Technology: Tunable white nTune™ is an all-digital light color temperature control within an nLight enabled luminaire. This brings tunable white lighting control into the mainstream with repeatable, consistent results in an economical luminaire form and system already familiar to schools. Designers and facility operators are granted the freedom to tie scenes to specific activities or to complement colors or materials within a visual environment. nTune™ allows color temperature settings through the Productivity Range of 3000K-5000K. Refer to the Programming User's Guide for instructions on customizing to your application with SensorView.



Tunable White GPHD

- Gamut:** One dimensional Warm-Cool
- Path:** Direct 3000K to 5000K (Productivity Range)
- Handle:** Two Natural Language Handles: Intensity and CCT
- Data:** nLight with nTune technology for both handles of control



Lumen Maintenance:

EPANL	Reported Lumen Maintenance	Forecasted Lumen Maintenance
SE LEDs	L90 @ 41k Hrs / L80 @ >54k Hrs / L70 @ >54k Hrs	L90 @ 41k Hrs / L80 @ 84k Hrs / L70 @ 134k Hrs
HE LEDs	L90 @ 44k Hrs / L80 @ >54k Hrs / L70 @ >54k Hrs	L90 @ 44k Hrs / L80 @ 93k Hrs / L70 @ 148k Hrs



EPANL

EPANL LED Flat Panel

ACCESSORIES

Accessories: Order as separate catalog number.	
DGA14	Drywall grid adapter for 1x4 recessed fixture.
DGA22	Drywall grid adapter for 2x2 recessed fixture.
DGA24	Drywall grid adapter for 2x4 recessed fixture.
PANLEM E10WCP BKT CVR	Field installable kit includes 10 watt battery, bracket and cover ¹
PANLEM BKT CVR	Field installable kit bracket and cover only, 10W battery NOT included ¹
2X2SMKSH	2'x2' Surface Mount Troffer Kit
2X4SMKSH	2'x4' Surface Mount Troffer Kit
1X4SMKSH	1'x4' Surface Mount Troffer Kit
BDP U	Field Installable Ballast Disconnect Plug
PAC 2DNF 36	Panel Air Craft Kit, 2 cables with Y splitter, No Power Feed, 36 inches. Recommended for 1X4 or 2X2 Panel Fixtures only. ²
PAC 2DF 36	Panel Air Craft Kit, 2 cables with Y splitter, with Power Feed, 36 inches. Recommended for 1X4 or 2X2 Panel Fixtures only. ^{2,3}
PAC 4DNF 36	Panel Air Craft Kit, 4 cables, No Power Feed, 36 inches. Recommended for 2X4, 1X4 or 2X2 Panel Fixtures. ²
PAC 4DF 36	Panel Air Craft Kit, 4 cables, with Power Feed, 36 inches. Recommended for 2X4, 1X4 or 2X2 Panel Fixtures. ^{2,3}
PAC 2DNF 72	Panel Air Craft Kit, 2 cables with Y splitter, No Power Feed 72 inches. Recommended for 1X4 or 2X2 Panel Fixtures only. ²
PAC 2DF 72	Panel Air Craft Kit, 2 cables with Y splitter, with Power Feed, 72 inches. Recommended for 1X4 or 2X2 Panel Fixtures only. ^{2,3}
PAC 4DNF 72	Panel Air Craft Kit, 4 cables, No Power Feed, 72 inches. Recommended for 2X4, 1X4 or 2X2 Panel Fixtures. ²
PAC 4DF 72	Panel Air Craft Kit, 4 cables, with Power Feed, 72 inches. Recommended for 2X4, 1X4 or 2X2 Panel Fixtures. ^{2,3}

Emergency Battery Estimated Lumens
Use the formula below to estimate the delivered lumens in emergency mode
Estimated Lumens = 1.25 x P x LPW
P = Output power of emergency driver (10W for PS1055CP)
LPW = Lumen per watt rating of the luminaire.

SMKSH Accessory



Notes:

1. Test switch must be remote mounted or installed in an adjacent ceiling tile.
2. See Suspension Kits section below for additional detail.
3. For MVOLT only, not available with 347V

Emergency Battery Pack Options – Field Installable

Battery Model Number	Wattage	Runtime (Minutes)	Lumen Output* @ 120 Lumens/Watt	Other
ILB CP07 2H A	7W	120	840	Storm Shelter / 2 Hour Runtime
ILB CP10 A	10W	90	1200	
ILBLP CP10 HE SD A	10W	90	1200	Title 20, Self Diagnostic
ILBLP CP15 HE SD A	15W	90	1800	Title 20, Self Diagnostic
ILB CP20 HE A	20W	90	2400	Title 20
ILB CP20 HE SD A	20W	90	2400	Title 20, Self Diagnostic

All the above are UL Listed products that are certified for field install external/remote to the fixture.

*Minimum delivered lumen output to assist in product selection for increased fixture mounting height.

The CP10 delivered emergency illumination outperforms legacy 1400 lumen fluorescent emergency ballast.

Please contact us at productsupportemergency@acuitybrands.com for any Emergency Battery related questions.

UL924 Sequence of Operation

For 90 minutes following any complete AC power interruption >200 ms:

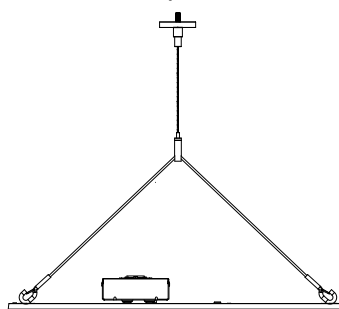
- Digital dimming is commanded to high end trim level.
- Device ignores wireless lighting control commands.

Suspension Kits

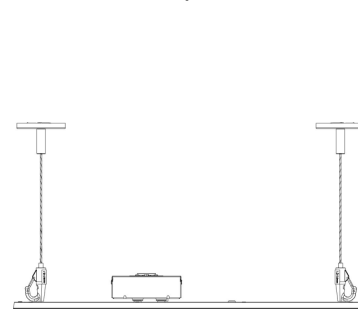
2 drops (1x4)



2 drops (2x2)



4 drops (2x4)



EPANL

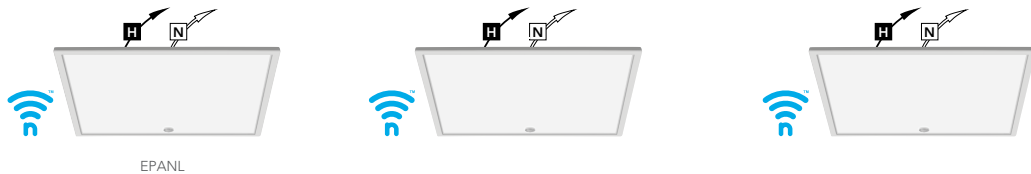
TYPE T2D

EPANL LED Flat Panel

nLight Platform

nLight embedded fixtures offer:	Customers get:
Manual Dimming	Convenience and visual comfort for occupants
Motion Sensing and/or Daylight Harvesting	Energy savings and code compliance
Fixture or Group Level Control	Ability to configure lighting to the space requirements
Flexibility	Ease of fixture moves, adds and changes
Wireless Wall Switch (nLight AIR Only)	Ease and flexibility of placement
Astronomical and Time of Day Scheduling	Energy savings and building security
Scalable Solution	nLight controls to grow with your business
Future-Ready	nLight platform to set foundation for future upgrades and capabilities

nLight Air Wireless

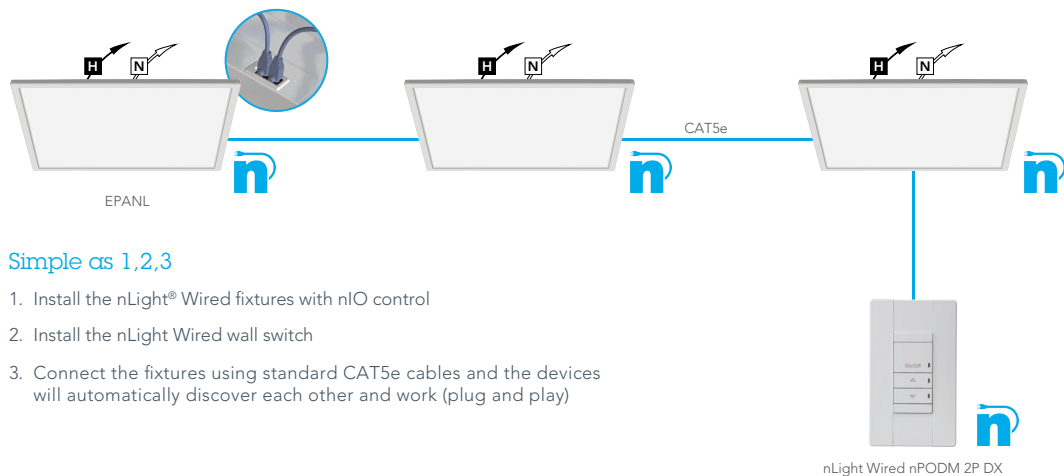


Simple as 1,2,3

1. Install the nLight® AIR fixtures with embedded smart sensor
2. Install the wireless battery-powered wall switch
3. With the CLARITY Pro app, pair the fixtures with the wall switch and if desired, customize the sensor settings for the desired outcome



nLight Wired Networking



Simple as 1,2,3

1. Install the nLight® Wired fixtures with nIO control
2. Install the nLight Wired wall switch
3. Connect the fixtures using standard CAT5e cables and the devices will automatically discover each other and work (plug and play)

EPANL LED Flat Panel

Controls Accessories

nLight® Wired Control Accessories:

Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlight.

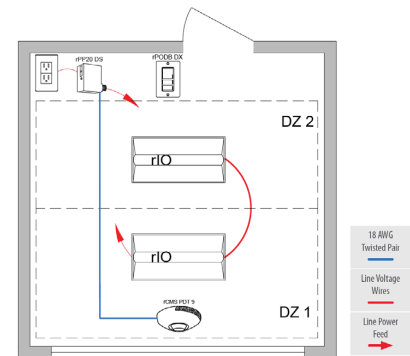
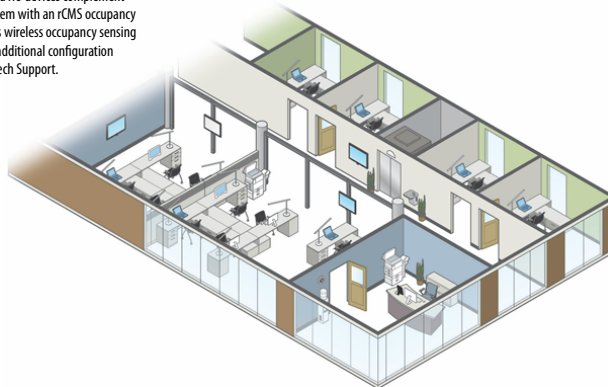
WallPod stations	Model number	Occupancy sensors	Model number
On/Off	nPODMA [Color]	Small motion 360°, ceiling (PIR / dual tech)	nCM 9 RJB / nCM PDT 9 RJB
On/Off & raise/lower	nPODMA DX [Color]	Large motion 360°, ceiling (PIR / dual tech)	nCM10 RJB / nCM PDT 10 RJB
Graphic touchscreen	nPOD TOUCH [Color]	Wall switch with raise/lower	nWSX PDT LV DX [color]
Photocell controls	Model number	Cat-5 cable (plenum rated)	Model number
Full range dimming	nCM ADCX RJB	10' cable	CATS 10FT J1
		30' cable	CATS 30FT J1

nLight® AIR Control Accessories:

Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlightair.

Wall switches	Model number
On/Off single pole	rPODBA [color] G2
On/Off two pole	rPODB A2P [color] G2
On/Off & raise/lower single pole	rPODBA DX [color] G2
On/Off & raise/lower two pole	rPODBA 2P DX [color] G2

EPANL fixtures with integrated rIO devices complement any small office space. Pair them with an rCMS occupancy sensor and the space now has wireless occupancy sensing and dimming capability. For additional configuration options please consult with Tech Support.



rCMS ¹						Example: RCMS PDT 10 AR G2	
Series / Detection	Power Supply ¹	Occupancy Detection	Lens (Required)	Operating Mode	Generation		
RCMS nLight AIR occupancy and daylight sensor	[blank] Power Supply ordered separately	[blank] PIR Detection PDT Dual Tech PIR/Microphonics	10 Large Motion/ Extended Range 360°	[BLANK] None AR Auxiliary Relay	G2 Generation 2 compatibility		
	PS 150 Standard 150 mA Power Supply		9 Small Motion/ Extended Range 360°				
			6 High Bay 360° Lens				

Notes

¹ RCMS requires low voltage power from either RPP20 DS 24V G2 or PS150.



Sensor Switch
WSX



nLight WIRED
nPOD UNITOUCH



nLight WIRED
nPODMA DX



nLight AIR
rPODBA



EPANL with rES7



rPODBA

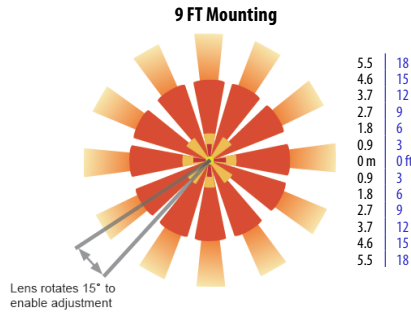


RCMS

EPANL LED Flat Panel

Sensor Coverage Pattern Mini 360° Lens

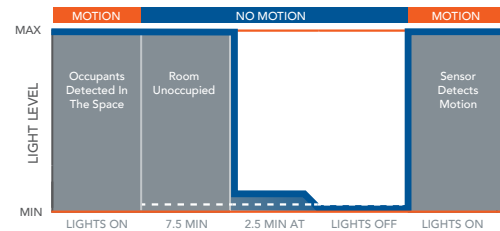
- Recommended for walking motion detection from mounting heights between 8 ft (2.44 m) and 20 ft (6.10 m)
- Initial detection of walking motion along sensor axes at distances of 2x the mounting height up to 15 ft (4.57 m) and
- 1.75x up to 20 ft (6.10 m).
- Provides 12 ft (3.66 m) radial detection of small motion when mounted at 9 ft (2.74 m)
- Initial detection will occur earlier when walking across sensor's field of view than when walking directly at sensor



nLight AIR Wireless

nLight AIR is the ideal solution for retrofit or new construction spaces where adding additional wiring can be labor intensive and nLight AIR is available with or without an integral sensor. The integrated rES7 or rES7PDT smart sensors are part of each luminaire in the nLight AIR network, which can be grouped to control multiple luminaires. The granularity of control with the digital PIR occupancy detection and daylight sensing makes a great solution for any application.

Sequence of Operation (nES7 and Sensor)



*The presetting on the automatic dimming photocell is 10fc (RES7).

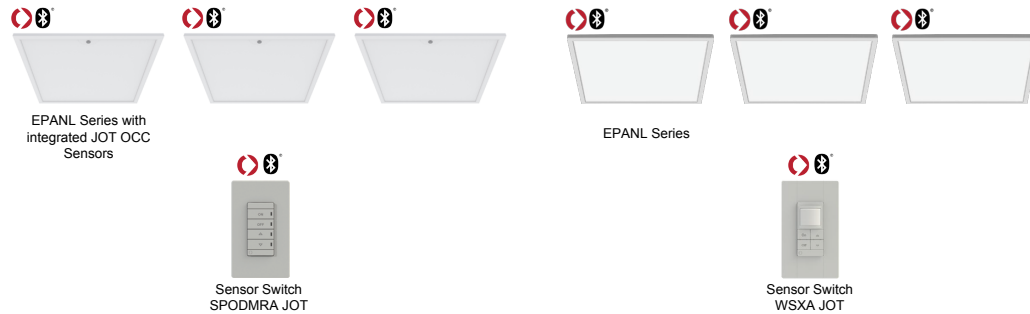
Sensor Switch JOT



Sensor Switch JOT Enabled Wireless Solution

Designed with contractors in mind, the Sensor Switch JOT enabled wireless solution offers a straightforward approach to the installation and pairing of lighting fixtures and controls. Absolutely no 0-10V control wires and no mobile apps are needed with JOT enabled products, allowing for lightning speed installation right out of the box.

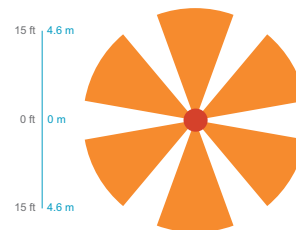
- Power:** Install JOT enabled fixtures and controls as instructed.
- Pair:** Insert the pairing tool into the pinhole on the wall switch; press and hold any button for 6 seconds.
- Play:** Once paired, each fixture will individually dim down to 10% brightness. All products will be fully functional.



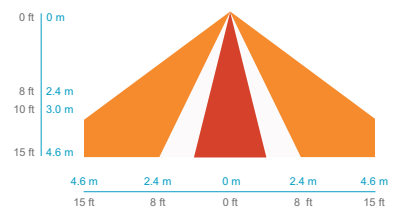
15F - LARGE MOTION EXTENDED RANGE 360

- Optimized full coverage from 8 ft - 15 ft (2.4 m - 4.5 m) mounting heights
- Reliable detection of large motion (e.g. pedestrian walking traffic)
- 1.3 x mounting height equals approximate detection range

TOP VIEW



SIDE VIEW



EPANL LED Flat Panel

Performance Data					
Model No.	DLC Classification	Reported Light Output	Reported Wattage	Reported Efficacy (AC)	DLC Product Id
EPANL 1X4 1500LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1511	14	108	P7WQ2HL
EPANL 1X4 1500LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1511	14	108	P7U30VTJ
EPANL 1X4 1500LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1574	14	113	P8VKRLEE
EPANL 1X4 1500LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1574	14	113	P7KC75SF
EPANL 1X4 1500LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1637	14	117	PJAP0LUK
EPANL 1X4 1500LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1637	14	117	P93PN6HF
EPANL 1X4 1500LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1699	14	122	PJ2LT8RF
EPANL 1X4 1500LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1699	14	122	PMO20WDF
EPANL 1X4 1500LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1419	12	119	P783S2UK
EPANL 1X4 1500LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1419	12	119	P08VAI49
EPANL 1X4 1500LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1457	12	122	PPJ3S90F
EPANL 1X4 1500LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1457	12	122	PKV3IEP
EPANL 1X4 1500LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	1508	12	127	P2590KI9
EPANL 1X4 1500LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	1508	12	127	P66FTD1J
EPANL 1X4 1500LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	1543	12	130	PD3A29J1
EPANL 1X4 1500LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	1543	12	130	PW3538GV
EPANL 1X4 3000LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	2841	27	106	PEYKSSNY
EPANL 1X4 3000LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	2841	27	106	P7W193ZL
EPANL 1X4 3000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	2960	27	110	PBMBSQA8
EPANL 1X4 3000LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	2960	27	110	PT0HAX5
EPANL 1X4 3000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3078	27	114	PNKUCIA
EPANL 1X4 3000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3078	27	114	P53ZWBUF
EPANL 1X4 3000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3197	27	119	PMH2SAT
EPANL 1X4 3000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3197	27	119	PFZRHYS
EPANL 1X4 3000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	2771	23	123	PJ1YE30
EPANL 1X4 3000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	2771	23	123	P49S1R0
EPANL 1X4 3000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	2845	23	126	PTUGXVMO
EPANL 1X4 3000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	2845	23	126	P61KCHV
EPANL 1X4 3000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	2945	23	130	PJYQUJN8
EPANL 1X4 3000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	2945	23	130	PJZRVW5F
EPANL 1X4 3000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3012	23	133	POATZ94T
EPANL 1X4 3000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3012	23	133	PT45WGFZ
EPANL 1X4 4000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	3426	31	111	PSWJLZ98
EPANL 1X4 4000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3963	37	107	P7M6FP4R
EPANL 1X4 4000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3963	37	107	PQH0HMOH
EPANL 1X4 4000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4116	37	111	PY8MM627
EPANL 1X4 4000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4116	37	111	P3XBCGJ0
EPANL 1X4 4000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3667	31	120	PKMNCN14
EPANL 1X4 4000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3667	31	120	PDWGL65K
EPANL 1X4 4000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3765	31	123	PJZ17EWI
EPANL 1X4 4000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3765	31	123	P4L0LVRG
EPANL 1X4 4000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3897	31	128	PZGUR2U
EPANL 1X4 4000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3897	31	128	PY7QZBWI
EPANL 1X4 4000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3985	31	130	PD4KJ8B3
EPANL 1X4 4000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3985	31	130	PELAOSTB
EPANL 1X4 4800LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4633	45	104	PII6VKUP
EPANL 1X4 4800LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4633	45	104	PKJ02BDR
EPANL 1X4 4800LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4807	45	108	P716D3WI
EPANL 1X4 4800LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4807	45	108	PJ87LC64
EPANL 1X4 4800LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4923	45	110	PICJQWGD
EPANL 1X4 4800LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4923	45	110	PZW1PDFZ
EPANL 1X4 4800LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4967	45	111	PQAFPPJ6
EPANL 1X4 4800LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4967	45	111	PCNBYZM0
EPANL 1X4 4800LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4340	37	117	PU1UIM58
EPANL 1X4 4800LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4340	37	117	PNSWOKZ3
EPANL 1X4 4800LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4456	37	120	P0BHX07V
EPANL 1X4 4800LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4456	37	120	P07FGWK3
EPANL 1X4 4800LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4612	37	124	PHAPQJJS
EPANL 1X4 4800LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4612	37	124	PZ9DDI8L
EPANL 1X4 4800LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4717	37	127	PL0V456F
EPANL 1X4 4800LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4717	37	127	PJIAJOSO
EPANL 1X4 5400LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5156	44	116	PKIBC75K
EPANL 1X4 5400LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5156	44	116	PC2IS9KU
EPANL 1X4 5400LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5272	44	119	PNX0E6ZR
EPANL 1X4 5400LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5272	44	119	PE4NWEQC
EPANL 1X4 5400LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5490	44	124	PF0B5KQD

TYPE T2D

EPANL LED Flat Panel

Performance Data					
Model No.	DLC Classification	Reported Light Output	Reported Wattage	Reported Efficacy (AC)	DLC Product Id
EPANL 1X4 5400LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5490	44	124	PVWWB0JI
EPANL 1X4 5400LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5665	44	128	PEC0GL65
EPANL 1X4 5400LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5665	44	128	P7PAYNFS
EPANL 1X4 6000LM 80CRI 30K [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	5953	55	109	P84A41CZ
EPANL 1X4 6000LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5953	51	117	PL3AU798
EPANL 1X4 6000LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5953	51	117	PCMNH26U
EPANL 1X4 6000LM 80CRI 35K [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	5997	55	110	PWJ6HVP3
EPANL 1X4 6000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5997	51	118	P31GEZNP
EPANL 1X4 6000LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5997	51	118	P9MS2FI2
EPANL 1X4 6000LM 80CRI 40K [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	6171	55	113	PD7JL7CS
EPANL 1X4 6000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	6171	51	121	PEC0ZVXY
EPANL 1X4 6000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	6171	51	121	PRC6VIDH
EPANL 1X4 6000LM 80CRI 50K [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	6240	55	114	P206CKK4
EPANL 1X4 6000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	6240	51	123	PSBGKZ54
EPANL 1X4 6000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	6240	51	123	PEVMDG8B
EPANL 2X2 2000LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1988	19	106	P084CQTR
EPANL 2X2 2000LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1988	19	106	PN6W7230
EPANL 2X2 2000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	2071	19	110	P4AJO6I1
EPANL 2X2 2000LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	2071	19	110	P4Y2S08D
EPANL 2X2 2000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	2154	19	115	P1QUALNF
EPANL 2X2 2000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	2154	19	115	PULQ3DQ4
EPANL 2X2 2000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	2237	19	119	P167DCJS
EPANL 2X2 2000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	2237	19	119	P1FNCFUQ
EPANL 2X2 2000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1856	16	119	P8MIUS1X
EPANL 2X2 2000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1856	16	119	PRXPVWQJ
EPANL 2X2 2000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	1906	16	123	PU253KEZ
EPANL 2X2 2000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	1906	16	123	PLNV5ZF6
EPANL 2X2 2000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	1972	16	127	PZSE53J1
EPANL 2X2 2000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	1972	16	127	PZKK2D04
EPANL 2X2 2000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	2017	16	130	PCLAME02
EPANL 2X2 2000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	2017	16	130	PV0MYAQV
EPANL 2X2 3400LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3291	30	109	PNSQ2LMI
EPANL 2X2 3400LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3291	30	109	PU14CBM6
EPANL 2X2 3400LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3428	30	113	PMKTPCS2
EPANL 2X2 3400LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3428	30	113	PB1DW61J
EPANL 2X2 3400LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3566	30	118	PWRHGEH4
EPANL 2X2 3400LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	3566	33	107	PS9YVB0V
EPANL 2X2 3400LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3566	30	118	PG7KB5GU
EPANL 2X2 3400LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3703	30	122	PL6024K5
EPANL 2X2 3400LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3703	30	122	PP79GBQH
EPANL 2X2 3400LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3198	27	121	P25AS4VV
EPANL 2X2 3400LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3198	27	121	PZENR7ML
EPANL 2X2 3400LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3285	27	124	PC28H7F3
EPANL 2X2 3400LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3285	27	124	PGPCX23Z
EPANL 2X2 3400LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3399	27	128	PWGICRAX
EPANL 2X2 3400LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3399	27	128	PZQGNSEP
EPANL 2X2 3400LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3477	27	131	P57KW7H4
EPANL 2X2 3400LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3477	27	131	PDS56J8H
EPANL 2X2 4000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4121	37	110	PSL7HREA
EPANL 2X2 4000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4121	37	110	PP2PR06A
EPANL 2X2 4000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4280	37	114	P94H4XFG
EPANL 2X2 4000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4280	37	114	PFQ0F3LM
EPANL 2X2 4000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3874	33	118	PTN8M365
EPANL 2X2 4000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3874	33	118	PXW23VVD
EPANL 2X2 4000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3978	33	121	P5661UUU
EPANL 2X2 4000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3978	33	121	PG06EXAT
EPANL 2X2 4000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4117	33	125	PD2JEZV9
EPANL 2X2 4000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4117	33	125	P8BAID21
EPANL 2X2 4000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4211	33	128	P3P7W4AB
EPANL 2X2 4000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4211	33	128	PQCCGU60
EPANL 2X2 4800LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4843	45	109	P00Y8NZ2
EPANL 2X2 4800LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4843	45	109	PB9Y8XNL
EPANL 2X2 4800LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4886	45	110	PW25Y5X9
EPANL 2X2 4800LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4886	45	110	PAAAM27H
EPANL 2X2 4800LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4420	36	121	PYMYFE0
EPANL 2X2 4800LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4420	36	121	PX02EX68
EPANL 2X2 4800LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4539	36	125	PZ0PLMI9
EPANL 2X2 4800LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4539	36	125	PF2L9X2I



EPANL

EPANL LED Flat Panel

Performance Data					
Model No.	DLC Classification	Reported Light Output	Reported Wattage	Reported Efficacy (AC)	DLC Product Id
EPANL 2X2 4800LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4697	36	129	PNQ40WFF
EPANL 2X2 4800LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4697	36	129	P2N53VB0
EPANL 2X2 4800LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4804	36	132	PG3ZCKUI
EPANL 2X2 4800LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4804	36	132	PND00X14
EPANL 2X4 3000LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3015	29	106	PGB293WJ
EPANL 2X4 3000LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3015	29	106	PXWRSANS
EPANL 2X4 3000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3141	29	110	PU32L41S
EPANL 2X4 3000LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3141	29	110	PWJ91G
EPANL 2X4 3000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3266	29	115	PVHS0QB
EPANL 2X4 3000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3266	29	115	PP0P99LT
EPANL 2X4 3000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3392	29	119	P4H3UGFQ
EPANL 2X4 3000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3392	29	119	PLI4CPSN
EPANL 2X4 3000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	2943	23	129	PHDEORE3
EPANL 2X4 3000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	2943	23	129	PYUNOTIN
EPANL 2X4 3000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	2986	23	131	P2GQ1ISA
EPANL 2X4 3000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	2986	23	131	PC23010
EPANL 2X4 3000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3071	23	135	PNWQLGKR
EPANL 2X4 3000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3071	23	135	P3CL956W
EPANL 2X4 3000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3114	23	137	PIIH40FQ
EPANL 2X4 3000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3114	23	137	P609TWNV
EPANL 2X4 3760LMHE 80CRI 40K MIN10 ZT MVOLT NACV	Premium	3984	27	147	PQMBSPAR
EPANL 2X4 4000LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	3914	38	104	PLDIMHXG
EPANL 2X4 4000LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	3914	38	104	P01K0BJN
EPANL 2X4 4000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4077	38	108	PPTL71HY
EPANL 2X4 4000LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4077	38	108	PRO2E004
EPANL 2X4 4000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4240	38	113	PT1H08CF
EPANL 2X4 4000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4240	38	113	PGSERWDA
EPANL 2X4 4000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4403	38	117	P8TD4A4V
EPANL 2X4 4000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4403	38	117	PTXVJNOI
EPANL 2X4 4000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3874	31	123	P8R62RB3
EPANL 2X4 4000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3874	31	123	P23T82YA
EPANL 2X4 4000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	3930	31	125	PIY82204
EPANL 2X4 4000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	3930	31	125	PSKVR7RT
EPANL 2X4 4000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4042	31	129	PPU6PYNE
EPANL 2X4 4000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4042	31	129	P9VNDDES
EPANL 2X4 4000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4098	31	130	PTRH2WMJ
EPANL 2X4 4000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4098	31	130	P55XJ12N
EPANL 2X4 4800LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4817	45	107	PZB2XRG3
EPANL 2X4 4800LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4817	45	107	PHYF1N9C
EPANL 2X4 4800LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4998	45	111	P4PIGUFW
EPANL 2X4 4800LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4998	45	111	PI2A3L85
EPANL 2X4 4800LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5119	45	113	P4SKVRJP
EPANL 2X4 4800LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5119	45	113	P018HM99
EPANL 2X4 4800LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5164	45	114	PG2MHOZE
EPANL 2X4 4800LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	5164	48	107	P70IOAPR
EPANL 2X4 4800LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5164	45	114	PWTSOASQ
EPANL 2X4 4800LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4491	37	120	P3RFGZH6
EPANL 2X4 4800LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4491	37	120	POC36E5U
EPANL 2X4 4800LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	4612	37	123	PYK5A8HX
EPANL 2X4 4800LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	4612	37	123	PYWZDYOR
EPANL 2X4 4800LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4773	37	127	P47QIRYT
EPANL 2X4 4800LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4773	37	127	PH0QXWON
EPANL 2X4 4800LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	4882	37	130	PR3ISII0
EPANL 2X4 4800LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	4882	37	130	PKP1XLJT
EPANL 2X4 5000LMHE 80CRI 40K MIN10 ZT MVOLT NACV	Premium	5218	37	141	PL4KXES
EPANL 2X4 5400LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5345	49	109	PO568XSR
EPANL 2X4 5400LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5345	49	109	P00696LI
EPANL 2X4 5400LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5546	49	113	PFC1L300
EPANL 2X4 5400LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5546	49	113	PK7Q1VHH
EPANL 2X4 5400LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5679	49	116	PR3K6SHH
EPANL 2X4 5400LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5679	49	116	P8KYWF8J
EPANL 2X4 5400LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	5730	49	117	PVKX9GJ
EPANL 2X4 5400LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	5730	49	117	PX1YH6FH
EPANL 2X4 5400LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5302	41	131	P3JOAC0V
EPANL 2X4 5400LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	5302	41	128	PNWXLXM3
EPANL 2X4 5400LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5302	41	131	PARJN9JC
EPANL 2X4 5400LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5421	41	134	P4E4JYPW
EPANL 2X4 5400LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	5421	41	131	PPKAF154

TYPE T2D

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Performance Data					
Model No.	DLC Classification	Reported Light Output	Reported Wattage	Reported Efficacy (AC)	DLC Product Id
EPANL 2X4 5400LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5421	41	134	PBVWKVM6
EPANL 2X4 5400LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5645	41	139	PWCONHWM
EPANL 2X4 5400LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	5645	41	137	PZRLJ13L
EPANL 2X4 5400LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5645	41	139	PAHJYVRW
EPANL 2X4 5400LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5825	41	144	PKDG7XHY
EPANL 2X4 5400LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	5825	41	141	P36758NK
EPANL 2X4 5400LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5825	41	144	P2LS10S9
EPANL 2X4 5757LMHE 80CRI 40K MIN10 ZT MVOLT NACV	Premium	5776	40	143	P71Q69QD
EPANL 2X4 6000LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6318	50	126	PD2QM1LA
EPANL 2X4 6000LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6318	50	126	P32NF8NU
EPANL 2X4 6000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6364	50	127	PSV30WTC
EPANL 2X4 6000LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	6364	55	115	P89SURCD
EPANL 2X4 6000LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6364	50	127	PK0759Q3
EPANL 2X4 6000LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6548	50	131	PWWK6LER
EPANL 2X4 6000LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6548	50	131	PHICROVH
EPANL 2X4 6000LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6622	50	132	PQMRLFRM
EPANL 2X4 6000LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6622	50	132	PSF8NN00
EPANL 2X4 6000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5755	43	135	P6JUAFC1
EPANL 2X4 6000LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	5755	45	128	PDDV7MOA
EPANL 2X4 6000LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5755	43	135	P0181095
EPANL 2X4 6000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	5884	43	138	PENZU105
EPANL 2X4 6000LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	5884	45	131	PIVHYPP1
EPANL 2X4 6000LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	5884	43	138	PKFWFCU
EPANL 2X4 6000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6127	43	144	P2GVOFOB
EPANL 2X4 6000LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	6127	45	136	PB0A5LE2
EPANL 2X4 6000LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6127	43	144	PA04TVD1
EPANL 2X4 6000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6322	43	148	P2ZYBVS5
EPANL 2X4 6000LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Premium	6322	45	140	P888TM5U
EPANL 2X4 6000LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6322	43	148	PKPSCMGA
EPANL 2X4 6800LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7013	62	113	PW2T9FQ
EPANL 2X4 6800LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7013	62	113	PBEOWDCQ
EPANL 2X4 6800LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7064	62	114	PW0040LR
EPANL 2X4 6800LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7064	62	114	P7ALFH3K
EPANL 2X4 6800LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7269	62	117	P8FE8QH
EPANL 2X4 6800LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	7269	65	111	PSLOA6G7
EPANL 2X4 6800LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7269	62	117	PIUM942B
EPANL 2X4 6800LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7351	62	118	PCMKG05N
EPANL 2X4 6800LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7351	62	118	P9AP1VBW
EPANL 2X4 6800LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6450	48	135	PT19MBX1
EPANL 2X4 6800LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6450	48	135	PNHSDDT2
EPANL 2X4 6800LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6596	48	138	PICAPAMD
EPANL 2X4 6800LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6596	48	138	PHA6TVBP
EPANL 2X4 6800LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6868	48	144	P81UL0J1
EPANL 2X4 6800LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6868	48	144	P7786JMO
EPANL 2X4 6800LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	7086	48	149	PU25XKJQ
EPANL 2X4 6800LMHE 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	7086	48	149	PMB46YK
EPANL 2X4 7200LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7388	66	111	P2QQ1V0K
EPANL 2X4 7200LM 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	7388	70	106	PF1518JE
EPANL 2X4 7200LM 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7388	66	111	P2GTCW3J
EPANL 2X4 7200LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7442	66	112	PCRM0D2R
EPANL 2X4 7200LM 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	7442	70	107	PKYV7048
EPANL 2X4 7200LM 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7442	66	112	P41RL2H5
EPANL 2X4 7200LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7657	66	115	PS2AC19A
EPANL 2X4 7200LM 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	7657	70	110	PBV78YXA
EPANL 2X4 7200LM 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7657	66	115	PCLJ4VZN
EPANL 2X4 7200LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Standard	7744	66	117	PIS28TOX
EPANL 2X4 7200LM 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] 347 [ALL OPTIONS]	Standard	7744	70	111	PSPB7FBG
EPANL 2X4 7200LM 80CRI 50K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Standard	7744	66	117	P1RQA8L6
EPANL 2X4 7200LMHE 80CRI 30K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6792	50	137	PIJOUK7J
EPANL 2X4 7200LMHE 80CRI 30K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6792	50	137	PW92GBXR
EPANL 2X4 7200LMHE 80CRI 35K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	6945	50	140	PHWEYL0D
EPANL 2X4 7200LMHE 80CRI 35K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	6945	50	140	PXHH12RI
EPANL 2X4 7200LMHE 80CRI 40K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	7232	50	146	PW3RZAGO
EPANL 2X4 7200LMHE 80CRI 40K [MVOLT, 120, 277] SLD [ALL OPTIONS]	Premium	7232	50	146	PZY6WXTJ
EPANL 2X4 7200LMHE 80CRI 50K [MIN1, MIN10] [BLANK, ZT, EZT, NLIGHT] [MVOLT, 120, 277] [ALL OPTIONS]	Premium	7462	50	151	PPYDM8D6
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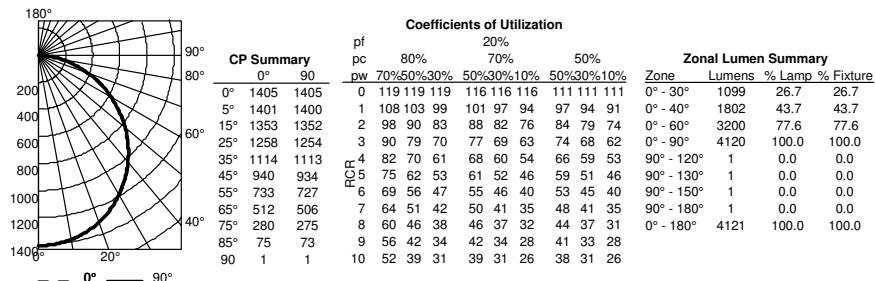
EPANL

EPANL LED Flat Panel

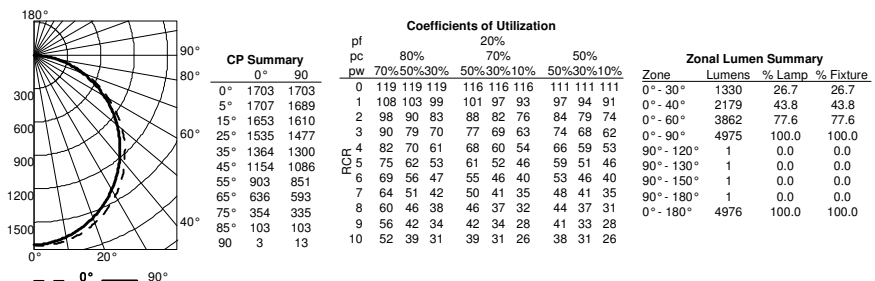
PHOTOMETRICS

Full Photometric data is available on Lithonia.acuitybrands.com

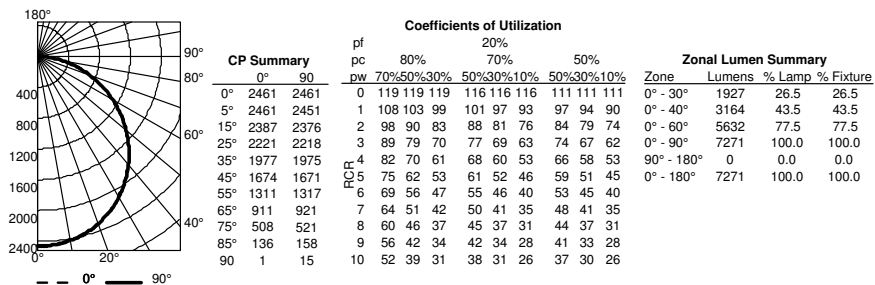
EPANL 2x2 4000LM 80CRI 40K, 4121 delivered lumens.



EPANL 2x4 4800LM 80CRI 40K, 5119 delivered lumens.



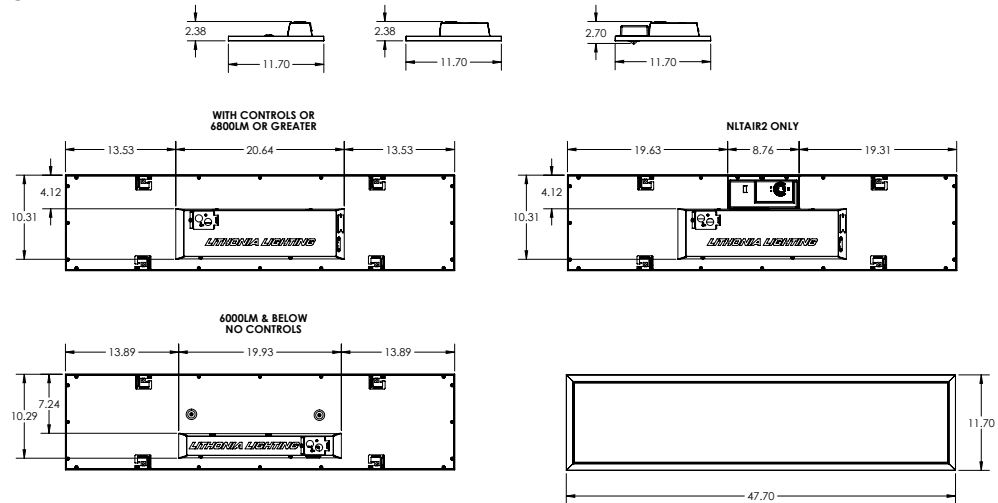
EPANL 2x4 6800LM 80CRI 40K, 7269 delivered lumens.



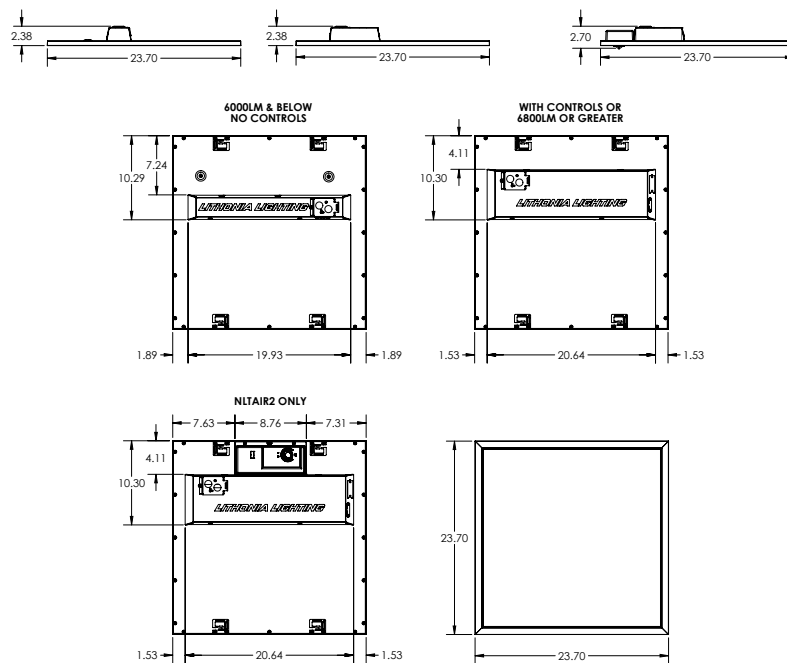
EPANL LED Flat Panel

DIMENSIONS

1X4 Configurations



2X2 Configurations

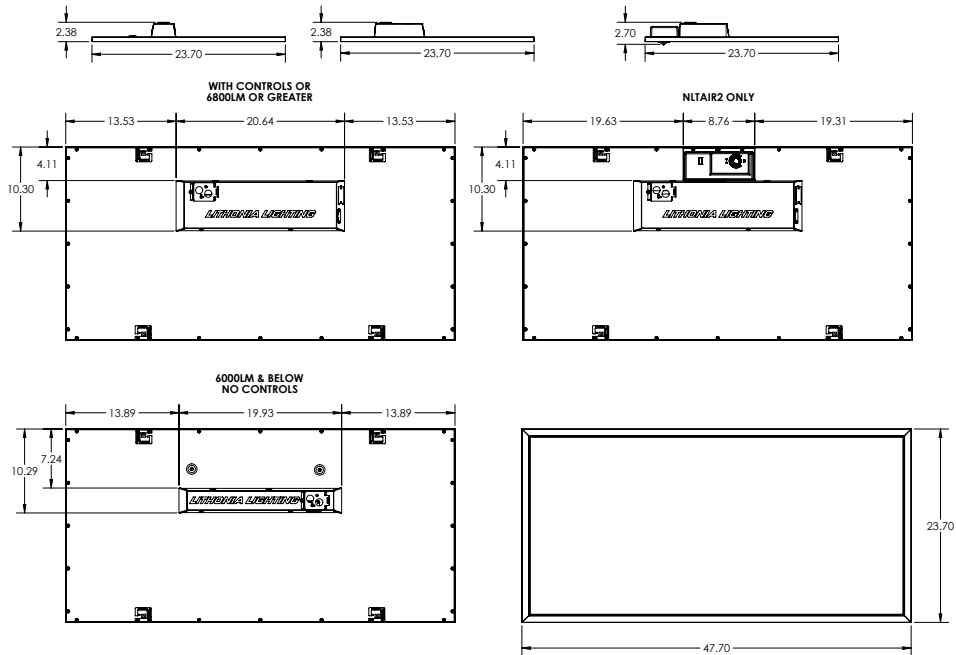


EPANL LED Flat Panel

TYPE T2D

DIMENSIONS (continued)

2X4 Configurations



SECTION 28 3500 - REFRIGERANT MONITORING SYSTEM

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 23 Chiller sections.
 - 4. Division 23 "Temperature Controls"
 - 5. Electrical Work specified in Division 26.

1.2 QUALITY ASSURANCE

- A. System Supplier Qualifications:
 - 1. Refrigerant monitoring system supplier shall be a firm regularly engaged in providing refrigerant leak detection systems whose products have been in satisfactory use in similar service for not less than one year and familiar with standard practices of safety and installation for refrigerant gas vapor detection systems. Supplier shall be familiar with current Michigan and International Mechanical and Fire Code requirements and installation of Code Compliant refrigerant gas vapor detection systems.
 - 2. Supplier shall be authorized factory trained service center to provide system design, fabrication, installation, service and training for gas detection products specified.
 - 3. System shall meet or exceed the latest applicable Michigan Building Code, Michigan Fire Code, Michigan Mechanical Code, International Fire Code, International Mechanical Code, NFPA, and ASHRAE Standard 15-2010.

4. Installation practices shall conform to Division 20 and 23 – Mechanical, and Division 26 - Electrical Specifications for materials and installation procedures.
5. The specification provided for this system is a performance specification. Refrigerant Monitoring System Supplier shall take full responsibility for proper detailed design and supply of Refrigerant Monitoring System including components and items described in this specification section. This is a LIFE SAFETY system.
6. Supplier shall work with necessary authority having jurisdiction to satisfy local code requirements as required.

1.3 ACTION SUBMITTALS

- A. Submit under provisions of Division 20 Section "Mechanical General Requirements" and as supplemented in this section.
 1. Product data for system components.
 2. Wiring diagrams from manufacturer differentiating between factory and field installed wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Indicate components for both field and factory wiring.
 3. Wiring diagrams shall include all interconnections between components, control panels, and other system interfaces.
 4. Piping diagrams from manufacturer differentiating between factory and field installed piping. Include diagrams for equipment and for system with all interconnections identified. Indicate components for both field and factory piping.
 5. Piping diagrams shall include all interconnections between components, control panels, and other system interfaces. Piping riser details shall be supplied.
 6. System operation description covering this specific Project including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
 7. Submit CODE COMPLIANCE documentation; itemizing building code references for design justification. At a minimum include the following: sample point locations, Calibration Report with before and after results of each analyzer, Alarm / Interface Report stating all field devices interlocked to system; manufacturer and model number, threshold levels with alarm and interface action at each level of alarm, field verification report, Safety Training Checklist with action procedures in alarm situation, and List of all owner attendees for each training session.
 8. Operating instructions for mounting at each control panel.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data for inclusion in Operating and Maintenance Manual specified in Division 01. Include data for each type product, including all features and operating sequences, both automatic and manual. Include recommendations for spare parts to be stocked at the site. Provide the names, addresses, and telephone numbers of service organizations that carry stock of repair parts for the system to be furnished.

PART 2 - PRODUCTS

2.1 MANUFACTURER/SYSTEM SUPPLIER

A. Refrigerant Analyzer Manufacturer:

1. Bacharach.
2. Mine Safety Appliance (MSA).
3. Thermal Gas Systems (Haloguard Refrigerant Monitors)
4. Trane.

- B. Local manufacturer's representative/supplier of refrigerant monitoring system shall provide complete engineered system drawings for installation contractor including all required visual indication lights, horns, signage, equipment emergency purge interlocks, and equipment emergency shutdown interlocks as required for the mechanical room where refrigerant monitoring system is to be located.

2.2 GENERAL

- A. Provide a refrigerant monitoring system where indicated in Contract Documents containing a series of detection points located in areas where refrigerant from a leak is likely to accumulate and / or be sensed. Include analyzer, sequencer and interface control panels(s), filters, sensors, alarm signaling devices, piping and all components necessary for a complete operational system. System shall provide various stages of alarming, and control chiller room mechanical ventilation in accordance with sequence of operation at values not to exceed specified Threshold Limit Value-Time Weighted Average (TLV-TWA). System shall be capable of detecting the presence of the specific refrigerant(s) actually used on this project. System shall be capable of detecting, indicating, alarming, shutting down equipment, and interfacing to building automation system (BAS). Oxygen depletion sensors are not acceptable.
- B. Refrigerants classified as A2, A3, B2 and B3 in the International Mechanical Code, ASHRAE 15 and ASHRAE 34 shall employ the appropriate sensing technology and conform to Class 1, Division 2, NFPA 70 requirements. Follow appropriate guidelines indicated in regulations concerning area classification requirements.
- C. Locate Refrigerant Analyzer and Local Interface Control Panel inside of the area to be monitored near the main exit from the mechanical room or as shown on the mechanical floor plan drawings.
- D. Sequential sampling and multi point monitoring shall be employed to provide minimum two (2) points of area sampling for each chiller. Additionally, monitoring shall be provided for any unsealed shafts or low floor areas located in the chiller mechanical room. Diluted samples due to ventilation air flow currents shall employ multi point monitoring techniques strategically located. Where multiple refrigerant types are used, properly select the quantity and type of refrigerant detectors and multipoint sequential sampling systems required to safely monitor the equipment room. Provide number of sampling points as indicated on plans with 20% (minimum 2) spare sample point capability on analyzer and expansion module.
- E. Provide one (1) hand-held leak detection monitor for each refrigerant type. Monitor shall allow maintenance personnel to pinpoint exact location of refrigerant leak to perform required repairs.

2.3 CONTROL PANEL AND CONTROL PANEL EQUIPMENT

- A. Analyzer: Provide Nema 4 wall mount enclosure. Analyzer shall employ non-dispersive infrared sensor macro light pipe gas cell technology or photo acoustic infrared technology to provide sensing down to one (1) part per million (ppm) for refrigerant type R-123 or twenty (20) parts per million (ppm) for all other refrigerant types and shall be compound specific and calibrated for refrigerant as required per chiller. Provide menu driven microprocessor based electronics with user friendly programming allowing operator to select alarm setpoints, auto zero frequency (if applicable), and latched or unlatched alarms. LCD digital display shall show concentration levels from all sample points, simultaneously if panel is capable or sequenced with sampling point being monitored. LCD indication shall be provided for alarm level #1 & #2, malfunction, flow loss, and zero cycle. If necessary, based on analyzer type, auto zero calibration shall be initiated manually at the monitor or automatically at preprogrammed user selectable intervals, or remotely from a dry contact input. If required for calibration, analyzer shall automatically zero by drawing air from an uncontaminated air source. Include built in sample pump. Differential pressure flow loss indication will occur when flow goes below 500 ml/min. Analyzer output contacts for alarm functions and remote indication shall be provided for Alarm Level 1, Alarm Level 2, and Malfunction Alarm (as specified below). Each contact rating 120 VAC, 8 amps resistive or 2 amp inductive. Unit shall be insensitive to vibration. Malfunction relay (normally open contacts) is de-energized on heater out of control, chopper failure, pump flow loss, analyzer low flow or malfunction alarm.
- B. Electrochemical sensing technology employing depletion sensors and short term life sensors, which deplete as a normal part of their operation or storage shelf life, shall not be acceptable.
- C. Local Interface Panel: Provide Local Interface Control Panel mounted inside of the area to be monitored; to include all alarm logic, system interlocks, interface relays, local alarm reset, alarm test, trouble relay, etc. as outlined below and on drawings. Panel face shall include area map with locations of chillers, location of each sample point with LED indication of alarm, and other pertinent field devices with legend. All control system interlocks and logic shall be provided in local interface panel.

System shall be configured to provide additional dry contact alarm contacts and output signals for control or for interface as follows and noted on drawings:

1. Interface to 24 hour supervised monitoring through Building Automation System. Note: When BAS is not available, an alternate option is to interface with the Security System or the Fire Alarm System.
 2. Remote supervision requirements: Malfunction (maintenance required) dry contact, Acceptable Environmental Level (AEL) low leak warning (first level) dry alarm contact, and Threshold Limit Value Time Weighted Average (TLV – TWA) high danger leak (second level) dry alarm contact.
 3. Direct interlock to purge ventilation system(s) as indicated on the drawings.
- D. Sequence of Operation: At the AEL level (first alarm), the system shall activate the amber warning beacon. At the TLV-TWA level (second alarm), the system shall activate the purge ventilation system shutdown chiller(s), activate the red alarm beacon, and sound the refrigerant leak audible alarm. If a system malfunction shall occur, the blue beacon shall be activated. Blue beacon, amber beacon, red beacon and horn are required at refrigerant analyzer panel location. Red beacon and horn are required at outside room entrances. BAS shall monitor above conditions. All control system interlocks and logic shall be provided in local interface panel. Analyzer display shall indicate which channel is in alarm. Upon system reset, the alarm beacons shall be deactivated only if the area monitored has returned to a safe condition. Break-glass manual switch for local purge ventilation mode activation is located outside the main equipment room entrance. Break-glass for refrigeration machine shutdown is located outside the main equipment room entrance.

- E. Alarm Relays. Provide plug in type electrical relay with isolated Form "C" contacts rated for 5 amps (minimum). Relays shall be de-energized during normal operation and shall energize upon alarm. Alarm contacts shall be available for each point of alarm back to the Building Automation System, and shall be used to energize various devices and equipment as outlined above and on the drawings.
- F. Alarm Reset. Provide push button reset switch on front of interface control panel to reset the self-latching alarm circuit. The alarm beacons shall remain on until the system is reset from the panel face. Upon reset, if the area monitored has been purged to a safe level the beacons shall be deactivated and safe entry shall be permitted. The alarms shall stay latched to prevent them from automatically resetting when the toxic condition goes away. Provide push button reset switch on front of interface control panel to acknowledge and silence alarm horn circuit. The alarm horns shall remain on until the system is silenced from the panel face. This control logic shall be provided for in the interface panel.
- G. Trouble Relay. Provide plug in type electrical relay with isolated Form "C" contacts rated for 5 amps (minimum). Relay shall be energized in normal operation, de-energized due to malfunction at any channel. Alarm contacts shall be available for remote monitoring at the Building Automation System.
- H. Power Supply. Provide terminals for dedicated 120 VAC, 60 Hz. input power supply. Power all alarm and warning devices and remote indication control panel from this control panel circuit. All remote field devices associated with this system shall be 120 VAC or as indicated.
- I. Tagging. Provide "Lamacoid" tag, red background with 1/2" high white letters at each remote visual and audible device. Anchor tag to wall adjacent to wall mounted devices, suspend with brass security chain adjacent to ceiling mounted devices.
 - 1. Tags located inside mechanical room at refrigerant analyzer panel shall be inscribed as follows:

DANGER - REFRIGERANT R-(as specified)

BLUE LIGHT - REFRIGERANT MONITORING SYSTEM MALFUNCTION.

AMBER LIGHT - WARNING, LOW LEVEL REFRIGERANT LEAK DETECTED.

RED LIGHT/HORN - ALARM, DANGER (HIGH LEVEL) REFRIGERANT LEAK DETECTED
LEAVE ROOM IMMEDIATELY!

NOTIFY FACILITIES MANAGEMENT IMMEDIATELY UPON INDICATION OF ANY ALARM.

2. Tags located outside mechanical room at each entrance shall be inscribed as follows:

DANGER - REFRIGERANT R-(as specified)

RED LIGHT/HORN - ALARM, DANGER (HIGH LEVEL) REFRIGERANT LEAK DETECTED.
STAY OUT OF ROOM!

WHEN REFRIGERANT RED LIGHT ACTIVATES AND/OR ALARM HORN SOUNDS.

NOTIFY FACILITIES MANAGEMENT IMMEDIATELY UPON INDICATION OF ALARM.

ROOM ACCESS BY AUTHORIZED PERSONNEL ONLY

- J. Provide alarm horns and beacons equal to Federal Signal or Edwards Manufacturing where indicated on drawings. Beacons shall be strobe, tower type; three color; blue, amber, and red and/or single color red beacons depending upon application. Where indicated alarm beacons shall be located outside each entrance to mechanical room, inside the mechanical room near the control panel and in clear view in event of alarm. Beacon assemblies outdoors shall be NEMA 4 rated. Where pilot lights are used for annunciation/indication purposes use Allen - Bradley; push-to-test or equal.
- K. Emergency Ventilation Switch as required by Michigan Mechanical Code and International Fire Code. A clearly identified switch of the break-glass type shall provide on-only control of the machinery room ventilation fans. Mount switch adjacent to main exit outside of machinery room.
- L. Emergency Shutoff Switch as required by Michigan Mechanical Code and International Fire Code. A clearly identified switch of the break-glass type shall provide off-only control of the refrigerant machines. Mount switch adjacent to main exit outside of machinery room.
- M. Filters. Inlet sample filter shall be mounted at each sample point. Provide two (2) years of spare filter elements figuring one (1) element per sample point for every (3) months of operation. Provide wall or uni-strut mountable filter bracket assembly with sample filter and direct compression fitting connection to sample line as indicated on the drawings.
- N. Sample Points. Sequential sampling and multi point monitoring shall be employed to provide minimum two (2) points of area sampling for each chiller. Provide monitoring as required for any pit areas located in the chiller mechanical room. Where multiple refrigerant types are used, properly select the quantity and type of refrigerant detectors and multipoint sequential sampling systems required to safely monitor the equipment room. For projects with future chiller requirements, provide number of sampling points as indicated or noted above and include 20% spare sample point capability on analyzer – provide expansion module as required. Sample locations indicated on drawings are approximate and must be field verified by system manufacturer. Ensure that enough sample points exist to properly monitor air samples both under normal ventilation conditions and under purge ventilation conditions.

2.4 CALIBRATION GAS AND HARDWARE

- A. Provide all necessary calibration gas and hardware for two years operation in a portable case. Turn over to owner after successful system start up.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Route conduits and tubing as required to ensure a neat and operating system. Sample inlet tubing shall be 1/4" o.d. rigid copper, properly supported, and run neatly parallel with, or at right angles to building construction. Tubing shall be void of kinks, sags and other irregularities. All bends shall be made with a tube bender.
- B. Seamless Copper Tubing; 1/4", Type K, ASTM B 88 or Type ACR, ASTM B 280; with cast bronze solder joint fittings, ASME B16.18; or wrought copper solder joint fittings, ASME B16.22; soldered or brazed; except forged brass compression type fittings at connections to equipment. Acceptable Alternate: Teflon tubing in electrical conduit.

3.2 TESTING & ACCEPTANCE

- A. Prior to project completion, manufacturer's factory trained representative shall program, start up, thoroughly test and calibrate, set alarm threshold levels, and verify that system is in compliance with operational sequence with no additional charge. Emulate actual properties of hazards present to prove gas will come into contact with sensor locations under actual ventilation conditions. Should corrections be required to any system, and after corrections have been completed, system shall be re-tested.
- B. Permanent Site Records. After system acceptance, provide facilities manager with "Permanent Site Records Manual" for this system to be maintained on site. Include "As Built" system drawings, calibration reports, service records, system design data, code references, sequence of operation matrix, etc.
- C. Manufacturer's factory trained representative shall provide training of plant personnel on both system operation and routine maintenance procedures. Minimum of two (4) hours training shall be provided. Include all devices in the system outlined above. Provide (3) complete operations and maintenance manuals in 3-ring binders.

3.3 INSPECTION AND SERVICING

A. On Site Service:

1. Annually after final acceptance until warranty expires including once just before warranty expires, manufacturer's factory trained representative shall systematically inspect, examine, clean and adjust, detector, panels, relays, and accessories pertaining to system. Provide updated reports for on-site records.
2. Annual System Operational Testing. During the warranty period, provide code required annual alarm operation and shutdown testing. Include, but not limited to, emergency power supply testing, ventilation interlock operation, interlocks to 24 hour supervised station, alarm signaling device operation, etc. and all interface operation. Provide updated reports for on-site records.

B. System supplier shall offer test and maintenance agreement to provide annual inspection and service to commence after conclusion of standard guarantee and warranty period.

C. System shall be provided with a two (2) year warranty and all applicable recommended spare and consumable parts for two years of operation.

END OF SECTION 28 3500

SECTION 270000 – GENERAL TECHNOLOGY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Attention is directed to Division 0, Bidding and Contract Requirements, and to other Sections of Division 1, General Requirements, which are hereby made a part of this Section.
- B. Related Specification Sections:
 - 1. 271000 – Structured Cabling & Communications Equipment Room Fittings
- C. Related Drawings:
 - 1. T1-01 First Second Floor Plan – Technology
 - 2. T1-02 Second Floor Plan – Technology

1.2 DEFINITIONS

- A. ADA: Americans With Disabilities Act
- B. AIA: American Institute of Architects
- C. B/W: Black and White
- D. DAS: Direct-Attached Storage
- E. FBO: Furnished By Other
- F. FCC: Federal Communication Commission
- G. FF: Fixed Focus
- H. IR: Infrared
- I. LAN: Local Area Network
- J. MPEG: Moving Picture Experts Group
- K. NAS: Network-Attached Storage
- L. NTSC: National Television System Committee
- M. PoE: Power over Ethernet
- N. PTZ: Pan/Tilt/Zoom
- O. RF: Radio Frequency
- P. SAN: Storage Area Network
- Q. TR: Telecommunications Room
- R. UTP: Unshielded Twisted Pair
- S. VMS: Video Management System
- T. WAN: Wide Area Network

1.3 SUMMARY

- A. The following buildings/sites are part of this project:
 - 1. Canton Township Public Safety Building, 1150 S. Canton Rd., Canton, MI 48188
- A. Integration and Engineering Services.
- B. Project Documentation.
- C. Technology work provided by others.
 - 1. None

1.4 GENERAL REQUIREMENTS

- A. Contractors are encouraged to visit the job site(s), examine and field verify the conditions at each site where the installation(s) will take place prior to submitting a bid proposal.

- B. The Contractor is required to provide all services necessary to design, engineer, procure, construct and verify the Project as specified within the bid package. These services shall conform to manufacturer specifications and applicable industry standards.
- C. All material(s) and equipment shall be furnished with all accessories necessary for a complete system.
- D. All material(s) and equipment shall be new and standard manufactured products.
- E. Any proposed material(s) and equipment with a known end of manufacture date shall be called- out within the Contractor's bid proposal.
- F. Contractor(s) is/are to provide all applicable permits, licenses, inspections, approvals, and fees required for a complete solution as part of their bid proposal.
- G. Contractor(s) shall utilize plenum rated cable and ties throughout this Project.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. The Contractor's base bid shall utilize products and materials from the manufacturers listed in the applicable specification sections. In addition, the Contractor may include equipment and design variations to the base bid as a voluntary alternate.

PART 3 – EXECUTION

3.1 PROJECT MANAGER/ENGINEER

- A. The awarded Contractor will provide a Project manager/engineer who will act as a single point of contact for all activities regarding this Project.
- B. The Project manager/engineer will be required to make on-site decisions regarding the scope of the work and any changes required by the work.
- C. The Project manager/engineer will be totally responsible for all aspects of the work and shall have the authority to make immediate decisions regarding implementation or changes to the work.

3.2 EXAMINATION

- A. The Contractor(s) shall choose the appropriate mounting method(s), products, and materials for each location based on manufacturer's specifications and requirements based on building structure, type of wall, etc.

3.3 INSTALLATION

- A. Perform all work in a neat and workmanlike manner in accordance with the latest edition of the National Electrical Code, the ANSI/NECA/BICSI-568-2005 Standard for Installing Commercial Building Telecommunications Cabling and Equipment and all ANSI/TIA/EIA standards documents relevant to this Project.
- B. Federal, state, and local codes, rules, regulations, and ordinances governing the work, are as fully part of the specifications as if herein repeated or hereto attached. If the Contractor should note items in the drawings or the specifications, construction of which would be code violations, promptly call them to the attention of the Architect/Technology Consultant in writing. Where the requirements of other sections of the specifications are more stringent than applicable codes,

rules, regulations, and ordinances, the specifications shall apply.

- C. Protect equipment during transit, storage, and handling to prevent damage, theft, soiling, and misalignment.
- D. Coordinate with the Architect/Technology Consultant for secure storage of equipment and materials. The Owner is not required to provide a secure storage area.
- E. Do not store equipment where conditions fall outside manufacturer's recommendations for environmental conditions.
- F. Do not install damaged equipment; remove from site and replace damaged equipment with new equipment.

3.4 RETROFIT/CUTOVER/DEMOLITION/EQUIPMENT REMOVAL

- A. Furnish equipment, materials, labor and services, and perform operations required to retrofit/cutover existing systems. Removals shown are general indications and may not indicate full extent of removals which may be required to complete the scope of work.
- B. Furnish equipment, materials, labor and services, and performing operations required to enable continued functioning of existing system until cutover to new system.
- C. Remove wiring, punch blocks, cabinets, outlets, raceways, and equipment not required for new system.
- D. Provide removals, relocations, and alterations to existing systems, equipment, and materials. Perform the scope of work in neat and workmanlike manner in accordance with the latest edition of the National Electrical Code, the ANSI/NECA/BICSI-568-2005 Standard for Installing Commercial Building Telecommunications Cabling, the BICSI Information Transport Systems Installation Manual, and all ANSI/TIA/EIA standards documents relevant to this Project.
- E. Existing equipment or material shall not be reused without specific approval of the Owner except as noted.
- F. Equipment and materials to be removed and not desired by the Owner shall be removed from District promptly.
- G. All equipment to be removed must be disposed of according to EPA and DOD standards. All owner tags are to be removed and the contractor shall provide certification of disposal per EPA/DOD standards.
- H. All equipment removed shall be recorded by Type, Manufacturer, Model, Asset Tag Number and Serial Number.
- I. Equipment and material to be removed and that is desired by the Owner shall be moved to an on-site storage location as directed by the Owner.

3.5 REMOVAL AND REPLACEMENT OF EXISTING CEILING TILES

- A. Carefully remove existing ceilings as required to perform the work. Store removed tiles in an area designated by the Owner. Modify and augment existing suspension systems as necessary. Restore ceiling systems to their original finish on a daily basis.
- B. Repair any damage to ceilings due to modifications, removal, and replacement of same. Replace damaged ceiling tiles, including tiles with holes or openings left as a result of demolition, with materials of like kind.

3.6 CUTTING AND PATCHING

- A. Provide openings, cutting, coring, and patching of openings in existing building construction as required. Patching includes openings and voids left in existing construction as a result of demolition.
- B. The Work shall include necessary assemblies and materials to maintain required fire ratings.
- C. Perform cutting as to not impair structural stability of building construction and systems. Do not drill holes or weld attachments to beams and other structural members without prior written approval from the Owner.

- D. The Work shall be done by craftspersons skilled in the particular trades affected.
- E. Patching materials shall match existing materials in type and quality. Patching shall be done in a manner to match appearance of adjacent surfaces.

3.7 CLEANING

- A. Cleaning shall occur on a daily basis in order to maintain a clean, orderly job site.
- B. Cleaning shall be performed to the satisfaction of the Owner.
- C. Unless otherwise indicated, clean shall mean free of dust, dirt, mud, debris, oil, grease, residues, and contamination. Acceptability shall be determined by sight, touch, and wiping with a clean soft cloth and suitable cleaning agent.

3.8 SLEEVES

- A. If not provided by the electrical Contractor, the Contractor is required to provide their own sleeves (including nylon bushings) for new conduit and cable penetrations of building construction.
- B. Use electrical metallic tubing sleeves for penetrations through exterior masonry/concrete walls and foundations, concrete floor slabs on grade and above grade, and concrete-filled decks
- C. Use only fire-rated listed assemblies for the type of sleeve being installed through CMU walls or gypsum walls for communications penetrations. Sleeve type shall be electrical metallic tubing.
- D. Secure sleeves firmly in place using filling and patching materials that match with surrounding construction.
- E. In floor penetrations, extend sleeve 4" above finished floor unless noted otherwise. In wall penetrations, cut sleeves flush with wall surface and use metal escutcheon plates in finished interior areas.
- F. Seal voids between sleeves and building construction with joint sealants. Make allowances for and coordinate the Work with installation of firestopping, conduit insulation, and waterproofing, as applicable.

3.9 PENETRATIONS OF BUILDING SURFACES

- A. If not provided by the electrical Contractor, the Contractor is required to provide their own building penetrations.
- B. Provide through-penetration firestop systems for penetrations through fire-rated walls, floors, and other partitions of building construction.
- C. Above Grade Level or Non-waterproof Areas
 - 1. Seal each annular space between conduits or cable and building surfaces. Pack space with Oakum, other rope packing, or backer rod materials and cover with fire-resistant sealant or other protection materials.
 - 2. Provide sleeves as specified in "Sleeves" section above for conduit and cable penetrations. Seal each space between conduit or cable and sleeve.
- D. Waterproof Areas (Above and Below Grade)
 - 1. In new and existing construction for penetrations through concrete below grade, ground water level or in other waterproof areas, provide through-wall and floor seals having galvanized fittings, sealing assemblies, and sleeves as specified.
 - 2. In existing construction when core bore drilled openings are used for conduit penetrations below grade, ground water level, or in other waterproof areas, provide sealing.

3.10 CONTINUITY OF SERVICES

- A. Take no action that will interfere with, or interrupt, existing building services unless previous arrangements have been made with the Architect/Technology Consultant. Arrange the work to minimize shutdown time.

- B. Owner's personnel will perform shutdown of operating systems. The Contractor shall give five (5) days' advance notice for systems shutdown.

3.11 PAINTING

- A. Touch up marred and bared surfaces of primed, galvanized, and finish painted equipment, materials, and accessories installed.
- B. Restore patched surfaces as close to the original condition and finish as reasonably possible. Where patching occurs in smooth painted surface, extend final paint coat over entire unbroken surface containing patch, after patched area has received two coats of primer and two coats of finished paint.

3.12 COMPLIANCE WITH LAWS AND REGULATIONS

- A. The awarded Contractor's performance shall comply with all applicable federal, state, and local laws, rules and regulations.
- B. The awarded Contractor shall give required notices, shall procure necessary governmental licenses and inspection, and shall pay all fees and charges in connection to the required notices, licenses, and inspections.
- C. Federal Communications Commission
 - 1. Any equipment requiring FCC registration or approval shall have received such approval and shall be appropriately identified.
- D. Codes, Standards, and Ordinances
 - 1. All work performed on this Project will be installed in accordance, but not limited to, with the following guidelines:
 - a. The current edition of the National Electrical Code® 568-2005 Edition.
 - b. The ANSI/NECA/BICSI 568-2005 Standard for Installing Commercial Building Telecommunications Cabling.
 - c. The current edition of the BICSI Telecommunications Distribution Methods Manual.
 - d. The current edition of the BICSI Cabling Installation Manual.
 - e. The latest issue of the ANSI/TIA/EIA Standards as published by Global Engineering Documents as ANSI/TIA/EIA Telecommunications Building Wiring Standards.
 - f. Infocomm/BICSI – AV Design Reference Manual.
 - g. All local codes and ordinances.

3.13 SAFETY

- A. All Contractors shall take the necessary precautions and bear the sole responsibility for the safety of the methods employed in performing the work.
- B. The Contractor shall at all times comply with the regulations set forth by federal, state, and local laws, rules, and regulations concerning "OSHA" and all applicable state labor laws, regulations, and standards.

END OF SECTION 270000

SECTION 271000 – STRUCTURED CABLING & COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Attention is directed to Division 0, Bidding and Contract Requirements, and to other Sections of Division 1, General Requirements, which are hereby made a part of this Section.
- B. Related Specification Sections:
 - 1. 270000 – General Technology Requirements
- C. Related Drawings:
 - 1. T1-01 First Second Floor Plan – Technology
 - 2. T1-02 Second Floor Plan – Technology

1.2 PROJECT SUMMARY

- A. The following buildings/sites are part of this project:
 - 1. Canton Township Public Safety Building, 1150 S. Canton Rd., Canton, MI 48188
- B. The contractor is responsible for all labor, products, and materials necessary to install a complete plenum rated structured cabling system that will be utilized as shown in the drawings, including, but not limited to backboards, cable supports, raceway, and cable management required to complete the system.
- C. Where adequate pathways are not provided by the electrical contractor, each contractor is required to provide their own penetrations, sleeves, and cores with firestopping.
- D. Any new data and voice locations will be connected via Category 6 Unshielded Twisted Pair (UTP) back to the nearest telecommunication room (MDF/IDF), on the same floor.
- E. All patch panels and patch cables.
- F. Electrical systems will be provided by others.

1.3 SUBMITTALS

- A. Manufacturer's technical data, specification sheets, maintenance manuals, and material safety data sheets must be provided within the contractor's bid proposal for the products listed below:
 - 1. Wire and Cable
 - 2. Outlets, Termination Jacks, Faceplates, and Connectors
 - 3. Terminal Blocks and Patch Panels
 - 4. Enclosures, Racks and Equipment Housings
 - 5. Firestopping Material
- B. Bill of materials, noting long lead time items.
- C. Project schedule
 - 1. Contractors shall provide a detailed project schedule within their bid proposal, including all major work components that materially affect any other work within the project and projected building completion timeframes.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. The following manufacturers are acceptable for the required equipment within this section.
 - 1. Plenum Rated Cable Plant (Category 6, 4 pair, UTP Cable, Color – Various)
 - a. Leviton or approved equivalent.
 - 2. Fiber Optic Cable
 - a. Leviton OM4 Multimode fiber optic cabling (12 strand) or approved equivalent.
 - 3. Patch Panels
 - a. Leviton Universal Patch Panels, Category 6 (48-port as required per wiring closet) or approved equivalent.
 - 4. Termination Jacks
 - a. Leviton Jacks, Category 6 (Color – Orange) or approved equivalent.
 - 5. Patch Cables
 - a. Leviton Universal Patch Cables, Category 6 (Color – Various), non-sleeved ends or approved equivalent.
 - 6. Faceplates
 - a. Leviton, 4-Port Faceplate, Designer with labels, White in color or approved equivalent.
 - b. Contractor shall furnish and install blank faceplates on any outlet provided by the electrical contractor for their potential technology use.
 - c. Contractor shall furnish and install blanks as required in each faceplate where ports are unused.
- B. The data cable shall contain numbers on the jacket illustrating the footage marks, at 10' intervals.
- C. All UTP cable, termination jacks, patch panels, and patch cords must be supplied from one manufacturer.

2.2 FIRESTOPPING MATERIALS

- A. Materials may be in the form of caulk, putty, strip, sheet, or devices that shall be specifically designed to fill holes, spaces, and voids at communications penetrations.
- B. In addition, firestopping materials shall also provide adhesion to substrates and maintain fire and smoke seal under normal expected movements of substrates, conduits, and cables.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. The awarded contractor must perform a walkthrough of the job sites prior to beginning installation. The walkthrough will be completed in conjunction with the Owner, Construction Manager and Technology Consultant.

3.1 INSTALLATION

- A. All Category 6 cabling must meet the ANSI/TIA/EIA T568B cabling specifications. All layouts and preparation of shop drawings and installation supervision shall be performed by a certified cable installer of the proposed solution.
- B. All Category 6 cabling must be continuous from the telecommunication room to the end location. Any splices in data cabling are strictly prohibited.
- C. The contractor shall provide all necessary galvanized bridle rings and/or J-hooks. The bridle rings and J-hooks shall be connected to the building structure. Bridle rings and J-hooks should be placed no farther

- than four (4) feet apart.
- D. Category 6 cabling shall be installed above the ceiling. The data cable must be installed independently from the ceiling grid and/or other support systems.
 - E. The Category 6 cable shall not be installed with a bend radius greater than the manufacturer's specifications.
 - F. The contractor shall ensure that data cables are not kinked, bent, overloaded, crushed, etc.
 - G. Data cables must be kept 5", at a minimum, from power lines and fluorescent lights.
 - H. The contractor shall provide a 15' service loop at the end of each data cable.
 - I. Each data and voice cable shall be labeled with the following information: telecommunication room, patch panel, and port number. For example: *IDF3-B-12* would reference *telecommunication room 3, patch panel B, and port number 12*.
 - J. Patch panels shall be labeled sequentially.
 - K. The awarded contractor is required to supply and install all Category 6 patch cables required to connect the patch panel to the network switch.
 - L. The awarded contractor is to provide and install cable tray or ladder rack as required, except where indicated to be provided by electrical contractor.

3.3 PROJECT DOCUMENTATION

- A. Submit three (3) copies of the following required items within one (1) month of the conclusion of the project:
 - 1. Approved shop drawings and submittals.
 - 2. Completed field installation drawings (in hard copy and electronic). These drawings should illustrate cable routes from telecommunication room to each location (as-built). In addition, each location shall identify the telecommunication room, patch panel, and port number. For example: *IDF3-B-12* would reference *telecommunication room 3, patch panel B, and port number 12*.
 - 3. The awarded contractor is responsible for updating the Owner's current set of as-built drawings. This includes the updates of Visio drawings for each cabinet, update of the CAD as-built drawings with cable pathways and updating the spreadsheet indicating the information below.
 - 4. Electronic spreadsheet detailing the following information: location, telecommunication closet, data/voice panel #, data/voice port #, switch stack #ID, switch IP, and switch port #.
 - 5. Any system manuals that are provided by the manufacturer.
 - 6. Warranty documents for products listed within this section.
 - 7. Cable certification test results (in hard copy and electronic).

3.4 WARRANTY

- A. Unless otherwise specified, unconditionally guarantee in writing the materials, equipment, and workmanship for a period of not less than twenty (20) years from date of Final Acceptance by the Owner. The Owner shall deem acceptance as beneficial use.
- B. Transfer manufacturer's warranties to the Owner in addition to the General System Guarantee. Submit these warranties on each item in list form with shop drawings. Detail specific parts within equipment that are subject to separate conditional warranty. Warranty proprietary equipment and systems involved in this contract during the guarantee period. Final payment shall not relieve the contractor of these obligations.

END OF SECTION 271000

SECTION 28 3500 - REFRIGERANT MONITORING SYSTEM

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.
- B. Related Sections include the following:
 1. Division 20 Section "Mechanical General Requirements."
 2. Division 20 Section "Basic Mechanical Materials and Methods."
 3. Division 23 Chiller sections.
 4. Division 23 "Temperature Controls"
 5. Electrical Work specified in Division 26.

1.2 QUALITY ASSURANCE

- A. System Supplier Qualifications:
 1. Refrigerant monitoring system supplier shall be a firm regularly engaged in providing refrigerant leak detection systems whose products have been in satisfactory use in similar service for not less than one year and familiar with standard practices of safety and installation for refrigerant gas vapor detection systems. Supplier shall be familiar with current Michigan and International Mechanical and Fire Code requirements and installation of Code Compliant refrigerant gas vapor detection systems.
 2. Supplier shall be authorized factory trained service center to provide system design, fabrication, installation, service and training for gas detection products specified.
 3. System shall meet or exceed the latest applicable Michigan Building Code, Michigan Fire Code, Michigan Mechanical Code, International Fire Code, International Mechanical Code, NFPA, and ASHRAE Standard 15-2010.

4. Installation practices shall conform to Division 20 and 23 – Mechanical, and Division 26 - Electrical Specifications for materials and installation procedures.
5. The specification provided for this system is a performance specification. Refrigerant Monitoring System Supplier shall take full responsibility for proper detailed design and supply of Refrigerant Monitoring System including components and items described in this specification section. This is a LIFE SAFETY system.
6. Supplier shall work with necessary authority having jurisdiction to satisfy local code requirements as required.

1.3 ACTION SUBMITTALS

- A. Submit under provisions of Division 20 Section "Mechanical General Requirements" and as supplemented in this section.
 1. Product data for system components.
 2. Wiring diagrams from manufacturer differentiating between factory and field installed wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Indicate components for both field and factory wiring.
 3. Wiring diagrams shall include all interconnections between components, control panels, and other system interfaces.
 4. Piping diagrams from manufacturer differentiating between factory and field installed piping. Include diagrams for equipment and for system with all interconnections identified. Indicate components for both field and factory piping.
 5. Piping diagrams shall include all interconnections between components, control panels, and other system interfaces. Piping riser details shall be supplied.
 6. System operation description covering this specific Project including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
 7. Submit CODE COMPLIANCE documentation; itemizing building code references for design justification. At a minimum include the following: sample point locations, Calibration Report with before and after results of each analyzer, Alarm / Interface Report stating all field devices interlocked to system; manufacturer and model number, threshold levels with alarm and interface action at each level of alarm, field verification report, Safety Training Checklist with action procedures in alarm situation, and List of all owner attendees for each training session.
 8. Operating instructions for mounting at each control panel.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data for inclusion in Operating and Maintenance Manual specified in Division 01. Include data for each type product, including all features and operating sequences, both automatic and manual. Include recommendations for spare parts to be stocked at the site. Provide the names, addresses, and telephone numbers of service organizations that carry stock of repair parts for the system to be furnished.

PART 2 - PRODUCTS

2.1 MANUFACTURER/SYSTEM SUPPLIER

- A. Refrigerant Analyzer Manufacturer:
1. Bacharach.
 2. Mine Safety Appliance (MSA).
 3. Thermal Gas Systems (Haloguard Refrigerant Monitors)
 4. Trane.
- B. Local manufacturer's representative/supplier of refrigerant monitoring system shall provide complete engineered system drawings for installation contractor including all required visual indication lights, horns, signage, equipment emergency purge interlocks, and equipment emergency shutdown interlocks as required for the mechanical room where refrigerant monitoring system is to be located.

2.2 GENERAL

- A. Provide a refrigerant monitoring system where indicated in Contract Documents containing a series of detection points located in areas where refrigerant from a leak is likely to accumulate and / or be sensed. Include analyzer, sequencer and interface control panels(s), filters, sensors, alarm signaling devices, piping and all components necessary for a complete operational system. System shall provide various stages of alarming, and control chiller room mechanical ventilation in accordance with sequence of operation at values not to exceed specified Threshold Limit Value-Time Weighted Average (TLV-TWA). System shall be capable of detecting the presence of the specific refrigerant(s) actually used on this project. System shall be capable of detecting, indicating, alarming, shutting down equipment, and interfacing to building automation system (BAS). Oxygen depletion sensors are not acceptable.
- B. Refrigerants classified as A2, A3, B2 and B3 in the International Mechanical Code, ASHRAE 15 and ASHRAE 34 shall employ the appropriate sensing technology and conform to Class 1, Division 2, NFPA 70 requirements. Follow appropriate guidelines indicated in regulations concerning area classification requirements.
- C. Locate Refrigerant Analyzer and Local Interface Control Panel inside of the area to be monitored near the main exit from the mechanical room or as shown on the mechanical floor plan drawings.
- D. Sequential sampling and multi point monitoring shall be employed to provide minimum two (2) points of area sampling for each chiller. Additionally, monitoring shall be provided for any unsealed shafts or low floor areas located in the chiller mechanical room. Diluted samples due to ventilation air flow currents shall employ multi point monitoring techniques strategically located. Where multiple refrigerant types are used, properly select the quantity and type of refrigerant detectors and multipoint sequential sampling systems required to safely monitor the equipment room. Provide number of sampling points as indicated on plans with 20% (minimum 2) spare sample point capability on analyzer and expansion module.
- E. Provide one (1) hand-held leak detection monitor for each refrigerant type. Monitor shall allow maintenance personnel to pinpoint exact location of refrigerant leak to perform required repairs.

2.3 CONTROL PANEL AND CONTROL PANEL EQUIPMENT

- A. Analyzer: Provide Nema 4 wall mount enclosure. Analyzer shall employ non-dispersive infrared sensor macro light pipe gas cell technology or photo acoustic infrared technology to provide sensing down to one (1) part per million (ppm) for refrigerant type R-123 or twenty (20) parts per million (ppm) for all other refrigerant types and shall be compound specific and calibrated for refrigerant as required per chiller. Provide menu driven microprocessor based electronics with user friendly programming allowing operator to select alarm setpoints, auto zero frequency (if applicable), and latched or unlatched alarms. LCD digital display shall show concentration levels from all sample points, simultaneously if panel is capable or sequenced with sampling point being monitored. LCD indication shall be provided for alarm level #1 & #2, malfunction, flow loss, and zero cycle. If necessary, based on analyzer type, auto zero calibration shall be initiated manually at the monitor or automatically at preprogrammed user selectable intervals, or remotely from a dry contact input. If required for calibration, analyzer shall automatically zero by drawing air from an uncontaminated air source. Include built in sample pump. Differential pressure flow loss indication will occur when flow goes below 500 ml/min. Analyzer output contacts for alarm functions and remote indication shall be provided for Alarm Level 1, Alarm Level 2, and Malfunction Alarm (as specified below). Each contact rating 120 VAC, 8 amps resistive or 2 amp inductive. Unit shall be insensitive to vibration. Malfunction relay (normally open contacts) is de-energized on heater out of control, chopper failure, pump flow loss, analyzer low flow or malfunction alarm.
- B. Electrochemical sensing technology employing depletion sensors and short term life sensors, which deplete as a normal part of their operation or storage shelf life, shall not be acceptable.
- C. Local Interface Panel: Provide Local Interface Control Panel mounted inside of the area to be monitored; to include all alarm logic, system interlocks, interface relays, local alarm reset, alarm test, trouble relay, etc. as outlined below and on drawings. Panel face shall include area map with locations of chillers, location of each sample point with LED indication of alarm, and other pertinent field devices with legend. All control system interlocks and logic shall be provided in local interface panel.

System shall be configured to provide additional dry contact alarm contacts and output signals for control or for interface as follows and noted on drawings:

1. Interface to 24 hour supervised monitoring through Building Automation System. Note: When BAS is not available, an alternate option is to interface with the Security System or the Fire Alarm System.
 2. Remote supervision requirements: Malfunction (maintenance required) dry contact, Acceptable Environmental Level (AEL) low leak warning (first level) dry alarm contact, and Threshold Limit Value Time Weighted Average (TLV – TWA) high danger leak (second level) dry alarm contact.
 3. Direct interlock to purge ventilation system(s) as indicated on the drawings.
- D. Sequence of Operation: At the AEL level (first alarm), the system shall activate the amber warning beacon. At the TLV-TWA level (second alarm), the system shall activate the purge ventilation system shutdown chiller(s), activate the red alarm beacon, and sound the refrigerant leak audible alarm. If a system malfunction shall occur, the blue beacon shall be activated. Blue beacon, amber beacon, red beacon and horn are required at refrigerant analyzer panel location. Red beacon and horn are required at outside room entrances. BAS shall monitor above conditions. All control system interlocks and logic shall be provided in local interface panel. Analyzer display shall indicate which channel is in alarm. Upon system reset, the alarm beacons shall be deactivated only if the area monitored has returned to a safe condition. Break-glass manual switch for local purge ventilation mode activation is located outside the main equipment room entrance. Break-glass for refrigeration machine shutdown is located outside the main equipment room entrance.

- E. Alarm Relays. Provide plug in type electrical relay with isolated Form "C" contacts rated for 5 amps (minimum). Relays shall be de-energized during normal operation and shall energize upon alarm. Alarm contacts shall be available for each point of alarm back to the Building Automation System, and shall be used to energize various devices and equipment as outlined above and on the drawings.
- F. Alarm Reset. Provide push button reset switch on front of interface control panel to reset the self-latching alarm circuit. The alarm beacons shall remain on until the system is reset from the panel face. Upon reset, if the area monitored has been purged to a safe level the beacons shall be deactivated and safe entry shall be permitted. The alarms shall stay latched to prevent them from automatically resetting when the toxic condition goes away. Provide push button reset switch on front of interface control panel to acknowledge and silence alarm horn circuit. The alarm horns shall remain on until the system is silenced from the panel face. This control logic shall be provided for in the interface panel.
- G. Trouble Relay. Provide plug in type electrical relay with isolated Form "C" contacts rated for 5 amps (minimum). Relay shall be energized in normal operation, de-energized due to malfunction at any channel. Alarm contacts shall be available for remote monitoring at the Building Automation System.
- H. Power Supply. Provide terminals for dedicated 120 VAC, 60 Hz. input power supply. Power all alarm and warning devices and remote indication control panel from this control panel circuit. All remote field devices associated with this system shall be 120 VAC or as indicated.
- I. Tagging. Provide "Lamacoid" tag, red background with 1/2" high white letters at each remote visual and audible device. Anchor tag to wall adjacent to wall mounted devices, suspend with brass security chain adjacent to ceiling mounted devices.
 - 1. Tags located inside mechanical room at refrigerant analyzer panel shall be inscribed as follows:

DANGER - REFRIGERANT R-(as specified)

BLUE LIGHT - REFRIGERANT MONITORING SYSTEM MALFUNCTION.

AMBER LIGHT - WARNING, LOW LEVEL REFRIGERANT LEAK DETECTED.

RED LIGHT/HORN - ALARM, DANGER (HIGH LEVEL) REFRIGERANT LEAK DETECTED
LEAVE ROOM IMMEDIATELY!

NOTIFY FACILITIES MANAGEMENT IMMEDIATELY UPON INDICATION OF ANY ALARM.

2. Tags located outside mechanical room at each entrance shall be inscribed as follows:

DANGER - REFRIGERANT R-(as specified)

RED LIGHT/HORN - ALARM, DANGER (HIGH LEVEL) REFRIGERANT LEAK DETECTED.
STAY OUT OF ROOM!

WHEN REFRIGERANT RED LIGHT ACTIVATES AND/OR ALARM HORN SOUNDS.

NOTIFY FACILITIES MANAGEMENT IMMEDIATELY UPON INDICATION OF ALARM.

ROOM ACCESS BY AUTHORIZED PERSONNEL ONLY

- J. Provide alarm horns and beacons equal to Federal Signal or Edwards Manufacturing where indicated on drawings. Beacons shall be strobe, tower type; three color; blue, amber, and red and/or single color red beacons depending upon application. Where indicated alarm beacons shall be located outside each entrance to mechanical room, inside the mechanical room near the control panel and in clear view in event of alarm. Beacon assemblies outdoors shall be NEMA 4 rated. Where pilot lights are used for annunciation/indication purposes use Allen - Bradley; push-to-test or equal.
- K. Emergency Ventilation Switch as required by Michigan Mechanical Code and International Fire Code. A clearly identified switch of the break-glass type shall provide on-only control of the machinery room ventilation fans. Mount switch adjacent to main exit outside of machinery room.
- L. Emergency Shutoff Switch as required by Michigan Mechanical Code and International Fire Code. A clearly identified switch of the break-glass type shall provide off-only control of the refrigerant machines. Mount switch adjacent to main exit outside of machinery room.
- M. Filters. Inlet sample filter shall be mounted at each sample point. Provide two (2) years of spare filter elements figuring one (1) element per sample point for every (3) months of operation. Provide wall or uni-strut mountable filter bracket assembly with sample filter and direct compression fitting connection to sample line as indicated on the drawings.
- N. Sample Points. Sequential sampling and multi point monitoring shall be employed to provide minimum two (2) points of area sampling for each chiller. Provide monitoring as required for any pit areas located in the chiller mechanical room. Where multiple refrigerant types are used, properly select the quantity and type of refrigerant detectors and multipoint sequential sampling systems required to safely monitor the equipment room. For projects with future chiller requirements, provide number of sampling points as indicated or noted above and include 20% spare sample point capability on analyzer – provide expansion module as required. Sample locations indicated on drawings are approximate and must be field verified by system manufacturer. Ensure that enough sample points exist to properly monitor air samples both under normal ventilation conditions and under purge ventilation conditions.

2.4 CALIBRATION GAS AND HARDWARE

- A. Provide all necessary calibration gas and hardware for two years operation in a portable case. Turn over to owner after successful system start up.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Route conduits and tubing as required to ensure a neat and operating system. Sample inlet tubing shall be 1/4" o.d. rigid copper, properly supported, and run neatly parallel with, or at right angles to building construction. Tubing shall be void of kinks, sags and other irregularities. All bends shall be made with a tube bender.
- B. Seamless Copper Tubing; 1/4", Type K, ASTM B 88 or Type ACR, ASTM B 280; with cast bronze solder joint fittings, ASME B16.18; or wrought copper solder joint fittings, ASME B16.22; soldered or brazed; except forged brass compression type fittings at connections to equipment. Acceptable Alternate: Teflon tubing in electrical conduit.

3.2 TESTING & ACCEPTANCE

- A. Prior to project completion, manufacturer's factory trained representative shall program, start up, thoroughly test and calibrate, set alarm threshold levels, and verify that system is in compliance with operational sequence with no additional charge. Emulate actual properties of hazards present to prove gas will come into contact with sensor locations under actual ventilation conditions. Should corrections be required to any system, and after corrections have been completed, system shall be re-tested.
- B. Permanent Site Records. After system acceptance, provide facilities manager with "Permanent Site Records Manual" for this system to be maintained on site. Include "As Built" system drawings, calibration reports, service records, system design data, code references, sequence of operation matrix, etc.
- C. Manufacturer's factory trained representative shall provide training of plant personnel on both system operation and routine maintenance procedures. Minimum of two (4) hours training shall be provided. Include all devices in the system outlined above. Provide (3) complete operations and maintenance manuals in 3-ring binders.

3.3 INSPECTION AND SERVICING

A. On Site Service:

1. Annually after final acceptance until warranty expires including once just before warranty expires, manufacturer's factory trained representative shall systematically inspect, examine, clean and adjust, detector, panels, relays, and accessories pertaining to system. Provide updated reports for on-site records.
2. Annual System Operational Testing. During the warranty period, provide code required annual alarm operation and shutdown testing. Include, but not limited to, emergency power supply testing, ventilation interlock operation, interlocks to 24 hour supervised station, alarm signaling device operation, etc. and all interface operation. Provide updated reports for on-site records.

B. System supplier shall offer test and maintenance agreement to provide annual inspection and service to commence after conclusion of standard guarantee and warranty period.

C. System shall be provided with a two (2) year warranty and all applicable recommended spare and consumable parts for two years of operation.

END OF SECTION 28 3500