

- 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. Method of attaching hangers to building structure.
 - 2. Size and location of initial access modules for acoustical tile.
 - 3. 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. Casing: Constructed of 0.034-inch mill galvanized steel or 0.032-inch aluminum.
1. Casing Lining: 1-inch- thick, coated, fibrous-glass duct liner complying with ASTM C 1071; secured with adhesive. Cover liner with nonporous foil.
 2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
 3. Air Outlet: S-slip and drive connections.
 4. Access: Removable panels for access to dampers and other parts requiring service, adjustment, or maintenance; with airtight gasket.
- D. 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.
- E. Velocity Sensor: Multipoint averaging array. Sensor located in air inlet.
- F. 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.
- G. Hot-Water Heating Coil: Copper tube, mechanically expanded into aluminum-plate fins; leak tested underwater to 200 psig; and factory installed.
- H. DDC Controls: Single-package unitary controller and actuator specified in Division 23 Section "Temperature Controls."
- I. 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. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Steel Cables: Stainless steel complying with ASTM A 492.
- D. 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.
- E. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

- F. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

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"

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
 2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
- B. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 233600

SECTION 233713 - 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 SPECIALTY DEVICES

- A. Spot Diffusers:
 1. Manufacturers: Subject to compliance with requirement, provide products by one of the following:
 - a. AirConcepts Inc.; APL Series.
 - b. Seiho International, Inc.; Model PK Series.
 2. Description: High velocity task air outlet.
 3. Materials: Heavy-gage aluminum rotatable body and double felt flange-body seal.
 4. Directional Air Pattern Control:
 - a. 70 deg global rotation minimum.
 - b. Plus or minus 35 deg deflection.
 - c. 360 deg rotation.
 5. Finish: as selected by architect.

6. Aperture Damper: Required.

2.3 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 233713

SECTION 233723 - 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. INFORMATIONAL SUBMITTALS
- B. Shop Drawings: For intake and relief ventilators. Include plans, elevations, sections, details, and ventilator attachments to curbs and curb attachments to roof structure.
- C. 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.

- D. Samples for Verification: For each type of exposed finish required for intake and relief ventilators.
- E. Welding certificates.

1.4 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."

1.5 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; suitably reinforced.
- D. Bird Screening: Galvanized-steel, 1/2-inch- square mesh, 0.041-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. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply an air-dried primer immediately after cleaning and pretreating.
3. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat and an overall minimum dry film thickness of 2 mils.
 - a. Color and Gloss: As indicated by manufacturer's designations .

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. 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.
4. Metal Liner: Galvanized steel.

B. 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. The Pate Company.
 - c. Roof Products & Systems.
 - d. Thybar Corporation.
 - e. Any of the listed hood 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.
4. Pitch Mounting: Manufacture curb for roof slope, top of curb shall be level.
5. Metal Liner: Galvanized steel.

- C. Motorized Backdraft Damper: Refer to DAMPERS - AUTOMATED in Division 23 Section "Temperature Controls."

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.
- C. Install goosenecks on curb base where throat size exceeds 9 by 9 inches.
- D. Install intake and relief hoods with clearances for service and maintenance.
- E. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- F. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Division 07 Section "Joint Sealants" for sealants applied during installation.
- G. Label intake and relief hoods according to requirements specified in Division 20 Section "Mechanical Identification."
- H. 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.
- I. 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 233723

SECTION 235100 - BREECHING, CHIMNEYS, AND STACKS

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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 "Draft Control Devices" for induced-draft and mechanical fans and motorized and barometric dampers.
 - 4. Division 23 Section "Metal Ducts" for double-wall factory fabricated grease duct.

1.2 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Special gas vents.

1.3 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: For vents, breeching, chimneys, and stacks. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, methods of field assembly, components, hangers, and location and size of each field connection.
 - 2. Provide engineered sizing data.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain listed system components through one source from a single manufacturer.
- B. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Combustion-Air Intake: Complete system, stainless steel, pipe, vent terminal with screen, inlet air coupling, and sealant.
- B. CPVC Plastic Pipe: ASTM F 441/F 441M, Schedule 40 Pipe.
 - 1. CPVC Schedule 40 Fittings: ASTM F 438, socket type.
 - 2. CPVC Solvent Cement: ASTM F 493.

2.2 LISTED SPECIAL GAS VENT

- A. Manufacturers:
 - 1. Cleaver-Brooks, Inc.; CBHL.
 - 2. DuraVent, Inc.; dba DuraVent/Security Chimneys.
 - 3. Heat-Fab, Inc.; Hart & Cooley, Inc.; Model Saf-T Vent Cl.
 - 4. Metal-Fab Inc.; Model Corr/Guard.
 - 5. Schebler Chimney Systems; eVent.
 - 6. Selkirk Inc.; Hart & Cooley, Inc.; Selkirk Metalbestos; Model DCV.
 - 7. Van-Packer Co.; Model CS.
- B. Description: Double-wall metal vents tested according to UL 1738 and rated for 550 deg F continuously, with positive, negative, or neutral flue pressure, complying with NFPA 211 and suitable for condensing gas-fired appliances.
- C. Construction: Inner shell and outer jacket separated by at least 3/32-inch airspace.
- D. Inner Shell: ASTM A 959, Type 29-4C stainless steel.
- E. Outer Jacket: Aluminized steel indoors and Type 304 stainless steel outdoors.
- F. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.
 - 1. Termination: Round chimney top design to exclude 98 percent of rainwater. A "Pointed Hat" stack cap is not acceptable.
 - 2. Termination: Adjustable wall thimble and horizontal termination with bird screen.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION

- A. Listed Special Gas Vent: Condensing gas appliances, and direct vented finned water-tube boilers and water heaters.
- B. CPVC Plastic Pipe and Fittings: Condensing gas water heaters reaching sanitizing temperatures.

3.3 INSTALLATION OF LISTED VENTS, CHIMNEYS and stacks

- A. Locate to comply with minimum clearances from combustibles and minimum termination heights according to product listing, local regulations, or NFPA 211, whichever is most stringent.
- B. Seal between sections of positive-pressure vents according to manufacturer's written installation instructions, using sealants recommended by manufacturer.
- C. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.
- D. Slope breeching down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain.

3.4 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.
- B. Clean breeching internally, during and after installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup finish to match factory or shop finish.
- C. Provide temporary closures at ends of breeching, chimneys, and stacks that are not completed or connected to equipment.

END OF SECTION 235100

SECTION 235216 - CONDENSING BOILERS

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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 "Water Treatment for Closed-Loop Hydronic Systems" for corrosion inhibitors required for modular cast-aluminum condensing boilers.
 - 4. Division 23 Section "Breeching, Chimneys, and Stacks."

1.2 SUMMARY

- A. This Section includes packaged, factory-fabricated and -assembled, gas-fired, condensing boilers, trim, and accessories for generating hot water.

1.3 ACTION SUBMITTALS

- A. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: For boilers, boiler trim, and accessories. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Design calculations and vibration isolation base details.
 - a. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
 - b. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails and equipment mounting frames.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
- B. Source quality-control test reports.
- C. Other Informational Submittals:
 - 1. ASME Stamp Certification and Report: Submit "A," "S," or "PP" stamp certificate of authorization, as required by authorities having jurisdiction, and document hydrostatic testing of piping external to boiler.

1.5 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Operation and Maintenance Data: For boilers 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. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.
- C. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."
- D. UL Compliance: Test boilers for compliance with UL 795, "Commercial-Industrial Gas Heating Equipment." Boilers shall be listed and labeled by a NRTL acceptable to authorities having jurisdiction.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 STAINLESS STEEL VERTICAL FIRE-TUBE CONDENSING BOILERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AERCO International; Benchmark Series.
 - 2. Cleaver-Brooks; CFC Series.
 - 3. Fulton Boiler Works, Inc.; Endura Series.
 - 4. HTP (Heat Transfer Products); UFT Series and EFT Series
 - 5. Lochinvar Corporation; Knight KH Series Fire Tube Boilers, FTXL, and Crest Series.
- B. Description: Factory-fabricated, -assembled, and -tested, vertical fire-tube condensing boiler with heat exchanger sealed pressure tight, built on a steel base; including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls. Water heating service only.
- C. Heat Exchanger: Corrosion-resistant stainless steel combustion chamber.
- D. Pressure Vessel: Stainless steel with welded heads and tube connections.
- E. Burner: Natural gas, forced draft.
- F. Blower: Centrifugal fan to operate during each burner firing sequence and to pre-purge and post-purge the combustion chamber.
 - 1. Motors: Comply with requirements specified in Division 20 Section "Motors."
 - a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- G. Gas Train: Combination gas valve with manual shutoff and pressure regulator.
- H. Ignition: Spark ignition with 100 percent main-valve shutoff with electronic flame supervision.
- I. Casing:
 - 1. Jacket: Sheet metal, with snap-in or interlocking closures.
 - 2. Control Compartment Enclosures: NEMA 250, Type 1A.
 - 3. Finish: Baked-enamel or powder-coated protective finish.
 - 4. Insulation: Minimum 2-inch- thick, mineral-fiber or polyurethane-foam insulation surrounding the heat exchanger.
 - 5. Combustion-Air Connections: Inlet and vent duct collars.
 - 6. Mounting base to secure boiler.
- J. Characteristics and Capacities: Refer to Schedule on Drawings.

2.2 HOT-WATER BOILER TRIM

- A. Include devices sized to comply with

- B. Aquastat Controllers: Operating and high limit.
- C. Safety Relief Valve: ASME rated.
- D. Pressure and Temperature Gage: Minimum 3-1/2-inch- diameter, combination water-pressure and -temperature gage. Gages shall have operating-pressure and -temperature ranges so normal operating range is about 50 percent of full range.
- E. Boiler Air Vent: Automatic.
- F. Drain Valve: Minimum NPS 3/4 hose-end gate valve.
- G. Circulation Pump: Non-overloading, in-line pump with split-capacitor motor having thermal-overload protection and lubricated bearings; designed to operate at specified boiler pressures and temperatures.

2.3 CONTROLS

- A. Boiler operating controls shall include the following devices and features:
 - 1. Control transformer.
 - 2. Set-Point Adjust: Set points shall be adjustable.
 - 3. Sequence of Operation: Electric, factory-fabricated and field-installed panel to control burner firing rate to maintain space temperature in response to thermostat with heat anticipator located in heated space.
 - 4. Sequence of Operation: Electric, factory-fabricated and field-installed panel to control burner firing rate to reset supply-water temperature inversely with outside-air temperature. At 0 deg F outside-air temperature, set supply-water temperature at 200 deg F; at 60 deg F outside-air temperature, set supply-water temperature at 140 deg F.
 - a. Include automatic, alternating-firing sequence for multiple boilers to ensure maximum system efficiency throughout the load range and to provide equal runtime for boilers.
 - 5. Provide contacts for connection to remote shutdown switch(es). Activation of remote shutdown switch shall cut power to the burner controls. Refer to Division 23 Section "Temperature Controls" for remote shutdown switches.
- B. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.
 - 1. High Cutoff: Automatic reset stops burner if operating conditions rise above maximum boiler design temperature.
 - 2. Low-Water Cutoff Switch: Electronic probe shall prevent burner operation on low water. Cutoff switch shall be automatic-reset type.
 - 3. Blocked Inlet Safety Switch: Manual-reset pressure switch field mounted on boiler combustion-air inlet.
 - 4. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.
- C. Building Management System Interface: Factory install hardware and software to enable building management system to monitor, control, and display boiler status and alarms.
 - 1. Hardwired Points:

- a. Monitoring: On/off status.
 - b. Control: On/off operation, hot water supply temperature set-point adjustment.
2. A communication interface with building management system shall enable building management system operator to remotely control and monitor the boiler from an operator workstation. Control features available, and monitoring points displayed, locally at boiler control panel shall be available through building management system.

2.4 ELECTRICAL POWER

- A. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.
- B. 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 boiler.
 1. House in NEMA 250, Type 1 enclosure.
 2. Wiring shall be numbered and color-coded to match wiring diagram.
 3. Install factory wiring outside of an enclosure in a metal raceway.
 4. Field power interface shall be to lockable, nonfused disconnect switch.
 5. Provide branch power circuit to each motor and to controls.
 6. Provide each motor with overcurrent protection.

2.5 ACCESSORIES

- A. Flue Side Condensate Neutralizer:
 1. Description: Designed to raise the PH level of flue side condensate to near neutral prior to condensate entering the sanitary drainage system.
 2. Materials: Neutralizer constructed of PVC pipe and fittings mounted on channel strut base with galvanized or stainless steel clamps and hardware; and charged with calcium carbonate.
 3. Manufacturers:
 - a. Axion Industries Ltd.; NeutraPal and NeutraPro Series.
 - b. BKI Industries, Inc.; Acid Neutralizer Kits.
 - c. J.J.M. Boiler Works; JM Neutralizing Tubes.
 - d. Neutrasafe Corporation; Neutra-Safe Condensate Neutralizers.
 - e. Any of the approved boiler manufacturers.

2.6 SOURCE QUALITY CONTROL

- A. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.
- B. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.
- C. Allow Owner access to source quality-control testing of boilers. Notify Architect 14 days in advance of testing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.
 - 1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.
- B. Examine mechanical spaces for suitable conditions where boilers will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 BOILER INSTALLATION

- A. Install boilers level on concrete base. Concrete base is specified in Division 20 Section "Basic Mechanical Materials and Methods," and concrete materials and installation requirements are specified in Division 03.
- B. Install natural gas-fired boilers according to NFPA 54.
- C. Install propane-fired boilers according to NFPA 58.
- D. Assemble and install boiler trim.
- E. Install electrical devices furnished with boiler but not specified to be factory mounted.
- F. Install control wiring to field-mounted electrical devices.

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 boiler to allow service and maintenance.
- C. Install piping from boiler flue gas condensate drain connection to condensate neutralizer, and from condensate neutralizer to nearest floor drain. Piping shall be PEX or CPVC at least full size of connection.
- D. Connect piping to boilers, except safety relief valve connections, with flexible connectors of materials suitable for service. Flexible connectors and their installation are specified in Division 20 Section "Pipe Flexible Connectors, Expansion Fittings and Loops."
- E. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas train connection. Provide a reducer if required.
- F. Connect hot-water piping to supply- and return-boiler tappings with shutoff valve and union or flange at each connection.

- G. Install piping from safety relief valves to nearest floor drain.
- H. Boiler Venting:
 - 1. Install flue venting kit and combustion-air intake.
 - 2. Connect full size to boiler connections. Comply with requirements in Division 23 Section "Breechings, Chimneys, and Stacks."
- I. Ground equipment according to Division 26 Section "Grounding and Bonding."
- J. Connect wiring according to Division 26 Section "Conductors and Cables."

3.4 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. Perform installation and startup checks according to manufacturer's written instructions.
 - 2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level and water temperature.
 - b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.5 DEMONSTRATION

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

END OF SECTION 235216

SECTION 236417 - CENTRIFUGAL WATER CHILLERS (AIR-COOLED)

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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 "Motors."
 - 4. Division 20 Section "Variable Frequency Controllers."
 - 5. Division 23 Section "Hydronic Piping."

1.2 SUMMARY

- A. This Section includes packaged, air-cooled, magnetic bearing, oil-free centrifugal water chillers having integrated variable frequency controllers. with
 - 1. Integrated free-cooling capabilities, suitable for closed loop chilling of a water / glycol solution. Free-cooling shall be completely packaged inside the chiller and shall include necessary controls and components to be fully automated by the chiller microprocessor.:
 - 2. Microprocessor-based controls.

1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. 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.
- C. 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.
- D. 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.
- E. 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.
- F. 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.
- G. SCCR: Short circuit current rating.

1.4 PERFORMANCE REQUIREMENTS

- A. Site Altitude: Chiller shall be suitable for altitude at which installed without affecting performance indicated. Make adjustments to affected chiller components to account for site altitude.

1.5 ACTION SUBMITTALS

- A. Product Data: Include refrigerant, rated capacities, operating characteristics, furnished specialties, and accessories.

1.6 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Complete set of manufacturer's certified prints of water chiller assemblies, control panels, sections and elevations, and unit isolation. Include the following:
 - 1. Assembled unit dimensions.
 - 2. Operating weight and load distribution.

3. Required clearances for maintenance and operation.
4. Size and location of piping and wiring connections.
5. Wiring Diagrams: Power, signal, and control wiring.

B. Coordination Drawings: Floor plans drawn to scale and coordinated with the following:

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 service clearances.

C. Certificates: For certification required in "Quality Assurance" Article.

D. Source quality-control test reports.

1.7 CLOSEOUT SUBMITTALS

A. Field Quality Control: Startup service reports.

B. Operation and Maintenance Data: For each water chiller to include in operation and maintenance manuals.

1.8 QUALITY ASSURANCE

A. AHRI Certification: Signed by manufacturer certifying compliance with requirements in AHRI 550/590, "Water Chilling Packages Using the Vapor Compression Cycle."

B. AHRI Rating: Rate chiller performance according to requirements in AHRI 550/590.

C. ASHRAE Certification: Signed by manufacturer certifying compliance with ASHRAE 15 for safety code for mechanical refrigeration. Comply with ASHRAE Guideline 3 for refrigerant leaks, recovery, and handling and storage requirements.

D. ASHRAE Compliance:

1. ASHRAE 15 for safety code for mechanical refrigeration.
2. ASHRAE 147 for refrigerant leaks, recovery, and handling and storage requirements.

E. ASHRAE Compliance: Water chillers shall comply with ASHRAE 90.1, "Energy Standard for Buildings Except Low-Rise Residential Buildings."

F. ASME Compliance: Fabricate and label chillers to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1. For chillers charged with R-134a refrigerant, include an ASME U-stamp and nameplate certifying compliance.

G. Comply with NFPA 70.

H. Comply with requirements of UL and UL Canada. Include label by an NRTL showing compliance.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Ship water chillers from the factory fully charged with refrigerant or nitrogen.

1.10 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, locations, and anchoring attachments of structural-steel support structures.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Trane; a Trane Technologies Brand.
 - 2. Smardt Chiller Group, Inc.
 - 3. Multistack, LLC.
 - 4. Dakin

2.2 PACKAGED WATER CHILLERS

- A. Description: Factory-assembled and -tested water chiller complete with compressor, evaporator, condenser, controls, interconnecting unit piping and wiring, indicated accessories, and mounting frame.
 - 1. For chillers with dual compressors, provide each compressor with a dedicated motor and motor controller, and provide for continued operation when either compressor-drive assembly fails or is being serviced.
- B. Water Chiller Characteristics and Capacities:
 - 1. Refer to Schedule on Drawings.
 - 2. Sound Power Level: 85 dBa at a distance of 25 feet .

2.3 COMPRESSORS

- A. Description: Variable displacement with gear-drive, open motor; direct-drive, hermetically sealed motor; or direct-drive, semi-hermetically sealed motor.
 - 1. Provide oil-free compressor technology using a permanent magnet synchronous motor, magnetic bearings, integral variable frequency controller, and digital electronic controls.
 - 2. Casing: Cast iron, precision ground.
 - 3. Impeller: High strength, cast-aluminum alloy on carbon- or forged-steel shaft; dynamically balanced.

- B. Capacity Control: Variable-inlet guide-vane assembly for stable operation without hot gas bypass, that is free of surge, cavitation, or vibration throughout throttling range from 100 to 15 percent of full load.
- C. Thrust Bearings: With proximity probes for positive pressure HFC-134a machines.
- D. Refrigerant Compatibility: Seals, O-rings, motor windings, and internal water chiller parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.
- E. Each compressor shall include a suction line butterfly valve and a discharge line combination stop check valve for isolation during service. Compressor electrical panel shall also include an individual disconnect to allow isolation during service

2.4 REFRIGERATION

- A. Refrigerant:
 - 1. Type: R-123; ASHRAE 34, Class B1 or R-134a; ASHRAE 34, Class A1.
 - 2. Compatibility: Chiller parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.
- B. Refrigerant Flow Control: Manufacturer's standard refrigerant flow-control device satisfying performance requirements indicated.
- C. Pressure Relief Device:
 - 1. Comply with requirements in ASHRAE 15 and in applicable portions of ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 - 2. For Chillers Using R-123: Rupture disc constructed of frangible carbon.
 - 3. For Chillers Using R-134a: ASME-rated, spring-loaded, pressure relief valve; single- or multiple-reseating type. Pressure relief valve(s) shall be provided for each heat exchanger. Evaporators and condenser shall have dual valves with one being redundant and configured to allow either valve to be replaced without loss of refrigerant. Barrels circuited for redundant refrigerant circuits shall include PRV as described for each circuit
- D. Refrigeration Transfer: Provide service valves and other factory-installed accessories required to facilitate transfer of refrigerant from chiller to a remote refrigerant storage and recycling system. Comply with requirements in ASHRAE 15 and ASHRAE 147.
- E. Refrigerant Isolation for Chillers Using R-134a: Factory install isolation valves in the compressor discharge line to the condenser and the refrigerant liquid line leaving the condenser to allow for isolation and storage of full refrigerant charge in the chiller condenser shell.
- F. Purge System:
 - 1. For chillers operating at subatmospheric pressures (using R-123 refrigerant), factory install an automatic purge system for collection and return of refrigerant and lubricating oil and for removal of non-condensables including, but not limited to, water, water vapor, and non-condensable gases.
 - 2. System shall be a thermal purge design, refrigerant or air cooled, equipped with a carbon filter that includes an automatic regeneration cycle.
 - 3. Factory wire to chiller's main power supply and system complete with controls, piping, and refrigerant valves to isolate the purge system from the chiller.
 - 4. Construct components of noncorrodible materials.

5. Controls shall interface with chiller control panel to indicate modes of operation, set points, data reports, diagnostics, and alarms.
6. Efficiency of not more than 0.02 lb of refrigerant per pound of air when rated according to AHRI 580.
7. Operation independent of chiller in accordance with ASHRAE 147.

2.5 HEAT EXCHANGERS

A. Evaporator:

1. Description: Shell-and-tube design, ASME labeled.
2. Shell Material: Carbon steel.
3. Tube Construction: Externally enhanced and individually replaceable, expanded into tube sheets.
 - a. Material: Copper.
 - b. Minimum Size: 3/4-inch OD; minimum 0.025-inch wall thickness and provide 0.050-inch thickness at plain lands contacting the intermediate tube supports and end sheets. Alternatively, 0.035-inch wall non-skip fin design tubes may be supplied if eddy current tests are provided at 5-year intervals by the chiller manufacturer for the life of the machine.
 - c. Internal Finish: Enhanced.
4. Water Box: Standard, with design working pressure of 150 psig, and having flanged *water-nozzle connections with a thermistor-type temperature* sensor factory installed in each nozzle.

B. Air-Cooled Condenser:

1. Air-cooled condenser coils shall have seamless copper tubing expanded into aluminum fins.
2. Condenser fan motors shall use Electronically Commutated (EC) design allowing for variable speed operation and shall be TEAO rated for continuous outdoor application.
3. Motor shall have a reversed stator and rotor eliminating the traditional shaft.
4. Condenser fan blades shall be composite material with aluminum hub, to maximize airflow and to provide increased efficiency over the fan performance curve.
5. Fans shall discharge vertically.
6. Fans shall serve dual-purpose duty, providing refrigeration head pressure control and/or free-cooling duty, thus reducing system footprint and overall quantity of fans on the chiller.
7. Condenser fans utilizing EC motor technology shall be capable of infinitely varying speeds from minimum to maximum design point allowing for refrigeration system operation down to minus 20 deg F. should free cooling operation be interrupted.
8. Variable frequency controllers shall not be permitted for fan speed control.
9. Each fan shall be wired with an individual fan overload to allow for one fan to be isolated and maintained without disturbing chiller operation. Provide decorative grille to provide protection for coil.
10. Condenser coil shall have an independent refrigeration circuit and charge per compressor
11. Remote condensers are not allowed.

2.6 INSULATION

- A. Closed-cell, flexible elastomeric thermal insulation complying with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 - 1. Thickness: 3/4 inch.
- B. Adhesive: As recommended by insulation manufacturer.
- C. Factory-applied insulation over all cold surfaces of chiller capable of forming condensation. Components shall include, but not be limited to, evaporator shell and end tube sheets, evaporator water boxes including nozzles, refrigerant suction pipe from evaporator to compressor, cold surfaces of compressor, refrigerant-cooled motor, and auxiliary piping.
 - 1. Apply adhesive to 100 percent of insulation contact surface.
 - 2. Before insulating steel surfaces, prepare surfaces for paint, and prime and paint as indicated for other painted components. Do not insulate unpainted steel surfaces.
 - 3. Seal seams and joints to provide a vapor barrier.
 - 4. After adhesive has fully cured, paint exposed surfaces of insulation to match other painted parts.

2.7 ELECTRICAL

- A. Factory installed and wired, and functionally tested at factory before shipment.
- B. Single-point, field-power connection to nonfused disconnect switch.
 - 1. Minimum SCCR according to UL 508 shall be as indicated on the Drawings or A, whichever is greater.
 - 2. Branch power circuit to each motor, electric heater, dedicated electrical load, and controls.
 - 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 AB 1, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit-trip set point.
 - 3. NEMA ICS 2-rated motor controller for auxiliary motors, hand-off-auto switch, and overcurrent protection for each motor. Provide variable frequency controller for each variable-speed motor furnished.
 - 4. Control-circuit transformer with primary and secondary side fuses.
- C. Terminal blocks with numbered and color-coded wiring to match wiring diagram. Spare wiring terminal block for connection to external controls or equipment.
- D. Factory-installed wiring outside of enclosures shall be in metal raceway except make terminal connections with not more than a 24-inch length of liquidtight conduit.
- E. Factory install and wire capacitor bank for the purpose of power factor correction to 0.95 at all operating conditions.

1. If capacitors are mounted in a dedicated enclosure, use same NEMA enclosure type as motor controller. Provide enclosure with service entrance knockouts and bushings for conduit.
2. Capacitors shall be non-PCB dielectric fluid, metallized electrode design, low loss with low-temperature rise. The kVAR ratings shall be indicated and shall not exceed the maximum limitations set by NFPA 70. Provide individual cells as required.
3. Provide each cell with current-limiting replaceable fuses and carbon-film discharge resistors to reduce residual voltage to less than 50 V within one minute after de-energizing.
4. Provide a ground terminal and a terminal block or individual connectors for phase connection.

2.8 CONTROLS

- A. Factory installed and wired, and functionally tested at factory before shipment.
- B. Standalone, microprocessor based, with all memory stored in nonvolatile memory so that reprogramming is not required on loss of electrical power.
- C. Enclosure: Share enclosure with electrical power devices or provide a separate enclosure of matching construction.
- D. The control center shall include an alphanumeric display showing all system parameters in the English language with numeric data in English (or metric) units. The chiller control panel shall provide control of chiller operation and monitoring of chiller sensors, actuators, relays and switches.
- E. Microprocessor shall have the capability of starting and stopping remote chilled water primary and condenser water pumps.
- F. Digital programming of essential setpoints through a color coded, tactile-feel keypad shall include:
 1. Leaving chilled water temperature.
 2. Percent current limit.
 3. Pull-down demand limiting.
 4. Seven-day time clock for starting and stopping the chiller, pumps, and tower (complete with holiday schedule).
 5. Remote reset temperature range.
 6. Chilled water primary pump(s) start/stop control.
- G. System operating information shall include:
 1. Return and leaving chilled water temperatures.
 2. Evaporator and condenser refrigerant pressures.
 3. Differential oil pressure.
 4. Percent motor current.
 5. Compressor discharge temperature.
 6. Compressor thrust bearing position (HFC-134a machines only)
 7. Operating hours.
 8. Number of compressor starts.
- H. Control center shall be able to interface with a building automation system with an available RS-232 port to provide the following:
 1. Remote chiller start and stop.

2. Reset of chilled water temperature.
3. Reset of current limit.

I. Additionally, the control center shall provide status message indicating:

1. Chiller is ready to start.
2. Chiller is operating.
3. Chiller is shut down on a safety requiring reset.
4. Chiller is shut down on a recycling safety.

2.9 MOTORS

A. Comply with requirements in Division 20 Section "Motors."

1. Open-drive motors shall have flanged or flexible coupling suitable for direct connection to compressor.

2.10 MOTOR CONTROLLERS (VFC)

A. Variable Frequency Controller: Factory installed and wired variable frequency controller meeting the requirements specified in Division 20 Section "Variable Frequency Controllers."

2.11 FINISH

- A. Paint chiller, using manufacturer's standard procedures. Color of finish coat to be manufacturer's standard.
- B. Provide Owner with quart container of paint used in application of topcoat to use in touchup applications after Project Closeout.

2.12 ACCESSORIES

A. Differential Pressure Sensors: For evaporator and condenser to prove fluid flow through evaporator and condenser.

B. Vibration Isolation:

1. Chiller manufacturer shall furnish vibration isolation for each chiller.
2. Neoprene Pad:
 - a. Two layers of 0.375-inch- thick, ribbed- or waffle-pattern neoprene pads separated by a 16-gage, stainless-steel plate.
 - b. Fabricate pads from 40- to 50-durometer neoprene.
 - c. Provide stainless-steel square bearing plate to load the pad uniformly between 20 and 40 psig with a 0.12- to 0.16-inch deflection.
3. Spring Isolator:
 - a. Stable in operation and designed for not less than 30 percent reserve deflection beyond actual operating conditions. Isolators shall be designed so that the Kx/Ky ratio shall be 1.0 or more for stability.

- b. Provide PVC or neoprene-coated springs and hot-dip, galvanized-steel components. Aluminum components shall be etched and painted. Nuts, bolts, and washers shall be zinc electroplated.
- c. Isolators shall be adjustable and with an open spring, having one or more coil springs attached to a top compression plate and a baseplate. An elastomeric pad with a minimum thickness of 0.25 inch shall be bonded to the baseplate.
- d. Spring assembly shall be removable and shall fit within a welded steel enclosure consisting of a top plate and rigid lower housing, which serves as a blocking device during installation. Isolated restraining bolts shall not be engaged during normal operation and shall connect the top plate and lower housing to prevent the isolated equipment from rising when drained of fluid.
- e. Isolators shall be selected for a nominal 1-inch deflection.

C. Sound Barrier:

- 1. Furnish removable and reusable sound-barrier covers over the compressor housing, hermetic motor, compressor suction and discharge piping, and condenser shell.
- 2. Provide for repeated installation and removal without use of tape or calk.
- 3. Inner and outer cover shall consist of a PTFE-impregnated fiberglass cloth enclosing heavy-density, needled fiberglass insulation material with a mass-loaded vinyl acoustic barrier.
- 4. Covers shall be double sewn and lock stitched with edges folded and sewn so no raw cut edges are exposed.
- 5. Form covers around control devices, gages, conduit, piping, and supports without degrading sound-barrier performance.
- 6. Continuously lap all exposed seams at least 2 inches for better sound containment.
- 7. Permanently label each section of cover to indicate its location, description, size, and number sequence.
- 8. Randomly place stainless-steel quilting pins to prevent covers from shifting and sagging.

D. Tool Kit: Chiller manufacturer shall assemble a tool kit specially designed for use in serving the chiller(s) furnished. Include special tools required to service chiller components not readily available to Owner service personnel in performing routine maintenance. Place tools in a lockable case with hinged cover. Provide a list of each tool furnished and attach the list to underside of case cover.

E. Hail Guard: Manufacturer shall mount to chiller frame an integral hail guard to prevent coil damage and rupture of refrigerant coils from hail and debris.

F. Pump Skid: Include single/dual pumps, glycol feed system and expansion tank with service valves.

G. Free Cool Coil: Factory mounted water coil for water side economizer. Coil, valve, controls and sensors shall be factory mounted and wired for pre-cool and 100 percent free cool at the schedules data shown.

H. Alternate to Free Cool Coil: Allow compressor/chillers to operate when ambient temperature is low and typically tripping the chiller.

2.13 SOURCE QUALITY CONTROL

A. Perform functional tests of chillers before shipping.

- B. Factory Performance Testing:
1. Factory performance test chillers, before shipping, according to AHRI 550/590.
 2. Test the following conditions:
 - a. Design conditions indicated.
 - b. At five point(s) of varying part-load performance to be selected by Owner at time of test.
 3. Allow Owner access to place where chillers are being tested. Notify Owner in writing at least 30 days in advance of testing.
 4. Prepare test report indicating test procedures, instrumentation, test conditions, and results. Submit copy of results within one week of test date.
- C. Factory test and inspect evaporator and condenser according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. Factory test and inspect evaporator and condenser according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1. Pressure test fluid side of heat exchangers, including water boxes, to 1.5 times the rated pressure. Pressure proof test refrigerant side of heat exchangers to a minimum of 45 psig. Vacuum and pressure test for leaks.
- E. Eddy Current Testing:
1. Perform factory testing of evaporator and condenser tubes of each chiller to ensure tube quality and longevity.
 2. Submit test report, including, as a minimum:
 - a. List of equipment used and equipment settings.
 - b. Test data reports and accompanying strip charts of calibrations.
 - c. Identify tubes with significant defects and typical indications.
 - d. Statistical summary of defect indications.
 - e. Recommendations concerning tube condition, tube replacement, tube removal for evaluation, and future frequency of testing.
 - f. Approval by an American Society for Nondestructive Testing, Level III eddy current technician.
- F. Owner Travel Expenses:
1. Include cost associated with Owner travel expenses to witness factory testing. Total value attributed to travel expenses shall be clearly indicated.
 2. Expenses shall include roundtrip coach airfare, out-of-town hotel accommodations, out-of-town meals (breakfast, lunch, dinner), out-of-town ground transportation, and all associated taxes and fees.
 3. Exclude other incidental expenses not indicated.
 4. Include travel expenses for one Owner representative.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine chillers before installation. Reject chillers that are damaged.

- B. Before water chiller installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, piping, and electrical to verify actual locations, sizes, and other conditions affecting water chiller performance, maintenance, and operations.
 - 1. Final water chiller locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 WATER CHILLER INSTALLATION

- A. Install chillers on support structure indicated.
- B. Install water chillers on concrete base. Concrete base is specified in Division 20 Section "Basic Mechanical Materials and Methods," and concrete material and installation requirements are specified in Division 03.
 - 1. Comply with requirements for vibration isolation devices specified in 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.
- E. Install and wire separate devices furnished by manufacturer.

3.3 CONNECTIONS

- A. Chilled-water 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 water chillers to allow service and maintenance.
- C. Evaporator Connections: Connect inlet to evaporator with controller-bulb well, shutoff valve, thermometer, strainer, pressure gage, and union or flange. Connect outlet to evaporator with shutoff valve, flow switch, balancing valve, thermometer, pressure gage, and union or flange.
- D. Install shutoff valves at chilled-water and condenser-water inlet and outlet connections.
- E. Refrigerant Pressure Relief Valve Connections: Extend vent piping to the outside without valves or restrictions.
- F. Ground water chillers according to Division 26 Section "Grounding and Bonding."
- G. Connect wiring according to Division 26 Section "Conductors and Cables."
- H. 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. Engage a factory 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 according to manufacturer's written instructions.
 - 5. Verify that refrigerant pressure relief is vented outside.
 - 6. Verify proper motor rotation.
 - 7. Verify static deflection of vibration isolators, including deflection during water chiller startup and shutdown.
 - 8. Verify and record performance of chilled- and condenser-water flow and low-temperature interlocks.
 - 9. Verify and record performance of water chiller protection devices.
 - 10. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
- D. Prepare a written startup report that records results of tests and inspections.
- E. 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.

3.5 DEMONSTRATION

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

END OF SECTION 236417

SECTION 237413 - 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.
 - 4. Division 23 Section "Unitary Rooftop Air Conditioners" for small outdoor units with integral refrigeration sections.
 - 5. Division 23 Section "Commercial Rooftop Air Conditioners" for large outdoor units with integral refrigeration sections.
 - 6. Division 23 Section "Air Cooled Refrigerant Condensers."

1.2 SUMMARY

- A. This Section includes indoor, central-station air-handling units with the following components and accessories as scheduled on the Drawings:
 - 1. Direct-expansion cooling.
 - 2. Chilled water cooling coils.
 - 3. Hot water heating coils.
 - 4. Steam heating coils.
 - 5. Electric-heating coils.
 - 6. Air blenders.
 - 7. Gas furnace.
 - 8. Energy recovery.
 - 9. Supply fan.
 - 10. Return fan.
 - 11. Exhaust/relief fan.
 - 12. Economizer outdoor- and return-air damper section.

- B. Products supplied but not installed under this Section:
 - 1. Roof curbs and equipment rails.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design vibration isolation details, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.4 DEFINITIONS

- A. DDC: Direct-digital controls.

1.5 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.

1.6 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.

1.7 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: Plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Structural members to which air handling units will be attached.
 - 2. Roof openings.
 - 3. Roof curbs and flashing.

1.8 CLOSEOUT SUBMITTALS

- A. Field quality control test reports.
- B. Operation and Maintenance Data: For air handling units to include in operation and maintenance manuals.

1.9 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 15 for refrigeration system safety.
 - 2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
 - 3. 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.

1.10 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.

- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.11 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. Filters: One set of filters for each unit.
 - 2. Gaskets: One set for each access door.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AAON, Inc.
 - 2. Buffalo Air Handling; Model J and Outdoor Model J.
 - 3. Carrier; Div. of United Technologies Corp.; 39 Series.
 - 4. Daikin Applied; a member of Daikin Industries, Ltd.
 - 5. JCI/YORK International Corporation.
 - 6. Nortek Air Solutions; Ventrol, Venmar, and Temtrol Divisions.
 - 7. Trane; a Trane technologies Brand; Performance Climate Changer.
 - 8. 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: Stainless steel, 0.1406 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.
 - 3. Outdoor Units: Able to withstand a salt spray test in accordance with ASTM B117 for a minimum of 500 consecutive hours.

2.3 FAN ARRAYS

- A. Refer to Division 23 Section "Fan Arrays."

2.4 COILS

- A. On outdoor units provide pipe housing on side of AHU where indicated on plans.

- B. 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.
 - 9. Special Coating: Heresite P-403 baked phenolic.

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: Linked damper blades, for 0 to 100 percent outdoor air, with motorized damper operator.
- B. Outdoor- and Return-Air Mixing Dampers: Parallel- or opposed-blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.
 - 1. Damper Motor: Modulating with adjustable minimum position.
 - 2. Relief-Air Damper: Gravity actuated with bird screen and hood.

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 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, whichever is greater.
 - 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.

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. Electric Heater: With integral thermostat to maintain minimum 50 deg F temperature in gas burner compartment.
- 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.
 - 2. Units without Internally Isolated Fans:

- a. Floor-Mounted Units: Support on concrete bases using housed-spring isolators. Secure units to anchor bolts installed in concrete bases.
- 3. Suspended Units: Suspend units from structural-steel support frame using threaded steel rods and spring hangers.
- 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.
 - 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.
- 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 furnace combustion chamber.
 3. Inspect for visible damage to coils 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 furnace flue and inspect for construction debris.
 10. Connect and purge gas line.
 11. Remove packing from vibration isolators.
 12. Inspect operation of barometric relief dampers.
 13. Verify lubrication on fan and motor bearings.
 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. 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. Perform the following operations for both minimum and maximum firing. Adjust burner for peak efficiency.
 - a. Measure gas pressure on manifold.
 - b. Inspect operation of power vents.
 - c. Measure combustion-air temperature at inlet to combustion chamber.
 - d. Measure flue-gas temperature at furnace discharge.
 - e. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
 - f. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
 20. Calibrate thermostats.
 21. Adjust and inspect high-temperature limits.
 22. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
 23. 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.
 24. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
 25. 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.
26. 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.
27. 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 237413

SECTION 238216 - 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. Shop Drawings: Diagram power, signal, and control wiring.
- B. 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. Greenheck.
 - 5. JCI/York International.
 - 6. Luvata/Heatcraft Commercial/Industrial Products.
 - 7. Nortek Air Solutions; Ventrol.
 - 8. Precision Coils; a business of Unison Comfort Technologies.
 - 9. 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.
- I. Frames, Chilled Water Coils: ASTM A 666, Type 304 stainless steel, minimum 0.0625 inch thick.

2.2 DRAIN PANS

- A. Description: For cooling coils, IAQ compliant formed to slope from all directions to the drain connection as required by ASHRAE 62.
- B. Construction: Minimum 22 gage, Type 304 stainless steel with welded joints, positively sloped a minimum of 1/8 inch per foot, with threaded drain connection at lowest point of pan. Intermediate pans piped to the primary drain pan are required for all stacked cooling coils.
- C. Provide intermediate coils with 3 inch deep pans for each tiered coil bank. Top pan shall extend 6 inches beyond face of coil and bottom pan shall extend not less than 12 inches beyond face of coil. Where more than two pans are used, pan extension shall be proportional.
- D. Supports: Same material as pans.
- E. Pipe pan drain to floor drain. A deep seal trap shall be installed on the drain pipe from the pans.
- F. Include factory-installed float switch to detect high condensate water level and disable associated fan operation.

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. Laboratory Terminal Unit Hot Water Coils: Caulk and seal frame and all housing tube openings in the field with a non-hardening sealant. Sealant type shall be approved by the coil manufacturer.
- D. 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.

- E. Install moisture eliminators for cooling coils. Extend drain pan under moisture eliminator.
- F. Straighten bent fins on air coils.
- G. 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.
- 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."
- D. Connect steam piping with gate valve and union and steam condensate piping with union, strainer, trap, and gate valve 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 "Steam and Condensate Piping."
- E. Connect refrigerant piping according to Division 23 Section "Refrigerant Piping."
- F. Ground equipment according to Division 26 Section "Grounding and Bonding."
- G. Connect wiring according to Division 26 Section "Conductors and Cables."

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 238216

SECTION 238224 - VERTICAL UNIT 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 "Basic Mechanical Materials and Methods."
 - 3. Division 23 Section "Water-Source Unitary Heat Pumps" for ground-loop, water-source heat-pump-type vertical unit ventilators.

1.2 SUMMARY

- A. This Section includes vertical style unit ventilators and accessories with the following heating and cooling features:
 - 1. Hydronic heating coil.
 - 2. Direct-expansion refrigerant cooling coil.

1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. DDC: Direct digital controller.

- C. HGBP: Hot-gas bypass.

1.4 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, and furnished specialties and accessories for each unit type and configuration.

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. 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.
- B. Samples for Initial Selection: For units with factory-applied color finishes.
- C. Samples for Verification: For each type of unit ventilator indicated.

1.6 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Operation and Maintenance Data: For unit ventilators to include in operation and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Maintenance schedules and repair part lists for motors, coils, integral controls, and filters.
- C. Warranty: Special warranty specified in this Section.

1.7 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. Comply with minimum COP/efficiency levels according to ASHRAE/IESNA 90.1.
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- E. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

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. Unit Ventilator Filters: Furnish spare filter for each filter installed.

PART 2 - PRODUCTS

2.1 UNIT VENTILATOR (high efficiency)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Airedale; High Efficiency Classmate or a comparable product by one of the following:
1. Modine Manufacturing Company; Airedale.
 2. System Air Company.
 3. Temspec Inc.
- B. Unit Casing: Constructed of galvanized sheet steel, braced and reinforced for rigidity, covered with baked dry powder epoxy resin paint in manufacturer's standard color as selected by Architect.
1. Cabinet front containing low level return air grille integral to door front and sound attenuating inlet plenum.
 2. Removable panels or hinged door with spring loaded pins for access to cooling coil, supply and evaporator fan/motor assemblies, electronic controls, filters, and dampers.
 3. Furnish matching outside air back plenum where indicated for field mounting to rear of unit to allow louver installation above existing window sill heights.
 4. Furnish matching blank-off panels where required to conceal back of unit. Coordinate with architectural casework.
 5. As a separate assembly, provide matching discharge plenum with hot water heating coil assembly for field mounting to top of unit. If manufacturer's standard design does not require a separate assembly housing the heating coil, furnish matching duct shroud to conceal supply duct from unit discharge to above finished ceiling. Coordinate with Architectural ceiling elevations.
 6. Unit shall be fitted with power disconnect switch located on control panel, sized for full load amperage. Switch lockable in off position.
- C. Insulation: Minimum 1-inch thick, matte-finish, closed-cell foam complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.
1. Fire-Hazard Classification: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
- D. Modulating Damper: Spring return type, designed to mix outside air with return air.
1. Capable of permitting 100 percent outside air into the conditioned space, or recycling return air and allowing minimum outside air into the conditioned space.
 2. Fully modulating allowing any mixture of outside air and return air with minimum damper position setting to continuously maintain outside air ventilation requirements dependent on control via the unit's DDC controls.
 3. Blade seals shall overlap for minimum leakage.

- E. Louver Blades: Aluminum, storm-proof, mounted at 45 degree angle in heavy gage extruded aluminum frames.
 - 1. Blade profile and louver size designed to prevent water penetration during full economizer operation.
 - 2. 1/2 inch mesh bird screen shall be attached to louver frame.
 - F. Fans and Fan Motor:
 - 1. Indoor fan assembly: Consisting of two blowers and one common-shafted electronically commutated motor (ECM).
 - a. ECM having a wide range of programmable speed and torque characteristics.
 - b. ECM fully programmable to compensate for wide variety of static pressures as well as lack of maintenance.
 - 2. Outdoor fan assembly: Consisting of two backward curved plug fans with centrifugal blower wheels.
 - G. Cooling:
 - 1. First stage: Fully modulating economizer.
 - 2. Second stage: Unit mounted chilled water coil.
 - H. Drain Pans
 - I. Filters: Accessible from front of unit a: Insulated galvanized steel with plastic liner. Drain pan shall be removable. Include factory-installed float switch to detect high condensate water level and disable fan operation and positioned to filter mixed air prior to conditioning. Microbial treated, and with minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
 - 1. Pleated Cotton-Polyester Media: 90 percent arrestance and 7 MERV.
 - J. Heating Coil: Factory piped and complete with isolation valves, balance valve, strainer, and manual air vent.
 - K. Furnish unit having factory wired and tested 3-speed motor switch. Unit shall be set to provide design airflow at specified static pressure on medium speed.
 - L. Manufacturer shall factory install DDC based controls as furnished by Temperature Controls Contractor. Refer to Temperature Control Drawings for scope of work.
- 2.2 BASIC UNIT CONTROLS
- A. Control devices are specified in Division 23 Section "HVAC Instrumentation and Controls," and operational sequences are indicated on the Drawings.
 - B. BAS Interface Requirements:
 - 1. Interface relay for scheduled operation.
 - 2. Interface relay to provide indication of fault at the central workstation.
 - 3. Provide BACnet or LonWorks interface for central BAS workstation for the following functions:

- a. Adjust set points.
 - b. Unit ventilator start, stop, and operating status.
 - c. Data inquiry to include outdoor-air damper position, supply- and room-air temperature and humidity.
 - d. Occupied and unoccupied schedules.
- C. Electrical Connection: Factory wire motors and controls for a single electrical connection.

2.3 CAPACITIES AND CHARACTERISTICS

- A. Refer to Schedule on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive unit ventilators 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 unit ventilator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install unit ventilators to comply with NFPA 90A.
- B. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above finished floor.
- C. Refer to Division 23 Section "Condensing Units" for condensing units matched to refrigerant cooling coil packaged in unit ventilators.

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. Specific connection requirements are as follows:
 - 1. Install piping adjacent to machine to allow service and maintenance.
 - 2. Connect piping to unit ventilator factory hydronic piping package. Install piping package if shipped loose.
 - 3. Connect condensate drain to indirect waste.
- B. Install refrigerant piping as required by Division 23 Section "Refrigerant Piping," and add refrigerant as required to compensate for length of piping.

- C. Connect supply and return ducts to unit ventilators with flexible duct connectors specified in Division 23 Section "Duct Accessories." Comply with safety requirements in UL 1995 for duct connections.
- 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. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
 - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
 - 4. Record temperatures entering and leaving energy recovery wheel when outdoor-air temperature is a minimum of 15 deg F higher, or 20 deg F lower, than room temperature.
- C. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.6 DEMONSTRATION

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

END OF SECTION 238224

SECTION 238240 - CENTRIFUGAL FAN CABINET UNIT HEATERS (HOT WATER)

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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, operating characteristics, furnished specialties, and accessories for each product indicated.

1.3 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. Plans, elevations, sections, and details.
 - 2. Location and size of each field connection.
 - 3. Location and arrangement of piping valves and specialties.
 - 4. Location and arrangement of integral controls.
 - 5. Wiring Diagrams: Power, signal, and control wiring.
- B. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which cabinet unit heaters will be attached.
3. Method of attaching hangers to building structure.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
6. Perimeter moldings for exposed or partially exposed cabinets.

1.4 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Operation and Maintenance Data: For cabinet unit heaters 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 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."

1.6 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. Filters: Furnish spare filter for each filter installed.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Carrier Corporation; United Technologies Corporation.
 2. Daikin Applied; a member of Daikin Industries, Ltd.
 3. Hydro-Air Components Inc.; Zehnder Rittling.
 4. Modine Manufacturing Company.
 5. Sterling Radiator; a Mestek Company.
 6. Trane; a Trane Technologies Brand.
 7. Vulcan Radiator; a Mestek Company.

- B. Description: A factory-assembled and -tested unit complying with AHRI 440.
- C. Coil Section Insulation: ASTM C 1071; surfaces exposed to airstream shall have erosion-resistant coating to prevent erosion of glass fibers.
 - 1. Thickness: Minimum 1/2 inch.
 - 2. Thermal Conductivity (k-Value): 0.26 Btu x in./h x sq. ft. at 75 deg F mean temperature.
 - 3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
 - 4. Adhesive: Comply with ASTM C 916 and with NFPA 90A or NFPA 90B.
 - 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Cabinet: Steel with baked-enamel finish with manufacturer's standard paint, in color selected by Architect.
 - 1. Horizontal Unit, Exposed Bottom Panels: Minimum 0.0528-inch- thick, sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.
 - 2. Vertical Unit, Exposed Front Panels: Minimum 0.0528-inch- thick, sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.
 - 3. Recessing Flanges for Units That Are Semirecessed or Fully Recessed: Steel, finished to match cabinet.
 - 4. Control Access Door: Key operated.
 - 5. Base for Surface, Vertical, Wall-Mounting Units: Minimum 0.0528-inch- thick steel, finished to match cabinet, 6 inches high with leveling bolts.
- E. Filters: Minimum arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
 - 1. Glass Fiber Treated with Adhesive: Throw-away type 80 percent arrestance and 5 MERV.
- F. Hot-Water Coil: Copper tube, 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 220 deg F. Include manual air vent and drain.
- G. Fan and Motor Board: Removable.
 - 1. Fan: Forward curved, double-width centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.
 - 2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 20 Section "Motors."
 - 3. Wiring Terminations: Connect motor to chassis wiring with plug connection.
- H. Electrical Connection: Factory wire motors and controls for a single field connection.
- I. Capacities and Characteristics: Refer to Schedule on Drawings.

2.2 UNIT CONTROLS

- A. Control devices are specified in Division 23 Section "Temperature Controls," and operational sequences are indicated on the Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive cabinet 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 cabinet unit heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install cabinet unit heaters to comply with NFPA 90A.
- B. Suspend cabinet unit heaters from structure with elastomeric hangers.
 - 1. Vibration isolators are specified in Division 20 Section "Mechanical Vibration and Controls."
- C. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
- D. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

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. Connect supply and return ducts to cabinet unit heaters with flexible duct connectors specified in Division 23 Section "Duct Accessories."
- D. Comply with safety requirements in UL 1995.
- E. Ground equipment according to Division 26 Section "Grounding and Bonding."
- F. 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 field-assembled components and equipment installation, including connections. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.

3.5 DEMONSTRATION

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

END OF SECTION 238240

SECTION 238241 - PROPELLER FAN UNIT HEATERS - STEAM, HOT WATER, ELECTRIC

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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 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 vertical discharge configuration with adjustable discharge louvers.
- B. Comply with UL 2021.
- C. Comply with UL 823.

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. Test and rate propeller unit-heater coils according to ASHRAE 33.
- B. 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.
- C. Propeller type, aluminum wheel directly mounted on motor shaft in the fan venturi.

2.5 FAN MOTORS

- A. Comply with requirements in Division 20 Section "Motors."
- B. Motor Type: Permanently lubricated, multispeed.

2.6 CONTROLS

- A. Control Devices:
 - 1. Wall-mounting fan-speed switch.
 - 2. Wall-mounting thermostat.

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."
- D. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting 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. Comply with safety requirements in UL 1995.
- D. 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."
- E. Unless otherwise indicated, install union and gate or ball valve on steam-supply connection and union, strainer, steam trap, and gate or ball valve on condensate-return connection of unit heater. Steam specialties are specified in Division 23 Section "Steam and Condensate Piping."
- F. Ground equipment according to Division 26 Section "Grounding and Bonding."
- G. 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. Operate electric heating elements through each stage to verify proper operation and electrical connections.
 - 3. Test and adjust controls and safeties.
- B. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 238241

SECTION 238317 - SNOW MELTING AND FLOOR HEATING

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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 installation requirements for sealing pipe penetrations through fire and smoke barriers.
 - 2. Division 20 Section "Mechanical General Requirements."
 - 3. Division 20 Section "Basic Mechanical Materials and Methods" for general piping materials and installation requirements.
 - 4. Division 20 Section "Hangers and Supports" for pipe supports, product descriptions, and installation requirements.
 - 5. Division 20 Section "Mechanical Identification" for labeling and identifying piping and equipment.
 - 6. Division 23 Section "General-Duty Valves for HVAC."
 - 7. Division 23 Section "Water Treatment for Closed-Loop Hydronic Systems" for glycol and related glycol fill equipment.
 - 8. Division 23 Section "Hydronic Piping" for pipes and connections to hydronic systems.

9. Division 23 Section "Hydronic and Steam Heat Exchangers."
10. Division 23 Section "Finned Water-Tube Boilers."
11. Division 23 Section "Condensing Boilers."
12. Division 23 Section "Temperature Controls" for thermostats, controllers, automatic control valves, and sensors.

1.2 SUMMARY

- A. This Section specifies components required for snow melting and radiant floor heating systems, including pipes, fittings, piping specialties, heat exchangers, and controls.
- B. Work includes furnishing all labor, materials and equipment necessary to install snow melting and radiant floor heating system(s) as indicated on the Drawings and as specified in this Section.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene monomer rubber.
- B. PEX: Crosslinked polyethylene.
- C. PEX/AL/PEX: Crosslinked polyethylene/aluminum/crosslinked polyethylene.

1.4 PERFORMANCE REQUIREMENTS

- A. Retain the services of a company specializing in snow melting and radiant floor heating systems to design, and furnish the complete snow melting and radiant floor heating system.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of radiant heating pipe, fitting, manifold, specialty, and control.
 1. For radiant heating piping and manifolds, include pressure and temperature rating, oxygen-barrier performance, fire-performance characteristics, and water flow and pressure drop characteristics.

1.6 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Show piping layout and details drawn to scale, including valves, manifolds, controls, and support assemblies, and their attachments to building structure.
 1. Shop Drawing Scale: Minimum 1/4 inch = 1 foot.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For radiant heating piping valves and equipment to include in operation and maintenance manuals.

- B. Written sequence of operation.

1.8 QUALITY ASSURANCE

- A. Complete snow melting system floor heating system shall be designed and provided by a firm regularly engaged in providing commercial snow melting and floor heating systems and having a minimum of 10 completed installations. Submit documentation to Mechanical Engineer.

PART 2 - PRODUCTS

2.1 SYSTEM SUPPLIER

- A. Subject to be designed compliance with requirements, complete snow melting system floor heating system snow melting and floor heating systems shall and provided by one of the following:
 1. Comfort Engineering Solutions LLC; Watts Radiant; Chesterfield, MI; Phone: 586-421-2400.
 2. Emerson Swan; A Swan Group Company; Watts Radiant; Livonia, MI; Phone: 877-791-7926.
 3. H.S. Buy Van Associates, Inc.; Uponor Wirsbo; Auburn Hills, MI; Phone 248-852-7610
 4. J.W. Sales, Inc.; Legend Radiant Products; Auburn Hills, MI; Phone: 248-745-8590.
 5. Michigan Air Products; Rehau; Troy, MI; Phone: 248-837-7000.
 6. R.L. Deppmann Company; MrPEX Systems Inc.; Southfield, MI; Phone: 248-354-3710
 7. Thaw-Pak Snow Melting and Radiant Heating; Performance Engineering Group; Livonia, MI; Phone: 734-266-5300.
 8. Viega North America, ProRadiant and S-no-Ice.

2.2 PEX PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Infloor Radiant Heating Inc.
 2. MrPEX Systems Inc.
 3. REHAU.
 4. ROTH Industries, Inc.
 5. Uponor Wirsbo Co.
 6. Vanguard Piping Systems, Inc.; a Viega Company.
 7. Viega North America.
 8. Watts Radiant, Inc.; a division of Watts Water Technologies, Inc.
 9. Zurn Plumbing Products Group; Zurn Radiant Heating Systems.
- B. Pipe Material: PEX plastic in accordance with ASTM F 876.
- C. Oxygen Barrier: Limit oxygen diffusion through the tube to maximum 0.10 mg per cu. m/day at 104 deg F in accordance with DIN 4726.

- D. Fittings: ASTM F 1807, metal-insert type with copper crimp rings and matching PEX tube dimensions; or plastic-insert type cold expansion fittings and corresponding rings, material meeting requirements of ASTM F 1960; or metal insert and cold jointing compression system meeting ASTM F 2080.
- E. Pressure/Temperature Rating: Minimum 100 psig and 180 deg F.

2.3 FORM STABLE PEX (PEX/AL/PEX) PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Aqua-Therm.
 - 2. IPEX Inc.
 - 3. MrPEX Systems Inc.
 - 4. ROTH Industries, Inc.
 - 5. Uponor Wirsbo Co.
 - 6. Viega North America.
 - 7. Watts Radiant, Inc.; a division of Watts Water Technologies, Inc.
 - 8. Zurn Plumbing Products Group; Zurn Radiant Heating Systems.
- B. Pipe Material: PEX plastic bonded to the inside and outside of a welded aluminum tube in accordance with ASTM F 1281.
- C. Oxygen Barrier: Limit oxygen diffusion through the pipe to maximum 0.10 mg per cu. m/day at 104 deg F in accordance with DIN 4726.
- D. Fittings: ASTM F 1974, metal insert fittings with split ring and compression nut (compression joint) or metal insert fittings with copper crimp rings (crimp joint).
- E. Flame-Spread and Smoke-Developed Indexes: 25 and 50 or less, respectively, tested in accordance with ASTM E 84.
- F. Pressure/Temperature Rating: Minimum 100 psig and 210 deg F.

2.4 EPDM PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Watts Radiant, Inc.; a division of Watts Water Technologies, Inc.
- B. Pipe Material: Crosslinked EPDM inner and outer tubes.
- C. Wall Thickness: Minimum 0.125 inch.
- D. Oxygen Barrier: Ductile aluminum foil layer applied to the inner tube to limit oxygen diffusion through the pipe to maximum 0.10 mg per cu. m/day at 104 deg F according to DIN 4726.
- E. Reinforcing Braid: Braided-aluminum wire between the inner and outer tube.
- F. Fittings: ASTM F 1807, copper with stainless-steel crimps or clamps.
- G. Pressure/Temperature Rating: Minimum 100 psig and 180 deg F.

2.5 DISTRIBUTION MANIFOLDS AND ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Infloor Heating Systems.
 2. MrPEX Systems Inc.
 3. Rehau Inc.
 4. ROTH Industries, Inc.
 5. Thaw-Pak Snow Melting and Radiant Heating Systems.
 6. Vanguard Plastics, Inc.; a Viega Company.
 7. Viega North America.
 8. Uponor Wirsbo Co.
 9. Watts Radiant, Inc.; a Division of Watts Water Technologies, Inc.
 10. Zurn Plumbing Products Group; Zurn Radiant Heating Systems.
- B. Manifold: Minimum NPS 1, brass, copper, anodized aluminum, or stainless steel.
- C. Main Shutoff Valves:
1. Factory installed on supply and return connections.
 2. Ball valve meeting requirements specified in Division 23 Section "General Duty Valves for HVAC."
- D. Manual Air Vents:
1. Body: Bronze.
 2. Internal Parts: Nonferrous.
 3. Operator: Key furnished with valve, or screwdriver bit.
 4. Inlet Connection: NPS 1/2.
 5. Discharge Connection: NPS 1/8.
 6. Pressure/Temperature Rating: Minimum 100 psig and 180 deg F.
- E. Balancing Valves:
1. Body: Bronze, ball or plug, or globe cartridge type.
 2. Ball or Plug: Brass or stainless steel.
 3. Globe Cartridge and Washer: Brass with EPDM composition washer.
 4. Seat: PTFE.
 5. Visual Flow Indicator: Flowmeter with visible indication in a clear plastic cap at top of valve.
 6. Differential Pressure Gage Connections: Integral seals for portable meter to measure loss across calibrated orifice.
 7. Handle Style: Lever or knob, with memory stop to retain set position if used for shutoff.
 8. Pressure/Temperature Rating: Minimum 100 psig and 180 deg F.
- F. Zone Control Valves (as required on Drawings):
1. Body: Bronze, ball or plug, or globe cartridge type.
 2. Ball or Plug: Brass or stainless steel.
 3. Globe Cartridge and Washer: Brass with EPDM composition washer.
 4. Seat: PTFE.
 5. Actuator: Replaceable electric motor.
 6. Pressure/Temperature Rating: Minimum 100 psig and 180 deg F.
- G. Thermometers: Refer to Division 20 Section "Meters and Gages."

- H. Mounting Brackets: Copper, or plastic or copper-clad steel, where in contact with manifold.

2.6 PIPING SPECIALTIES

A. Cable Ties:

1. Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
2. Minimum Width: 1/8 inch.
3. Tensile Strength: 20 lb, minimum.
4. Temperature Range: Minus 40 to plus 185 deg F.

2.7 BRAZED PLATE HEAT EXCHANGERS

A. Manufacturers:

1. Alfa Laval Thermal, Inc.
2. Armstrong Pumps, Inc.
3. Bell & Gossett; Xylem Inc.
4. GEA PHE Systems North America, Inc.; FP Series.
5. Mueller, Paul Company.

- B. Configuration: Brazed assembly consisting of two end plates, one with threaded nozzles and pattern-embossed plates.

C. End-Plate Material: Type 316 stainless steel.

D. Threaded Nozzles: Type 316 stainless steel.

E. Plate Material: Type 316 stainless steel.

F. Brazing Material: Copper.

G. Capacity and Characteristics: Refer to schedule on the Drawings.

2.8 HEAT EXCHANGERS

- A. Refer to Division 23 Section "Hydronic and Steam Heat Exchangers."

2.9 BOILER

- A. Refer to Division 23 Section "Condensing Boilers."

2.10 HYDRONIC PUMPS

- A. Type and capacity as scheduled on the Drawings.

B. Refer to Division 23 Section "Hydronic Pumps" for additional requirements.

2.11 CONTROLS (FLOOR HEATING)

- A. Sequence of operation is indicated on the Drawings.
- B. Temperature-control devices are specified in Division 23 Section "Temperature Controls."
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Danfoss Inc.
 - 2. HeatLink USA Inc.
 - 3. Honeywell.
 - 4. Infloor Radiant Heating Inc.
 - 5. IPEX Inc.
 - 6. REHAU.
 - 7. Slant/Fin Corp.
 - 8. Tekmar Control Systems, Ltd.
 - 9. Uponor Wirsbo Co.
 - 10. Vanguard Piping Systems, Inc.; a Viega Company.
 - 11. Viega North America.
 - 12. Watts Radiant, Inc.; a division of Watts Water Technologies, Inc.
 - 13. Zurn Plumbing Products Group.
- D. Wall-Mounting Thermostat:
 - 1. Minimum temperature range from 50 to 90 deg F.
 - 2. Manually operated with on-off switch.
 - 3. Day and night setback and clock program with minimum four periods per day.
 - 4. Operate pumps or open zone control valves if room temperature falls below the thermostat setting, and stop pumps or close zone control valves when room temperature rises above the thermostat setting.

2.12 CONTROLS (SNOW MELTING)

- A. Sequence of operation is indicated on the Drawings.
- B. Temperature-control devices are specified in Division 23 Section "Temperature Controls."
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. HBX Control Systems Inc.
 - 2. Infloor Radiant Heating Inc.
 - 3. REHAU.
 - 4. Tekmar Control Systems, Ltd.
 - 5. Uponor Wirsbo Co.
 - 6. Vanguard Piping Systems, Inc.; a Viega Company.
 - 7. Viega North America; Advanced Snow Melt Control.
 - 8. Watts Radiant, Inc.; a division of Watts Water Technologies, Inc.
- D. Combination Ice and Snow, and Combination Temperature and Moisture Sensor:
 - 1. Automatic control with manual on, automatic, and standby/reset switch.

2. Combination ice and snow; and combination temperature and moisture sensors shall sense the surface conditions of pavement and shall be programmed to operate pump and zone control valves as follows:
 - a. Temperature Span: 34 to 44 deg F.
 - b. Adjustable Delay Off Span: 30 to 90 minutes.
 - c. Start Pump or Open Zone Control Valves: Following two-minute delay if ambient temperature is below set point and precipitation is detected.
 - d. Stop Pump or Close Zone Control Valves: On detection of a dry surface plus time delay.
3. Corrosion-proof and waterproof enclosure suitable for outdoor mounting, for controls and precipitation and temperature sensors.
4. Contactor of sufficient size to control pumps and valves.
5. Provide relay with contacts to indicate operational status, on or off, for interface with central HVAC control system workstation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and substrates to receive radiant heating piping for compliance with requirements for installation tolerances and other conditions affecting performance.
 1. Ensure that surfaces and pipes in contact with radiant heating piping are free of burrs and sharp protrusions.
 2. Ensure that surfaces and substrates are level and plumb.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Install the following types of radiant heating piping for the applications described:
 1. Piping in Exterior Pavement: PEX .
 2. Piping in Interior Reinforced-Concrete Floors: PEX .
 3. Piping in Level Fill Concrete Floors (Not Reinforced): PEX .
 4. Piping Not Embedded in Concrete Floors or Pavement: Refer to Division 23 Section "Hydronic Piping."

3.3 INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location 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 on Shop or Coordination Drawings.
- B. Install radiant heating piping continuous from the manifold through the heated panel and back to the manifold without piping joints in heated panels.

- C. Connect radiant piping to manifold in a reverse-return arrangement.
- D. Do not bend pipes in radii smaller than manufacturer's minimum bend radius dimensions.
- E. Install manifolds in accessible locations, or install access panels to provide maintenance access as required in Division 08 Section "Access Doors and Frames."
- F. Refer to Division 23 Sections "Hydronic Piping" and "HVAC Water Treatment" for pipes and connections to hydronic systems and for glycol-solution fill requirements.
- G. Fire- and Smoke-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials according to Division 07 Section "Through-Penetration Firestop Systems."
- H. Piping in Exterior Pavement:
 - 1. Secure piping in concrete by attaching pipes to reinforcement using cable ties.
 - 2. Space cable ties a maximum of 18 inches o.c., and at center of turns or bends, to maintain required spacing.
 - 3. Maintain 2-inch minimum cover.
 - 4. Avoid crossing expansion or control joints. Where joints must be crossed, employ either of the following methods:
 - a. Install a sleeve of 3/8-inch- thick, foam-type insulation or PE pipe around tubing and extending for a minimum of 10 inches on each side of slab joints to protect the tubing passing through expansion or control joints. Anchor sleeve to slab form at control joints to provide maximum clearance for saw cut.
 - b. Route tubing under the joint into the sand bedding material.
 - 5. Maintain minimum 40-psig pressure in piping during concrete placement and continue for 24 hours after placement.
- I. Piping in Interior Reinforced-Concrete Floors:
 - 1. Secure piping in concrete floors by attaching pipes to reinforcement using cable ties.
 - 2. Space cable ties a maximum of 18 inches o.c., and at center of turns or bends.
 - 3. Maintain 2-inch minimum cover.
 - 4. Avoid crossing expansion or control joints. Where joints must be crossed, employ either of the following methods:
 - a. Install a sleeve of 3/8-inch- thick, foam-type insulation or PE pipe around tubing and extending for a minimum of 10 inches on each side of slab joints to protect the tubing passing through expansion or control joints. Anchor sleeve to slab form at control joints to provide maximum clearance for saw cut.
 - b. Route tubing under the joint into the sand bedding material.
 - 5. Maintain minimum 40-psig pressure in piping during concrete placement and continue for 24 hours after placement.
- J. Piping in Level Fill Concrete Floors (Not Reinforced):
 - 1. Secure piping in concrete floors by attaching pipes to subfloor using tracks, clamps, or staples.

2. Space tracks, clamps, or staples a maximum of 18 inches o.c., and at center of turns or bends.
 3. Maintain 3/4-inch minimum cover.
 4. Avoid crossing expansion or control joints. Where joints must be crossed, employ either of the following methods:
 - a. Install a sleeve of 3/8-inch- thick, foam-type insulation or PE pipe around tubing and extending for a minimum of 10 inches on each side of slab joints to protect the tubing passing through expansion or control joints. Anchor sleeve to slab form at control joints to provide maximum clearance for saw cut.
 - b. Route tubing under the joint into the sand bedding material.
 5. Maintain minimum 40-psig pressure in piping during the concrete pour and continue for 24 hours during curing.
- K. Revise locations and elevations as required to suit field conditions and ensure integrity of piping.
- L. After system balancing has been completed, mark balancing valves to permanently indicate final position.
- M. Perform the following adjustments before operating the system:
1. Open valves to fully open position.
 2. Check operation of automatic valves.
 3. Set temperature controls so all zones call for full flow.
 4. Purge air from piping.

3.4 FIELD QUALITY CONTROL

- A. Prepare radiant heating piping for testing as follows:
1. Open all isolation valves and close bypass valves.
 2. Open and verify operation of zone control valves.
 3. Flush with clean water, and clean strainers.
- B. Tests and Inspections:
1. Leak Test: After installation, but prior to concrete placement, charge system and test for leaks. Subject piping to hydrostatic test pressure that is not less than 1.5 times the design pressure but not more than 100 psig. Repair leaks and retest until no leaks exist.
 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning radiant heating piping components that do not pass tests, and retest as specified above.
- D. Prepare a written report of testing.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain Snow Melting and Radiant Floor Heating Systems.

END OF SECTION 238317

SECTION 260010 - ELECTRICAL GENERAL REQUIREMENTS

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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.
- B. Mechanical and Electrical Specifications have been developed utilizing Construction Specifications Institute MasterFormat and make use of the Facilities Services

Subgroup - Divisions 20-28; Site and Infrastructure Subgroup - Division 33; and Process Equipment Subgroup - Divisions 40 and 42.

- C. Division 1 Documents and Architectural Specifications in Divisions 2 through 14 have been developed in the MasterFormat 95 Edition and utilize Division 1 through Division 14.
- D. Where Division 15 Mechanical or Division 16 Electrical are referenced in Division 1 Documents, or within the Architectural Specifications in Divisions 2 through 14, they should refer to Division 20-28, 33, 40, and 42. For additional cross reference information refer to the Construction Specifications Institute.

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 complementary, 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 if revisions to the Drawings or Specifications are required to conform to applicable ordinances, codes, or regulations. Identify the cost associated with these revisions in the bid.

- 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: Avoid interference with the work of other trades. Remove and relocate 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. Comply with rules of local utility companies. 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 outlined 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 that exceed 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, apart from 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, be standard products of manufacturers regularly engaged in the production of electrical equipment and 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. Provide detailed layout shop Drawings on electronic media of all lighting and power distribution systems, routing of conduits, combining of circuits, circuiting, details, and related information necessary for installation and maintenance. After review by the Architect/Engineer, electronic Drawings will be stamped and returned to the Contractor.
- D. If deviations (not substitutions) from the Contract Documents are deemed necessary by the Contractor, the details of such deviations, the reason for the deviation, and the resulting changes shall be included 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 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 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 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 related to the existing systems that are being removed such as, but not limited to, electrical equipment, cabinets, devices, lighting fixtures, conduit, fittings, boxes, wiring, and supports. No abandoned components of the electrical systems indicated to be removed shall remain.
 - 1. Where electrically powered equipment is included in the demolition scope of other trades, disconnect electrical wiring connections and remove circuit wiring complete.
- 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 otherwise, removed materials shall not be reused in the work.
 - 1. Materials indicated to be salvaged shall be carefully removed, stored, and protected from damage.
 - 2. Salvaged materials intended to be re-used shall be thoroughly cleaned, refurbished if necessary, and determined to be fully functional prior to placing back into service.
 - 3. Salvaged materials of value that are not to be reused shall remain the property of the Owner unless such ownership is waived. Items that the Owner has waived 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, outlet boxes that remain recessed in walls shall be properly blanked off, and conduits capped. After alterations are complete, the entire installation shall present a "finished" look, as approved by the Architect/Engineer. The original function of the present electrical systems remaining in service shall not be changed unless specifically indicated as part of the project scope.
- E. Reroute signal wires, lighting, and power wiring as required to maintain services that are to remain and/or unaffected by the renovations. 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 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 specifically indicated on the drawings or approved by the Architect/Engineer.
- H. Existing lighting shall be reused where indicated on plans. Reused fixtures shall be detergent cleaned, re-lamped, 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 conflict with the Drawings and Specifications, report such conflicts to the Architect/Engineer for resolution.
- B. Device Location:
 - 1. Allow for wiring devices, control devices, and fire alarm devices to be relocated within a 10' radius to accommodate final coordination with furnishings and other finish elements. Devices relocated prior to installation shall be done without additional cost to the project.

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 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 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, following 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 before 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. Upon 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 as 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 additional electrical work which may be proposed or requested, furnish an itemized cost breakdown of material and labor required to complete the work. Proceed only after receiving a written authorization.
- B. Before providing an itemized break-down for additional electrical work, submit unit prices for the following items: 1/2", 3/4", 1", 1-1/2" EMT conduit; #12, #10, #8, #6, #2 building wire; duplex receptacles, GFCI receptacles, data box and raceway, V4000 wiremold, and fittings, fire alarm audible/visual notification appliance and visual notification appliance, clocks and speakers, and other common electrical work which may be anticipated for any future revisions. These unit costs, once agreed to, shall be applied to additions and deducts for all project change orders.

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 260010

SECTION 260519 - 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.

B. Related Sections include the following:

- 1. Division 26 Section "Medium-Voltage Cables" for single-conductor and multiconductor cables, cable splices, and terminations for electrical distribution systems with 2001 to 35,000 V.
- 2. Division 26 Section "Control-Voltage Electrical Power Cables" for multiconductor cables for electrical control and communications systems operating at 70V and less.
- 3. Division 27 Section "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.3 ACTION SUBMITTALS

- A. Submit letter of compliance (intent) for copper and aluminum building wire.
- B. Provide product data for the following:
 - 1. Tray Cable, Type TC
 - 2. Power Cable for Variable Frequency Controlled Motors

1.4 informational submittals

- A. Field Quality-Control Test Reports.

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.

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 TRAY CABLE, TYPE TC

A. Description: A factory assembly of insulated current-carrying conductors with or without an equipment grounding conductor in a nonmetallic jacket.

B. Manufacturers:

1. Alpha Wire Company
2. Belden
3. Encore
4. General Cable
5. Okonite
6. Service Wire Co.
7. Southwire Company

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-73-532/NEMA WC 57 for Type TC cables used for control, thermocouple extension, and instrumentation.
4. Comply with ICEA S-95-658/NEMA WC 70 for Type TC cables used for power distribution.
5. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

E. Ground Conductor: Insulated.

F. Conductor Insulation: Type XHHW-2. Comply with UL 44.

G. Shield: None.

2.4 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: 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 ¼ 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.

2.5 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 120V 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. 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 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
- G. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.
- H. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- I. Provide a separate neutral conductor for each circuit unless multi-wire branch circuits are specifically indicated on the drawings.
- J. 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.
- K. 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.
- L. Do not route conductors across roof without prior approval from engineer.
- M. 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.
- 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.
- K. Use appropriately sized compression pin adapters to make terminations at equipment where equipment lugs cannot accommodate conductors that are oversized for voltage drop or similar conditions.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260533 "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 260519

SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER 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 control-voltage electrical power cables for the following systems:

- 1. Temperature controls
- 2. Building automation
- 3. Lighting control
- 4. Low voltage lighting power limited circuits
- 5. Public address and distributed audio
- 6. Audio-visual systems
- 7. Shade control systems
- 8. Class 1 and Class 2 power limited circuits supplying LED lighting on the secondary of low voltage drivers or power supplies.
- 9. Any control voltage, signal cable or power limited circuit required.

- B. Section Includes the following:

- 1. Category 5e balanced twisted pair cable.

2. Balanced twisted pair cable hardware.
3. RS-232 cable.
4. RS-485 cable.
5. Control cable.
6. Control-circuit conductors.

C. Related Requirements:

1. Section 260010 "Electrical General Requirements".
2. Section 260529 "Hangers and Supports for Electrical Systems".
3. Section 260533 "Raceways and Boxes".
4. Section 260536 "Cable Trays".
5. Section 271500 "Communications Horizontal Cabling" and Section 271300 "Communications Backbone Cabling" for cable intended for owner's voice and data cabling network cable infrastructure.
6. Section 283100 "Fire Alarm" for cable specific to fire alarm systems signaling line circuits and notification appliance circuits.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Category 5e balanced twisted pair cable.
2. Balanced twisted pair cable hardware.
3. RS-232 cable.
4. RS-485 cable.
5. Control cable.
6. Control-circuit conductors.

1.4 INFORMATIONAL SUBMITTALS

- A. Source quality-control reports.
- B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Cable specifications shall meet the minimum requirements of the equipment or control system manufacturer for which the cables are intended to support, or as specified in other sections.
 1. Coordinate with submittals for each special system, where applicable.
 2. Where cable specifications for specific systems differ from these specifications, use the cable with performance characteristics required by the manufacturer, with the appropriate environmental rating and color coding as indicated.
 3. All execution articles in this section shall apply to all control voltage cable systems in addition to control system manufacturer requirements. Where these specifications differ or conflict with the system manufacturer instructions or recommendations, the more restrictive requirements shall apply.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262, by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.
 - 1. Flame Travel Distance: 60 inch or less.
 - 2. Peak Optical Smoke Density: 0.5 or less.
 - 3. Average Optical Smoke Density: 0.15 or less.
- D. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.
- E. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.

2.2 CATEGORY 5e BALANCED TWISTED PAIR CABLE

- A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 5e cable at frequencies up to 100 MHz.
- B. Standard: Comply with ICEA S-90-661, NEMA WC 63.1, and TIA-568-C.2 for Category 5e cables.
- C. Conductors: 100 ohm, No. 24 AWG solid copper.
- D. Shielding/Screening: Unshielded twisted pairs (UTP)
- E. Cable Rating: Plenum.
- F. Jacket: Color coded thermoplastic.
 - 1. Color shall be determined by system served by cabling.

2.3 BALANCED TWISTED PAIR CABLE HARDWARE

- A. Description: Hardware designed to connect, splice, and terminate balanced twisted pair copper communications cable.
- B. General Requirements for Balanced Twisted Pair Cable Hardware:
 - 1. Comply with the performance requirements of balanced twisted pair cable required for the system.
 - 2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
 - 3. Cables must be terminated with connecting hardware of same category or higher.
- C. Source Limitations: Obtain balanced twisted pair cable hardware from single source from single manufacturer.
- D. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.

1. Features:
 - a. Universal T568A and T568B wiring labels.
 - b. Labeling areas adjacent to conductors.
 - c. 24 or 48 ports.
 2. Construction: 16-gauge steel and mountable on 19 inch equipment racks.
 3. Number of Jacks per Field: One for each four-pair cable indicated plus spares and blank positions adequate to suit specified expansion criteria.
- E. Patch Cords: Factory-made, four-pair cables in lengths required for specific application; terminated with an eight-position modular plug at each end.
1. Patch cords must have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords must have latch guards to protect against snagging.
- F. Plugs and Plug Assemblies:
1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair 100 ohm unshielded or shielded balanced twisted pair cable.
 2. Comply with IEC 60603-7-1, IEC 60603-7-2, IEC 60603-7-3, IEC 60603-7-4, and IEC 60603-7.5.
 3. Marked to indicate transmission performance.
- G. Jacks and Jack Assemblies:
1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair 100 ohm unshielded or shielded balanced twisted pair cable.
 2. Designed to snap-in to a patch panel or faceplate.
 3. Standards:
 - a. Category 5e, unshielded balanced twisted pair cable must comply with IEC 60603-7-2.
 - b. Category 6, unshielded balanced twisted pair cable must comply with IEC 60603-7-4.
 - c. Category 6a, unshielded balanced twisted pair cable must comply with IEC 60603-7-41.
 4. Marked to indicate transmission performance.
- H. Faceplate:
1. Four port, minimum, vertical single-gang faceplates designed to mount to single-gang wall boxes.
 2. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices".
 3. Metal Faceplate: Stainless steel, complying with requirements in Section 262726 "Wiring Devices".
 4. For use with snap-in jacks accommodating any combination of balanced twisted pair, optical fiber, and coaxial work area cords.
 - a. Flush mounting jacks, positioning the cord at a 45-degree angle.
- I. Legend:

1. Machine printed, in the field, using adhesive-tape label.
2. Snap-in, clear-label covers and machine-printed paper inserts.

2.4 RS-232 CABLE

A. Plenum-Type, TIA 232-F:

1. Three or Nine, No. 22 AWG, stranded (7x30) tinned copper conductors. Conductor quantity as required for application.
2. PE insulation.
3. Aluminum foil-polyester tape shield with 100 percent shield coverage.
4. Fluorinated ethylene propylene jacket.
5. Conductors are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
6. Flame Resistance: Comply with NFPA 262.

2.5 RS-485 CABLE

A. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. Flame Resistance: NFPA 262.

2.6 CONTROL CABLE

A. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

1. Multi-pair, twisted, No. 16 AWG, stranded (19x29) or No. 18 AWG stranded tinned-copper conductors. Number of pairs and gauge as required by the application.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

2.7 CONTROL-CIRCUIT CONDUCTORS

A. Class 1 Control Circuits:

1. Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.
2. Type TC, complying with UL 1277 in raceway.
3. Type MC, complying with UL 1569.

B. Class 2 Control Circuits:

1. Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.
2. Power-limited cable, concealed in building finishes.
3. Power-limited tray cable, in cable tray.

C. Class 3 Remote-Control and Signal Circuits:

1. Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.
2. Power-limited cable, concealed in building finishes.
3. Power-limited tray cable, in cable tray
4. Type TW or Type TF, complying with UL 83, in raceway.

D. Class 2 Control Circuits and Class 3 Remote-Control and Signal Circuits That Supply Critical Circuits: Circuit Integrity (CI) cable.

1. Smoke control signaling and control circuits.

2.8 SOURCE QUALITY CONTROL

- A. Factory test twisted pair cables according to TIA-568-C.2.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Test category 5E cables on receipt at Project site.

1. Test each pair of twisted pair cable for open and short circuits.

3.2 INSTALLATION OF RACEWAYS AND BOXES

- A. Comply with requirements in Section 260533 "Raceways and Boxes" for raceway selection and installation requirements for conduits as supplemented or modified in this Section.

1. Outlet boxes for cables must be no smaller than 4 inch square by 2-1/8 inch deep with extension ring sized to bring edge of ring to within 1/8 inch of the finished wall surface.
2. Flexible metal conduit must not be used.

- B. Comply with TIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.

- C. Install manufactured conduit sweeps and long-radius elbows if possible.

- D. Raceway Installation in Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.
2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard if entering the room from overhead.
4. Extend conduits 3 inch above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA-568-C Series of standards.
2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems."
3. Terminate all conductors; cable must not contain unterminated elements. Make terminations only at indicated outlets, terminals, control panels, cross-connect and patch panels.
4. Cables may not be spliced and must be continuous from terminal to terminal. Do not splice cable between termination, tap, or junction points unless specifically allowed and indicated in the system manufacturers installation instructions.
5. Cables serving a common system may be grouped in a common raceway. Install network cabling and control wiring and cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
6. Secure and support cables at intervals not exceeding 30 inch and not more than 6 inch from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
9. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Do not use heat lamps for heating.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Monitor cable pull tensions.
11. Support: Do not allow cables to lie on removable ceiling tiles.
12. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
13. Provide strain relief.
14. Keep runs short. Allow extra length for connecting to terminals. Do not bend cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
15. Ground wire must be copper, and grounding methods must comply with IEEE C2.
16. Where ceilings consist of exposed construction, cable shall be installed on top of joists, beams etc. and shall be concealed from view. Where the structural elements do not allow for the cable to be installed in a concealed fashion, then install the cable in conduit.
17. Install all cable in conduit in mechanical rooms, loading docks and similar service spaces.
18. Drops to surface mounted devices shall be installed in conduit in service spaces or surface raceway in finished spaces.
19. Where the ceiling is exposed, route the conduit or raceway up to the structural member that will conceal the cable.
20. No exposed cable shall be visible below the ceiling.

C. Balanced Twisted Pair Cable Installation:

1. Comply with TIA-568-C.2.
2. Do not untwist balanced twisted pair cables more than 1/2 inch at the point of termination to maintain cable geometry.

D. Installation of Control-Circuit Conductors:

1. Install wiring in raceways.
2. Use insulated spade lugs for wire and cable connection to screw terminals.

E. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces and other equipment rooms with terminating hardware and interconnection equipment.
2. Suspend cable that is not in a raceway a minimum of 8 inch above ceilings by cable supports not more than 30 inch apart.
3. Unless specifically permitted otherwise for open ceiling applications in finished areas, cable must not be run through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.

F. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only when space under floor is used for the transport of environmental air.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Below each feed point, neatly coil a minimum of 72 inch of cable in a coil not less than 12 inch in diameter.

G. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-D recommendations for separating unshielded copper voice and data communications cable from potential EMI sources including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment must be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 5 inch.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 12 inch.
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 24 inch.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment must be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 2-1/2 inch.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 6 inch.
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 12 inch.
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures must be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 3 inch.
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 6 inch.
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 48 inch.

6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inch.

3.4 REMOVAL OF CONDUCTORS AND CABLES

- A. Remove abandoned conductors and cables. Abandoned conductors and cables are those installed that are not terminated at equipment and are not identified with a tag for future use.

3.5 CONTROL-CIRCUIT CONDUCTORS

- A. Minimum Conductor Sizes:
 1. Class 1 remote-control and signal circuits; No 14 AWG.
 2. Class 2 low-energy, remote-control, and signal circuits; No. 16 AWG.
 3. Class 3 low-energy, remote-control, alarm, and signal circuits; No 12 AWG.

3.6 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping" Chapter.

3.7 GROUNDING

- A. For data communication wiring, comply with TIA-607-B and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.
- B. For control-voltage wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Observe installation instructions for grounding according to system manufacturer's installation instructions, where applicable.

3.8 IDENTIFICATION

- A. Comply with requirements for identification specified in Division 26 Section "Electrical Identification."
- B. Identify data and communications system components, wiring, and cabling according to TIA-606-B; label printers must use label stocks, laminating adhesives, and inks complying with UL 969.
- C. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire must have a unique tag.
- D. Color Coding: Provide control voltage cables with jacket color to indicate system served: Coordinate with owner's published standards or owner's network and security consultants.

1. Use the following color-coding scheme, or submit project specific scheme for approval:
 - a. Temperature controls: Blue with unique striping for each sub-system
 - b. Building automation backbone: Blue
 - c. Lighting control: Green
 - d. Low voltage lighting power limited circuits: Black with grey stripe
 - e. Public address and distributed audio: Brown
 - f. Audio-visual systems: Yellow
 - g. Shade control systems: Black with red stripe
 - h. Class 1 and Class 2 power limited circuits supplying LED lighting on the secondary of low voltage drivers or power supplies. Black with green stripe
 - i. Miscellaneous power limited cables not otherwise specified: Black.
 - j. Reserved for Fire Alarm: Red
 - k. Reserved for Enterprise Network/Telecommunications Cable: White
 - l. Reserved for Video Surveillance: Purple
 - m. Reserved for Access Control: Orange

3.9 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Visually inspect cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments and inspect cabling connections to confirm compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination, but not after cross-connection.
 - a. Test instruments must meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in its "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in its "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

B. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide or transfer the data from the instrument to the computer, save as text files, print, and submit.

C. End-to-end cabling will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 260523

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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 "Underground Ducts and Utility Structures" for ground test wells.
 - 2. Division 26 Section "Lightning Protection" for additional grounding and bonding materials.
 - 3. Division 26 Section "Electrical General Requirements".
 - 4. 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 1100 - 1992: Recommended Practice for Powering and Grounding Sensitive Electronic Equipment.
- H. IEEE C2: National Electrical Safety Code.
- I. NETA MTS - 2001: Maintenance Testing Specifications.
- J. NFPA 70: National Electrical Code.
- K. NFPA 70B: Recommended Practice for Electrical Equipment Maintenance.
- L. NFPA 780: Lightning Protection Code.
- M. TIA/EIA 607: Commercial Building Grounding and Bonding Requirements Standard.
- N. UL 96: Lightning Protection Components.
- O. UL 467: Grounding and Bonding Equipment.
- P. UL 486 A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.
- Q. UL 486B: Wire Connectors for Use with Aluminum Conductors.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Ground rods.
 - 2. Compression-type connectors.

1.5 INFORMATIONAL SUBMITTALS

- A. Field Quality Control 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.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents

1. Submit under provisions of Division 26 "Electrical General Requirements".
2. Accurately record actual locations of grounding electrodes and connections to building steel.

1.7 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. Comply with UL 467.

B. Comply with NFPA 70; for medium-voltage underground construction, comply with IEEE C2.

C. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

D. Comply with ANSI/TIA/EIA-607 "Standard for Commercial Building Grounding and Bonding Requirements for Telecommunications".

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. Grounding Rods:

- a. American Electric-Blackburn.
- b. Apache Grounding/Erico Inc.
- c. Chance/Hubbell.

3. Mechanical Connectors:

- a. American Electric-Blackburn.
- b. Burndy.
- c. Chance/Hubbell.

4. Exothermic Connections:

- a. Cadweld.

5. 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, tinned, 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.
 3. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; size per the NEC.
- H. Aluminum Bonding Conductors: As follows:
 1. Bonding Conductor: Stranded aluminum conductor; size per the NEC.
 2. Bonding Jumper: Aluminum tape, braided bare aluminum conductors, terminated with aluminum ferrules; size per the NEC.
- I. Electrical Grounding Busbar
 1. 24" (min) x 2" x ¼" tin plated, copper busbar with two rows of ¼" x 20 tapped holes 1" on center.
- J. Telecommunications Main Grounding Busbar (TMGB)
 1. 48" (min) x 4" x ¼" tin plated, copper busbar with three rows of ¼ x 20 tapped holes 1" on center.
- K. 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.

2.4 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel.
 - 1. Size: **5/8** in diameter.
 - 2. Length: **120 inches**.
- B. Ground Rods: Sectional type; copper-clad steel.
 - 1. Size: **5/8]** in diameter.
 - 2. Length: **64 inches**.
- C. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Provide handholes as specified in Division 2 Section "Underground Ducts and Utility Structures."

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. Install equipment grounding conductors in all feeders and circuits. Terminate each end on suitable lugs, bus or bushing.
- E. Install equipment grounding conductors in all feeders and circuits. Terminate each end on suitable lugs, bus or bushing.
- F. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
- G. 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.
- H. Water Heater, Heat-Tracing, and Anti-frost Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and anti-

frost heating cable. Bond conductor to heater units, piping, connected equipment, and components.

- I. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a separate equipment grounding conductor with supply branch-circuit conductors. Bond pole and foundation reinforcing steel to equipment ground conductor.
- 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. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and ground rods.
- F. 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.
- G. 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.

- H. 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. Equipotential Ground: Interconnect grounding electrodes to form one, electrically continuous, equipotential grounding electrode system. Grounding electrodes to be interconnected include:

1. Metal Underground Water Service Pipe.
2. Metal In-Ground Support Structure.
3. Concrete Encased Electrode.
4. Ground Rods.
5. Lightning Protection System.

- B. Metal Underground Water Service Pipes in direct contact with the earth for 10 feet or more: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to all metal water service entrances to building including fire protection water service entrance. Connect grounding conductors to metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

- C. Metal in-ground support structure in direct contact with the earth vertically for 10 feet (3.0 m) or more, with or without concrete encasement: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to at least one metal in-ground support structure, or as otherwise indicated. Connect grounding conductors to metal in-ground support structure by exothermic welds. Bond metal grounding conductor conduit or sleeve to conductor at each end.

- D. Concrete Encased Electrode: Fabricate according to NFPA 70, Paragraph 250-81(c):

1. Provide a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG. If concrete foundation is less than 20 feet long, coil excess conductor within the base of the foundation
2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts.
3. Extend grounding conductor below grade and connect to building grounding grid or to a grounding electrode external to concrete.

- E. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.

1. Verify that final backfill and compaction has been complete before driving ground rods.
2. Drive ground rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
3. Interconnect ground rods with grounding electrode conductors. Use exothermic welds or non-reversing compression-type connectors, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.

- F. Concrete Encased Electrode: Fabricate according to NFPA 70, Paragraph 250-81(c):
 - 1. Provide a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG. If concrete foundation is less than 20 feet long, coil excess conductor within the base of the foundation.
 - 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts.
 - 3. Extend grounding conductor below grade and connect to building grounding grid or to a grounding electrode external to concrete.
- G. Common Ground Bonding with Lightning Protection System: Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor. Install in conduit where routed above grade.
- H. 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.
- I. 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.
- J. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.
- K. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.
- L. 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.
- M. Separately Derived AC Power Systems: Ground separately-derived ac power system neutrals including distribution transformers to grounding electrodes per NFPA 70.
- N. Packaged Engine Generator: Separately ground the packaged engine generator neutral to grounding electrodes per NFPA 70.
- O. Install one test well for each service at the ground rod electrically closest to the service entrance. Set top of well flush with finished grade or floor.
- P. Grounding Bus:
 - 1. Install grounding bus in the locations listed below and elsewhere as indicated:
 - a. Electrical equipment rooms.
 - b. Telephone equipment rooms.
 - c. Rooms housing service equipment.

2. Use insulated spacer; space 2 inch from wall and support from wall 12 inches above finished floor, unless otherwise indicated.
- Q. 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.
- R. Bond together metal building elements not attached to grounded structure; bond to ground.
- S. Provide a flexible braid bonding jumper at each set of columns at expansion joints.

3.4 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

- A. Manholes and Handholes: Install a driven ground rod close to wall, inside manhole, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide a No. 1/0 AWG conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- B. Pad-Mounted Transformers and Switches: Install two ground rods and counterpoise circling pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with transformers/substations by connecting them to underground cable and grounding electrodes. Use not less than a No. 2 AWG conductor for counterpoise and for taps to equipment ground pad. Bury counterpoise not less than 18 inches below grade and 6 inches from the foundation.

3.5 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. 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. TMGB and TGB installation: Use insulated spacer; space 2 inch from wall and support from wall 12 inches above finished floor, unless otherwise indicated.
- 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.

3.6 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, and at ground test wells.
 - 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. Perform ground-impedance measurements utilizing either the intersecting curves method or the slope method. (Ref. Nos. 40 and 41 in IEEE Std. 81).
 - e. Equipment Grounds: Utilize two-point method of IEEE 81. Measure between equipment ground being testing and known low-impedance grounding electrode or system.
 - 3. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
 - a. Equipment Rated 500 kVA and Less: 10 ohms.
 - b. Equipment Rated 500 to 1000 kVA: 5 ohms.
 - c. Equipment Rated More Than 1000 kVA: 3 ohms.
 - d. Substations and Pad-Mounted Switching Equipment: 5 ohms.
 - e. Manhole Grounds: 10 ohms.

- f. The telecommunications grounding system shall have a maximum resistance of 1 ohm as measured from the TMGB ground to earth ground.
4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

3.7 GRADING AND PLANTING

- A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Division 2 Section "Landscaping." Maintain restored surfaces. Restore disturbed paving as indicated.

END OF SECTION 260526

SECTION 260529 - 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.
 - 2. Construction requirements for concrete bases.
- B. Related Sections include the following:
 - 1. Division 26 Section "Vibration and Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. 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 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.
 - 2. Nonmetallic slotted support systems.
 - 3. Roof mounted supports

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit; 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. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- diameter holes at a maximum of 8 inches o.c., in at least 1 surface.
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. Fabco Plastics Wholesale Limited.
 - d. Seasafe, Inc.
 2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
 3. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
 4. Rated Strength: Selected to suit applicable load criteria.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- 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, 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.
 - 1. Secure raceways and cables to these supports with:
 - a. Two-bolt conduit clamps
 - b. Single-bolt conduit clamps
 - c. Single-bolt conduit clamps using spring friction action for retention in support channel.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 - 6. To Steel:
 - 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.

7. To Light Steel: Sheet metal screws.
 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel support systems attached to substrate.
- E. Slotted support systems applications:
1. Indoor dry and damp Locations: Painted Steel
 2. Outdoors and interior wet locations: Galvanized Steel
- F. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.
- G. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.
- 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 CONCRETE BASES

- A. Provide concrete bases for all floor mounted electrical equipment.
- B. Provide concrete bases for all exterior, grade level electrical equipment, and where indicated.
- C. Base/Pad Construction:
 - 1. Construct per manufacturer's recommendations for particular equipment, including suggested piers and dowel rods.
 - 2. Interior concrete bases shall have a minimum depth of 4" unless other indicated or recommended by the manufacturer.
 - 3. Exterior concrete bases shall have a minimum depth of 8" unless other indicated or recommended by the manufacturer.
 - 4. Construct concrete bases for primary and secondary power distribution equipment per requirements of the electrical utility, where submitted for its review.
- D. Anchor equipment to base per both supports and equipment manufacturer's instructions.
- E. Coordinate conduit openings and sleeve locations in base with requirements of equipment to be supported.
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of the base.
 - 2. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.

3.6 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.

3.7 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 Section "High-Performance Coatings" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

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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 26 Section, "Underground Ducts and Raceways for Electrical Systems" for exterior duct banks, manholes and underground utility construction.

2. Division 07 Section, "Penetration Firestopping" for firestopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
3. Division 26 Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings, and for access floor boxes and service poles.
4. Division 26 "Hangers and Supports for Electrical Systems" for concrete bases.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. LFMC: Liquidtight flexible metal conduit.
- D. LFNC: Liquidtight flexible nonmetallic conduit.
- E. RNC: Rigid nonmetallic conduit.
- F. PVC: Polyvinyl Chloride.
- G. HDPE: High Density Polyethylene.

1.4 ACTION 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.
- C. All work in natatoriums, pool areas and fountain structures shall be in accordance with N.E.C. article 680, "Swimming Pools, Fountains, and Similar Installations."

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. Aluminum Rigid Conduit: ANSI C80.5.
- D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
1. Comply with NEMA RN 1.
 2. Coating Thickness: 0.040 inch, minimum.
- E. EMT: ANSI C80.3.
- F. FMC: Aluminum.
- G. LFMC: Flexible steel conduit with PVC jacket.
- H. 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. Fittings for EMT: Steel, compression type.
 2. 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. Spiralduct, Inc./AFC Cable Systems, Inc.
 16. Thomas & Betts Corporation.
- B. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.
- C. RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.
- D. LFNC: UL 1660.
- E. HDPE: UL 651, ASTM D 3350, ASTM D 1248 Schedule 40.

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 unless otherwise noted.
- 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: Hinged type.
- F. Finish: Manufacturer's standard enamel finish.

2.5 NONMETALLIC WIREWAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hoffman.
 - 2. Lamson & Sessions; Carlon Electrical Products.
- B. Description: Fiberglass polyester, extruded and fabricated to size and shape indicated, with no holes or knockouts. Cover is gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections are flanged, with stainless-steel screws and oil-resistant gaskets.
- C. Description: PVC plastic, extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections with plastic fasteners.
- D. 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.
- E. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

2.6 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.

2.7 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. Floor Boxes: Nonmetallic, nonadjustable, round.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

- G. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover. Shall be used in areas exposed to water.
- H. 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.
- I. 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.

2.8 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. Description: Comply with ANSI/SCTE 77.
 - 1. Color of Frame and Cover: Green.
 - 2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
 - 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
 - 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - 5. Cover Legend: Molded lettering, "ELECTRIC", "COMMUNICATIONS" or as indicated for each system service.
 - 6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 - 7. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell: Quazite
 - b. Armorcast Products Company.
 - c. Carson Industries LLC.
 - d. CDR Systems Corporation.
 - e. NewBasis.
 - f. Christy Concrete Products.

2.9 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."

2.10 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: Carbon steel. Include two for each sealing element.
 - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.11 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.

2.12 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 - 1. Tests of materials shall be performed by a independent testing agency.
 - 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 - 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. 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 4X Stainless Steel.
- C. Boxes, Enclosures, and Handholes:
 - 1. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Non-deliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
 - 2. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Non-deliberate Loading by Vehicles: Polymer-concrete units, SCTE 77, Tier 8 structural load rating.
- D. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4X, stainless steel in damp or wet locations.
- E. Minimum Raceway Size: 3/4-inch trade size.
- F. 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 compression, steel fittings. Comply with NEMA FB 2.10.
 - 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- G. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- H. Do not install aluminum conduits in contact with concrete.
- I. Install surface raceways only where indicated on Drawings.
- J. 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. Provide pull string and 25% spare capacity in every branch circuit conduit.
- V. 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.
- W. 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.
- X. 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.
- Y. 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.
- Z. 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.
- AA. 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.
- BB. 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.
- CC. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- DD. Locate boxes so that cover or plate will not span different building finishes.
- EE. 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.

- FF. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- GG. Set floor boxes level and flush with finished floor surface. Trim non-metallic boxes after installation to fit flush with finished floor surface.
- HH. Install hinged-cover enclosures and cabinets plumb. Support at each corner.
- II. Do not route feeders across roof unless approved in writing by Engineer.
- JJ. 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.
- KK. Ferrous metal conduit in natatorium/pool environments shall use compression or threaded fittings. Conduit, fittings, boxes, and supports shall be treated with corrosion resistant paint specified in Division 9.
- LL. Route conduits in finished areas with exposed ceilings at underside of structural deck or as high as possible.

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. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- J. 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.

- K. 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."
- L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
- M. 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.
- N. 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 260533

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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 steel cable trays and accessories for telecommunications cable.
- B. Related Sections include the following:
 - 1. Division 7 Section under "Through Penetration Firestop Materials" for firestopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
 - 2. Division 27 Section "Communications Equipment Room Fittings."

1.3 ACTION SUBMITTALS

- A. Product Data: Include data indicating dimensions and finishes for each type of cable tray indicated.
- B. Shop Drawings: For each type of cable tray.
 - 1. Show fabrication and installation details of cable tray, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets,

hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.

2. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
3. Seismic-Restraint Details: Signed and sealed by a qualified professional engineer.
 - a. Design Calculations: Calculate requirements for selecting seismic restraints.
 - b. Detail fabrication, including anchorages and attachments to structure and to supported cable trays.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans and sections drawn to scale. Include scaled cable tray layout and relationships between components and adjacent structural and mechanical elements. Show the following:
 1. Vertical and horizontal offsets and transitions.
 2. Clearances for access above and to side of cable trays.
 3. Vertical elevation of cable trays above floor or bottom of ceiling structure.
- B. Field Quality Control Test Reports: Written reports for grounding of cable tray as specified in Part 3.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain cable tray components through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NEMA VE 1, "Metal Cable Tray Systems," if cable tray types specified are defined in the standard.
- D. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate layout and installation of cable trays 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. [B-Line Systems, Inc.](#)
2. [Chalfant Cable Trays.](#)
3. [Mono-Systems, Inc.](#)
4. [MPHusky.](#)
5. [Wiremold.](#)
6. Thomas & Betts.

2.2 MATERIALS AND FINISHES

- A. Cable Trays, Fittings, and Accessories: Steel, with the following finish:
1. Mill galvanized before fabrication, complying with ASTM A 653/A 653M, G90 coating.
 2. Hot-dip galvanized after fabrication, complying with ASTM A 123/A 123M, Class B2.
 3. PVC coating applied in a fluidized bed or by electrostatic spray.
 4. Epoxy-resin paint over paint manufacturer's recommended primer and corrosion-inhibiting treatment.
- B. Cable Trays, Fittings, and Accessories: Aluminum, complying with Aluminum Association's alloy 6063-T6 for rails, rungs, and cable trays, and alloy 5052-H32 or alloy 6061-T6 for fabricated parts.
- C. Cable Trays, Fittings, and Accessories: Stainless steel, Type 304.
- D. Protect steel hardware against corrosion by galvanizing according to ASTM B 633 or cadmium plating according to ASTM B 766.
- E. Fabricate cable tray products with rounded edges and smooth surfaces.
- F. Sizes and Configurations:
1. Type: wire basket.
 2. Material and Finish: Steel with epoxy-resin paint finish.
 3. Width: as indicated
 4. Cross-Rung Spacing: minimum 6" spacing
 5. Minimum Fitting Radius: minimum 6" radius
 6. Inside Depth: 3" depth
 7. Cover Type: None.
 8. NEMA Load/Span Class: 8B
9. Construction: As indicated on Drawings.

2.3 CABLE TRAY ACCESSORIES

- A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
- B. Covers: Solidtype of same materials and finishes as cable tray.
- C. Barrier Strips: Same materials and finishes as cable tray.
- D. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.4 WIRE BASKET SUPPORT SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. [B-Line Flex-Tray](#).
 2. [Cablofil - EZ Tray](#) - Wire-mesh.
 3. [P-W Industries, Inc.](#) - Wire mesh.
 4. Wiremold.
 5. Mono-Systems, Inc.
- B. Description: Continuous, welded steel wire mesh construction, 2" x 4" longitudinal and lateral spacing orientation respectively, width and load depth as indicated with mounting hardware to secure in place.
- C. Material: ASTM A510 high strength steel wires.
- D. Finish: electrostatic, powder-coat paint finish for tray. Exact color to be determined by Architect at time of shop drawing submittal.
- E. Inside Width: 12 inches, as indicated.
- F. Inside Depth: 3 inches.
- G. Inside Radius Fittings: 12 inches.
- H. Provide manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, inside radius fittings, can grounding straps. All splicing connectors shall be UL listed for bonding or #6 AWG copper bonding conductors shall be installed at all splices of separate cable tray sections.
- I. Wall brackets shall be Cablofil CRP Reinforced Bracket, or equivalent, sized as required to bear full width of cable tray.
- J. Provide lay-in lugs for grounding and bonding cable tray.
- K. Provide cable roller kit, Cablofil FAS Roller, or equivalent, including all mounting hardware.

2.5 SOURCE QUALITY CONTROL

- A. Perform design and production tests according to NEMA VE 1.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CABLE TRAY INSTALLATION

- A. Remove burrs and sharp edges from cable trays.
- B. Fasten cable tray supports securely to building structure as specified in Division 26 Section "Hangers and Supports for Electrical Systems," unless otherwise indicated.
 - 1. Locate and install supports according to NEMA VE 1.
- C. Make connections to equipment with flanged fittings fastened to cable tray and to equipment. Support cable tray independently of fittings. Do not carry weight of cable tray on equipment enclosure.
- D. Install expansion connectors where cable tray crosses building expansion joint and in cable tray runs that exceed 90 feet. Space connectors and set gaps according to NEMA VE 1.
- E. Make changes in direction and elevation using standard fittings.
- F. Make cable tray connections using standard fittings.
- G. Locate cable tray above piping unless accessibility to cable tray is required or unless otherwise indicated.
- H. Seal penetrations through fire and smoke barriers according to Division 7 Section "Through-Penetration Firestop Systems."
- I. Sleeves for Future Cables: Install capped sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.
- J. Workspace: Install cable trays with sufficient space to permit access for installing cables.
- K. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5000, and 15 000 V.
- L. Install covers after installation of cable is completed.
- M. After installation of cable trays is completed, install warning signs in visible locations on or near cable trays.
- N. Support trays in accordance with Division 26 Section "Hangers and Supports for Electrical Systems". Provide supports at each connection point, at the end of each run, and at other points to maintain spacing between supports of 10 ft maximum, in general, and 6 feet maximum for wall-mounted tray in Telecom spaces.
- O. Spacing of supports shall be less than the span length of straight sections in all cases. Refer to NEMA VE2.
- P. Support ladder type tray from trapeze hangers unless noted as wall bracket mounted. Do not use center hung supports except for center spline supported cable tray. Use manufacturer standard wall brackets in lieu of field fabricated.

- Q. Ground and bond cable tray. Provide continuity between tray components. Use anti-oxidant compound to prepare aluminum contact surfaces before assembly. Bond tray to ground minimum every 100' or at each end, and at all locations required by NEMA VE2 with a minimum #1 AWG copper insulated ground wire.
- R. Cable tray shall be installed physically continuous for the complete run as shown on Drawings. Sprinkler piping, metal studs, ductwork, conduit, etc. shall not interfere with the wiring space provided by the cable tray or access to the cable tray.
- S. Coordinate with the installation of ductwork, sprinkler piping, etc. to provide cable tray access of at least 6" above the top of the tray run and at least 12" on each side of the tray.
- T. Where cable tray passes through fire rated walls, provide firestop pillows as specified for rating as required. Refer to Architectural Drawings for locations of rated walls.
- U. Where cable tray passes through floors or walls requiring smoke tight construction, provide 3M composite sheets and moldable putty to develop a smoke tight installation after all cables have been installed.
- V. Support cable tray independently of other systems and do not use cable tray or its supports for supporting other systems.
- W. Balance cable load for center spline supported cable tray evenly on each side to prevent twisting of tray.
- X. Provide lateral or transverse supports for cable tray to prevent swaying.

3.3 WIRE BASKET SUPPORT SYSTEMS INSTALLATION

- A. Install wire basket as indicated; in accordance with recognized industry practices (NEMA VE-2 2000), to ensure that the cable tray equipment complies with requirements of NEC, and applicable portions of NFPA 70B and NECA's "Standards of Installation" pertaining to general electrical installation practices.
- B. Coordinate wire basket with other electrical work as necessary to properly interface installation of wire basket runway with work of other trades.
- C. Provide sufficient space encompassing wire basket to permit access for installing and maintaining cables.

3.4 CONNECTIONS

- A. Ground cable trays according to manufacturer's written instructions.
- B. 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.

3.5 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:

1. After installing wire basket support systems and after electrical circuitry has been energized, test for compliance with requirements.
2. Perform the following electrical test and visual and mechanical inspections:
 - a. Visually inspect each cable tray joint and each ground connection for mechanical continuity.
 - b. Measure ground resistance of each system of cable tray from the most remote element to the point where connection is made to service disconnect enclosure grounding terminal. Record resistance in ohms.
3. Report results in writing.

3.6 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure wire basket support systems is without damage or deterioration at time of Substantial Completion.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION 260536

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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. Underground-line warning tape.
- 4. Warning labels and signs.
- 5. Instruction signs.
- 6. Equipment identification labels.
- 7. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: For each piece of electrical equipment and electrical system components to be index of nomenclature for electrical equipment and system

components used in identification signs and labels. Use same designations indicated on Drawings.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and ANSI C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.145.

1.5 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 UNDERGROUND-LINE WARNING TAPE

- A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.
 - 1. Not less than 6 inches wide by 4 mils thick.
 - 2. Compounded for permanent direct-burial service.
 - 3. Embedded continuous metallic strip or core.
 - 4. Printed legend shall indicate type of underground line.

2.4 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
- C. 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."

2.5 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
 - 1. Engraved legend with black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.
 - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.6 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.

2.7 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.

2.8 WIRING DEVICE IDENTIFICATION

- A. Description: Self adhesive label with black upper case letters on clear polyester label, font size 7.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Accessible Raceways and Metal-Clad Cables More Than 600 V: Identify with "DANGER-HIGH VOLTAGE" in black letters at least 2 inches high, with self-adhesive vinyl labels. Repeat legend at 10-foot maximum intervals.
- B. 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.
- C. 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.
- D. 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.
- E. 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.
- F. Branch-Circuit Conductor Identification: Mark junction box covers in indelible ink with the panel and breaker numbers of other circuits contained within.
- G. Conductor Identification: Locate at each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection or termination point.
- H. 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.
- I. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- J. 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.
- K. Instruction Signs:
 1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
 2. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.
- L. 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. Electrical switchgear and switchboards.
 - d. Transformers.
 - e. Electrical substations.
 - f. Emergency system boxes and enclosures.
 - g. Motor-control centers.

- h. Disconnect switches.
- i. Enclosed circuit breakers.
- j. Motor starters.
- k. Push-button stations.
- l. Power transfer equipment.
- m. Contactors.
- n. Remote-controlled switches, dimmer modules, and control devices.
- o. Battery inverter units.
- p. Battery racks.
- q. Power-generating units.
- r. Voice and data cable terminal equipment.
- s. Master clock and program equipment.
- t. Intercommunication and call system master and staff stations.
- u. Television/audio components, racks, and controls.
- v. Fire-alarm control panel and annunciators.
- w. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
- x. Monitoring and control equipment.
- y. Uninterruptible power supply equipment.
- z. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.
- aa. Breakers or switches at distribution panels.

- M. Wiring Device Identification Labels: On each faceplate install circuit designation label that is consistent with panelboard directories, and as-built plan drawings. Apply labels to receptacle faceplates centered below bottom outlet. Apply labels to toggle switch faceplates on backside.

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. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
- I. 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.
- J. 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
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- K. 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.
- L. Painted Identification: Prepare surface and apply paint according to Division 9 painting Sections.
- M. Degrease and clean surface to receive nameplates.
- N. Install nameplate and labels parallel to equipment lines.
- O. Secure nameplate to equipment front using screws.

- P. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.
- Q. Identify conduit using field painting where required.
- R. Paint red colored band on each fire alarm conduit and junction box.
- S. Paint bands 10 feet on center, and 4 inches minimum in width.

END OF SECTION 260553

SECTION 260573 - 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 C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
4. 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 ACTION SUBMITTALS

- 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 INFORMATIONAL SUBMITTALS

- 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 full size representation in PDF format and submitted with the study.
- D. The report shall be signed and sealed by the Professional Engineer supervising the study.
- E. The data files native to the software used to complete the study shall be provided to the owner.

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 and registered in the state where the project is located.
- 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 across the full range of over currents, from overload to the maximum available fault current, and for the full range of overcurrent protective device opening times associate with those fault currents.

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 480 and 208 volt panelboard, one arc flash label shall be provided.
 2. For each motor control center, one arc flash label shall be provided.
 3. For each low voltage switchboard, one arc flash label shall be provided.
 4. For each switchgear, one flash label shall be provided.
 5. For medium voltage switches one arc flash label shall be provided
- G. Labels shall be field installed by the contractor.

END OF SECTION 260573

SECTION 260923 - 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. Time controllers.
- 2. Outdoor and indoor photoelectric control.
- 3. Occupancy sensors.
- 4. Outdoor motion sensors.
- 5. Lighting contactors.

- 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.
3. Division 26 Section "Dimming Controls" for architectural dimming system equipment.
4. Division 26 Section "Lighting Control Systems" for programmable lighting systems.

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. NEMA ICS 2: Industrial Control and Systems Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC Part 8: Disconnect Devices for Use in Industrial Control Equipment.
- D. NFPA 70: National Electrical Code.
- E. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.
- F. UL 486B: Wire Connectors for Use with Aluminum Conductors.
- G. UL 773: Plug-in, Locking Photocontrols for Use with Area Lighting.
- H. UL 773A: Nonindustrial Photoelectric Switches for Lighting Control.
- I. UL 917: Clock Operated Switches.
- J. UL 1449: Surge Protective Devices.
- K. UL 1598: Luminaires.
- L. 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 ACTION 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.

1.6 INFORMATIONAL SUBMITTALS

- A. Field quality-control test reports.

1.7 CLOSEOUT SUBMITTALS

- A. 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.

1.8 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.

1.9 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.

1.10 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.

2.2 TIME CONTROLLERS

A. Manufacturers:

1. Intermatic, Inc.
2. TORK.

B. General

1. Provide NEMA Type 1-general purpose steel enclosure with corrosion-resistant primer and baked enamel finish in manufacturer's standard color.
2. Provide enclosure suitable for surface mounting with hinged front; padlock hasp; and side, bottom, and back knockouts for conduit connections.
3. Provide heavy-duty pressure terminals suitable for wire sizes up to no. 8 AWG.

C. Digital Time Controller: Electronic, solid-state programmable units with alphanumeric display complying with UL 917.

1. Contact Configuration: SPDT.
2. Contact Rating Normally Open: (20-A inductive or resistive, 120-277-V ac, 20-A ballast load, 120-277 V ac.) (10-A inductive or resistive, 120-277-V ac, 10-A ballast load, 120 277 V ac.)
3. Contact Rating Normally Closed: 10-A inductive or resistive, 120-277-V ac, 10-A ballast load, 120-277 V ac.
4. Input Voltage:120 volts.
5. Programs: 2-channels.
 - a. For each channel, 7 day or full year load control, minimum 1,000 on/off operations with one-minute programming resolution; minimum 99 holiday event scheduling; automatic adjustment for daylight savings (with disable); automatic leap year compensation; manual override ON and OFF to the next scheduled event; LCD display.
6. Circuitry: Allow connection of a photoelectric relay as substitute for on and off function of a program on selected channels.
7. Astronomical Time: Provide astronomic feature adjustable from 10° to 60° Northern and Southern latitudes with 1-99 minute adjustable offset from sunrise to sunset for All channels.
8. Battery Backup: Field replaceable lithium battery with minimum 8 year life for schedules and time clock.

2.3 OUTDOOR PHOTOELECTRIC CONTROL

A. Manufacturers:

1. Intermatic, Inc.

2. Square D.
3. TORK.

B. General

1. Provide fully-gasketed, weathertight enclosure constructed of die cast zinc, with one-half inch conduit nipple for mounting purposes, and with positioning lug to permit full 360-degree adjustable orientation of photocell.
2. Provide hermetically-sealed, one-inch-diameter, cadmium sulphide photoelectric cell with manual, light level selector.
3. Provide photoelectric control suitable for an operating temperature range of minus 40 degrees F to plus 140 degrees F.

C. Description: Solid state, with DPST dry contacts rated for 1800 VA to operate connected load, relay, or contactor coils; and complying with UL 773.

1. Light-Level Monitoring Range: 1.5 to 10 footcandle, with an adjustment for turn-on and turn-off levels within that range.
2. Time Delay: 15-second minimum, to prevent false operation.
3. Lightning Arrester: Air-gap type.
4. Mounting: Twist lock complying with IEEE C136.10, with base and stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the North sky exposure.
5. Provide hermetically-sealed, one inch diameter, cadmium sulphide photoelectric cell with manual, 2 to 50 footcandle, light level selector.
6. Provide photoelectric control suitable for an operating temperature range of minus 30 degrees F to plus 140 degrees F.

2.4 INDOOR PHOTOELECTRIC CONTROL

A. Manufacturers:

1. Wattstopper LS-101.
2. Sensorswitch CM-PC.

B. Photoelectric Sensor: Solid-state, light-level sensor unit utilizing an internal photoconductive cell to detect changes in lighting levels and capable of controlling any lighting source.

1. Housing: White, thermoplastic, tamper resistant, ceiling mount.
2. Sensor shall operate on 24V DC power through a control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.
3. Light-Level Monitoring Range: 50 to 1000 footcandle, with an adjustment for turn-on and turn-off levels within that range.
4. Deadband: Adjustable range of 10 to 300%.
5. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with deadband adjustment.
6. Indicator: Two LEDs to indicate the beginning of on and off cycles.
7. Manual override function.
8. Provide indoor photoelectric switches and control units from single manufacturer.
9. Provide indoor photoelectric switches from same manufacturer as occupancy sensors.
10. Provide all control units and relays required to interface with occupancy sensors as required.

C. Indoor Photoelectric 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 indoor photoelectric sensor, control lighting loads and provide a minimum of one auxiliary contact.
 - b. Sensor control units shall mount external to 4" sq junction box in the ceiling space. Wiring between control unit and photoelectric switch 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 sensor, provided all required contacts are provided.
 - f. Maximum of 3 sensors per power pack. Verify exact quantities required with manufacturer.

2.5 OCCUPANCY SENSORS

A. 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.

B. 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: finish as selected by architect, 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.
- C. 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.
- D. 110° Wall Mounted Dual Technology Occupancy Sensor
1. Manufacturers:
 - a. Perfect Sense DTC.
 - b. Wattstopper DT-200
 - c. Hubbell Building Automation "LO-DT" Series.

- d. Sensorswitch WV-PDT-R/WV-BR.
 - e. Philips LRM2265.
 - f. Leviton OSW12-MOW.
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.
- E. 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-UOW.
2. Description: Ceiling mounted, 360° coverage, ultrasonic or microphonics sensing occupancy sensor.
- a. Housing: White, thermoplastic, tamper resistant.
 - b. 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.
- F. 360° Ceiling Mounted Passive Infrared Occupancy Sensor.
1. Manufacturers:
- a. Perfect Sense CPS.
 - b. Wattstopper CI-200.
 - c. Hubbell Building Automation OMNI-IR.
 - d. Greengate OMC-P-04500-R.
 - e. Sensorswitch CM-9.
 - f. Philips LRM2250.
 - g. 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.

G. 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.

2.6 OUTDOOR MOTION SENSORS (PIR)

A. Outdoor Motion Sensors (PIR).

1. Manufacturers:
 - a. Provide motion sensor by same manufacturer as light fixture.
2. Description: Suitable for operation in ambient temperatures ranging from minus 40 deg F to 130 deg F, UL 773A rated as raintight.
 - a. Operation: Turn lights on when sensing infrared energy changes between background and moving body in area of coverage; with an adjustable time delay for turning lights off.
 - b. Housing: Grey, thermoplastic, tamper resistant, raintight.
 - c. Sensor Output:
 - 1) Suitable for switching 300 W of tungsten load at 120- or 277-V ac.
 - 2) Sensor shall be compatible with all electronic ballasts and PL lamp ballast systems.
 - d. Lampholders: Polycarbonate, UL 1598 rated for wet locations and suitable for use with PAR 20 or PAR 38 lamps, 150 watts maximum per lamp.

- e. Sensor Output: 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. Mounting: Sensor: Suitable for mounting in any position on a standard outdoor junction box.
- g. Adjustable Time Delay. Adjustable from 12 seconds to 16 minutes.
- h. Automatic Light-Level Sensor: Adjustable from 0.5 to 200 footcandle; keeps lighting off during daylight hours.
- i. Detection Coverage: Up to 35 feet, with a field of view of 180 degrees.
- j. Provide motion sensors and control units from single manufacturer.

B. Outdoor Motion 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 motion sensors, control lighting loads and provide a minimum of one auxiliary contact.
 - b. Motion sensor control units shall mount external to 4" sq junction box in the ceiling space. Wiring between control unit and motion 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 motion sensor, provided all required contacts are provided.
 - f. Maximum of 3 sensors per power pack. Verify exact quantities required with manufacturer.

2.7 LIGHTING CONTACTORS

A. Manufacturers:

1. Cutler-Hammer; Eaton Corporation.
2. Square D Co.
3. General Electric.
4. Siemens.
5. Square D Co; class 8903.

B. Contactor

1. Electrically-operated electrically-held mechanically-held unless otherwise indicated contactor open type contactor suitable for panelboard mounting, per NEMA ICS2, with 600 volt, 60 hertz three pole contacts.
2. Provide contacts to be 100 percent, continuously rated for all types of ballast and tungsten lighting and resistance loads without the need for in-rush current derating.
3. Provide NEMA type 1 enclosure unless otherwise indicated.
4. Provide NEMA type 1 hinged cover cabinet enclosure sized as required for contactors as indicated on drawings. Mount switches and indicating lights required on front of enclosure. Install terminal strips for connection of all external control wiring connections.

5. Provide bus terminal suitable for panelboard mounting.
6. Provide corrosion-resistant primer treatment with light gray baked acrylic enamel finish.
7. Provide the following control and indicating devices:
 - a. Auxiliary contacts: One field convertible.
 - b. Auxiliary relay to convert maintained-contact type control circuit to momentary-contact type control circuit necessary for contactor control.
 - c. Hand-off-auto selector switch, of the heavy-duty "oil-tight", maintained-contact type, mounted on the front cover with legend plate.
 - d. Green pilot light to indicate "power on" condition. Mount on front cover with legend plate.

PART 3 - EXECUTION

3.1 LIGHTING CONTACTOR INSTALLATION

- A. Install lighting contactors as indicated on plan. Install at accessible locations. Switch controls where provided shall be no higher than 54" or lower than 48".
- B. Demonstrate proper operation of all lighting control functions to the Owner and Engineer.

3.2 OUTDOOR PHOTOELECTRIC CONTROL INSTALLATION

- A. Mount photocell on roof or parapet to ½" GRS conduit, supported to building structure below. Coordinate roof penetration with roofing contractor.
- B. Install photoelectric control oriented in the northeast direction and not within any potential shadows.
- C. Adjust photocell sensitivity and delay to meet owner's requirements. Multiple adjustments may be required, as needed.

3.3 TIME CONTROLLER INSTALLATION

- A. Install time controller, near contactor control equipment or as indicated on plan. Install at accessible location.
- B. Program time controller as directed by the owner. Train owner in time clock programming.

3.4 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.

3.5 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.

3.6 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Electrical Identification."
- B. Label time switches and contactors with a unique designation.

3.7 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
 - 2. Operational Test: Verify 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.

3.8 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 260923

SECTION 260943 - 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. 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 ACTION 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. Submit qualifications of commissioning agent and draft functional test plans for review and approval.

1.5 INFORMATIONAL SUBMITTALS

- A. 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.

B. Field quality-control test reports and commissioning reports at project closeout.

1.6 CLOSEOUT SUBMITTALS

A. Software licenses and upgrades required by and installed for operation and programming of digital devices.

B. 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.

C. Warranty: Special warranty specified in this Section.

1.7 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.

1.8 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".

1.9 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.

1.10 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. Batteries for all sensors and switches: Quantity equal to 10% percent of each type and size, but no fewer than 3 of each type and size.

1.11 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.

1.12 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 - Cooper Lighting

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. Wireless Networked Control Zone Characteristics

1. All wireless networked devices paired, meshed or grouped together shall automatically follow the “out of box” default sequence of operations.
2. Wireless network communication shall support uniform and instant response such that all luminaires in a lighting control zone respond immediately and synchronously in response to a sensor or wall station signal.
3. To support the system architecture requirement for distributed intelligence, wireless network communication shall support communication of control signals from sensors and wall stations to networked luminaires and wireless load control devices, without requiring any communication, interpretation, or translation of information through a backbone device such as a wireless access point, communication bridge or gateway.
4. All wireless communication shall be encrypted using at least 128-bit Advanced Encryption Standard (AES).
5. The following types of wired networked control devices shall be provided for egress and/or emergency light fixtures:
 - a. 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 or interruption of power sensed via line voltage connections.

D. 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 sounds 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 WIRELESS NETWORKED DEVICES

A. Wireless Networked Sensor Interface

1. The device shall be capable of broadcasting the following manual wall control commands: on, off, and adjust dim level.

B. Wireless Networked Light Controllers (No Sensor)

1. The wireless light controller shall be capable of providing continuous dimming and on/off control of one commercial light fixture including fluorescent, HID, induction and LEDs.
2. An external antenna attached to the luminaire shall not be allowed.
 - a. Each wireless light controller shall provide measurement capability of the amperage, voltage, wattage, and watt-hours of its controlled lighting.

C. Wireless Networked Digital Sensors

1. In addition to providing Wireless Networked Light Controllers functionality, also provides:

- a. Integrated digital occupancy sensing and digital photocell sensor.
- b. Sensor shall connect directly to the wireless light controller and shall be suitable for embedding into the enclosure of a luminaire.
- c. Sensor shall have software-adjustable settings
- d. Photocell shall be suitable for closed and open loop applications.

D. Wireless Network Communication Bridge

1. A communication bridge device shall be provided that interfaces with the System Controller via Owner's LAN connection and interfaces with wireless network.
2. Device shall be capable of communicating with a group of a minimum of 250 wireless networked devices and luminaires, to reduce the amount of communication bridges required in the system.

2.7 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 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.

3.3 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.

3.4 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.

3.5 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.

3.6 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.

3.7 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.

3.8 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.

3.9 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.

3.10 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 260943

SECTION 262200 - DRY-TYPE TRANSFORMERS (600 V AND LESS)

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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 types of dry-type transformers rated 600 V and less, with capacities up to 750 kVA:
 - 1. Distribution transformers.
 - 2. Buck-boost transformers.
 - 3. Isolation transformers.
 - 4. Control and signal transformers.
- B. Related Section includes the following:
 - 1. Division 26 Section "Electrical General Requirements."
 - 2. Division 26 Section "Grounding and Bonding."
 - 3. Division 26 Section "Conductors and Cables."
 - 4. Division 26 Section "Raceways and Boxes."
 - 5. Division 26 "Hangers and Supports for Electrical Systems" for concrete bases.

1.3 REFERENCES

- A. ANSI/IEEE C57.12.9: Test Code for Dry-Type Distribution and Power Transformers
- B. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum)
- C. NEMA ST 1: Specialty Transformers
- D. NEMA ST 20: Dry Type Transformers for General Applications
- E. NEMA TP 1: Guide for Determining Energy Efficiency for Distribution Transformers
- F. NEMA TP 2: Standard Test Method for Measuring the Energy Consumption of Distribution Transformers
- G. NETA ATS: Acceptable Testing Specifications for Electrical Power Distribution Equipment and Systems
- H. NFPA 70: National Electrical Code
- I. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors
- J. UL 486B: Wire Connectors for Use with Aluminum Conductors
- K. UL 506: Specialty Transformers
- L. UL 1561: Dry-Type General Purpose and Power Transformers

1.4 ACTION SUBMITTALS

- A. Product Data Include rated nameplate data, capacities, weights, dimensions, utility or manufacturer's anchorage and base recommendations, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.
 - 1. Transformer Inrush: Provide time-current coordination curves demonstrating transformer inrush and ANSI damage curves with primary overcurrent device selections to clear inrush yet still protecting damage curve.
- B. Shop Drawings: Wiring and connection diagrams.

1.5 INFORMATIONAL SUBMITTALS

- A. Manufacturer Seismic Qualification Certification: Submit certification that transformer assembly and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems " Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Source quality-control test reports. Include loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.
 - C. Field quality control test reports
 - D. Output Settings Reports: Record of tap adjustments specified in Part 3.

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 IEEE C 57.12.91.
- C. Comply with NFPA 70.
- D. Energy-Efficient Transformers Rated 15 kVA and Larger: Certified as meeting 2016 efficiency levels when tested according to NEMA TP2.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.
- B. Store, protect, and handle products to site under provisions of Division 26 section "Electrical General Requirements."
- C. Deliver transformers individually wrapped for protection and mounted on shipping skids.
- D. Accept transformers on site. Inspect for damage.
- E. 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.
- F. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

1.8 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork shall meet load requirements. Requirements for concrete bases for electrical equipment are specified in Division 26 "Hangers and Supports for Electrical Systems."

- B. Coordinate installation of wall-mounting and structure-hanging supports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. [Acme.](#)
 - 2. Eaton
 - 3. ABB
 - 4. Siemens Industries, Inc.
 - 5. [Square D/Groupe Schneider NA.](#)
 - 6. [Sola/Hevi-Duty Electric.](#)

2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and tested, air-cooled units for 60 Hz service.
- B. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- C. Transformers Rated 15 kVA and Larger:
 - 1. Comply with 10 CFR 431 (DOE 2016) efficiency levels.
 - 2. Marked as compliant with DOE 2016 efficiency levels by qualified electrical testing laboratory recognized by authorities having jurisdiction.
- D. Shipping Restraints: Paint or otherwise color-code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside transformer enclosure.

2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NEMA ST 20, and list and label as complying with UL 1561.
- B. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.
 - 1. One leg per phase.
 - 2. Grounded to enclosure.
- C. Coils: Continuous windings without splices, except for taps.
 - 1. Coil Material: Copper.
 - 2. Internal Coil Connections: Brazed or pressure type.
- D. Encapsulation: Transformers smaller than 30 kVA must have core and coils completely resin encapsulated.
- E. Enclosures: Ventilated

1. Core and coil must be encapsulated within resin compound to seal out moisture and air.
 2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.
 3. Vibration Isolation: Isolate core and coil from enclosure using vibration-absorbing mounts.
 4. Wiring Compartment: Sized for conduit entry and wiring installation.
 5. Environmental Protection:
 - a. Indoor: UL 50E, Type 2.
 - b. Outdoor: UL 50E, Type 3R.
 6. Finish Color: Gray weather-resistant enamel.
- F. Provide transformers that are internally braced to withstand seismic forces specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems".
- G. Taps for Transformers 3 kVA and Smaller: None.
- H. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.
- I. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
- J. Insulation Class, Smaller Than 30 kVA: 180 deg C, UL-component-recognized insulation system with maximum of 115 deg C rise above 40 deg C ambient temperature.
- K. Insulation Class, 30 kVA and Larger: 220 deg C, UL-component-recognized insulation system with maximum of 115 deg C rise above 40 deg C ambient temperature.
- L. Basic Impulse Level: 10 kV.
- M. Mounting: Suitable for mounting as indicated.
- N. Wall Brackets: Manufacturer's standard brackets.
- O. Grounding: Provide ground-bar kit or ground bar installed on inside of transformer enclosure.
- P. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.
- Q. K-Factor Rating: Transformers indicated to be K-factor rated must comply with UL 1561 requirements for non-sinusoidal load current-handling capability to degree defined by designated K-factor.
1. Unit may not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor, without exceeding indicated insulation class in 40 deg C maximum ambient and 24-hour average ambient of 30 deg C.
 2. Indicate value of K-factor on transformer nameplate.
 3. Unit must comply with requirements of DOE 2016 efficiency levels when tested in accordance with NEMA TP 2 with K-factor equal to one.

2.4 SHEILDED ISOLATION TRANSFORMERS

- A. Description: Factory-assembled and -tested, air cooled, dry-type, shielded isolation transformer rated for 60 Hz operation. Comply with NEMA ST 20, and list and label as complying with UL 1561.
- B. General: Comply with the requirements specified for Distribution Transformers.
- C. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.
 - 1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
 - 2. Include special terminal for grounding the shield.
 - 3. Shield Effectiveness:
 - a. Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.
 - b. Common-Mode Noise Attenuation: Minus 120 dBA minimum at 0.5 to 1.5 kHz; minus 65 dBA minimum at 1.5 to 100 kHz.
 - c. Normal-Mode Noise Attenuation: Minus 52 dBA minimum at 1.5 to 10 kHz.

2.5 BUCK-BOOST TRANSFORMERS

- A. Description: Factory-assembled and tested, self-cooled, two-winding dry type, rated for continuous duty and with wiring terminals suitable for connection as autotransformer and rated for 60 Hz operation. Transformers shall comply with NEMA ST 1 and shall be listed and labeled as complying with UL 506 or UL 1561.
- B. Provide transformers that are internally braced to withstand seismic forces specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- C. Sound rating: Comply with NEMA ST 20.
- D. Insulation class 185 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.
- E. Enclosure: Totally enclosed, non-ventilated, NEMA 250, Type 3R.
 - 1. Finish Color: Gray.
- F. Mounting: Wall.
- G. Wall Brackets: Manufacturer's standard brackets.
- H. Nameplate: Include transformer connection data.

2.6 CONTROL AND SIGNAL TRANSFORMERS

- A. Description: Factory-assembled and tested, self-cooled, two-winding dry type, rated for continuous duty, and 60 Hz operation, complying with NEMA ST 1, and listed and labeled as complying with UL 506.
- B. Ratings: Continuous duty. If rating is not indicated, provide at least 50 percent spare capacity above connected peak load.

2.7 SOURCE QUALITY CONTROL

- A. Factory Tests and Inspections: Provide the factory tests on the actual transformers provided or on similar units identical to those provided. Test and inspect assembled system, by, or under supervision of, qualified electrical testing laboratory recognized by authorities having jurisdiction, in accordance with IEEE C57.12.01 and IEEE C57.12.91 before delivering to site. Affix label with name and date of certification of system compliance on control units.
1. Resistance measurements of windings at rated voltage connections and at tap connections.
 2. Ratio tests at rated voltage connections and at tap connections.
 3. Phase relation and polarity tests at rated voltage connections.
 4. No load losses, and excitation current and rated voltage at rated voltage connections.
 5. Impedance and load losses at rated current and rated frequency at rated voltage connections.
 6. Applied and induced tensile tests.
 7. Regulation and efficiency at rated load and voltage.
 8. Insulation-Resistance Tests:
 - a. Line-side to ground.
 - b. Load-side to ground.
 - c. Line-side to load-side.
 9. Temperature tests.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls and floors for suitable mounting conditions where transformers will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install Products in accordance with manufacturer's instructions.
- B. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.
 1. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.
 2. Brace wall-mounting transformers as specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

- C. Install floor mounted transformers on and anchor to concrete bases according to manufacturer's recommendations.
 - 1. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.
- D. Install floor mounted transformers on and anchor to concrete bases according to manufacturer's recommendations, seismic codes at Project, and requirements in Division 26 section "Vibration and Seismic Controls for Electrical Systems."
 - 1. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.
- E. Identification: Engraved metal or laminated-plastic nameplate mounted with corrosion resistant screws. Provide nameplate according to Division 26 Section "Electrical Identification" indicating the following:
 - 1. Transformer designation (e.g. "T-1").
 - 2. Primary power characteristics (e.g. "480V, 3PH, 3W").
 - 3. Secondary power characteristics (e.g. "208Y/120V, 3PH, 4W").
 - 4. Power rating (e.g. "75 kVA").
 - 5. Power source (e.g. "Fed from DP-1).

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."
- C. Provide conduit according to Division 26 Section "Raceways and Boxes" for connections to transformer case. Make conduit connections to side panel of enclosure.
- D. 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.
- E. Check for damage and tighten connections prior to energizing transformer.

3.4 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality control tests in accordance with Division 26 section "Electrical Testing" for transformers 75KVA and above:
 - 1. Visual and Mechanical Inspection
 - a. Inspect for physical damage, cracked insulators, tightness of connections, defective wiring and general mechanical and electrical conditions.
 - b. Verify proper core grounding.
 - c. Verify proper equipment grounding.
 - d. Compare equipment nameplate with single line diagram and report discrepancies.
 - 2. Electrical Tests

- a. Perform insulation resistance tests, winding-to-winding and windings-to-ground, utilizing a meg-ohmmeter with test voltage output in accordance with N.E.T.A. Acceptance Testing Specifications, Table 10.5. Test duration shall be for 10 minutes with resistance values tabulated at 30 seconds, 1 minute, and 10 minutes. Calculate Polarization index.
- b. Perform a turns ratio test between windings at every tap position. The final tap setting is to be set at the secondary system rated voltage at full load or as directed by the Architect/Engineer.
- c. Verify proper secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.
- d. Test mounting and anchorage devices according to requirements in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

3. Test Values

- a. Perform insulation resistance tests in accordance with N.E.T.A. Acceptance Testing Specifications, Table 10.5. Results to be temperature corrected in accordance with Table 10.14.
- b. The polarization index should be above 1.2 unless an extremely high value is obtained initially, such that when doubled will not yield a meaningful value.
- c. Turns ratio test results shall not deviate more than one half percent (0.5%) from either the adjacent coils or the calculated ratio.

3.5 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 5 percent. Submit recording and tap settings as test results.
- B. Adjust buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.
- C. Output Settings Report: Prepare a written report that records output voltages and tap settings.

END OF SECTION 262200

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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 service and distribution switchboards rated 600 V and less.
- B. Related Sections:
 - 1. Division 26 “Hangers and Supports for Electrical Systems” for concrete bases.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.

- C. RFI: Radio-frequency interference.
- D. RMS: Root mean square.
- E. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions, utility or manufacturer's anchorage and base recommendations, 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 switchboard and related equipment.
 - 1. 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. 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 switchboards and overcurrent protective devices.
 - d. Descriptive documentation of optional barriers specified for electrical insulation and isolation if specified.
 - e. Utility company's metering provisions with indication of approval by utility company if called out.
 - f. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 2. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. 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.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1, include the following:

1. Routine maintenance requirements for switchboards and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
3. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain switchboards through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NEMA PB 2, "Dead-front Distribution Switchboards."
- D. Comply with NFPA 70.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver in sections or lengths that can be moved past obstructions in delivery path.
- B. Store indoors in clean dry space with uniform temperature to prevent condensation. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- C. Handle switchboards according to NEMA PB 2.1 and NECA 400.

1.9 PROJECT CONDITIONS

- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
- B. 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.
- 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 Owner's representative no fewer than seven days in advance of proposed interruption of electric service.
 2. Indicate method of providing temporary electric service.
 3. Do not proceed with interruption of electric service without written permission from the Owner's representative

1.10 COORDINATION

- A. Coordinate layout and installation of switchboards 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.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork shall meet load requirements. Requirements for concrete bases for electrical equipment are specified in Division 26 "Hangers and Supports for Electrical Systems."

1.11 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. Potential Transformer Fuses: 2 of each size and type.
 - 2. Control-Power Fuses: 2 of each size and type.
 - 3. Fuses for Fused Switches: Equal to 10 percent of amount installed for each size and type, but no fewer than 3 of each size and type.
 - 4. Indicating Lights: 3 of each size and type.

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 MANUFACTURED UNITS

- A. Manufacturers:
 - 1. [Eaton](#).
 - 2. ABB
 - 3. Siemens Industries, Inc.
 - 4. [Square D by Schneider Electric](#).
- B. Front-Connected, Front-Accessible Switchboard:
 - 1. Main devices over 1200A: Fixed, individually mounted.
 - 2. Main devices below 1200A, panel mounted.
 - 3. Branch Devices: panel-mounted.
 - 4. Sections rear aligned.
- C. Nominal System Voltage: As noted on Drawings.
- D. Main-Bus Continuous: As noted on Drawings.

- E. Fabricate and test switchboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- F. Enclosure: Steel, NEMA 250, Type 1 not over 102 in height.
- G. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- H. Outdoor Enclosures: Type 3R.
 - 1. Finish: Factory-applied finish in manufacturer's custom color; undersurfaces treated with corrosion-resistant undercoating.
- I. Insulation and isolation for main and vertical buses of feeder sections.
- J. Utility Metering Compartment: Fabricated compartment and section complying with utility company's requirements. If separate vertical section is required for utility metering, match and align with basic switchboard.
- K. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
- L. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
- M. Buses and Connections: Three phase, four wire, unless otherwise indicated.
 - 1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity with feeder circuit-breaker line connections.
 - 2. Phase- and Neutral-Bus Material: Tin-plated, high-strength, electrical-grade aluminum alloy with copper- or tin-plated, aluminum circuit-breaker line connections.
 - a. If bus is aluminum, use copper- or tin-plated aluminum for circuit-breaker line connections.
 - b. If bus is copper, use copper for feeder circuit-breaker line connections.
 - 3. Ground Bus: 1/4-by-2-inch- minimum-size, hard-drawn copper of 98 percent conductivity, equipped with pressure connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
 - 4. Contact Surfaces of Buses: Silver plated.
 - 5. Main Phase Buses, Neutral Buses, and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
 - 6. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.
 - 7. Neutral Buses: 100 percent of the ampacity of phase buses, unless otherwise indicated, equipped with pressure connectors for outgoing circuit neutral cables. Bus extensions for busway feeder neutral bus are braced.
- N. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

2.3 SURGE PROTECTIVE DEVICES

- A. Direct bus connected type as specified in Division 26 Section "Surge Protective Devices."
- B. Provide Surge Protective Device for switchboards that are part of the emergency distribution system.
- C. Provide Surge Protective Device for switchboards elsewhere where indicated on the drawings.

2.4 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. Electronic trip-unit circuit breakers shall have RMS sensing, field-replaceable rating plug, and the following field-adjustable settings with restricted access cover:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I²t response.
 - 3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 - 4. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.
- 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 material.
 - 2. Application Listing: Appropriate for application; 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. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
 - 7. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
- C. Enclosed, Insulated-Case Circuit Breaker: Fully rated, encased-power circuit breaker with interrupting capacity rating to meet available fault current.

1. Fixed circuit-breaker mounting.
 2. Two-step, stored-energy closing.
 3. Microprocessor-based trip units with interchangeable rating plug, LED trip indicators, and the following field-adjustable settings with restricted access cover.
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments with I^2t response.
 - d. Ground-fault pickup level, time delay, and I^2t response.
 4. Remote trip indication and control.
 5. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control"
 6. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
- D. Fused Switches rated 800A and below: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
- E. Fuses are specified in Division 26 Section "Fuses."
- F. Circuit breaker selection for transformer primary protection:
1. Circuit Breaker Selection for Transformer Primary Protection: Provide circuit breakers with time-current characteristics to clear transformer inrush currents while still providing protection for the ANSI through-fault protection curve. Provide circuit breakers with adjustable magnetic trip or electronic trip units as necessary to provide time-current curve shaping to achieve long time trip indicated on drawings, inrush coordination and damage protection.
- G. Circuit breakers rated 1200A and above:
1. Circuit breakers rated 1200A and above, not specified elsewhere with zone selective interlocking, shall be provided with an energy reducing maintenance switch with local status indicator.
 2. The switch and status indicators shall be remote from the circuit breaker, located at the entrance to the electrical room where the circuit breaker is installed.

2.5 INSTRUMENTATION

- A. Instrument Transformers: NEMA EI 21.1, IEEE C57.13, and the following:
1. Potential Transformers: Secondary voltage rating of 120 V and NEMA accuracy class of 0.3 with burdens of W, X, and Y.
 2. Current Transformers: Ratios shall be as indicated with accuracy class and burden suitable for connected relays, meters, and instruments.
 3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kV.
- B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:

- a. Phase Currents, Each Phase: Plus or minus 1 percent.
 - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
 - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
 - d. Megawatts: Plus or minus 2 percent.
 - e. Megavars: Plus or minus 2 percent.
 - f. Power Factor: Plus or minus 2 percent.
 - g. Frequency: Plus or minus 0.5 percent.
 - h. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from 5 to 60 minutes.
 - i. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent. Accumulated values unaffected by power outages up to 72 hours.
2. Mounting: Display and control unit flush or semi-flush mounted in instrument compartment door.

2.6 CONTROL POWER

- A. Control Circuits: 120 V, supplied through secondary disconnecting devices from control-power transformer.
- B. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
- C. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.7 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 locking all overcurrent devices in switchboard. Provisions shall remain in place whether or not lock is installed.
- C. Furnish portable test set to test functions of solid-state trip devices without removal from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.
- D. Spare-Fuse Cabinet: Suitably identified, wall-mounted, lockable, compartmented steel box or cabinet. Arrange for wall mounting.

PART 3 - EXECUTION

3.1 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

3.2 EXAMINATION

- A. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Install switchboards and accessories according to NEMA PB 2.1 and NECA 40.
- B. Install switchboards and anchor to concrete bases according to utility or manufacturer's recommendations, seismic codes at Project, and requirements in Division 26 Section "Hangers and Supports for Electrical Systems."
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
- D. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
- E. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.
 - 1. Set field-adjustable switches and circuit-breaker trip ranges.
- F. Install spare-fuse cabinet.

3.4 ADJUSTING

- A. Adjust circuit breaker trip and time delay settings to values as instructed by the Engineer.

3.5 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Electrical Identification."
- B. Switchboard Nameplates: Label each switchboard compartment with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.6 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each switchboard 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, Sections 7.1, 7.5, 7.6, 7.9, 7.10, 7.11, and 7.14 as appropriate. Certify compliance with test parameters.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Instruments, Equipment, and Reports:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 2) Prepare a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.7 CLEANING

- A. On completion of installation, inspect interior and exterior of switchboards. 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.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories.

END OF SECTION 262413

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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. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.
 - 3. Isolation power 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 ACTION 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.

1.5 CLOSEOUT SUBMITTALS

- A. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- B. 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.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- C. Comply with NEMA PB 1.
- D. Comply with NFPA 70.

1.7 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 Owner's representative no fewer than seven days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without written permission from Owner's representative.

1.8 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.

1.9 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.
 - b. ABB.
 - c. [Siemens Industries, Inc.](#)
 - d. Square D by Schneider Electric

2.2 MANUFACTURED UNITS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Enclosures: Mounting as noted on panel schedules. NEMA PB 1, Type 1.
 1. Rated for environmental conditions at installed location.
 - a. Outdoor Locations: NEMA 250, Type 3R.
 - b. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 2. Cabinet Front: Flush or surface cabinet as noted on the Drawings.
 - a. Eaton LTDD (Piano hinge trim)
 - b. ABB - 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: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Same finish as panels and trim.
 4. Directory Card: With transparent protective cover, mounted in metal frame, inside panelboard door.
- C. 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.
 3. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box as called out on panel schedules.
- D. Conductor Connectors: Suitable for use with conductor material.
 1. Main and Neutral Lugs: Mechanical type.
 2. Ground Lugs and Bus Configured Terminators: Compression type.
 3. Feed-Through Lugs: Mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 4. Double Lugs: Mechanical type mounted at location of main incoming lugs.
- E. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.

- F. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.
- G. 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 DISTRIBUTION PANELBOARDS

- A. Main bus bars, neutral and ground, shall be copper and sized in accordance with U.L. Standards to limit temperature rise on any current carrying part to the maximums as indicated in UL67.
- B. Doors: Secured with vault-type latch with tumbler lock; keyed alike. Omit for fused-switch panelboards.
- C. Main Overcurrent Protective Devices: Circuit breaker.
- D. Branch Overcurrent Protective Devices:
 - 1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
 - 2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.5 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.

2.6 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. Electronic trip-unit circuit breakers shall have RMS sensing; field-replaceable rating plug; and with the following field-adjustable settings with restricted access cover:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I²t response.
 3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 4. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
 5. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
 6. 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.
- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
- D. Fuses are specified in Division 26 Section "Fuses."
- E. Circuit Breaker Selection for Transformer Primary Protection:

1. Circuit Breaker Selection for Transformer Primary Protection: Provide circuit breakers with time-current characteristics to clear transformer inrush currents while still providing protection for the ANSI through-fault protection curve. Provide circuit breakers with adjustable magnetic trip or electronic trip units as necessary to provide time-current curve shaping to achieve long time trip indicated on drawings, inrush coordination and damage protection.

2.7 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 Owner's representative.
- 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 262416

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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 equipment for utility company's electricity metering and electricity metering by Owner.

1.3 ACTION SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes. Describe electrical characteristics, features, and operating sequences, both automatic and manual. Include the following:
 - 1. Electricity-metering equipment.
- B. Shop Drawings for Electricity-Metering Equipment:
 - 1. Dimensioned plans and sections or elevation layouts.
 - 2. Wiring Diagrams: Power, signal, and control wiring specific to this Project. Identify terminals and wiring designations and color codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features.
 - 3. Mounting and anchoring devices recommended by manufacturer to resist seismic forces specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer Seismic Qualification Certification for Electricity-Metering Equipment: Submit certification that equipment components and their mounting and anchorage provisions have been designed to remain in place without separation of any parts or loosening of factory-made connections when subjected to the seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
 - 1. Basis for Certification: Indicate whether certification is based on actual test of assembled components or on calculations.
 - 2. Detailed description of equipment mounting and anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For electricity-metering equipment 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 testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, store, and handle modular meter center as specified in NECA 400.

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 Owner's representative no fewer than two days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without written permission from Owner's representative.

1.9 COORDINATION

- A. Electrical Service Connections: Coordinate with utility companies and components they furnish as follows:
 - 1. Comply with requirements of utilities providing electrical power and communication services.
 - 2. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

PART 2 - PRODUCTS

2.1 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

- A. Current-Transformer Cabinets: Comply with requirements of electrical power utility company.
- B. Meter Sockets: Comply with requirements of electrical power utility company.

2.2 EQUIPMENT FOR ELECTRICITY METERING BY OWNER

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - 1. E-MON L.P.
 - 2. National Meter Industries, Inc.
 - 3. Osaki Meter Sales, Inc.
 - 4. Power Measurement.
 - 5. Square D; Schneider Electric.
- B. Kilowatt-Hour/Demand Meter: Electronic three-phase meters, measuring electricity use and demand.
 - 1. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated for its application.
 - 2. Display: Digital liquid crystal, indicating accumulative kilowatt hours, current time and date, current demand, historic peak demand, and time and date of historic peak demand.
 - 3. Programmable Contact Module: Unit shall have push-button switches and a display for setting the demand level at which an integral set of Form C contacts shall be operated to initiate indicated action.
 - 4. Enclosure: NEMA 250, Type 1 minimum, with hasp for padlocking or sealing.
 - 5. Identification: Comply with Division 26 Section "Electrical Identification."
 - 6. Memory Backup: Self-contained to maintain memory throughout power outages of 72 hours, minimum.
 - 7. Sensors: Current-sensing type, with current or voltage output, selected for optimum range and accuracy for ratings of circuits indicated for this application.
 - a. Type: solid core.
 - 8. Meter Accuracy: Nationally recognized testing laboratory certified to comply with ANSI C12.1.
 - 9. Current-Transformer Cabinet: Listed or recommended by metering equipment manufacturer for use with sensors indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with equipment installation requirements in NECA 1.

- B. Install equipment for utility company metering. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required by utility company.
- C. Install modular meter center according to NECA 400 switchboard installation requirements.

3.2 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality control tests in accordance with Division 26 section "Electrical Testing."
 - B. Test Owner's electricity-metering installation for proper operation, accuracy, and usability of output data.
 - 1. Connect a load of known kilowatt rating, 1.5 kW minimum, to a circuit supplied by metered feeder.
 - 2. Turn off circuits supplied by metered feeder and secure them in off condition.
 - 3. Run test load continuously for eight hours, minimum, or longer to obtain a measurable meter indication. Use test load placement and setting that ensures continuous, safe operation.
 - 4. Check and record meter reading at end of test period and compare with actual electricity used based on test load rating, duration of test, and sample measurements of supply voltage at test load connection. Record test results.
 - 5. Repair or replace deficient or malfunctioning metering equipment, or correct test setup; then retest. Repeat for each meter in installation until proper operation of entire system is verified.

END OF SECTION 262713

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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. Pin and sleeve connectors and receptacles.
 - 7. 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 FB 11: Plugs, Receptacles, and Connectors of the Pin and Sleeve Type for Hazardous Locations.
- E. NEMA WD 1: General Requirements for Wiring Devices.
- F. NEMA WD 6: Wiring Device - Dimensional Requirements.
- G. UL 20: General-Use Snap Switches.
- H. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.
- I. UL 486B: Wire Connectors for Use with Aluminum Conductors.
- J. UL 498: Electrical Attachment Plugs and Receptacles.
- K. UL 943: Ground Fault Circuit Interrupters.
- L. NECA 130-2010: Installing and Maintaining Wiring Devices.

1.5 ACTION SUBMITTALS

- A. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations for each type of product indicated.

1.6 INFORMATIONAL SUBMITTALS

- A. Field quality control test reports

1.7 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.

1.8 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 GENERAL WIRING DEVICE REQUIREMENTS

- A. Comply with NFPA 70, NEMA WD 1, NEMA WD 6, Federal Specification WC-596G and UL498.
- B. Devices for Owner-Furnished Equipment:
 - 1. Receptacles: Match plug configurations.
 - 2. Cord and Plug Sets: Match equipment requirements.
- C. 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. 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

2.3 INDUSTRIAL-GRADE RECEPTACLES

- A. Industrial Heavy-Duty Pin and Sleeve Devices: Comply with IEC 309-1.

2.4 USB RECEPTACLES

- A. Tamper-Resistant Duplex NEMA 5-20R and USB Charging Receptacle:

1. Decorator style.
2. Comply with UL 1310.
3. Complies with Federal Specification DSCC W-C 596G testing requirements.
4. USB Charging 3.0A (minimum), 5VDC dual ports.
 - a. Comply with battery charging specification USB BC1.2
 - b. Compatible with USB 1.1/2.0/3.0 devices, including Apple products.
5. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Wiring Device: USB20X2-x
 - b. Eaton/Arrow Hart Wiring Devices: TR7756-x
 - c. Legrand, Pass & Seymour: PTTR20ACUSB Full Duplex USB A and C.
 - d. Leviton: T5833 Full Duplex USB A and C.

2.5 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. Weather-Resistant Duplex GFCI Receptacle, NEMA 5-20R:

1. Manufacturers: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell Wiring Device-Kellems: GFWRST20
 - b. Eaton/Arrow Hart Wiring Devices WRS GF20
 - c. Leviton: GFWR2
 - d. Legrand, Pass & Seymour: 2097TRWR

D. 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

2.6 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

2.7 WALL SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Hubbell Wiring Device-Kellems: 1220 Series
 2. Eaton/Arrow Hart Wiring Devices: AH1220 Series
 3. Leviton: 1220 Series
 4. Legrand, Pass & Seymour: PS20AC Series
- 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.

2.8 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
 - b. Smooth, high-impact thermoplastic.
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

2.9 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, including pool environments.
- G. Install weatherproof cover plates on receptacles in damp locations.
- H. Install weatherproof While-In-Use cover plates on receptacles in wet locations.
- I. Use oversized plates for outlets installed in masonry walls.
- J. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
- K. Remove wall plates and protect devices and assemblies during painting.
- L. Adjust locations of floor service outlets to suit arrangement of partitions and furnishings.
- M. 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 262726

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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, panelboards, and switchboards.
- 2. Spare-fuse cabinets.

1.3 ACTION SUBMITTALS

- A. Product Data: Include the following for each fuse type indicated:

- 1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
- 2. Let-through current curves for fuses with current-limiting characteristics.
- 3. Time-current curves, coordination charts and tables, and related data.
- 4. Fuse size for elevator feeders and elevator disconnect switches.

- B. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

- 1. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
- 2. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Division 1 Section " Operation and Maintenance Data," include the following:
 - a. Let-through current curves for fuses with current-limiting characteristics.
 - b. Time-current curves, coordination charts and tables, and related data.
 - c. Ambient temperature adjustment information.

1.5 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.

1.6 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.

1.7 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

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. Fuses: Quantity equal to 10% percent of each fuse type and size, but no fewer than 1 of each type and 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. Service Entrance: Class T, fast acting.
 2. Feeders: Class RK5, time delay.
 3. Motor Branch Circuits: Class RK5, time delay.
 4. Other Branch Circuits: Class RK5, time delay.

2.3 SPARE-FUSE CABINET

- A. Cabinet: Wall-mounted, 0.05-inch- thick steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
1. Size: 30 inches high by 24 inches wide by 12 inches deep.
 2. Finish: Gray, baked enamel.
 3. Identification: "SPARE FUSES" in 1-1/2-inch- high letters on exterior of door.
 4. Fuse Pullers: For each size of fuse.

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.
- C. Install spare-fuse cabinet(s).

3.3 IDENTIFICATION

- A. Install labels indicating fuse rating and type on outside of the door on each fused switch.

END OF SECTION 262813

SECTION 262816 - 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 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, 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. UL listing for series rating of installed devices.
 5. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- B. Shop Drawings: Diagram power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

- A. 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.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section " 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.

1.8 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.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 2. Altitude: Not exceeding 6600 feet.

1.10 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.

1.11 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. Spares: For the following:
 - a. Potential Transformer Fuses: 2 of each size and type.
 - b. Control-Power Fuses: 2 of each size and type
 - c. Fuses for Fusible Switches: Equal to 10 percent of amount installed for each size and type, but no fewer than 3 of each size and type.
 - 2. Spare Indicating Lights: Six of each type installed.

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.
 - 2. ABB.
 - 3. Siemens Industries, Inc.
 - 4. Square D by Schneider Electric.
- 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 3032-2W.
 - c. Pass & Seymour 7812.
 - d. Bryant 30102.
2. Three Pole:
 - a. Hubbell 1379.
 - b. Leviton MS303-DSW.
 - 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.
2. ABB.
3. Siemens Industries, Inc.
4. Square D by Schneider Electric.

- B. Molded-Case Circuit Breaker: NEMA AB 1, 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. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip-Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller and let-through ratings less than NEMA FU 1, RK-5.
5. 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.
 4. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 5. 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."
 6. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
 7. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
 8. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
- 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.
 3. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage. Provide "dummy" trip unit where required for proper operation.
 4. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay. Provide "dummy" trip unit where required for proper operation.
 5. Key Interlock Kit: Externally mounted to prohibit operation; key shall be removable only when switch is in off position.
 6. Circuit breaker selection for primary
- F. Circuit Breaker Selection for Transformer Primary Protection: Provide circuit breakers with time-current characteristics to clear transformer inrush currents while still providing protection for the ANSI through-fault protection curve. Provide circuit breakers with adjustable magnetic trip or electronic trip units as necessary to provide time-current curve shaping to achieve long time trip indicated on drawings, inrush coordination and damage protection.
- 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 CONCRETE BASES

- A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.
- B. Concrete base is specified in Division 26 Section "Hangers and Supports for Electrical Systems," and concrete materials and installation requirements are specified in Division 3.

3.3 INSTALLATION

- A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.
- C. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- D. Install switches with off position down.
- E. Install NEMA KS 1 enclosed switch where indicated for motor loads $\frac{1}{2}$ HP and larger and equipment loads greater than 30A.
- F. Install toggle disconnect switch, surface mounted, where indicated for motor loads less than $\frac{1}{2}$ HP and equipment loads 30A. and less.
- G. Install fuses in fusible disconnect switches.
- H. Install flexible liquid tight conduit from toggle disconnect switch to portable equipment. Leave a 6'-0" whip.
- I. Install flexible liquid tight conduit from toggle disconnect switch to stationary equipment.
- J. Install control wiring from early break contacts in motor disconnect switch to variable frequency controllers to shut down controller when switch is open.
- K. Install equipment on exterior foundation walls at least one inch from wall to permit vertical flow of air behind breaker and switch enclosures.
- L. Support enclosures independent of connecting conduit or raceway system.

- M. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.4 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.

3.5 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.
 - 4. Inspect proper installation of type, size, quantity, and arrangement of mounting or anchorage devices complying with manufacturer's certification.
- B. 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. 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.
- 8) For circuit breakers 800A and larger, verify all functions of trip unit by means of secondary injection in lieu of primary injection.

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.

3.6 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip and time delay settings to values as determined by the protective device coordination study.

3.7 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 262816

SECTION 262913 - 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 26 Section "Electrical Power Monitoring and Control" for interfacing communication and metering requirements.
2. 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.
3. Division 26 "Hangers and Supports for Electrical Systems" for concrete bases.

1.3 ACTION 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.

1.4 INFORMATIONAL SUBMITTALS

- A. 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. UL listing for series rating of overcurrent protective devices in combination controllers.
 - e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices in combination controllers.
 2. Wiring Diagrams: Power, signal, and control wiring.
- B. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around enclosed controllers where pipe and ducts are prohibited. Show enclosed controller layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.
- C. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "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.
- B. 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.

1.6 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.

1.7 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. Source Limitations: Obtain enclosed controllers of a single type through one source from a single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NFPA 70.
- E. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed controllers, minimum clearances between enclosed controllers, and for adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances.

1.8 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. Deliver products to site under provisions of Section 260010. Store and protect products under provisions of Section 260010.
- C. 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.

- D. 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.
- E. 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.

1.9 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of each contactor and indicate circuits controlled. Submit under provisions of 26 0010.

1.10 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 Owner's representative 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 written permission from Owner's representative.

1.11 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 size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."
- D. Coordinate features of enclosed controllers and accessory devices with pilot devices and control circuits to which they connect.
- E. 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.

1.12 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. Spare Fuses: Furnish one spare for every five installed, but no fewer than one set of three of each type and rating.
2. Indicating Lights: Two of each type installed.
3. Keys: Furnish 2 of each to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ABB.
 2. [Danfoss Inc.](#); Danfoss Electronic Drives Div.
 3. [Eaton](#).
 4. [Rockwell Automation; Allen-Bradley Co.; Industrial Control Group.](#)
 5. [Siemens](#)
 6. [Square D](#) by Schneider Electric

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, non-reversing, 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. Non-fusible Disconnecting Means: NEMA KS 1, heavy-duty, non-fusible 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 VARIABLE FREQUENCY CONTROLLERS

- A. Refer to Division 20 section "Variable Frequency Controllers."
- B. Equipment furnished by mechanical trades and installed by electrical trades.

2.4 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. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
 - 3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - 4. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

2.5 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. Elapsed Time Meters: Heavy duty with digital readout in hours.
- H. Meters: Panel type, 2-1/2-inch minimum size with 90- or 120-degree scale and plus or minus 2 percent accuracy. Where indicated, provide transfer device with an off position. Meters shall indicate the following:
 - 1. Ammeter: Output current, with current sensors rated to suit application.
 - 2. Voltmeter: Output voltage.
 - 3. Frequency Meter: Output frequency.
- I. Multifunction Digital-Metering Monitor: UL-listed or -recognized, microprocessor-based unit suitable for three- or four-wire systems and with the following features:
 - 1. Inputs from sensors or 5-A current-transformer secondaries, and potential terminals rated to 600 V.
 - 2. Switch-selectable digital display of the following:
 - a. Phase Currents, Each Phase: Plus or minus 1 percent.
 - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
 - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
 - d. Three-Phase Real Power: Plus or minus 2 percent.
 - e. Three-Phase Reactive Power: Plus or minus 2 percent.

- f. Power Factor: Plus or minus 2 percent.
 - g. Frequency: Plus or minus 0.5 percent.
 - h. Integrated Demand with Demand Interval Selectable from 5 to 60 Minutes: Plus or minus 2 percent.
 - i. Accumulated energy, in megawatt hours (joules), plus or minus 2 percent; stored values unaffected by power outages for up to 72 hours.
 - 3. Mounting: Display and control unit flush or semi-flush mounted in instrument compartment door.
 - J. Phase-Failure and Undervoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection. Provide adjustable undervoltage setting.
 - K. Current-Sensing, Phase-Failure Relays for Bypass Controllers: Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30 to 40 percent, or loss of supply voltage; with adjustable response delay.
 - L. 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,
- 2.6 FACTORY FINISHES
- A. Enclosure Finish: The enclosure shall be finished with 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. Install freestanding equipment on concrete bases.
- C. Comply with mounting and anchoring requirements specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- D. Enclosed Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 26 Section "Fuses."
- E. Install motor control equipment and contactors in accordance with manufacturer's instructions.
- F. Select and install heater elements in motor starters to match installed motor characteristics.
- G. 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 CONCRETE BASES

- A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.
- B. Concrete base is specified in Division 26 Section "Hangers and Supports for Electrical Systems," and concrete materials and installation requirements are specified in Division 3.

3.5 IDENTIFICATION

- A. Identify enclosed controller, components, and control wiring according to Division 26 Section "Electrical Identification."

3.6 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.

3.7 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."

3.8 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. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:
 - 1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
 - 2. Assist in field testing of equipment.
 - 3. Report results in writing.
- C. 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, "." 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.

3.9 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

3.10 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 " Demonstration and Training."

END OF SECTION 262913

SECTION 264113 - 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 a complete lightning protection system including all labor, materials and installation as specified herein.
- B. The entire system shall be copper and shall be installed as a concealed system as required.
- C. Installers of system shall be registered with Underwriters' Laboratories and certified by the Lightning Protection Institute.
- D. The entire 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 ACTION SUBMITTALS

- A. Submit product data showing dimensions and materials of each component and include indication of listing in accordance with ANSI/UL 96.
- 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.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality control test reports

1.6 CLOSEOUT SUBMITTALS

- A. Record Documents
- B. UL master label certificate

1.7 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of air terminals, grounding electrodes, bonding connections, and routing of system conductors.

1.8 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@ECLC.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. Copper air terminals shall be minimum 10 inches long, 1/2 inch diameter base, solid copper with nickel chrome plate finish, blunt tip Thompson 55BT, or approved equal.
- F. Cable to ground rod connector shall be heavy duty cast copper bronze, Thompson #230, or approved equal.
- G. Aluminum air terminals shall be a minimum 10 inches long, 1/2 inches diameter base, solid aluminum blunt tip, Thompson A55BT or approved equal.
- H. "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.

- I. 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. This is a poured concrete and/or masonry building. The use of reinforcing rods in lieu of cable down conductors will not be permitted. However, at least one continuous vertical run of reinforcing rods shall be bonded at both top and bottom to each down cable. All cable imbedded in poured concrete or masonry shall be copper.
- F. If down conductor cables are run in conduit, the conduit shall be bonded to the down conductor cable at both top and bottom
- G. Copper down conductors to ground installed around the perimeter of the building shall average not over 100 feet apart, and in no case shall the distance between any two such grounds exceed 100 feet apart.
- H. 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.
- I. All connections, except where otherwise specifically approved or accepted, shall be bronze bolt and nut clamps.
- J. Spacing between air terminals shall not exceed 20 feet.

- K. Where the building exceeds 50 feet in width, provide center roof protection.
- L. 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.
- M. All mechanical and electrical equipment on the roof shall be bonded to the lightning protection system as required.
- N. 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.
- O. 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.
- P. 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.
- Q. 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 Architect/Engineer upon completion.

END OF SECTION 264113

SECTION 265119 - 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."

2. Division 26 "Lighting Control Systems"
3. Division 26 "Dimming Controls"

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 ACTION 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. Samples for Verification: For each type of luminaire.
 1. Include Samples of luminaires and accessories to verify finish selection.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Lighting luminaires.
 2. Suspended ceiling components.
 3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
 4. Structural members to which luminaires will be attached.
 5. Initial access modules for acoustical tile, including size and locations.
 6. Items penetrating finished ceiling, including the following:
 - a. Other luminaires.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 7. Moldings.
- B. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Product Test Reports: For each luminaire, for tests performed by a qualified testing agency.
- D. Sample warranty.

1.6 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.

1.7 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. LED Drivers 5% attic stock of each type and rating installed. Furnish at least one of each type.
 2. Diffusers and Lenses: 1% attic stock of each type and rating installed. Furnish at least one of each type.
 3. Guards: 5% attic stock of each type and rating installed. Furnish at least one of each type.

1.8 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. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- C. Provide luminaires from a single manufacturer for each luminaire type.
- D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- E. Mockups: For interior lighting luminaires in room or module mockups, complete with power and control connections.
 - 1. Obtain Architect's approval of luminaires in mockups before starting installations.
 - 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- F. 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.
- G. 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 State Police, Fire Marshall Division Policy Number 11-06 "Plastic Materials as Interior Finishes" pertaining to the use of plastic lenses in lighting fixtures for health care facilities.
 - 6. Michigan Department of Community Industry Services requirements that all lamps shall be protected from breakage. Exposed lamps are not acceptable.
- H. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 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.

1.11 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 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 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.

2.3 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. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. Unless otherwise specified in Luminaire product data, provide products with a minimum CRI of 80.

- E. Unless otherwise specified in Luminaire product data, provide products with a CCT of 3500K.
- F. Unless otherwise specified in Luminaire product data, provide products with an IES LM-80 rated lamp life of 50,000 hours.
- G. Driver
 - 1. Provided as an integrated component of the luminaire or as an external component of an assembly of luminaires.
 - 2. Nominal Input Voltage: All drivers shall be rated for use on either 120V or 277V systems.

2.4 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.

2.5 EMERGENCY AUTOMATIC LOAD CONTROL RELAY

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. [Bodine](#) BLCD Series.
 - 2. [Nine-24, Inc.](#): ELCR Series.
 - 3. LVS, EPC Series
 - 4. IOTA, ETS-20 Series
 - 5. Functional Devices, Inc., ESR Series
 - 6. ETC, ALCR Series
 - 7. Wattstopper, ELCU series
- B. Description:
 - 1. The Automatic Load Control Relay (ALCR) shall provide required functionality to allow any standard lighting control device to control emergency lighting in conjunction with normal lighting in any area of the building.
 - 2. The ALCR shall allow control of emergency lighting fixtures in tandem with normal lighting in an area while ensuring that emergency lighting will turn on

- immediately to full brightness upon loss of normal power supplying the control device.
 3. Emergency lighting operation shall be independent for each controlled area and shall not require a generalized power failure for proper operation.
 4. Self-contained with integral ½" nipple mount with snap in locking feature for mounting into a standard junction box knock out.
 5. Normally closed dry contacts capable of switching 20 amp emergency ballast loads @ 120-277 VAC, 60 Hz, or 10 amp tungsten loads @ 120 VAC, 60 Hz.
 6. Universal rated voltage inputs provided for normal power sense and normal switched power at 120-277 VAC, 60 Hz.
 7. Integral momentary test switch. Pressing and holding this switch shall instantly force the unit into emergency mode and turn on emergency lighting. Releasing the test switch shall immediately return the unit to normal operation.
 8. Dedicated leads and 24 VDC source for connection to remote test switch, fire alarm system, or other external system capable of providing a normally closed dry contact closure. Breaking contact between the terminals shall force and hold the emergency lighting on until the terminals are again closed. An integral LED indicator shall indicate the unit's current remote activation status.
 9. Separate LEDs to indicate the presence of normal and emergency power sources. The LEDs shall indicate the unit's current operational mode (normal or emergency).
 10. Normal power input leads shall be connected to the line side of the control device such that any upstream fault causing a loss of power, including the tripping of the branch circuit breaker, will force the unit into the emergency mode and turn on the emergency lighting.
 11. Automatically switch emergency lighting on and off as normal lighting is switched. When normal power is not available, the unit shall force and hold emergency lighting on regardless of the state of any external control device until normal power is restored.
 12. Utilize zero crossing circuitry to protect relay contacts from inrush current.
 13. Plenum rated housing equipped with compression flying leads.
 14. The unit shall be UL listed to the UL924 standard and labeled for connection to both normal and emergency lighting power sources.
- C. Provide device with proper rating for total load and load type being transferred
- D. Provide for devices suitable for line voltage and low voltage dimming control where required such that device bypasses dimming control signal to luminaire to provide full output upon loss of normal power.
- E. Coordinate with luminaire product data, lighting control schedules and details and diagrams included on the drawings for dimming characteristics.
- 2.6 BRANCH CIRCUIT EMERGENCY LIGHTING TRANSFER SWITCH
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. LVS EPC-D-F-ATS Series
 2. Bodine.
- B. Description: Localized load transfer switch to allow emergency fixture to be powered and controlled by the normal lighting circuit, sense presence of normal power ahead of control circuit and switch luminaire (both line and neutral) over to emergency source upon loss of normal source.

- C. Universal dimming capability to allow the lighting to be controlled and dimmed by the normal lighting circuit during normal times. In the event of a loss of the normal branch circuit, and transfer the designated emergency fixtures from normal dimming control to the emergency power source and bring them to full brightness, regardless of the current state of the dimming system.
- D. Device shall be mounted remotely for each control circuit as application requires.
- E. Listed and labeled by an NRTL to the UL1008 for emergency operation and listed for field installation.
- F. Integral test switch and indicating lamps to indicate status.
- G. Provide device with proper rating for total load and load type being transferred
- H. Coordinate with luminaire product data, lighting control schedules and details and diagrams included on the drawings.

2.7 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.

2.8 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.

2.9 LUMINAIRE FIXTURE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "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. Support luminaires independent of ceiling framing. Support recessed grid luminaires from two opposite corners directly to structure. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- E. Exposed Grid Ceilings: Support surface mounted luminaires on grid ceiling directly from building structure.
- F. Install recessed luminaires to permit removal from below.
- G. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- H. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- I. Install fixture with no gaps between adjacent fixtures or between fixtures and surrounding surfaces. Trims of fixtures shall be properly and uniformly aligned.
- J. 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.
- K. 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.
- L. Wall-Mounted Luminaire Support:
 - 1. Attached to structural members in walls.
 - 2. Do not attach luminaires directly to gypsum board.
- M. Ceiling-Mounted Luminaire Support:
 - 1. Ceiling mount with two 5/32-inch- diameter aircraft cable supports adjustable to 120 inches in length.
 - 2. Ceiling mount with pendant mount with 5/32-inch- diameter aircraft cable supports adjustable to 120 inches in length.
 - 3. Ceiling mount with hook mount.
- N. 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 wire support 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.
- O. Comply with requirements in Section 260519 "Conductors and Cables" for wiring connections.
- P. Fixtures shall have their exterior labels removed and shall be thoroughly cleaned.
- Q. 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 260553 "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 STARTUP SERVICE

- A. Comply with requirements for startup specified in Division 26 Section "Lighting Control Systems."

3.8 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.

3.9 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 265119

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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. Exterior luminaires with lamps and ballasts.
- 2. Luminaire-mounted photoelectric relays.
- 3. Poles and accessories.

- B. Related Sections include the following:

- 1. Division 26 Section "LED Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.3 DEFINITIONS

- A. CRI: Color-rendering index.
- B. Luminaire: Complete lighting fixture, including ballast housing if provided.
- C. Pole: Luminaire support structure, including tower used for large area illumination.
- D. Standard: Same definition as "Pole" above.

1.4 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

- A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-4.
- B. Live Load: Single load of 500 lbf, distributed as stated in AASHTO LTS-4.
- C. Ice Load: Load of 3 lbf/sq. ft., applied as stated in AASHTO LTS-4.
- D. Wind Load: Pressure of wind on pole and luminaire, calculated and applied as stated in AASHTO LTS-4.
 - 1. Wind speed for calculating wind load for poles 50 feet or less in height is 110 mph.

1.5 ACTION SUBMITTALS

- A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
 - 2. Details of attaching luminaires and accessories.
 - 3. Details of installation and construction.
 - 4. Luminaire materials.
 - 5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.
 - a. For indicated luminaires, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
 - b. Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 - 6. Photoelectric relays.
 - 7. Ballasts, including energy-efficiency data.
 - 8. Lamps, including life, output, and energy-efficiency data.
 - 9. Materials, dimensions, and finishes of poles.
 - 10. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
 - 11. Anchor bolts for poles.
 - 12. Manufactured pole foundations.

B. Shop Drawings:

1. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
2. Design calculations, certified by a qualified professional engineer, indicating strength of screw foundations and soil conditions on which they are based.
3. Wiring Diagrams: Power and control wiring.

C. Samples for Verification: For products designated for sample submission in Exterior Lighting Device Schedule. Each sample shall include lamps and ballasts.

1.6 INFORMATIONAL SUBMITTALS

- A. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4 and that load imposed by luminaire has been included in design.
- B. Qualification Data: For agencies providing photometric data for lighting fixtures.
- C. Field quality-control test reports.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and poles to include in emergency, operation, and maintenance manuals.
- B. Warranty: Special warranty specified in this Section.

1.8 MAINTENANCE MATERIALS SUBMITTALS

- A. Spare parts
- B. Extra stock material

1.9 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7.
- 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 IEEE C2, "National Electrical Safety Code."
- E. Comply with NFPA 70.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Package aluminum poles for shipping according to ASTM B 660.
- B. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- C. Handle wood poles so they will not be damaged. Do not use pointed tools that can indent pole surface more than 1/4 inch deep. Do not apply tools to section of pole to be installed below ground line.
- D. Retain factory-applied pole wrappings on fiberglass and laminated wood poles until right before pole installation. Handle poles with web fabric straps.
- E. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period.
 - 1. Warranty Period for Luminaires: Five years from date of Substantial Completion.
 - 2. Warranty Period for Metal Corrosion: Five years from date of Substantial Completion.
 - 3. Warranty Period for Color Retention: Five years from date of Substantial Completion.
 - 4. Warranty Period for Lamps: Replace lamps and fuses that fail within 12 months from date of Substantial Completion; furnish replacement lamps and fuses that fail within the second 12 months from date of Substantial Completion.
 - 5. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than three years from date of Substantial Completion.

1.12 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. Glass and Plastic Lenses, Covers, and Other Optical Parts: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Ballasts: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Guards: 10 for every 20 of each type and rating installed. Furnish at least one of each type.

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. Basis of Design Product: The design of each item of exterior luminaire and its support is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 LUMINAIRES, GENERAL REQUIREMENTS

- A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
- B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.
- G. Exposed Hardware Material: Stainless steel.
- H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.
- J. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
- K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

- L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and - tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
- M. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
 - 2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
 - a. Color: As selected from manufacturer's standard catalog of colors.
- N. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - 2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
 - 3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
 - 4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
 - a. Color: as selected by architect.

2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

- A. Comply with UL 773 or UL 773A.
- B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay.
 - 1. Relay with locking-type receptacle shall comply with NEMA C136.10.
 - 2. Adjustable window slide for adjusting on-off set points.

2.4 POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS

- A. Structural Characteristics: Comply with AASHTO LTS-4.
 - 1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in Part 1 "Structural Analysis Criteria for Pole Selection" Article, with a gust factor of 1.3.

2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.
- B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.
- C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
 1. Materials: Shall not cause galvanic action at contact points.
 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, unless stainless-steel items are indicated.
 3. Anchor-Bolt Template: Plywood or steel.
- D. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 3 Section "Cast-in-Place Concrete."
- E. Power-Installed Screw Foundations: Factory fabricated by pole manufacturer, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole base flange and strength required to support pole, luminaire, and accessories.
- F. Breakaway Supports: Frangible breakaway supports, tested by an independent testing agency acceptable to authorities having jurisdiction, according to AASHTO LTS-4.

2.5 STEEL POLES

- A. Poles: Comply with ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psig; 1-piece construction up to 40 feet in height with access handhole in pole wall.
 1. Shape: Round, straight.
 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- B. Brackets for Luminaires: Detachable, cantilever, without underbrace.
 1. Adapter fitting welded to pole and bracket, then bolted together with galvanized-steel bolts.
 2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire.
 3. Match pole material and finish.
- C. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- D. Steps: Fixed steel, with nonslip treads, positioned for 15-inch vertical spacing, alternating on opposite sides of pole; first step at elevation 10 feet above finished grade.
- E. Intermediate Handhole and Cable Support: Weathertight, 3-by-5-inch handhole located at midpoint of pole with cover for access to internal welded attachment lug for electric cable support grip.

- F. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- G. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported cable times a 5.0 safety factor.
- H. Platform for Lamp and Ballast Servicing: Factory fabricated of steel with finish matching that of pole.
- I. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.
- J. Galvanized Finish: After fabrication, hot-dip galvanize complying with ASTM A 123/A 123M.
- K. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
 - 2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
 - 3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
 - a. Color: As selected by Architect from manufacturer's full range.

2.6 POLE ACCESSORIES

- A. Duplex Receptacle: 120 V, 20 A in a weatherproof assembly complying with Division 26 Section "Wiring Devices" for ground-fault circuit-interrupter type.
 - 1. Recessed, 12 inches above finished grade.
 - 2. Nonmetallic polycarbonate plastic or reinforced fiberglass cover, color to match pole, that when mounted results in NEMA 250, Type 3R enclosure.
 - 3. With cord opening.
- B. Minimum 1800-W transformer, protected by replaceable fuses, mounted behind access cover.
- C. Base Covers: Manufacturers' standard metal units, arranged to cover pole's mounting bolts and nuts. Finish same as pole.
- D. Transformer Type Base: Same material and color as pole. Coordinate dimensions to suit pole's base flange and accept indicated accessories.
- E. Vibration Dampener: For all steel and aluminum lighting poles taller than 25', provide factory installed vibration dampening device to eliminate second mode or higher resonance that can occur with low velocity steady state winds.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

- A. Install exterior lighting system per N.E.C.A./I.E.S.N.A. 501-2006.
- B. Install lamps in each luminaire.
- C. Fasten luminaire to indicated structural supports.
 - 1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- D. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources.

3.2 POLE INSTALLATION

- A. Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.
- B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features, unless otherwise indicated on Drawings:
 - 1. Fire Hydrants and Storm Drainage Piping: 60 inches.
 - 2. Water, Gas, Electric, Communication, and Sewer Lines: 5 feet.
 - 3. Trees: 10 feet.
 - 4. Underground water retention basins: 5 feet
- C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Division 3 Section "Cast-in-Place Concrete."
- D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
 - 1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
 - 2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
 - 3. Install base covers, unless otherwise indicated.
 - 4. Use a short piece of 1/2-inch- diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
- E. Raise and set poles using web fabric slings (not chain or cable).

3.3 BOLLARD LUMINAIRE INSTALLATION

- A. Align units for optimum directional alignment of light distribution.
- B. Install on concrete base with top 4 inches above finished grade or surface at bollard location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 3 Section "Cast-in-Place Concrete."

3.4 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINAIRES

- A. Install on concrete base with top 4 inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 3 Section "Cast-in-Place Concrete."

3.5 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Division 26 Section "Raceways and Boxes." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.6 GROUNDING

- A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding."
- B. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding."

3.7 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.
 - 1. Verify operation of photoelectric controls.
- C. Illumination Tests:
 - 1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IESNA testing guide(s):
 - a. IESNA LM-5, "Photometric Measurements of Area and Sports Lighting."
 - b. IESNA LM-50, "Photometric Measurements of Roadway Lighting Installations."
 - c. IESNA LM-52, "Photometric Measurements of Roadway Sign Installations."
 - d. IESNA LM-64, "Photometric Measurements of Parking Areas."
 - e. IESNA LM-72, "Directional Positioning of Photometric Data."
- D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain luminaire lowering devices. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 265600



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. A typically configured 2BLT2 features a **Unified Glare Rating (UGR)** starting at 18, UGR data available on page 8. High performance extruded acrylic diffusers conceal LEDs and efficiently deliver light in a volumetric distribution. Five 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 MSD7ADXC ((Passive infrared (PIR)) or MSDPD7ADXC ((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 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. Designed for use in NEMA standard Type G (1" & 15/16"), NFG (9/16"), and SS (9/16") grid ceilings. Consult factory about other ceiling types.

For recessed mounting in hard ceiling applications, Drywall Grid Adapters (DGA) are available as an accessory. See Accessories section. Suitable for damp location.

LISTINGS — CSA Certified to meet U.S. and Canadian standards. IC rated. Tested in accordance with ISO 14644-1; suitable for use in ISO 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.

GOVERNMENT PROCUREMENT — BAA – Product with the BAA option qualifies as a domestic end product under the Buy American Act as implemented in the FAR and DFARS. Product with the BAA option also qualifies as manufactured in the United States under DOT Buy America regulations.

BABA – Build America Buy America: Product with the BAA option also qualifies as produced in the United States under the definitions of the Build America, Buy America Act. Please refer to www.acuitybrands.com/buy-american for additional information.

WARRANTY — 5-year limited warranty. This is the only warranty provided and no other statements in this specification sheet create any warranty of any kind. All other express and implied warranties are disclaimed. 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	Other Manufacturers: CORELITE "CLASS RX" Series DAY-BRIGHT "FLUXGRID" Series ORACLE "22-ODVH-LED" Series
Notes	
Type	L1

BLT Series LED



ADP Diffuser Option

2BLT2

2' x 2'
LED



Ribbed Reflector Option



eldoLED

BAA

BABA

Specifications

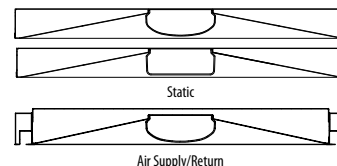
Length: 23-3/4 (60.3)

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

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 when used with Acuity Brands' controls products.

All configurations of this luminaire are calibrated and tested to meet the Acuity Brands' specifications for chromatic consistency – including color rendering, color fidelity, and color temperature tolerance around standard CIE chromaticity coordinates.

To learn more about Acuity A+ standards, specifications, and testing visit www.acuitybrands.com/aplus.



Items marked by a shaded background qualify for the Design Select program and ship in 15 days or less. To learn more about Design Select, visit www.acuitybrands.com/designselect. *See ordering tree for details

2BLT Volumetric Recessed Lighting 2'x2'

L1



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 ‡	<table border="1"> <tr> <td colspan="2">Standard efficiency ‡ (>125 LPW)</td> <td colspan="2">High efficiency ‡ (>130 LPW)</td> </tr> <tr> <td>20L</td> <td>2000</td> <td>20LHE</td> <td>2000</td> </tr> <tr> <td>33L</td> <td>3300</td> <td>33LHE</td> <td>3300</td> </tr> <tr> <td>40L</td> <td>4000</td> <td>40LHE</td> <td>4000</td> </tr> <tr> <td>48L</td> <td>4800</td> <td>48LHE</td> <td>4800</td> </tr> </table>	Standard efficiency ‡ (>125 LPW)		High efficiency ‡ (>130 LPW)		20L	2000	20LHE	2000	33L	3300	33LHE	3300	40L	4000	40LHE	4000	48L	4800	48LHE	4800	<table border="1"> <tr> <td>ADP</td> <td>Curved, ribbed</td> </tr> <tr> <td>ADSM</td> <td>Curved, smooth</td> </tr> <tr> <td>SDP</td> <td>Square, ribbed</td> </tr> <tr> <td>SDSM</td> <td>Square, smooth</td> </tr> <tr> <td>LUGR</td> <td>Low UGR lens ‡</td> </tr> <tr> <td colspan="2">Includes trim rings to match sensored version</td> </tr> <tr> <td>ADPT</td> <td>Curved, ribbed</td> </tr> <tr> <td>ADSMT</td> <td>Curved, smooth</td> </tr> <tr> <td>SDPT</td> <td>Square, ribbed</td> </tr> <tr> <td>SDSMT</td> <td>Square, smooth</td> </tr> <tr> <td>LUGRT</td> <td>Low UGR lens with trim ‡</td> </tr> </table>	ADP	Curved, ribbed	ADSM	Curved, smooth	SDP	Square, ribbed	SDSM	Square, smooth	LUGR	Low UGR lens ‡	Includes trim rings to match sensored version		ADPT	Curved, ribbed	ADSMT	Curved, smooth	SDPT	Square, ribbed	SDSMT	Square, smooth	LUGRT	Low UGR lens with trim ‡	(blank) MVOLT 120 120V 277 277V 347 347V ‡	<table border="1"> <tr> <td>EZ1</td> <td>eldoLED dims to 1% (0-10 volt dimming)</td> </tr> <tr> <td>GZ1</td> <td>Dims to 1% (0-10V dimming)</td> </tr> <tr> <td>GZ10</td> <td>Dims to 10% (0-10V dimming)</td> </tr> <tr> <td>SLD</td> <td>Step-level dimming ‡</td> </tr> </table>	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 ‡	<table border="1"> <tr> <td>LP830</td> <td>82CRI, 3000 K</td> </tr> <tr> <td>LP835</td> <td>82CRI, 3500 K</td> </tr> <tr> <td>LP840</td> <td>82CRI, 4000 K</td> </tr> <tr> <td>LP850</td> <td>82CRI, 5000 K</td> </tr> <tr> <td>LP930</td> <td>90CRI, 3000K</td> </tr> <tr> <td>LP935</td> <td>90CRI, 3500K</td> </tr> <tr> <td>LP940</td> <td>90CRI, 4000K</td> </tr> <tr> <td>LP950</td> <td>90CRI, 5000K</td> </tr> </table>	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
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nLight Interface	Control ‡
<p>nLight Wired</p> <p>(blank) no nLight® interface</p> <p>N80 nLight with 80% lumen management</p> <p>N80EMG nLight with 80% lumen management For use with generator supply EM power ‡</p> <p>N100 nLight without lumen management</p> <p>N100EMG nLight without lumen management For use with generator supply EM power ‡</p> <p>nLight Wireless</p> <p>(blank) no nLight® interface</p> <p>NLTAIR2 nLight AIR Generation 2 enabled ‡</p>	<p>nLight Wired</p> <p>(blank) No sensor control</p> <p>NES7 nLight™ nES 7 PIR integral occupancy sensor ‡</p> <p>NESPD7 nLight™ nES PDT 7 dual technology integral occupancy control ‡</p> <p>NES7ADCX nLight™ nES 7 ADCX PIR integral occupancy sensor with automatic dimming photocell ‡</p> <p>NESPD7ADCX nLight™ nES PDT 7 dual technology integral occupancy sensor with automatic dimming photocell ‡</p> <p>nLight Wireless</p> <p>RES7 nLight AIR control with PIR integral occupancy sensor and automatic dimming photocell ‡</p> <p>RES7PDT nLight AIR control with PDT dual technology integral occupancy sensor and automatic dimming photocell ‡</p> <p>RIO nLight AIR radio module without sensor ‡</p> <p>RES7EM nLight AIR PIR integral occupancy sensor with automatic dimming photocell and UL924 Emergency Operation, via power interrupt detection ‡</p> <p>RES7PDTEM nLight AIR microphonics dual technology occupancy sensor with automatic dimming photocell and UL924 Emergency Operation, via power interrupt detection ‡</p> <p>RIOEM nLight AIR radio module less sensor, with UL924 Emergency Operation, via power interrupt detection ‡</p> <p>Individual Control</p> <p>MSD7ADCX PIR integral occupancy sensor with automatic dimming control photocell ‡</p> <p>MSD7ADCX PDT integral occupancy sensor with automatic dimming control photocell ‡</p> <p>JOT Wireless room control with "Just One Touch" pairing ‡</p> <p>JOTVTX15 Wireless occupancy sensor with "Just One Touch" pairing ‡</p>

Standby Mode	Options																																				
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NOTE: ‡ indicates option value has ordering restrictions. Please reference the Option Value Ordering Restrictions chart on the next page. Options are sorted alphanumerically.



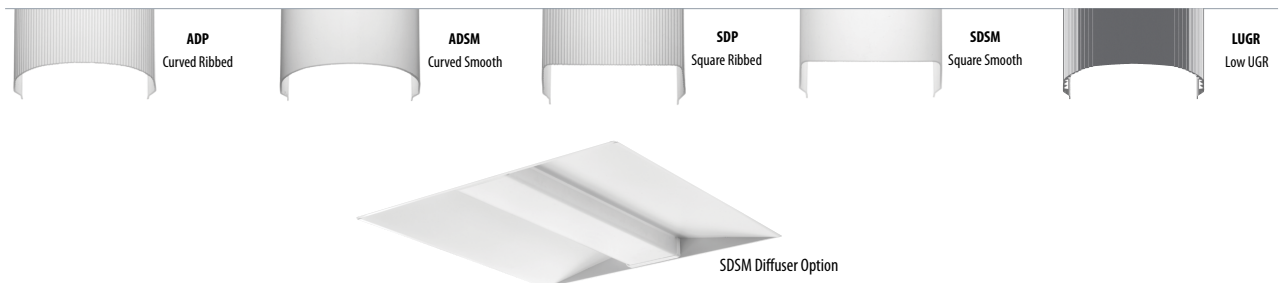
BLT-2X2

2BLT Volumetric Recessed Lighting 2'x2'

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‡ 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. If a job pack is selected, use JP28 only.
BGTD	Not available with JOT, JOTVTX15 sensor options or emergency battery options. Must specify voltage. Requires BSE labeling, voltage specific. Example: BGTD BSE10.
Control	Must specify diffuser with trim rings.
CP	Not available with N80, N80EMG, N100, N100EMG, PWS1836, PWS1846, PWS1846 PWSLV or PWS1856LV.
E10WSTAR	Not compatible with 347V.
EL7L, EL14L, E10WLCP	When using pre-wire option, use PWS1846 or PWS1846 PWSLV.
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, NESPDT7, NES7ADCX, NESPDT7ADCX, MSD7ADCX, MSDPDT7ADCX, RES7, RES7PDT, RIO, JOT, JOTVTX15. Not available when sensor options combined with 'A' air supply return option.
JP44	Not available with NES7, NESPDT7, NES7ADCX, NESPDT7ADCX, MSD7ADCX, MSDPDT7ADCX, RES7, RES7PDT, RIO, JOT, JOTVTX15. Not available 'A' air supply return option. Not available with battery and PWS together.
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.
LUGR, LUGRT	Due to the unique optics used to drive the low UGR distribution, the LUGR lens is not uniformly lit and presents visible striping.
MSD7ADCX, MSDPDT7ADCX	Only available with E21 driver option. 0-10v dimming wires not accessible via access plate.
NES7, NESPDT7, NES7ADCX, NESPDT7ADCX	Requires N80, N80EMG, N100, or N100EMG. Only available with E21 driver.
NLTAIR2	Must order with nLight Wireless option from Control section. Not available with GZ10 driver.
NOC	Can only be ordered in conjunction with E21 or GZ1, 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
RES7, RES7PDT, RIO	See UL 924 Sequence of Operation chart on page 3. When combined with the E21 option, can be used as a normal power sensing device for nLight AIR devices and luminaires with EM emergency options.
RES7EM, RES7PDEEM, RIOEM	See UL924 Sequence of Operation chart on page 3. Not available with GZ10 or GZ1 driver.
RRL	For ordering logic consult: RRL_2013.
SLD	Not available with any nLight Interface or Control options.

Multiple Diffuser Options

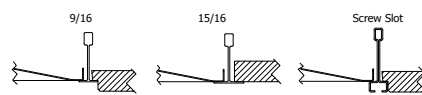


Non-Configurable BLT

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

- The below information applies to all nLight AIR devices with an EM option.
- EM devices will remain at their high-end trim and ignore wireless lighting control commands, unless a normal-power-sensed (NPS) broadcast is received at least every 8 seconds.
 - Using the CLAIRITY+ mobile app, EM devices must be associated with a group that includes a normal power sensing device to receive NPS broadcasts.
 - Only non-emergency rPP20, rLSXR, rSBOR, rSDGR, and nLight AIR luminaires with version 3.4 or later firmware can provide normal power sensing for EM devices. See specification sheets for control devices and luminaires for more information on options that support normal power sensing.



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2BLT Volumetric Recessed Lighting 2'x2'

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Accessories & Replacement Parts

Accessories: Order as separate catalog number.	
DGA22	Drywall grid adapter for 2x2 recessed fixture
2X2SMKSH 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.		
*247WJV	2DBLT24 ADP LENS ASSEMBLY	2 ft. replacement lens
*249P2P	2DBLT24 SDP LENS ASSEMBLY	2 ft. replacement lens
*249P2W	2DBLT24 ADSM LENS ASSEMBLY	2 ft. replacement lens
*249P32	2DBLT24 SDSM LENS ASSEMBLY	2 ft. replacement lens
*237LT1	2DBLT24 ADPT LENS ASSEMBLY	2 ft. replacement lens
*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
*237MS7	2DBLT24 ADSMT SENSOR LENS ASSEMBLY	2 ft. replacement lens
*237MSH	2DBLT24 SDSMT SENSOR LENS ASSEMBLY	2 ft. replacement lens

Emergency Battery Pack Options - Field Installable

Battery Model Number	Wattage	Runtime (Minutes)	Lumen Output* @ 120 Lumens/Watt	Other
ILB CP07 2HA	7W	120	840	Storm Shelter/ 2-hour Runtime
ILB CP10 A	10W	90	1200	
ILB CP10 HE AELR A	10W	90	1200	Title 20; Enabled with Self Testing, Automated Reporting (STAR)
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 techsupport@iotaengineering.com for any Emergency Battery related questions.

BSE Labeling Options

- BSE10 Drivers load transfer relay installed per manufacturer's instructions. Voltage, BGTD and BSE10 called out.
- BSE14 One voltage fixture with driver load control relay supplied with one prewire (PWS option). Prewire wired for normal circuit, the control relay for emergency circuit left unconnected. Voltage, BGTD, BSE14 and prewire called out, in the description.

*For configurations with Reloc or two voltages an RFA modification is required



BLT-2X2

2BLT Volumetric Recessed Lighting 2'x2'

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Enabled with STAR

Emergency Lighting with Self-Testing Automated Reporting (STAR), enables self-testing and automated reporting to aid in life safety code compliance. Build your solution and choose your preferred deployment from Mobile STAR, where test data is logged in each individual unit and broadcast to the **CLAIRity™+** app, or Connected STAR, where test data is logged in the STAR Gateway by IOTA® and emailed directly.

Leave the ladders, disruptions and written records behind with emergency lighting solutions with STAR!

Life Safety Code NFPA 101 testing and reporting requirements for emergency lighting include:



Testing for 30 seconds every 30 days



Testing for 90 minutes once a year



Record keeping and to report to the authority having local jurisdiction

MOBILE STAR

For small scale applications

CONNECTED STAR

For large scale applications

2BLT Volumetric Recessed Lighting 2'x2'

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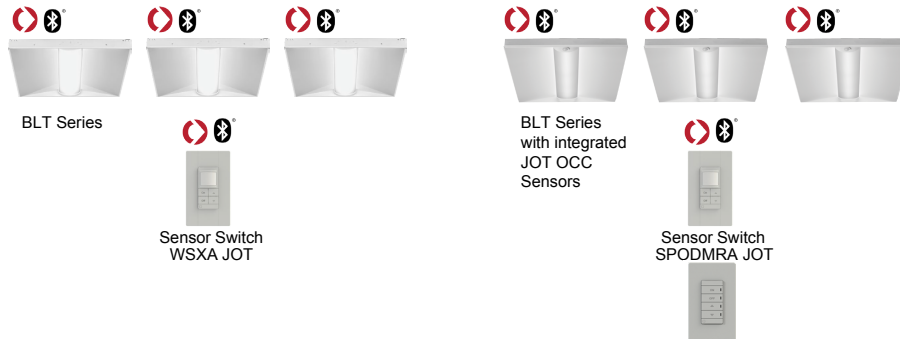
JOT Wireless



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'

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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'

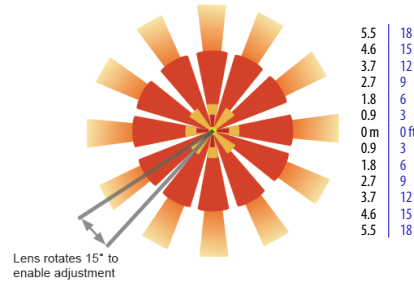
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Sensor Options					
Option	Automatic Dimming Photocell	Occupancy Sensing		nLight Wired Networking	nLight AIR Networking
		PIR	PDT		
MSD7ADCX	X	X			
MSDPDT7ADCX	X		X		
NES7		X		X	
NES7ADCX	X	X		X	
NESPDT7			X	X	
NESPDT7ADCX	X		X	X	
RES7	X	X			X
RESPDT7	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 MSPDT7ADCX 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

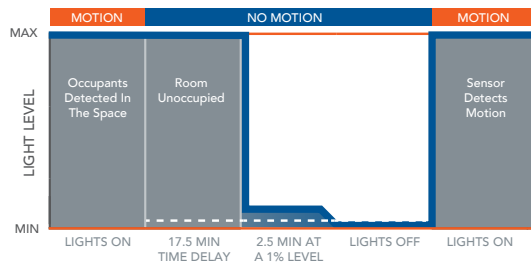
nLight AIR is the ideal solution for retrofit or new construction spaces where adding additional wiring can be labor intensive and nLight AIR is available with or without an integral sensor. The integrated rES7 or rES7PDT smart sensors are part of each luminaire in the nLight AIR network, which can be 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.

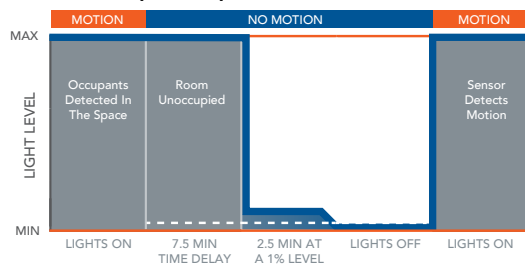
For areas like restrooms, private offices, open offices, conference rooms or any space with obstructions, the nES PDT 7 dual technology sensor is recommended. The nES PDT 7 utilizes both PIR (passive infrared) and Microphonics technologies to detect occupancy. Additionally, the nESPDT7ADCX includes an 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).

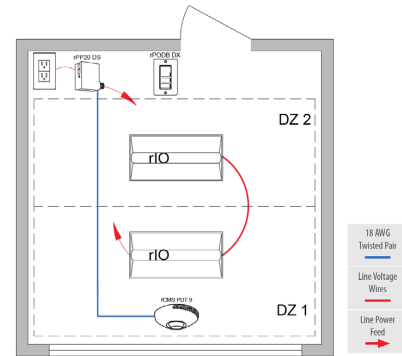
2BLT Volumetric Recessed Lighting 2'x2'

Controls Accessories

nLight® Wired Control Accessories: <i>Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlight.</i>			
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: <i>Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlightair.</i>	
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	[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

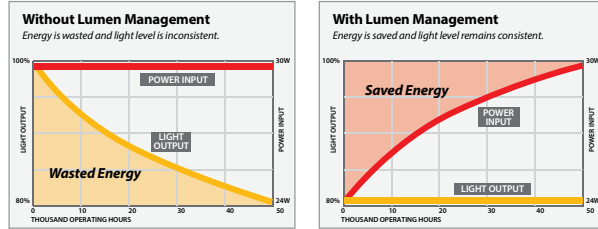
¹ RCMS requires low voltage power from either RPP20 DS 24V G2 or PS150.



2BLT2 Volumetric Recessed Lighting 2'x2'

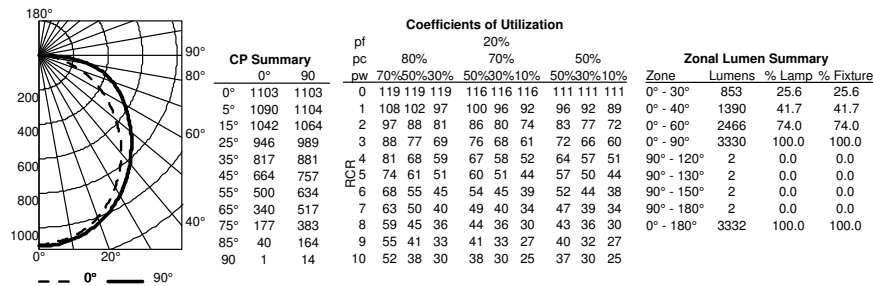
Constant Lumen Management

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.

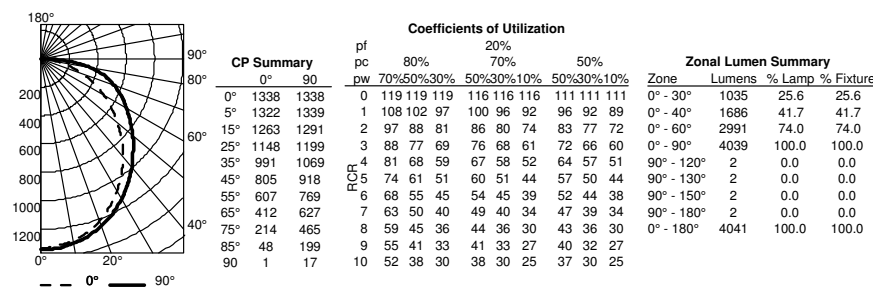


PHOTOMETRICS

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



UNIFIED GLARE RATING (UGR)

Lumen Package	UGR Values of BLT 2x2 @ 80CRI and 3500K																			
	UGR (70% 50% 20% reflectance using a 4H x 8H room size)																			
	ADP		ADPT		ADSM		ADSMT		SDP		SDPT		SDSM		SDSMT		LUGR		LUGRT	
Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	
20L	17.8	21.6	17.8	21.8	17.7	21.4	18	21.1	18.3	21.3	18	21	18.1	21.5	18	20.9	16.3	17.9	17.6	18.2
20LHE	17.6	21.5	17.6	21.6	19.5	22.8	17.6	21.5	17.8	21.4	17.6	21.5	17.9	21.3	17.9	21.4	16.1	17.7	17.4	18
33L	19.5	23.3	19.5	22.8	19.9	23.2	19.3	22.4	19.6	22.6	19.3	22.3	19.6	22.3	19.4	22.2	18	19.6	19.3	19.8
33LHE	19.7	23.3	19.7	23.1	20.5	23.7	19.7	22.8	20	23	19.7	22.7	19.8	23.2	19.8	22.6	17.9	19.5	19.2	19.8
40L	20.2	24	20.3	23.7	20.5	23.8	20.2	24	20.5	23.5	20.2	23.2	20.5	23.2	20.3	23.2	18.7	20.3	20	20.5
40LHE	20.2	24.1	20.3	23.7	20.9	24.6	20.2	23.4	20.5	23.5	20.2	23.3	20.5	23.2	20.3	23.2	18.7	20.3	20	20.5
48L	20.8	24.6	20.7	24.8	20.9	24.6	20.8	24.6	21	24.5	20.7	24.6	21	24.5	21	24.5	19.4	21.1	20.7	21.3
48LHE	20.7	24.3	20.7	24.1	20.9	24.2	20.8	24.6	21	24	20.7	23.7	20.9	23.7	20.8	23.6	19.4	21	20.7	21.2

UGR varies based on luminaire options and is affected by application dependent parameters. Numbers depicted here are considered "Luminaire-UGR and/or "Point-UGR" values.
To determine a more precise maximum UGR value ("Application-UGR"), a full lighting design layout should be completed with the selected luminaire configuration for each application



BLT-2X2

2BLT Volumetric Recessed Lighting 2'x2'

L1

Performance Data					
Model Number	Lumens	LPW	Watts	DLC Listing	DLC ID
2BLT2 20L ADP EZ1 (GZ1, GZ10) LP840	2092	127.8	16.4	Premium	PM92196A
2BLT2 20L ADP EZ1 (GZ1, GZ10) LP835	2036	124.4	16.4	Premium	P6445UVD
2BLT2 20L ADPT EZ1 (GZ1, GZ10) LP840	2061	125.9	16.37		
2BLT2 20L ADPT EZ1 (GZ1, GZ10) LP835	2008	122.7	16.37		
2BLT2 33L ADP EZ1 (GZ1, GZ10) LP835	3300	124.6	26.5	Premium	PHSXHE8F
2BLT2 33L ADP EZ1 (GZ1, GZ10) LP840	3391	128.1	26.5	Premium	PD18CKQ8
2BLT2 33L ADPT EZ1 (GZ1, GZ10) LP840	3343	126.3	26.5	Premium	PF98CZ2H
2BLT2 33L ADPT EZ1 (GZ1, GZ10) LP835	3254	122.9	26.5	Premium	S-0IDCZL
2BLT2 40L ADP EZ1 (GZ1, GZ10) LP835	4034	130.2	31	Premium	P1XWW9GV
2BLT2 40L ADP EZ1 (GZ1, GZ10) LP840	4144	133.8	31	Premium	PHCQ2CQF
2BLT2 40L ADPT EZ1 (GZ1, GZ10) LP835	3977	128.4	31	Premium	PW6RMMJ4
2BLT2 40L ADPT EZ1 (GZ1, GZ10) LP840	4086	131.9	31	Premium	PSYYDAA8
2BLT2 48L ADP EZ1 (GZ1, GZ10) LP835	5022	117.2	42.9	Standard	PLRJR1R1G
2BLT2 48L ADP EZ1 (GZ1, GZ10) LP840	5159	120.4	42.9	Standard	P8G93YOK
2BLT2 48L ADPT EZ1 (GZ1, GZ10) LP835	4951	115.5	42.9	Standard	PITU3V6X
2BLT2 48L ADPT EZ1 (GZ1, GZ10) LP840	5087	118.7	42.9	Standard	PSX2XU76

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.

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	1939	132.3	14.7	Premium	PUQCZNQI
2BLT2 20LHE ADP EZ1 (GZ1, GZ10) LP840	1992	135.9	14.7	Premium	PJCZRW21
2BLT2 20LHE ADPT EZ1 (GZ1, GZ10) LP840	1964	134.0	14.7	Premium	PLC4RF4L
2BLT2 33LHE ADP EZ1 (GZ1, GZ10) LP835	3247	133.0	24.4	Premium	PXXZN9PH
2BLT2 33LHE ADP EZ1 (GZ1, GZ10) LP840	3336	136.7	24.4	Premium	PKPJYYRF
2BLT2 33LHE ADPT EZ1 (GZ1, GZ10) LP835	3202	131.1	24.4	Premium	PZC8BZS5
2BLT2 33LHE ADPT EZ1 (GZ1, GZ10) LP840	3290	134.7	24.4	Premium	PMS5G8AFU
2BLT2 40LHE ADP EZ1 (GZ1, GZ10) LP835	4044	135.5	29.9	Premium	PJ55XFFP
2BLT2 40LHE ADP EZ1 (GZ1, GZ10) LP840	4155	139.2	29.9	Premium	PEGFHPZD
2BLT2 40LHE ADPT EZ1 (GZ1, GZ10) LP835	3987	133.6	29.9	Premium	P8E16E9B
2BLT2 40LHE ADPT EZ1 (GZ1, GZ10) LP840	4096	137.2	29.9	Premium	PFRRSSVG
2BLT2 48LHE ADP EZ1 (GZ1, GZ10) LP835	4944	139.8	35.4	Premium	P558XUZP
2BLT2 48LHE ADP EZ1 (GZ1, GZ10) LP840	5080	143.6	35.4	Premium	P1863H56
2BLT2 48LHE ADPT EZ1 (GZ1, GZ10) LP835	4875	137.8	35.4	Premium	PHPTG5M8
2BLT2 48LHE ADPT EZ1 (GZ1, GZ10) LP840	5009	141.6	35.4	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.



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. A typically configured 2BLT2 features a **Unified Glare Rating (UGR)** starting at 18, UGR data available on page 8. High performance extruded acrylic diffusers conceal LEDs and efficiently deliver light in a volumetric distribution. Five 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 MSD7ADXC ((Passive infrared (PIR)) or MSDPDT7ADXC ((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 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. Designed for use in NEMA standard Type G (1" & 15/16"), NFG (9/16"), and SS (9/16") grid ceilings. Consult factory about other ceiling types.

For recessed mounting in hard ceiling applications, Drywall Grid Adapters (DGA) are available as an accessory. See Accessories section. Suitable for damp location.

LISTINGS — CSA Certified to meet U.S. and Canadian standards. IC rated. Tested in accordance with ISO 14644-1; suitable for use in ISO 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.

GOVERNMENT PROCUREMENT — BAA – Product with the BAA option qualifies as a domestic end product under the Buy American Act as implemented in the FAR and DFARS. Product with the BAA option also qualifies as manufactured in the United States under DOT Buy America regulations.

BABA – Build America Buy America: Product with the BAA option also qualifies as produced in the United States under the definitions of the Build America, Buy America Act. Please refer to www.acuitybrands.com/buy-american for additional information.

WARRANTY — 5-year limited warranty. This is the only warranty provided and no other statements in this specification sheet create any warranty of any kind. All other express and implied warranties are disclaimed. 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	Other Manufacturers: CORELITE "CLASS RX" Series DAY-BRIGHT "FLUXGRID" Series ORACLE "22-ODVH-LED" Series
Notes	
Type	L2

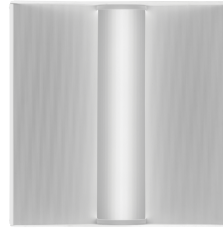
BLT Series LED



ADP Diffuser Option

2BLT2

2' x 2'
LED



Ribbed Reflector Option



eldoLED

BAA

BABA

Specifications

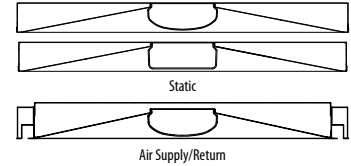
Length: 23-3/4 (60.3)

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

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 when used with Acuity Brands' controls products. All configurations of this luminaire are calibrated and tested to meet the Acuity Brands' specifications for chromatic consistency – including color rendering, color fidelity, and color temperature tolerance around standard CIE chromaticity coordinates.

To learn more about Acuity A+ standards, specifications, and testing visit www.acuitybrands.com/aplus.



Items marked by a shaded background qualify for the Design Select program and ship in 15 days or less. To learn more about Design Select, visit www.acuitybrands.com/designselect. *See ordering tree for details

2BLT Volumetric Recessed Lighting 2'x2'

L2



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 LUGR Low UGR lens ‡ Includes trim rings to match sensored version ADPT Curved, ribbed ADSMT Curved, smooth SDPT Square, ribbed SDSMT Square, smooth LUGRT Low UGR lens with trim ‡	(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 ‡ NESPDT7 nLight™ nES PDT 7 dual technology integral occupancy control ‡ NES7ADCX nLight™ nES 7 ADCX PIR integral occupancy sensor with automatic dimming photocell ‡ NESPDT7ADCX nLight™ nES PDT 7 dual technology integral occupancy sensor with automatic dimming photocell ‡ nLight Wireless RES7 nLight AIR control with PIR integral occupancy sensor and automatic dimming photocell ‡ RES7PDT nLight AIR control with PDT dual technology integral occupancy sensor and 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 ‡ MSDPDT7ADCX 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) ‡ E10WLCP EM Self-Diagnostic battery pack, 10W Constant Power, Certified in CA Title 20 MAEDBS ‡ E10WSTAR Emergency battery pack, Enabled with STAR ‡ 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 WH Glossy White DWAM Anti-Microbial paint JP28 Job packaging ‡ JP44 Job packaging ‡ IPSX Gasketed diffuser compartment to meet IPSX rating ‡ BAA Buy America(n) Act and/or Build America Buy America Qualified

NOTE: ‡ indicates option value has ordering restrictions. Please reference the Option Value Ordering Restrictions chart on the next page. Options are sorted alphanumerically.



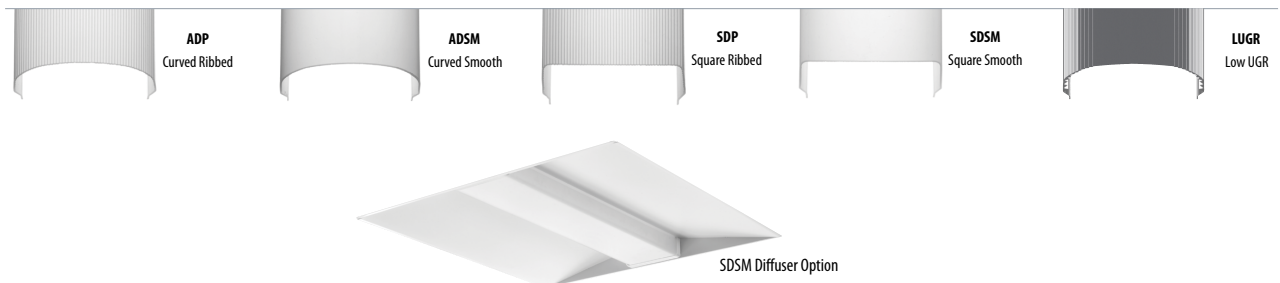
BLT-2X2

2BLT Volumetric Recessed Lighting 2'x2'

L2

‡ 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. If a job pack is selected, use JP28 only.
BGTD	Not available with JOT, JOTVTX15 sensor options or emergency battery options. Must specify voltage. Requires BSE labeling, voltage specific. Example: BGTD BSE10.
Control	Must specify diffuser with trim rings.
CP	Not available with N80, N80EMG, N100, N100EMG, PWS1836, PWS1846, PWS1846 PWSLV or PWS1856LV.
E10WSTAR	Not compatible with 347V.
EL7L, EL14L, E10WLCP	When using pre-wire option, use PWS1846 or PWS1846 PWSLV.
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, NESPDT7, NES7ADCX, NESPDT7ADCX, MSD7ADCX, MSDPDT7ADCX, RES7, RES7PDT, RIO, JOT, JOTVTX15. Not available when sensor options combined with 'A' air supply return option.
JP44	Not available with NES7, NESPDT7, NES7ADCX, NESPDT7ADCX, MSD7ADCX, MSDPDT7ADCX, RES7, RES7PDT, RIO, JOT, JOTVTX15. Not available 'A' air supply return option. Not available with battery and PWS together.
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.
LUGR, LUGRT	Due to the unique optics used to drive the low UGR distribution, the LUGR lens is not uniformly lit and presents visible striping.
MSD7ADCX, MSDPDT7ADCX	Only available with E21 driver option. 0-10v dimming wires not accessible via access plate.
NES7, NESPDT7, NES7ADCX, NESPDT7ADCX	Requires N80, N80EMG, N100, or N100EMG. Only available with E21 driver.
NLTAIR2	Must order with nLight Wireless option from Control section. Not available with GZ10 driver.
NOC	Can only be ordered in conjunction with E21 or GZ1, 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
RES7, RES7PDT, RIO	See UL 924 Sequence of Operation chart on page 3. When combined with the E21 option, can be used as a normal power sensing device for nLight AIR devices and luminaires with EM emergency options.
RES7EM, RES7PDEEM, RIOEM	See UL924 Sequence of Operation chart on page 3. Not available with GZ10 or GZ1 driver.
RRL	For ordering logic consult: RRL_2013.
SLD	Not available with any nLight Interface or Control options.

Multiple Diffuser Options

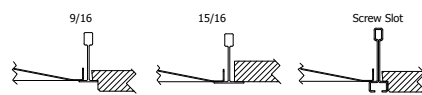


Non-Configurable BLT

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

- The below information applies to all nLight AIR devices with an EM option.
- EM devices will remain at their high-end trim and ignore wireless lighting control commands, unless a normal-power-sensed (NPS) broadcast is received at least every 8 seconds.
 - Using the CLAIRITY+ mobile app, EM devices must be associated with a group that includes a normal power sensing device to receive NPS broadcasts.
 - Only non-emergency rPP20, rLSXR, rSBOR, rSDGR, and nLight AIR luminaires with version 3.4 or later firmware can provide normal power sensing for EM devices. See specification sheets for control devices and luminaires for more information on options that support normal power sensing.



BLT-2X2

2BLT Volumetric Recessed Lighting 2'x2'

L2

Accessories & Replacement Parts

Accessories: Order as separate catalog number.	
DGA22	Drywall grid adapter for 2x2 recessed fixture
2X2SMKSH 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.		
*247WJV	2DBLT24 ADP LENS ASSEMBLY	2 ft. replacement lens
*249P2P	2DBLT24 SDP LENS ASSEMBLY	2 ft. replacement lens
*249P2W	2DBLT24 ADSM LENS ASSEMBLY	2 ft. replacement lens
*249P32	2DBLT24 SDSM LENS ASSEMBLY	2 ft. replacement lens
*237LT1	2DBLT24 ADPT LENS ASSEMBLY	2 ft. replacement lens
*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
*237MS7	2DBLT24 ADSMT SENSOR LENS ASSEMBLY	2 ft. replacement lens
*237MSH	2DBLT24 SDSMT SENSOR LENS ASSEMBLY	2 ft. replacement lens

Emergency Battery Pack Options - Field Installable

Battery Model Number	Wattage	Runtime (Minutes)	Lumen Output* @ 120 Lumens/Watt	Other
ILB CP07 2HA	7W	120	840	Storm Shelter/ 2-hour Runtime
ILB CP10 A	10W	90	1200	
ILB CP10 HE AELR A	10W	90	1200	Title 20; Enabled with Self Testing, Automated Reporting (STAR)
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 techsupport@iotaengineering.com for any Emergency Battery related questions.

BSE Labeling Options

- BSE10 Drivers load transfer relay installed per manufacturer's instructions. Voltage, BGTD and BSE10 called out.
- BSE14 One voltage fixture with driver load control relay supplied with one prewire (PWS option). Prewire wired for normal circuit, the control relay for emergency circuit left unconnected. Voltage, BGTD, BSE14 and prewire called out, in the description.

*For configurations with Reloc or two voltages an RFA modification is required



BLT-2X2

2BLT Volumetric Recessed Lighting 2'x2'

L2

Enabled with STAR

Emergency Lighting with Self-Testing Automated Reporting (STAR), enables self-testing and automated reporting to aid in life safety code compliance. Build your solution and choose your preferred deployment from Mobile STAR, where test data is logged in each individual unit and broadcast to the **CLAIRity™+** app, or Connected STAR, where test data is logged in the STAR Gateway by IOTA® and emailed directly.

Leave the ladders, disruptions and written records behind with emergency lighting solutions with STAR!

Life Safety Code NFPA 101 testing and reporting requirements for emergency lighting include:



Testing for 30 seconds every 30 days



Testing for 90 minutes once a year



Record keeping and to report to the authority having local jurisdiction

MOBILE STAR

For small scale applications

CONNECTED STAR

For large scale applications

2BLT Volumetric Recessed Lighting 2'x2'

L2

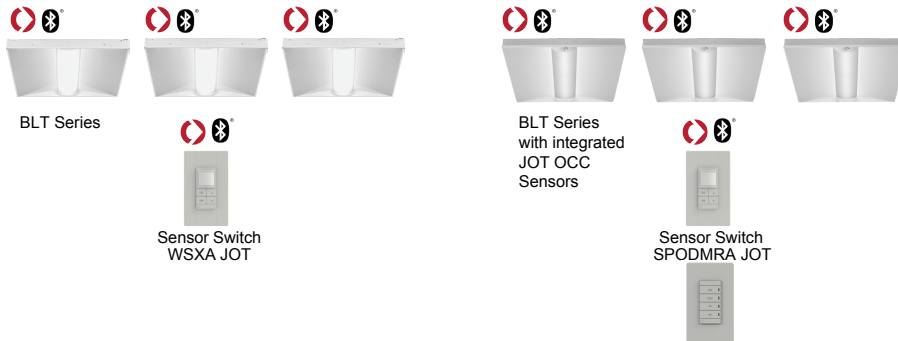
JOT Wireless



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'

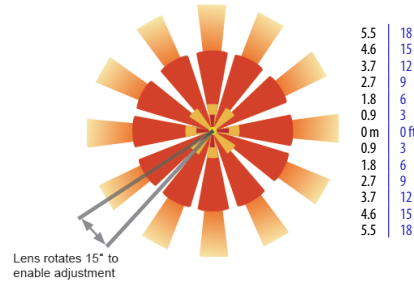
L2

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 MSPDT7ADCX 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

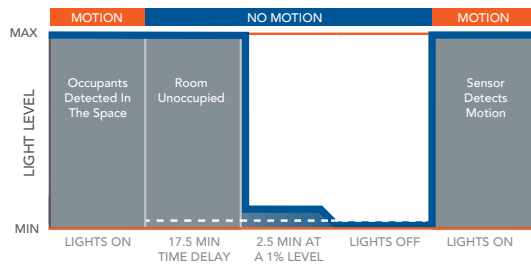
nLight AIR is the ideal solution for retrofit or new construction spaces where adding additional wiring can be labor intensive and nLight AIR is available with or without an integral sensor. The integrated rES7 or rES7PDT smart sensors are part of each luminaire in the nLight AIR network, which can be 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.

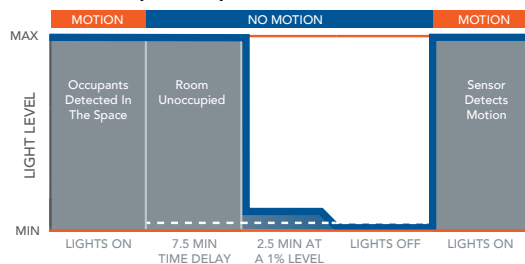
For areas like restrooms, private offices, open offices, conference rooms or any space with obstructions, the nES PDT 7 dual technology sensor is recommended. The nES PDT 7 utilizes both PIR (passive infrared) and Microphonics technologies to detect occupancy. Additionally, the nESPDT7ADCX includes an 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).

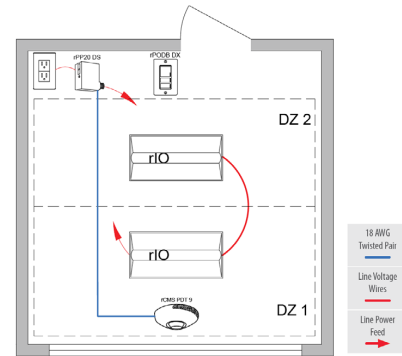
2BLT Volumetric Recessed Lighting 2'x2'

Controls Accessories

nLight® Wired Control Accessories: <i>Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlight.</i>			
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: <i>Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlightair.</i>	
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 PDT 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

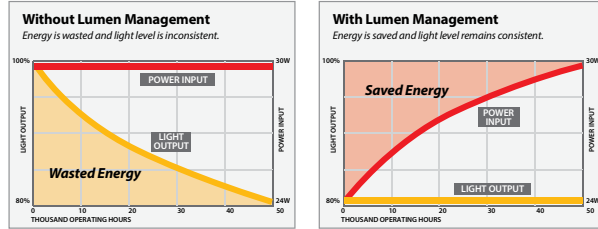


RCMS

2BLT2 Volumetric Recessed Lighting 2'x2'

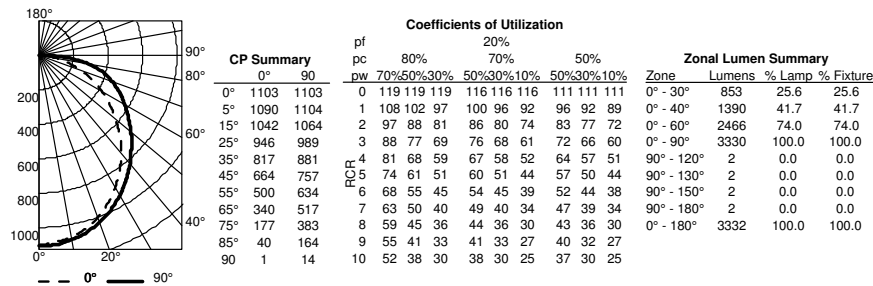
Constant Lumen Management

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.

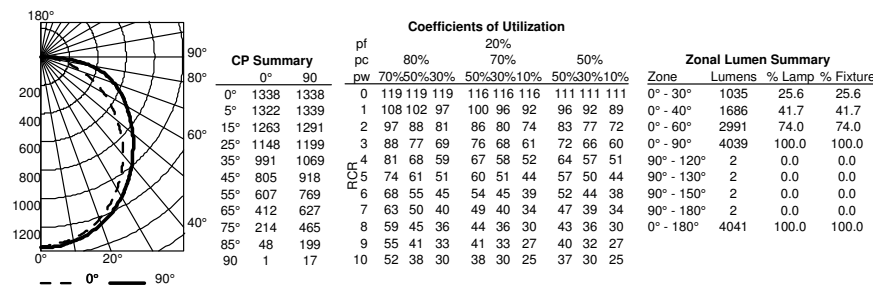


PHOTOMETRICS

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



UNIFIED GLARE RATING (UGR)

Lumen Package	UGR Values of BLT 2x2 @ 80CRI and 3500K																			
	UGR (70% 50% 20% reflectance using a 4H x 8H room size)																			
	ADP		ADPT		ADSM		ADSMT		SDP		SDPT		SDSM		SDSMT		LUGR		LUGRT	
Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	Crosswise	Endwise	
20L	17.8	21.6	17.8	21.8	17.7	21.4	18	21.1	18.3	21.3	18	21	18.1	21.5	18	20.9	16.3	17.9	17.6	18.2
20LHE	17.6	21.5	17.6	21.6	19.5	22.8	17.6	21.5	17.8	21.4	17.6	21.5	17.9	21.3	17.9	21.4	16.1	17.7	17.4	18
33L	19.5	23.3	19.5	22.8	19.9	23.2	19.3	22.4	19.6	22.6	19.3	22.3	19.6	22.3	19.4	22.2	18	19.6	19.3	19.8
33LHE	19.7	23.3	19.7	23.1	20.5	23.7	19.7	22.8	20	23	19.7	22.7	19.8	23.2	19.8	22.6	17.9	19.5	19.2	19.8
40L	20.2	24	20.3	23.7	20.5	23.8	20.2	24	20.5	23.5	20.2	23.2	20.5	23.2	20.3	23.2	18.7	20.3	20	20.5
40LHE	20.2	24.1	20.3	23.7	20.9	24.6	20.2	23.4	20.5	23.5	20.2	23.3	20.5	23.2	20.3	23.2	18.7	20.3	20	20.5
48L	20.8	24.6	20.7	24.8	20.9	24.6	20.8	24.6	21	24.5	20.7	24.6	21	24.5	21	24.5	19.4	21.1	20.7	21.3
48LHE	20.7	24.3	20.7	24.1	20.9	24.2	20.8	24.6	21	24	20.7	23.7	20.9	23.7	20.8	23.6	19.4	21	20.7	21.2

UGR varies based on luminaire options and is affected by application dependent parameters. Numbers depicted here are considered "Luminaire-UGR and/or "Point-UGR" values.
To determine a more precise maximum UGR value ("Application-UGR"), a full lighting design layout should be completed with the selected luminaire configuration for each application



BLT-2X2

2BLT Volumetric Recessed Lighting 2'x2'

L2

Performance Data					
Model Number	Lumens	LPW	Watts	DLC Listing	DLC ID
2BLT2 20L ADP EZ1 (GZ1, GZ10) LP840	2092	127.8	16.4	Premium	PM92196A
2BLT2 20L ADP EZ1 (GZ1, GZ10) LP835	2036	124.4	16.4	Premium	P6445UVD
2BLT2 20L ADPT EZ1 (GZ1, GZ10) LP840	2061	125.9	16.37		
2BLT2 20L ADPT EZ1 (GZ1, GZ10) LP835	2008	122.7	16.37		
2BLT2 33L ADP EZ1 (GZ1, GZ10) LP835	3300	124.6	26.5	Premium	PHSXHE8F
2BLT2 33L ADP EZ1 (GZ1, GZ10) LP840	3391	128.1	26.5	Premium	PD18CKQ8
2BLT2 33L ADPT EZ1 (GZ1, GZ10) LP840	3343	126.3	26.5	Premium	PF98CZ2H
2BLT2 33L ADPT EZ1 (GZ1, GZ10) LP835	3254	122.9	26.5	Premium	S-0IDCZL
2BLT2 40L ADP EZ1 (GZ1, GZ10) LP835	4034	130.2	31	Premium	P1XWW9GV
2BLT2 40L ADP EZ1 (GZ1, GZ10) LP840	4144	133.8	31	Premium	PHCQ2CQF
2BLT2 40L ADPT EZ1 (GZ1, GZ10) LP835	3977	128.4	31	Premium	PW6RMMJ4
2BLT2 40L ADPT EZ1 (GZ1, GZ10) LP840	4086	131.9	31	Premium	PSYYDAA8
2BLT2 48L ADP EZ1 (GZ1, GZ10) LP835	5022	117.2	42.9	Standard	PLRJR1R1G
2BLT2 48L ADP EZ1 (GZ1, GZ10) LP840	5159	120.4	42.9	Standard	P8G93YOK
2BLT2 48L ADPT EZ1 (GZ1, GZ10) LP835	4951	115.5	42.9	Standard	PITU3V6X
2BLT2 48L ADPT EZ1 (GZ1, GZ10) LP840	5087	118.7	42.9	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.

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
2BLT2 20LHE ADP EZ1 (GZ1, GZ10) LP835	1939	132.3	14.7	Premium	PUQCZNI
2BLT2 20LHE ADP EZ1 (GZ1, GZ10) LP840	1992	135.9	14.7	Premium	PJCZRW21
2BLT2 20LHE ADPT EZ1 (GZ1, GZ10) LP840	1964	134.0	14.7	Premium	PLC4RF4L
2BLT2 33LHE ADP EZ1 (GZ1, GZ10) LP835	3247	133.0	24.4	Premium	PXXZN9PH
2BLT2 33LHE ADP EZ1 (GZ1, GZ10) LP840	3336	136.7	24.4	Premium	PKPJYRF
2BLT2 33LHE ADPT EZ1 (GZ1, GZ10) LP835	3202	131.1	24.4	Premium	PZC8BZSS
2BLT2 33LHE ADPT EZ1 (GZ1, GZ10) LP840	3290	134.7	24.4	Premium	PMSG8AFU
2BLT2 40LHE ADP EZ1 (GZ1, GZ10) LP835	4044	135.5	29.9	Premium	PJ55XFFP
2BLT2 40LHE ADP EZ1 (GZ1, GZ10) LP840	4155	139.2	29.9	Premium	PEGFHPZD
2BLT2 40LHE ADPT EZ1 (GZ1, GZ10) LP835	3987	133.6	29.9	Premium	P8E16E9B
2BLT2 40LHE ADPT EZ1 (GZ1, GZ10) LP840	4096	137.2	29.9	Premium	PFRSSSVG
2BLT2 48LHE ADP EZ1 (GZ1, GZ10) LP835	4944	139.8	35.4	Premium	P558XUZP
2BLT2 48LHE ADP EZ1 (GZ1, GZ10) LP840	5080	143.6	35.4	Premium	P1863H56
2BLT2 48LHE ADPT EZ1 (GZ1, GZ10) LP835	4875	137.8	35.4	Premium	PHPTG5M8
2BLT2 48LHE ADPT EZ1 (GZ1, GZ10) LP840	5009	141.6	35.4	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.



BLT-2X2

COMMERCIAL INDOOR: One Lithonia Way Conyers, GA 30012 Phone: 800-705-SERV (7378) www.lithonia.com

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DIGITAL NAVIGATION

[Ordering Tree](#) [SensorSwitch JOT](#) [nLight Platform](#) [Photometrics](#) [Performance Data](#)

FEATURES & SPECIFICATIONS

INTENDED USE — The CPX Series LED is a low-glare back-lit panel featuring an external driver. This cost-effective, reliable flat panel is visually comfortable and can be recessed mounted. Suitable for many applications such as schools, offices, retail, convenience stores, hospitals, healthcare facilities and other commercial spaces. A typically configured CPX features a **Unified Glare Rating (UGR)** starting at 17. Certain airborne contaminants can diminish the integrity of acrylic. [Click here for Acrylic Environmental Compatibility table for suitable uses. U.S. Patent No. 10,681,784.](#)

CONSTRUCTION — A metal frame with satin white lens provides excellent shielding and uniform luminance. CPX's low-profile design provides increased installation flexibility especially in restricted plenum spaces. The back plate includes integral T-bar clips for installation into T-grid ceilings.

ELECTRICAL — Direct-lit Panel with Long-Life LEDs, coupled with a high-efficiency driver, provide superior illumination for extended service life. Greater than 70% LED lumen maintenance at 60,000 hours (L80>60,000). 0-10V dimming driver. Options available for dimming to 1% or 10%. Contains non-isolated dimming leads.

Integrated Wireless Sensor (single room control) — SensorSwitch wireless dimming (JOT) or luminaire embedded occupancy sensor control (VPIR15) with JOT pairing for wall switch On/Off/Dimming control or auto off when the space is unoccupied. See page 8 for more details of the integrated wireless 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.

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.

LISTINGS — CSA certified to meet US and Canadian standards. Damp location listed. IC rated. IP5X Rated. DesignLights Consortium® (DLC) qualified product. Not all versions of this product may be DLC qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified. Rated for NSF/ANSI Standard 2 - Light Fixture for Splash Zone and Non-Food Zone. NOM Certified.

GOVERNMENT PROCUREMENT — BAA – Product with the BAA option qualifies as a domestic end product under the Buy American Act as implemented in the FAR and DFARS. Product with the BAA option also qualifies as manufactured in the United States under DOT Buy America regulations.

BABA – Build America Buy America: Product with the BAA option also qualifies as produced in the United States under the definitions of the Build America, Buy America Act. Please refer to www.acuitybrands.com/buy-american for additional information.

WARRANTY — 5-year limited warranty. This is the only warranty provided and no other statements in this specification sheet create any warranty of any kind. All other express and implied warranties are disclaimed. 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	Other Manufacturers: METALUX "22FPX" Series DAY-BRIGHT "FLUXPANEL" Series ORACLE "22-FPL1-LED" Series
Notes	
Type	L3

CPX LED PANEL

Configurable

1' x 4', 2' x 2' and 2' x 4'



[†] Tested in accordance with ISO 14644-14; suitable for ISO Class 5-9 positive and negative pressure clean rooms.

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 when used with Acuity Brands controls products.

All configurations of this luminaire are calibrated and tested to meet the Acuity Brands' specifications for chromatic consistency – including color rendering, color fidelity, and color temperature tolerance around standard CIE chromaticity coordinates.

To learn more about Acuity A+ standards, specifications, and testing visit www.acuitybrands.com/aplus.



Items marked by a shaded background qualify for the Design Select program and ship in 15 days or less. To learn more about Design Select, visit www.acuitybrands.com/designselect. *See ordering tree for details

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Design Select options indicated by this color background.

Looking for Contractor Select readily available configurations? Click here to visit Contractor Select™ spec sheet or go to www.contractorselect.com

ORDERING INFORMATION

Example: CPX 2X2 3200LM 80CRI 40K SWL MIN10 ZT MVOLT E10WLCP

Series	Fixture Dimension	Lumen Output ‡	CRI	Color Temperature	Diffuser	Minimum Dimming Level	
CPX LED Panel	1X4 1' X 4'	Standard lumens: 2000LM 2000 Lumens 3200LM 3200 Lumens 4000LM 4000 Lumens 5000LM 5000 Lumens 6000LM 6000 Lumens	80CRI 80 CRI 90CRI 90 CRI ‡	30K 3000K 35K 3500K 40K 4000K 50K 5000K	SWL Satin White A12 Prismatic A12 Pattern	MIN10 Dims to 10% MIN1 Dims to 1% ‡	
		High Efficiency lumens: 3200LMHE 3200 Lumens 4000LMHE 4000 Lumens		3200LMHE 3200 Lumens 4000LMHE 4000 Lumens			
		2000LM 2000 Lumens 3200LM 3200 Lumens 4000LM 4000 Lumens 5000LM 5000 Lumens 6000LM 6000 Lumens		3200LMHE 3200 Lumens 4000LMHE 4000 Lumens			
	2X2 2' X 2'	2000LM 2000 Lumens 3200LM 3200 Lumens 4000LM 4000 Lumens 5000LM 5000 Lumens 6000LM 6000 Lumens	4000LMHE 4000 Lumens 5000LMHE 5000 Lumens	3000LM 3000 Lumens 4000LM 4000 Lumens 5000LM 5000 Lumens 6000LM 6000 Lumens 7200LM 7200 Lumens 8500LM 8500 Lumens 10000LM 10000 Lumens ‡	3000LM 3000 Lumens 4000LM 4000 Lumens 5000LM 5000 Lumens 6000LM 6000 Lumens 7200LM 7200 Lumens 8500LM 8500 Lumens 10000LM 10000 Lumens ‡	4000LMHE 4000 Lumens 5000LMHE 5000 Lumens	
		3000LM 3000 Lumens 4000LM 4000 Lumens 5000LM 5000 Lumens 6000LM 6000 Lumens 7200LM 7200 Lumens 8500LM 8500 Lumens 10000LM 10000 Lumens ‡	4000LMHE 4000 Lumens 5000LMHE 5000 Lumens				
		3000LM 3000 Lumens 4000LM 4000 Lumens 5000LM 5000 Lumens 6000LM 6000 Lumens 7200LM 7200 Lumens 8500LM 8500 Lumens 10000LM 10000 Lumens ‡	4000LMHE 4000 Lumens 5000LMHE 5000 Lumens				
		3000LM 3000 Lumens 4000LM 4000 Lumens 5000LM 5000 Lumens 6000LM 6000 Lumens 7200LM 7200 Lumens 8500LM 8500 Lumens 10000LM 10000 Lumens ‡	4000LMHE 4000 Lumens 5000LMHE 5000 Lumens				
		3000LM 3000 Lumens 4000LM 4000 Lumens 5000LM 5000 Lumens 6000LM 6000 Lumens 7200LM 7200 Lumens 8500LM 8500 Lumens 10000LM 10000 Lumens ‡	4000LMHE 4000 Lumens 5000LMHE 5000 Lumens				
		3000LM 3000 Lumens 4000LM 4000 Lumens 5000LM 5000 Lumens 6000LM 6000 Lumens 7200LM 7200 Lumens 8500LM 8500 Lumens 10000LM 10000 Lumens ‡	4000LMHE 4000 Lumens 5000LMHE 5000 Lumens				

Dimming ‡	Voltage	Step Level Dimming	Emergency Option
(blank) If Controls are being used. ZT Generic 0-10V Dimming EZT eldoLED 0-10V Dimming ‡	MVOLT MVOLT, 120-277V 120 120V 277 277V 347 347 ‡	(blank) None SLD Step Level Dimming ‡	(blank) No battery E10WLCP EM Self-Diagnostic battery pack, 10W Constant Power, Certified in CA Title 20 MAEDBS ‡ E10WRSTAR Emergency battery pack, Enabled with STAR ‡ E7W Emergency Battery Pack, 7W, CA Title 20 Noncompliant ‡ GTD Generator Transfer Device ‡

Control Input	Sensor	Options
(blank) No controls	(blank) No sensor	GLR Fast-blowing fuse ‡ GMF Slow-blowing Fuse ‡ PWS1836 6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit ‡ PWS1846 6' pre-wire, 3/8" diameter, 18 gauge, 2 circuit ‡ PWS1856LV 6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit w/ low voltage ‡ PWS1846 PWSLV Two cables: one 6' pre-wire, 3/8" diameter, 18 gauge, 2 circuits; one 6' pre-wire, 3/8" diameter, 18 gauge ‡ DWAM Anti-Microbial paint CP Chicago plenum ‡ NPLT Narrow Pallet BAA Buy America(n) Act and/or Build America Buy America Qualified
SSE Sensor Switch Embedded	APIR Occ sensing with passive infrared - on/off functionality and auto dimming photocell APDT Occ sensor dual tech (passive infrared & microphonics) and auto dimming photocell VAPIR15 Vertex low-profile on/off occupancy sensor with auto dimming photocell with VLP programming at 15ft mounting height	
NLIGHT nLight enabled NLIGHTER nLight enabled, for use with generator supply EM power NLIGHTLM nLight enabled with lumen management NLIGHTERLM nLight enabled with lumen management, for use with generator supply EM power	(blank) No sensor, Control Input function only PIR Occ sensing with passive infrared - on/off functionality PDT Occ sensor dual tech (passive infrared & microphonics) APIR Occ sensing with passive infrared - on/off functionality and auto dimming photocell APDT Occ sensor dual tech (passive and microphonics) and auto dimming photocell.	
NLTAIR2 nLight AIR Generation 2 (wireless) enabled ‡ NLTAIREM2 nLight AIR Generation 2 (wireless) enabled and UL924 Emergency Operation, via power interrupt detection. ‡	(blank) No sensor, Control Input function only APIR Occ sensing with passive infrared - on/off functionality and auto dimming photocell APDT Occ sensor dual tech (passive and microphonics) and auto dimming photocell APIREM Occ sensing with passive infrared - on/off functionality and auto dimming photocell and UL924 Emergency operation, via power interrupt detection APDTEM Occ sensing dual tech- ((passive infrared & microphonics) and auto dimming photocell and UL924 Emergency operation, via power interrupt detection	
JOT Wireless room control with "Just One Touch" pairing	(blank) No sensor, Control Input function only VAPIR15 Vertex low-profile on/off occupancy sensor with auto dimming photocell at 15ft mounting height	

NOTE: ‡ indicates option chosen has ordering restriction or note. Please reference restrictions/notes chart on next page. Restriction notes are sorted in the sequence they appear in the ordering tree.



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OPTION VALUE RESTRICTIONS/ NOTES

‡ Option Value Ordering Notes/ Restrictions	
Option value	Restriction
Lumen Output High Efficiency (HE)	HE is not available with 90CRI.
10000LM	Not available with JOT or with VAPIR15.
MIN1	Required for all Control Input Options, except JOT.
90CRI	Not available with 2000 Lumens or any HE lumen package.
Dimming	If Control Input option selected leave this section blank.
EZT	Not available with 10000LM combined with 2X4.
347	347 not available with SLD, E10WLCP, E7W, and GTD Options.
SLD	Leave Minimum Dimming Level and Dimming option sections blank. Not available with MIN1, MIN10, EZT, ZT or GTD. Not available with any controls.
E10WLCP, E7W	Not available with 347. Configurations with E10WLCP or E7W to be used in daisy chaining or through wiring will require a Y connector not supplied. If used with CP option the contractor must verify that the Y connector is Chicago Plenum rated.
E10WRSTAR	Not compatible with 347.
GTD	Not available with 347, SLD or in 1X4 combined with 6000LM.
NLTAIR2	See UL924 Sequence of Operation Chart below. Can be used as a normal power sensing device for nLight AIR devices and luminaires with EM emergency options.
NLTAIREM2	See UL924 Sequence of Operation Chart below. Leave Sensor option section blank, not available with APIR, APDT, APIREM, or APDTEM.
GLR, GMF	Must specify voltage, only available with 120 or 277V.
PWS1836	Not available with E10WLCP, E7W, GTD or E10WRSTAR.
PWS1846	Only available with E10WLCP, E7W or SLD.
PWS1856LV	Not available with E10WLCP, E7W or Controls.
PWS1846 PWSLV	Not available with Controls or SLD.
CP	CP Not available with PWS1836, PWS1846, PWS1856LV, or PWS1846 PWSLV, NLIGHT, NLIGHTER, NLIGHTLM, NLIGHTERLM options.

ACCESSORIES

Accessories: Order as separate catalog number.

ILBLP CP10 HE SD A	IOTA 10 Watt Constant Power, High Efficiency LED Emergency Driver for CA Title 20 ‡
ELA PSDMT	Remote mount tray for ILBLP battery.
DGA14	Drywall grid adapter for 1x4 recessed fixture.
DGA22	Drywall grid adapter for 2x2 recessed fixture.
DGA24	Drywall grid adapter for 2x4 recessed fixture.
1X4SMKSH	Multi-Use Surface Mount Kit 1x4, Shallow Depth
2X2SMKSH	Multi-Use Surface Mount Kit 2x2, Shallow Depth
2X4SMKSH	Multi-Use Surface Mount Kit 2x4, Shallow Depth
1X4SMKSH PAF	Multi-Use Surface Mount Kit 1X4 Post-Paint
2X2SMKSH PAF	Multi-Use Surface Mount Kit 2X2 Post-Paint
2X4SMKSH PAF	Multi-Use Surface Mount Kit 2X4 Post-Paint
PAC 2DNF 36	Panel Air Craft Kit, 2 cables with Y splitter, No Power Feed, 36 inches. Recommended for 2X2 or 1X4 Panel Fixture.
PAC 2DF 36	Panel Air Craft Kit, 2 cables with Y splitter, with Power Feed, 36 inches. Recommended for 2X2 or 1X4 Panel Fixture. ¹
PAC 4DNF 36	Panel Air Craft Kit, 4 cables, No Power Feed, 36 inches. Recommended for 2X4 or 2X2 or 1X4 Panel Fixtures.
PAC 4DF 36	Panel Air Craft Kit, 4 cables, with Power Feed, 36 inches. Recommended for 2X4 or 2X2 or 1X4 Panel Fixtures. ¹
PAC 2DNF 72	Panel Air Craft Kit, 2 cables with Y splitter, No Power Feed 72 inches. Recommended for 2X2 or 1X4 Panel Fixture.
PAC 2DF 72	Panel Air Craft Kit, 2 cables with Y splitter, with Power Feed, 72 inches. Recommended for 2X2 or 1X4 Panel Fixture. ¹
PAC 4DNF 72	Panel Air Craft Kit, 4 cables, No Power Feed, 72 inches. Recommended for 2X4 or 2X2 or 1X4 Panel Fixtures.
PAC 4DF 72	Panel Air Craft Kit, 4 cables, with Power Feed, 72 inches. Recommended for 2X4 or 2X2 or 1X4 Panel Fixtures. ¹
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
CPX Gasket Kit	Fixture/Grid foam gasket, cut to size, 2x4/1x4/2x2 ²

Emergency Battery Delivered Lumens

Use the formula below to determine the delivered lumens in emergency mode

$$\text{Delivered Lumens} = 1.25 \times P \times LPW$$

P = Output power of emergency driver (10W for PS1055)

LPW = Lumen per watt rating of the luminaire.

Notes

- For MVOLT only, not available with 347V.
- CPX Gasket kit accommodates a single 1x4, 2x2 or 2x4 CPX fixture. This kit does not make the fixture IP65 compliant.

UL924 Sequence of Operation

The below information applies to all nLight AIR devices with an EM option.

- EM devices will remain at their high-end trim and ignore wireless lighting control commands, unless a normal-power-sensed (NPS) broadcast is received at least every 8 seconds.
- Using the **CLAIRITY+** mobile app, EM devices must be associated with a group that includes a normal power sensing device to receive NPS broadcasts.
- Only non-emergency rPP20, rLSXR, rSBOR, rSDGR, and nLight AIR luminaires with version 3.4 or later firmware can provide normal power sensing for EM devices. See specification sheets for control devices and luminaires for more information on options that support normal power sensing.

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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
ILB CP10 HE AELR A	10W	90	1200	Title 20; Enabled with Self Testing, Automated Reporting (STAR)
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

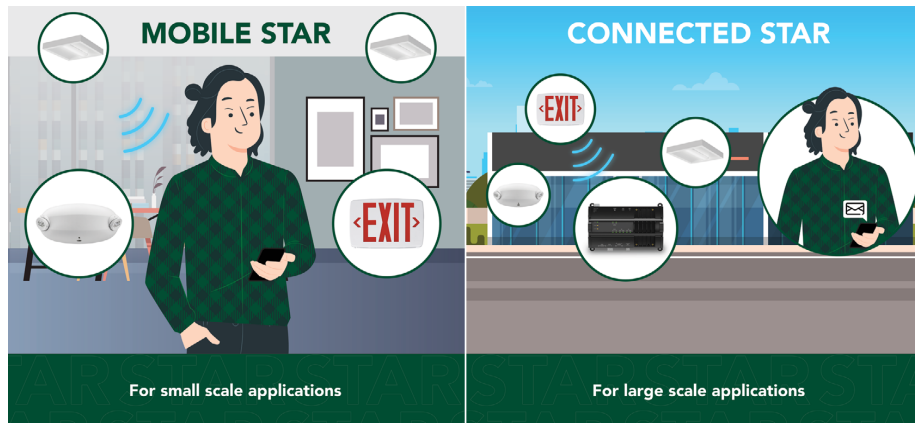
All the above are UL Listed products that are certified for field install external/remote to the fixture.
*Minimum delivered lumen output to assist in product selection for increased fixture mounting height.
The CP10 delivered emergency illumination outperforms legacy 1400 lumen fluorescent emergency ballast.
Please contact us at techsupport@iotaengineering.com for any Emergency Battery related questions.

Enabled with STAR

Emergency Lighting with Self-Testing Automated Reporting (STAR), enables self-testing and automated reporting to aid in life safety code compliance. Build your solution and choose your preferred deployment from Mobile STAR, where test data is logged in each individual unit and broadcast to the **CLAIRity™+ app**, or Connected STAR, where test data is logged in the STAR Gateway by **IOTA®** and emailed directly. **Leave the ladders, disruptions and written records behind with emergency lighting solutions with STAR!**

Life Safety Code NFPA 101 testing and reporting requirements for emergency lighting include:

-  Testing for 30 seconds every 30 days
-  Testing for 90 minutes once a year
-  Record keeping and to report to the authority having local jurisdiction



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Optical Performance

UGR Values of CPX 1x4 @ 80CRI and 3500K (70% 50% 20% reflectance using a 4H x 8H room size)				
Lumen Package	A12		SWL	
	Crosswise	Endwise	Crosswise	Endwise
2000LM	17.5	17.6	19.8	19.5
3200LM	19.1	19.2	21.4	21.1
3200LMHE	19.3	19.3	21.5	21.3
4000LM	19.9	20	22.2	21.9
4000LMHE	20	20.1	22.3	22
5000LM	20.6	20.7	22.9	22.6
6000LM	21.5	21.6	23.8	23.5

UGR Values of CPX 2x2 @ 80CRI and 3500K (70% 50% 20% reflectance using a 4H x 8H room size)				
Lumen Package	A12		SWL	
	Crosswise	Endwise	Crosswise	Endwise
2000LM	17.3	17.6	19.7	19.5
3200LM	19.1	19.4	21.5	21.3
3200LMHE	19.1	19.4	21.5	21.3
4000LM	19.7	20.1	22.2	22
4000LMHE	19.7	20.1	22.2	22
5000LM	20.4	20.8	22.9	22.6
6000LM	21.1	21.5	23.6	23.3

UGR Values of CPX 2x4 @ 80CRI and 3500K (70% 50% 20% reflectance using a 4H x 8H room size)				
Lumen Package	A12		SWL	
	Crosswise	Endwise	Crosswise	Endwise
3000LM	16.2	16.4	18.5	18.4
4000LM	17.4	17.8	19.9	19.7
4000LMHE	17.6	17.9	20	19.9
5000LM	17.7	17.9	20	19.9
5000LMHE	18	18.3	20.4	20.3
6000LM	18.2	18.5	20.6	20.5
7200LM	19.1	19.4	21.5	21.4
8500LM	19.7	20	22.1	22
10000LM	20.3	20.6	22.7	22.5

*UGR varies based on luminaire options and is affected by application dependent parameters. Numbers depicted here are considered "Luminaire-UGR and/or "Point-UGR" values. To determine a more precise maximum UGR value ("Application-UGR"), a full lighting design layout should be completed with the selected luminaire configuration for each application.

Lumen Maintenance

Reported Lumen Maintenance	Forecasted Lumen Maintenance
L90 @ 37k Hrs / L80 @ >60k Hrs / L70 @ > 60k Hrs	L90 @ 37k Hrs / L80 @ 76k Hrs / L70 @ 120k Hrs

*Note - Reported LM based on IES standard 6X test period for LM-80 report. Forecasted LM based on TM-21 report extrapolation past 6X LM-80 testing.

CPX compatible with
Sensor Switch™
WSX-D and SPOD
wall switches.



WSX-D



SPOD

PHOTOMETRICS

See www.lithonia.com for photometry reports.



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Intelligent Luminaire Technology Guide

Choose nomenclature from these columns

Control/ Sensor Configurations	Control Input	Sensor	Sensor	Notes
		SSE +	APIR =	MSD 7 ADCX
	SSE +	APDT =	MSD PDT 7 ADCX	Individual fixture control only. PDT integral occupancy sensor with automatic dimming control photocell.
	SSE +	VPIR15 =	VERTEX 15F EZ VLP	Vertex low-profile on/off occupancy sensor with auto dimming photocell with VLP programming at 15ft mounting height.
	JOT +	(blank) =	BTRM JOT BTA	Wireless room control with "Just One Touch" pairing.
	JOT +	VPIR15 =	BTRM JOT BTA + VERTEX 15F EZ VLP GSKT	Wireless room control with "Just One Touch" pairing.
	NLIGHT +	(blank) =	nIO EZ PH	nLight enabled only. No onboard sensor.
	NLIGHT +	PIR =	nIO EZ PH + nES 7	nLight enabled with PIR integral occupancy sensor.
	NLIGHT +	PDT =	nIO EZ PH + nES PDT 7	nLight enabled with dual technology occupancy control sensor.
	NLIGHT +	APIR =	nIO EZ PH + nES 7 ADCX	nLight enabled with PIR integral occupancy sensor with automatic dimming photocell.
	NLIGHT +	APDT =	nIO EZ PH + nES PDT 7 ADCX	nLight enabled with dual technology occupancy controls sensor with automatic dimming photocell.
	NLIGHTER +	(blank) =	nIO EZ PH ER	Emergency nLight enabled only. No onboard sensor.
	NLIGHTER +	PIR =	nIO EZ PH ER + nES 7	Emergency nLight enabled with PIR integral occupancy sensor.
	NLIGHTER +	PDT =	nIO EZ PH ER + nES PDT 7	Emergency nLight enabled with dual technology occupancy control sensor.
	NLIGHTER +	APIR =	nIO EZ PH ER + nES 7 ADCX	Emergency nLight enabled with PIR integral occupancy sensor with automatic dimming photocell.
	NLIGHTER +	APDT =	nIO EZ PH ER + nES PDT 7 ADCX	Emergency nLight enabled with dual technology occupancy controls sensor with automatic dimming photocell.
	NLIGHTLM +	(blank) =	nIO EZ PH N80	nLight enabled only with 80% constant lumen management. No onboard sensor.
	NLIGHTLM +	PIR =	nIO EZ PH N80 + nES 7	nLight enabled with 80% constant lumen management with PIR integral occupancy sensor.
	NLIGHTLM +	PDT =	nIO EZ PH N80 + nES PDT 7	nLight enabled with 80% constant lumen management with dual technology occupancy control sensor.
	NLIGHTLM +	APIR =	nIO EZ PH N80 + nES 7 ADCX	nLight enabled with 80% constant lumen management with PIR integral occupancy sensor with automatic dimming photocell.
	NLIGHTLM +	APDT =	nIO EZ PH N80 + nES PDT 7 ADCX	nLight enabled with 80% constant lumen management with dual technology occupancy controls sensor with automatic dimming photocell.
	NLIGHTERLM +	(blank) =	nIO EZ PH ER N80	Emergency nLight enabled only with 80% constant lumen management. No onboard sensor.
	NLIGHTERLM +	PIR =	nIO EZ PH ER N80 + nES 7	Emergency nLight enabled with 80% constant lumen management with PIR integral occupancy sensor.
	NLIGHTERLM +	PDT =	nIO EZ PH ER N80 + nES PDT 7	Emergency nLight enabled with 80% constant lumen management with dual technology occupancy control sensor.
	NLIGHTERLM +	APIR =	nIO EZ PH ER N80 + nES 7 ADCX	Emergency nLight enabled with 80% constant lumen management with PIR integral occupancy sensor with automatic dimming photocell.
	NLIGHTERLM +	APDT =	nIO EZ PH ER N80 + nES PDT 7 ADCX	Emergency nLight enabled with 80% constant lumen management with dual technology occupancy controls sensor with automatic dimming photocell.
	NLTAIR2 +	(blank) =	RIO EZ PH 180D G2	nLight AIR Generation 2 enabled.
	NLTAIREM2 +	(blank) =	RIO EZ PH ER 180D G2	nLight AIR Generation 2 enabled.
	NLTAIR2 +	APIR =	RES7 G2	nLight AIR Generation 2 enabled.
	NLTAIR2 +	APDT =	RES7 PDT 90D G2	nLight AIR Generation 2 enabled.
	NLTAIR2 +	APIREM =	RES7 EM 90D G2	nLight AIR Generation 2 enabled.
	NLTAIR2 +	APDTEM =	RES7 PDT EM 90D G2	nLight AIR Generation 2 enabled.



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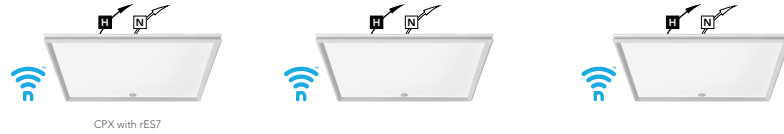
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nLight Platform

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 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)



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

Configurable CPX LED Flat Panel

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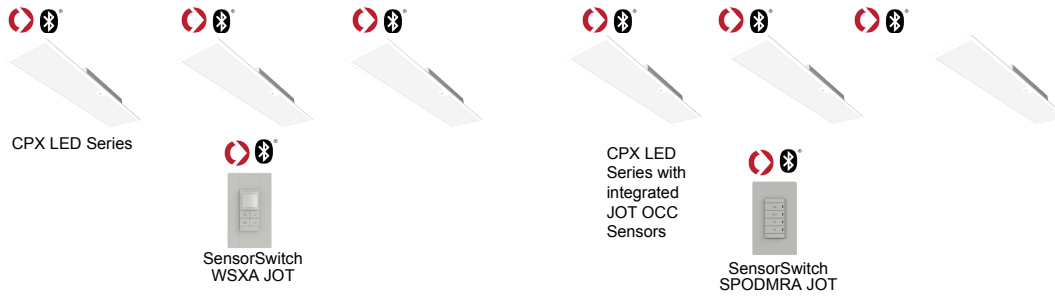
JOT WIRELESS



SensorSwitch JOT Enabled Wireless Solution

Designed with contractors in mind, the SensorSwitch 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.



CPX 2X4 with JOT Vertex Sensor



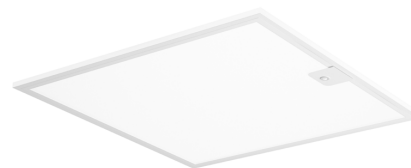
CPX 1X4 with JOT Vertex sensor



CPX 2X2 RES7



CPX 2X2 with JOT Vertex Sensor



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Configurable CPX

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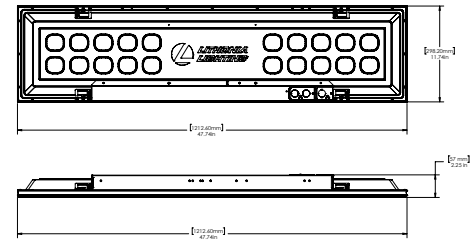
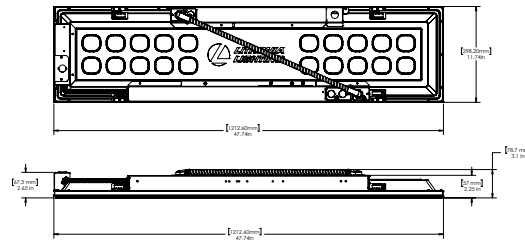
Configurable CPX LED Flat Panel

DIGITAL NAVIGATION | [Home](#) | [Ordering](#) | [SensorSwitch JOT](#) | [nLight Platform](#) | [Photometrics](#) | [Performance Data](#)

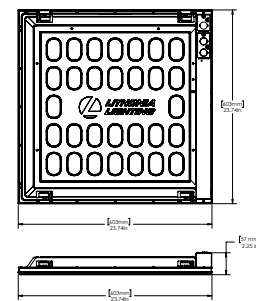
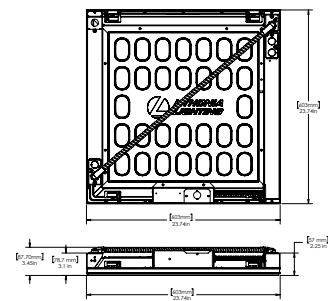
L3

DIMENSIONS

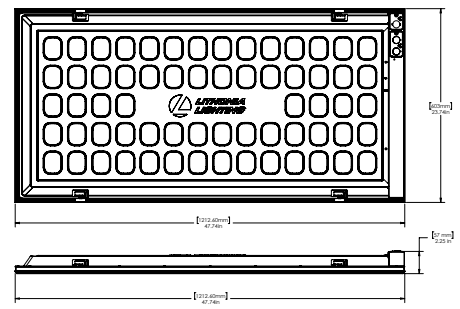
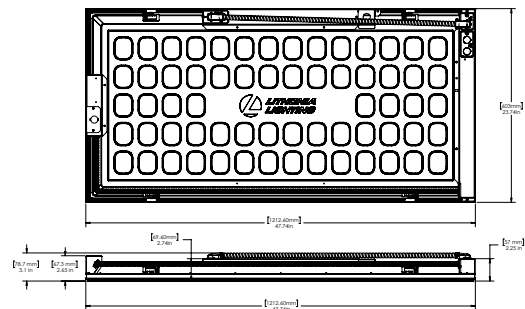
Length: 47.8" 121.4cm
Width: 11.8" 30.0cm
Depth: 2.3" 5.7cm
Weight:
Unit: 9.25 lbs
Unit Carton: 10.25 lbs



Length: 23.8" 60.5cm
Width: 23.8" 60.5cm
Depth: 2.3" 5.7cm
Weight:
Unit: 9.45lbs
Unit Carton: 10.45lbs



Length: 47.8" (121.4cm)
Width: 23.8" 60.5cm
Depth: 2.3" 5.7cm
Weight:
Unit: 17.25 lbs
Unit Carton: 19.25 lbs



All dimensions are the same except the height with the STAR configuration. Includes conduit
1X4- 3.21"-depth
2X2- 3.24"-depth
2X4-3.25"-depth



Configurable CPX



Diva 3 PT

- Pendant
- Rectangle
- Adjustable 20°
- 3" Inner Aperture

Project:	
Type:	L4
Contact:	



Other Manufacturers:
INTEGGER "ELEVATE" Series
LF ILLUMINATION "SNH-C" Series
INTENSE "GX" Series

ORDERING INFO

P2 DI3PT

FINISH TO BE
SELECTED BY
ARCHITECT

MODEL	Wattage	Kelvin	CRI	Beam	Lens	Color	Driver	Installation	I.P. Rating
DI3PT: Diva 3 PT	27 : 27W(09W x3)	27 : 2700k	A : 80	6 : 60°	F : Frosted	WS : Matte White	00 : No Driver	LI : Canopy for Integral Driver (Canopy for Integral ELV or 0-10V driver) RL : Retro-Fit Enclosure for Lutron™ R0 : Retro-Fit Enclosure CC : Concrete Ceiling	D : Dry IP 20
	39 : 39W(13W x3)	30 : 3000k	B : 95	3 : 36°	P : Prismatic	BK : Matte Black	N0 : Non-Dimmable		
		35 : 3500k		2 : 24°	C : Clear	CC : Custom Color	E0 : ELV Dimmable		
		40 : 4000k		1 : 10°(WD, TH, TD, and RGBW not possible with 10°)	X : Hex Louver + Solite		Z0 : 0-10V Dimmable to 1%		
	AM : Amber	WD : Warm Dim 1800K to 3000K				B0 : Bluetooth	L0 : Lutron™ (Lutron EcoSystem)		
	TD : Tunable White 2700K to 6500K (Daylight)					D0 : DALI(Not possible with concrete ceiling)			
	TH : Tunable White 1800K to 4000K (Hospitality)					X0 : DMX(Not possible with concrete ceiling)			
	RW : RGBW (Driver must be remote)					V0 : Low Voltage CC2CV(Price does not include power supply)			

Notes:

Drivers are designed with universal input voltage compatibility, accommodating a range from 120V to 277V.

SPECIFICATIONS

LED Source

Tool-free field-replaced LED module. Propriety high performance aluminum extruded heatsink, anodized black for maximum LED life. 2 SDCM Binning for all static colors.

Beams

Computer-optimized reflector design, high reflected finish aluminum for 24°, 36° and 60°. For 10° beam angle option a Total Internal Reflection technology is used.

Trim

We use CNC machining to precision-machine 6063 aluminum trims to tight tolerances. Then, we powder coat them in our in-house facility for a durable, long-lasting finish. This process ensures that our trims meet our high standards of quality and performance.

Fixture retention

Pendant canopy to be mounted to standard 3"-4" octagonal junction box, with hardware supplied by others. Please refer to the proper installation instructions if a different condition for mounting is presented. Comes standard with an 8' field adjustable aircraft cable kit. Pendant cord is a possible option, please contact factory.

Life

L80(10K): 55,000+ hrs at 80% of initial lumens.

Label

ETL listed for US Canada. CE labeled. CCC label available on request.

Warranty

5 years limited warranty.

<https://zanibonilighting.com/terms-and-conditions.html>

Zaniboni lighting - Ph +1(727)213-0410 - Fx +1(727)683 - 9720 - zanibonilighting.com - 101 N Garden Ave Suite 230, Clearwater - FL 33755
The manufacture reserves the right to change or modify the design, dimensions, and photometric information at any time without notice. The manufacturer accepts no liability for consequential damage which is occasioned to the user based on the data provided.

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page 1

PERFORMANCE INFO

L4

3000K Power 80 CRI Performance

Performance Options	27W (9W x 3 lights)	39W (13W x 3 lights)
Source Lumens [lm]	3924 (1308 x 3 lights)	5256 (1752 x 3 lights)
Delivered Lumens [lm]	3270 (1090 x 3 lights)	4380 (1460 x 3 lights)
Efficacy [lm / W]	126	116
Multipliers	0.75	1.00
Current [mA]	250	350

CRI/CCT Multiplier

CRI/CCT Multiplier	2700°K	3000°K	3500°K	4000°K
80 CRI	0.94	1.00	1.02	1.03
95 CRI	0.78	0.81	0.84	0.86

RGBW Performance (All Colors On)

Power Options	9W	13W
Source Lumens [lm]	670	944
Delivered Lumens [lm]	603	850
Efficacy [lm / W]	71	69

RGBW Performance (Single Color) @ 13 Watts

Color	Red	Green	Blue	White (6500K)	Totals
Source Lumens [lm]	210	267	90	376	944
Delivered Lumens [lm]	190	241	81	339	850
Efficacy [lm / w]	15	20	7	28	69

Hex Louvre Multiplier

Beam	10°	24°	36°	60°
Lumens Multiplier	0.54	0.58	0.54	0.53
Beam Multiplier	0.98	0.76	0.76	0.75

Amber (Wavelength 590nm) Values @ 7 Watts / 700mA

Power Options	3W	5W	7W
Source Lumens [lm]	241	355	473
Delivered Lumens [lm]	207	305	407
Efficacy [lm / W]	75	68	65

Beam-Lumens Lens Multiplier

Nominal Optic	10°	24°	36°-1	60°-1
Clear	11°-1.00	27°-1.00	35°-1.00	54°-1.00
Frosted	31°-0.89	50°-0.88	55°-0.88	64°-0.90
Prismatic	37°-0.93	54°-0.95	63°-0.96	66°-0.97

Splay Color Multiplier

White	Shadow Gray	Black
1.00	0.95	0.92

Warm Dim

(CCT 1800K - 3000K) Values @ 3000K / 95CRI [13W]

Power Options	13W
Source Lumens [lm]	1101
Delivered Lumens [lm]	991
Efficacy [lm / W]	84

Warm Dim

(CCT 1800K - 3000K) @ Different CCT 13W / 95CRI

CCT Value	1800K	2200K	2700K	3000K
Source Lumens [lm]	33	220	551	1101
Delivered Lumens [lm]	30	198	495	991
Efficacy [lm / W]	84	84	84	84

Tunable White Hospitality

(CCT 1800K - 4000K) Values @ 3000K & 95CRI

Power Options	9W	13W
Source Lumens [lm]	889	1245
Delivered Lumens [lm]	800	1120
Efficacy [lm / W]	92	91

Tunable White Daylight

(CCT 2700K - 6500K) Values @ 3000K & 95CRI

Power Options	9W	13W
Source Lumens [lm]	927	1298
Delivered Lumens [lm]	834	1168
Efficacy [lm / W]	96	95

Tunable White Hospitality

(CCT 1800K - 4000K) @ Different CCT 13W 95CRI

CCT Value	1800K	3000K	3500K	4000K
Source Lumens [lm]	818	1245	1274	1306
Delivered Lumens [lm]	736	1120	1147	1175
Efficacy [lm / W]	60	91	94	96

Tunable White Daylight

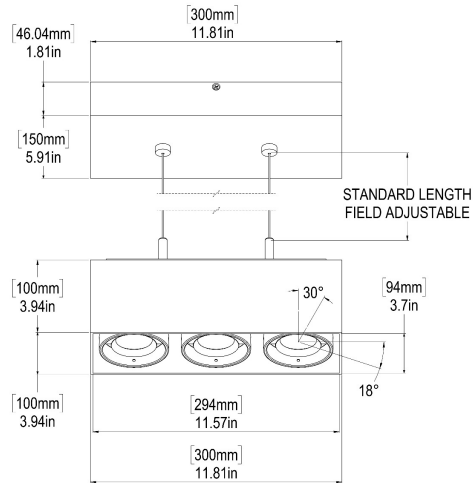
(CCT 2700K - 6500K) @ Different CCT 13W 95CRI

CCT Value	2700K	3000K	3500K	6500K
Source Lumens [lm]	1229	1294	1359	1465
Delivered Lumens [lm]	1106	1168	1223	1319
Efficacy [lm / W]	90	95	100	108

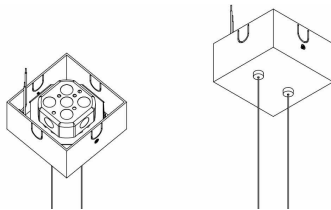
DIMENSIONS / DRAWINGS

Luminaire without housing

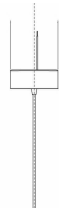
L4



Installation

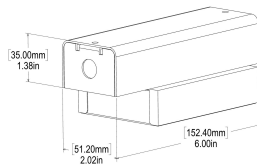


CC : Concrete Ceiling



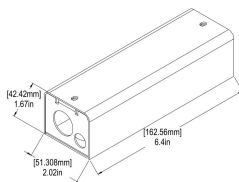
LI: Canopy for On-Board Driver / Canopy for Integral Driver

Canopy for on-board ELV or 0-10V driver. Dali / DMX / Lutron requires access from above on all fixtures with a cutout at or below 81mm.



RL: Retro Fit-Enclosure Coupled With Lutron HI-Lume Driver

When using the Retro-Fit Enclosure along with any Lutron HI-Lume Driver, the Lutron Driver will be mounted atop the Retro-Fit enclosure with the line voltage connection inside the junction box. This configuration is suitable for fixtures with a cutout size below 104mm, but it requires access from above for installation.



R0: Retro Fit-Enclosure

This housing is designed for easy installation in existing spaces. It comes in various cutout sizes, making it compatible with different light fixtures. It's ideal for use in plaster or t-bar ceilings where you want to retrofit or upgrade lighting without major modifications.

L5

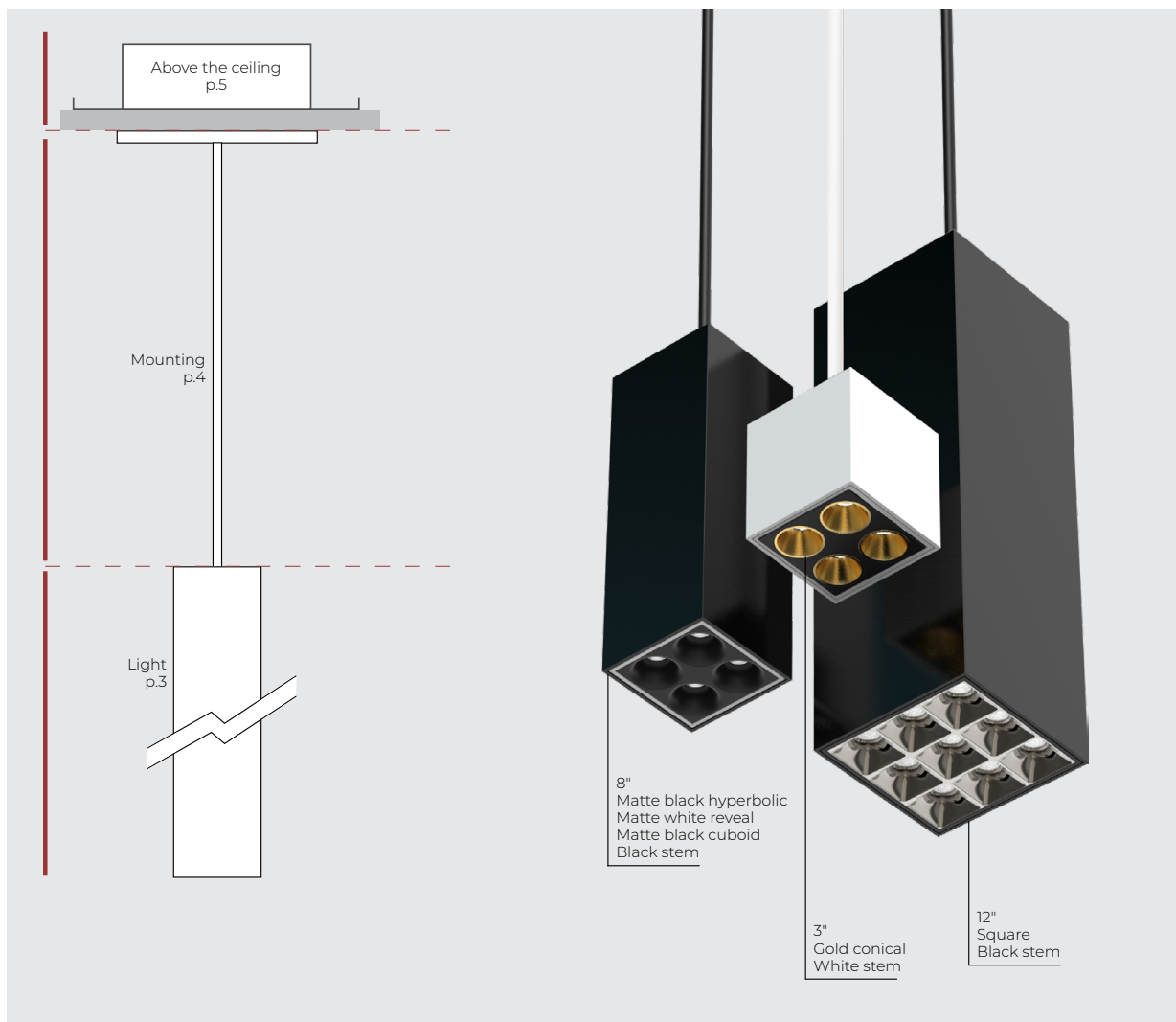
LUMENWERX

CLUSTER

PENDANT PLANAR

DESCRIPTION

Cluster is the precise, and scalable family of downlights, wall washers, and adjustables, available in both linear and planar configurations and for recessed, pendant, and surface mounting. Based on a fundamental 1.2" square cell, Cluster delivers lighting that is optically sophisticated and aesthetically refined. Cluster pendant planar downlights is available in 2x2 and 3x3 cell configurations, all with a choice of precision optics, beam spreads and subtle louver treatments. Surface downlights fit a choice of 3", 8" or 12" deep cuboid enclosures. Nominal light output is 200 lumens per cell. Pendant Cluster can be suspended using stems. A canopy for conduit connection is available. Driver is either integral or remote, which is capable of powering multiple luminaires.



Other Manufacturers:
LIGHTHEADED "MINIMALIST" Series

L5

CLUSTER
PENDANT PLANAR

LUMENWERX

Project: _____

Type: _____

Order Guide
LIGHT

LUMINAIRE ID	CUBOID HEIGHT	CUBOID FINISH	LOUVER	LOUVER FINISH		
CLU22P - Cluster 2X2 Pendant CLU33P - Cluster 3X3 Pendant	3IN - 3" 8IN - 8" 12IN - 12"	FTMW - Textured matte white FTMB - Textured matte black CF# - Custom finish, specify RAL#	CON ¹ - Conical HYP - Hyperbolic SQR - Square ¹ Faceplate matches body finish black and white only.	MF01 - Matte white MF04 - Matte black BL05 - Black chrome GL06 - Gold CP06 - Copper		
REVEAL FINISH	LIGHT SOURCE	OPTIC	BEAM	CRI	COLOR TEMP.	
	SW			90CRI		
FTMW - Textured matte white FTMB - Textured matte black CF# - Custom finish, specify RAL#	SW - Static white	SOF - Soft edge downlight REF - Sharp edge downlight	SOF NFL - Narrow flood FLD - Flood WFL - Wide flood	REF SPT - Spot FLD - Flood WFL - Wide flood	90CRI - 90 CRI 27K - 2700K 30K - 3000K 35K - 3500K 40K - 4000K 50K - 5000K	
DRIVER	VOLTAGE	LUMEN PACKAGE ²	DIMMING	CANOPY TYPE ⁴	CANOPY FINISH	SUSPENSION
INTEGRAL	120V - 120V 277V - 277V	CLU22P - 811LM - 811 lm CLU33P - 1743LM - 1743 lm ² Lumen packages shown at 3500K, with SOF-NFL 25°. For other, see lumen output multipliers on page 5.	DI - 1% 0-10V ELV ³ - ELV 120V TRI ³ - TRIAC 120V ³ Available with 120V only.	FLS ⁵ - Flat square canopy, 4" octagonal junction box DS - Deep square canopy, driver in canopy CDS - Conduit feed, square canopy ⁴ See page 4 for details. ⁵ Not available with 3" cuboid height when specified with integral driver.	FTMW - Textured matte white FTMB - Textured matte black CF# - Custom finish, specify RAL#	STEM ⁶ BKS##IN - Textured black stem WHS##IN - Textured white stem CF#S##IN ⁷ - Custom finish stem ⁶ Min 18" - max 48", specify length (##) in inches. ⁷ Specify RAL#.
REMOTE	DO NOT SPECIFY FOR REMOTE. SEE "REMOTE DRIVER BOX" SECTION BELOW.					

REMOTE DRIVER BOX

Ordered separately. Specify each required remote driver box on a separate line.

REMOTE DRIVER ⁸	LUMINAIRE QTY. ⁹	LUMINAIRE ID	VOLTAGE	LUMEN PACKAGE ¹⁰	DIMMING ¹²												
RDB# - Remote driver box	#X - Number of luminaires	CLU22P - Cluster 2x2 Pendant CLU33P - Cluster 3x3 Pendant	120V - 120V 277V - 277V UNV - 120V-277V	<table border="1"> <thead> <tr> <th></th> <th>Low¹¹</th> <th>Medium¹¹</th> <th>High</th> </tr> </thead> <tbody> <tr> <td>CLU22P</td> <td>203LM - 203 lm</td> <td>507LM - 507 lm</td> <td>811LM - 811 lm</td> </tr> <tr> <td>CLU33P</td> <td>436LM - 436 lm</td> <td>1089LM - 1089 lm</td> <td>1743LM - 1743 lm</td> </tr> </tbody> </table> ¹⁰ Watts and lumen per watts will vary based on the number of lighting units per remote driver as well as on the type of driver selected. ¹¹ Not available with RELV and RTRI dimming options.		Low ¹¹	Medium ¹¹	High	CLU22P	203LM - 203 lm	507LM - 507 lm	811LM - 811 lm	CLU33P	436LM - 436 lm	1089LM - 1089 lm	1743LM - 1743 lm	RD1 - 1% 0-10V RELV ¹³ - ELV 120V RTRI ¹³ - TRIAC 120V RDA ¹⁴ - DALI RLDE1 ¹⁴ - Lutron Hi-Lume 1% Eco ELD1 - eldoLED 1% EcoDrive 0-10V ELDO - eldoLED 0.1% SOLOdrive 0-10V ¹² For configurations involving different cluster sizes on a remote driver, please consult factory. ¹³ Available with 120V only. ¹⁴ On-site commissioning is required.
	Low ¹¹	Medium ¹¹	High														
CLU22P	203LM - 203 lm	507LM - 507 lm	811LM - 811 lm														
CLU33P	436LM - 436 lm	1089LM - 1089 lm	1743LM - 1743 lm														
⁸ Specify an RDB number (#) for each required remote driver box.	⁹ Specify number (#) of luminaires per remote driver.																

EXAMPLE CODE:

INTEGRAL DRIVER

LIGHT	CLU22P-3IN-FTMW-CON-MF01-FTMW-SW-SOF-NFL-90CRI-35K-INTEGRAL-120V-811LM-DI-DS-FTMW-BKS18IN	REMOTE DRIVER	N/A
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REMOTE DRIVER

LIGHT	CLU22P-3IN-FTMW-CON-MF01-FTMW-SW-SOF-NFL-90CRI-35K-REMOTE-FLS-FTMW-BKS18IN	REMOTE DRIVER	RDB1-6X-CLU22P-120V-507LM-RD1 RDB2-2X-CLU22P-120V-507LM-RD1
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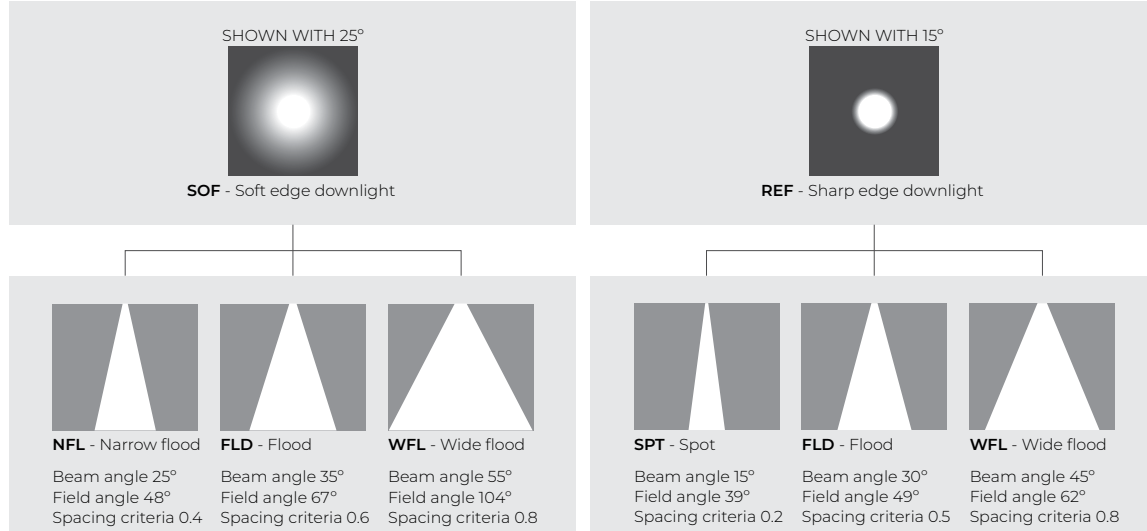
L5

CLUSTER
PENDANT PLANAR

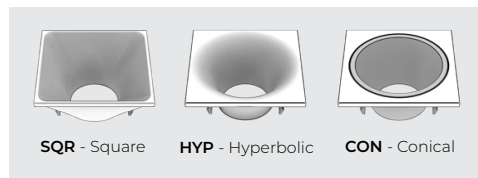
LUMENWERX

LIGHT

OPTICS & BEAM ANGLE

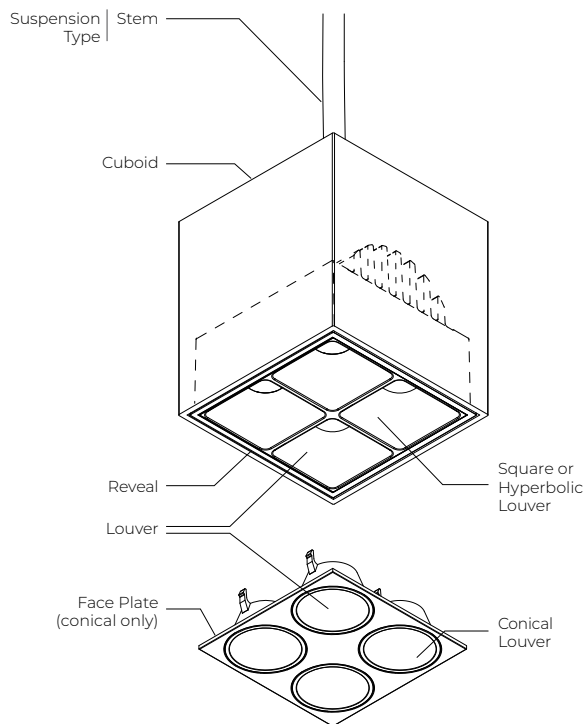


LOUVER SHAPE



LOUVER FINISH

Louvers are injection molded with integral texture and color

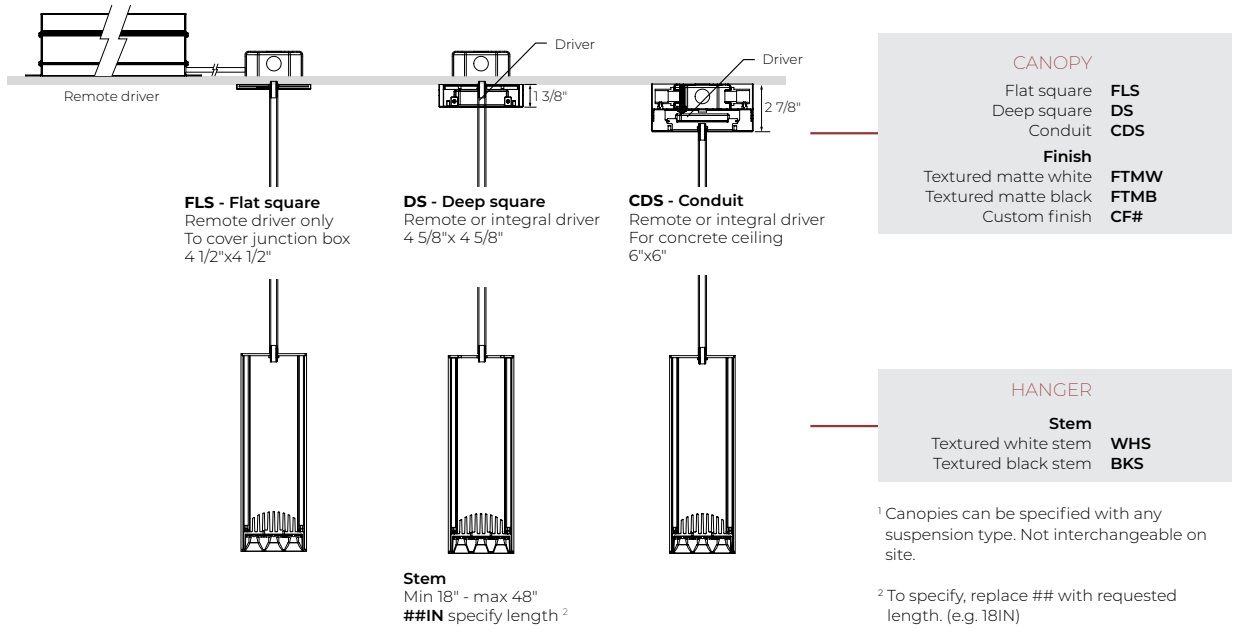


L5

CLUSTER
PENDANT PLANAR

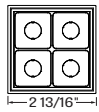
LUMENWERX

MOUNTING ¹

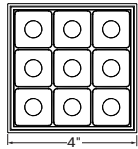


BOTTOM VIEW

CLUP22



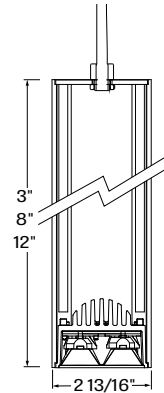
CLUP33



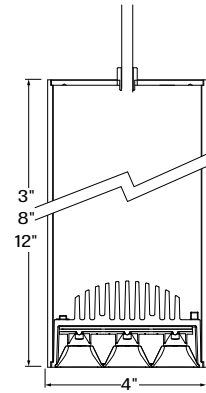
See linear spec sheet for more sizes

CROSS SECTION

CLUP22



CLUP33



L5

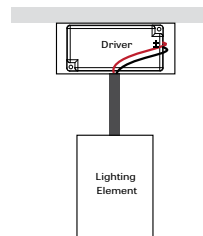
CLUSTER
PENDANT PLANAR

LUMENWERX

DRIVER

INTEGRAL CANOPY DRIVER

The integral driver is sized to the lighting unit and is connected directly with Class 2 wiring and quick-splice connectors. The driver is accessible for service through the canopy.



MULTIPLIER

GENERAL LUMEN OUTPUT MULTIPLIER AT 90 CRI

OPTICS	2700K						3000K						3500K						4000K					
	SOFT			SHARP			SOFT			SHARP			SOFT			SHARP			SOFT			SHARP		
BEAM ANGLE	25	35	55	15	30	45	25	35	55	15	30	45	25	35	55	15	30	45	25	35	55	15	30	45
LUMEN OUTPUT MULTIPLIER	0.87	0.92	0.82	0.80	0.84	0.86	0.93	0.99	0.87	0.86	0.89	0.92	1	1.06	0.94	0.92	0.96	0.99	1.03	1.09	0.97	0.95	0.99	1.02

LUMEN PACKAGE (AT 3500K, SOFT 25° BEAM) - INTEGRAL DRIVER

LUMINAIRE ID	LUMEN OUTPUT	WATTS	EFFICACY LM/W	LUMEN PACKAGE	VOLTAGE	INTEGRAL DRIVER
CLUP22	811 lm	10.4W	78 lm/W	Use the multiplier tables to calculate the lumen package	120 - 120V 277 - 277V	D1 - 1% 0-10V ELV ¹ - ELV 120V TRI ¹ - TRIAC 120V ¹ Available with 120V only.
CLUP33	1743 lm	21.5W	81 lm/W			

REMOTE DRIVER

The remote driver can power several lighting units, depending on their total power. The minimum and maximum number of lighting units and driver type are shown in the table below and must be observed. The remote driver and lighting units are wired together through connection boxes, which are furnished pre-wired to the driver enclosure. All wiring is Class 2 with quick-splice connectors. The remote driver requires access from above the ceiling (or an access panel).

LUMEN PACKAGE¹ (AT 3500K, SOFT 25° BEAM) - REMOTE DRIVER

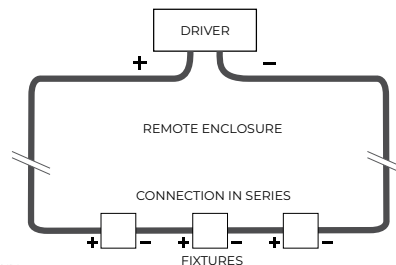
LUMINAIRE ID	LUMEN PACKAGE ²			VOLTAGE	REMOTE DRIVER	NUMBER OF LIGHTING UNITS PER DRIVER
CLUP22 CLUP33	LOW 203 lm 436 lm	MEDIUM 507 lm 1089 lm	HIGH 811 lm 1743 lm	120 - 120V 277 - 277V UNV - 120V-277V	RDI - 1% 0-10V RELV ³ - ELV 120V RTRI ³ - TRIAC 120V RDA ⁴ - DALI RLDEI ⁴ - Lutron Hi-lume 1% Eco ³ Available with 120V only. ⁴ On-site commissioning is required.	See table below for maximum and minimum possible number of lighting units per each driver. For configurations involving different cluster sizes on a remote driver, please consult factory.

¹ Watts and lumen per watts will vary based on the number of lighting units per remote driver as well as on the type of driver selected.

NUMBER OF LIGHTING UNITS PER DRIVER - MINIMUM AND MAXIMUM

DRIVER TYPE	CLUP22	CLUP33
D1 - 1% 0-10V	2 - 6	1 - 2
ELV - ELV 120V	3	1
TRI - TRIAC 120V	3	1
DA - DALI	2 - 6	1 - 2
LDEI - Lutron Hi-lume 1% Eco	2 - 4	1

For any quantities of lighting units per driver that fall outside the minimum and maximum listed above, please consult factory.





LUMENWERX

CLUSTER PENDANT PLANAR

OPTICS

SOFT-EDGED FEATHERED BEAM (SOF)

The Soft-Edged Feathered Beam blends the light into darker areas for a gentle brightness transition. Each LED emitter directs light through a single, custom molded circular optic using total internal reflection (TIR) to shape the light. A 0.5" reflective square louver provides a cut off with a UGR of 10. Three different TIR elements create a choice of beam spread: 25° narrow flood (NFL), 35° flood (FLD), or 55° wide flood (WFL).

SHARP-EDGED CUT-OFF BEAM (REF)

The Sharp-Edged Cut-Off Beam creates dramatic impact, limiting the spread of light outside of the primary beam. A molded conical reflector redirects light from each emitter into the desired beam angle. A 0.5" reflective square louver provides a cut off with a UGR of 10. Three different TIR elements create a choice of beam spread: 15° spot (SPT), 30° flood (FLD), or 45° wide flood (WFL).

LIGHT SOURCE

Custom array of high-flux LEDs mounted onto aluminum-backed circuitry. Available in 2700K, 3000K, 3500K and 4000K with a minimum 90 CRI with elevated R9 value. Color consistency is maintained to within 3 SDCM. All LEDs have been tested in accordance with IESNA LM-80-08 and the results have shown L80 lumen maintenance greater than 60,000 hours. Absolute product photometry is measured and presented in accordance with IESNA LM-79, unless otherwise indicated.

WEIGHT

	BODY		CUBOID 3"		CUBOID 8"		CUBOID 12"	
	Lb	Kg	Lb	Kg	Lb	Kg	Lb	Kg
CLUP22	0.70	0.30	0.38	0.17	0.87	0.40	1.27	0.58
CLUP33	1.10	0.50	0.55	0.25	1.17	0.53	1.67	0.76

CONSTRUCTION

Housing - Die-cast aluminum (0.95" nominal)

Optics - Polycarbonate

Cuboid - Aluminum extrusion

Cover pendant - 18 gauge aluminum sheet

Extension bar - Galvanized steel

CERTIFICATIONS

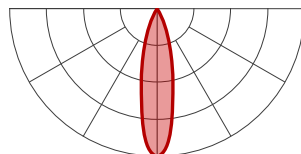
ETL - Rated for indoor dry/damp locations.

Conforms to UL 1598 Standard and certified to CAN/CSA Standard C22.2 No. 250.0

WARRANTY

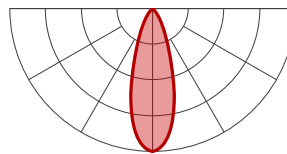
Lumenwerx provides a five-year limited warranty on electrical and mechanical performance of the luminaires, including the LED boards, drivers, and auxiliary electronics. Lumenwerx will repair or replace defective luminaires or components at our discretion, provided they have been installed and operated in accordance with our specifications. Other limitations apply, please refer to the full warranty on our website.

SOFT-EDGE DOWNLIGHT



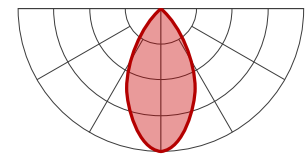
NFL - Narrow flood

Beam angle 25°
Field angle 48°
Spacing criteria 0.4



FLD - Flood

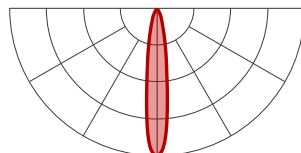
Beam angle 35°
Field angle 67°
Spacing criteria 0.6



WFL - Wide flood

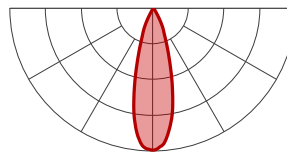
Beam angle 55°
Field angle 104°
Spacing criteria 0.8

SHARP-EDGE DOWNLIGHT



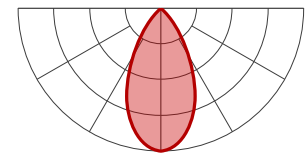
SPT - Spot

Beam angle 15°
Field angle 39°
Spacing criteria 0.2



FLD - Flood

Beam angle 30°
Field angle 49°
Spacing criteria 0.5



WFL - Wide flood

Beam angle 45°
Field angle 62°
Spacing criteria 0.8



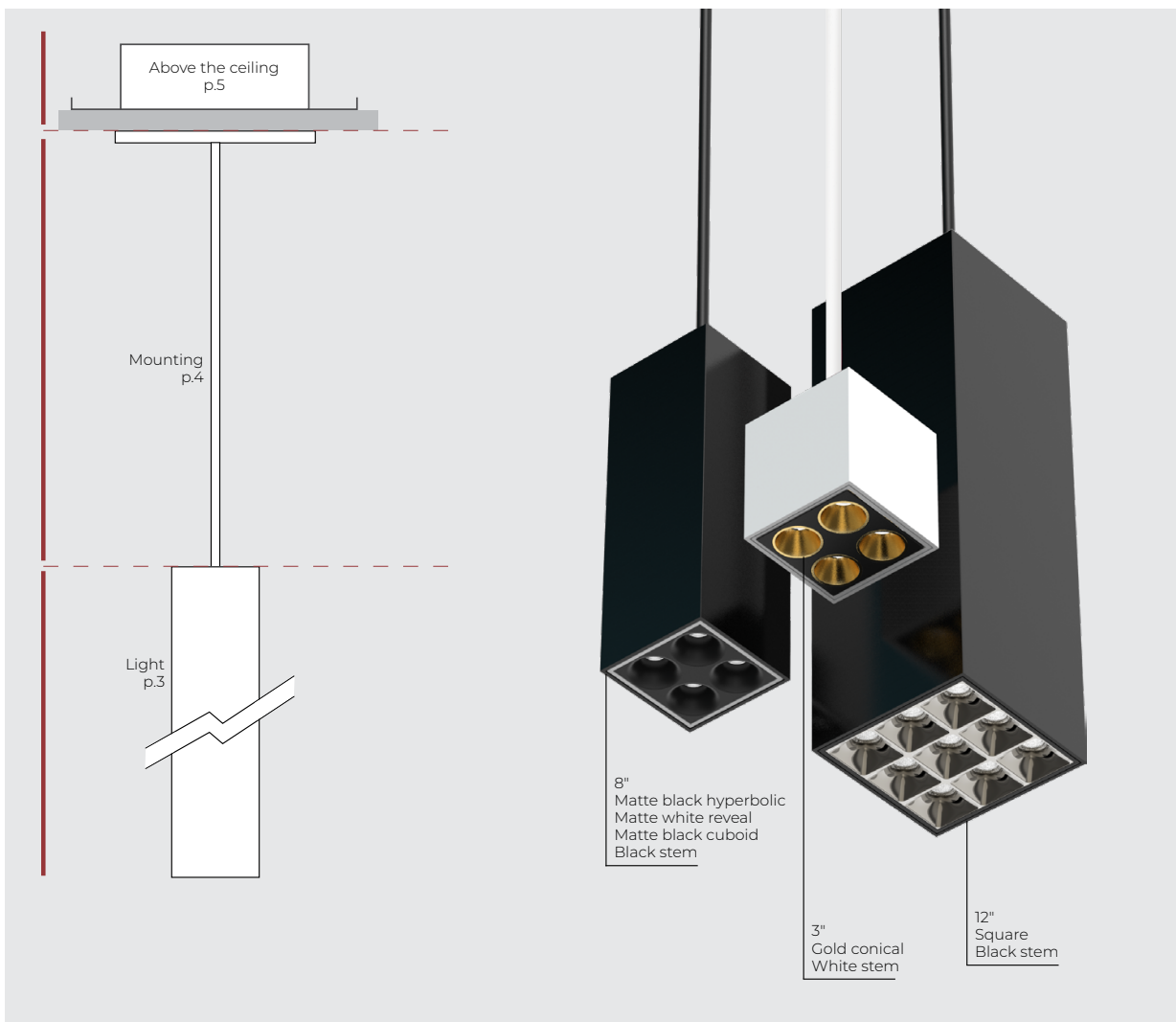
CLUSTER

PENDANT PLANAR

LUMENWERX

DESCRIPTION

Cluster is the precise, and scalable family of downlights, wall washers, and adjustables, available in both linear and planar configurations and for recessed, pendant, and surface mounting. Based on a fundamental 1.2" square cell, Cluster delivers lighting that is optically sophisticated and aesthetically refined. Cluster pendant planar downlights is available in 2x2 and 3x3 cell configurations, all with a choice of precision optics, beam spreads and subtle louver treatments. Surface downlights fit a choice of 3", 8" or 12" deep cuboid enclosures. Nominal light output is 200 lumens per cell. Pendant Cluster can be suspended using stems. A canopy for conduit connection is available. Driver is either integral or remote, which is capable of powering multiple luminaires.



Other Manufacturers:
LIGHTHEADED "MINIMALIST" Series

L6

CLUSTER
PENDANT PLANAR

LUMENWERX

Project: _____

Type: _____

Order Guide
LIGHT

LUMINAIRE ID	CUBOID HEIGHT	CUBOID FINISH	LOUVER	LOUVER FINISH		
CLU22P - Cluster 2X2 Pendant CLU33P - Cluster 3X3 Pendant	3IN - 3" 8IN - 8" 12IN - 12"	FTMW - Textured matte white FTMB - Textured matte black CF# - Custom finish, specify RAL#	CON ¹ - Conical HYP - Hyperbolic SQR - Square ¹ Faceplate matches body finish black and white only.	MF01 - Matte white MF04 - Matte black BL05 - Black chrome GL06 - Gold CP06 - Copper		
REVEAL FINISH	LIGHT SOURCE	OPTIC	BEAM	CRI	COLOR TEMP.	
	SW			90CRI		
FTMW - Textured matte white FTMB - Textured matte black CF# - Custom finish, specify RAL#	SW - Static white	SOF - Soft edge downlight REF - Sharp edge downlight	SOF NFL - Narrow flood FLD - Flood WFL - Wide flood	SPT - Spot FLD - Flood WFL - Wide flood	90CRI - 90 CRI 27K - 2700K 30K - 3000K 35K - 3500K 40K - 4000K 50K - 5000K	
DRIVER	VOLTAGE	LUMEN PACKAGE ²	DIMMING	CANOPY TYPE ⁴	CANOPY FINISH	SUSPENSION
INTEGRAL	120V - 120V 277V - 277V	CLU22P - 811LM - 811 lm CLU33P - 1743LM - 1743 lm ² Lumen packages shown at 3500K, with SOF-NFL 25°. For other, see lumen output multipliers on page 5.	DI - 1% 0-10V ELV ³ - ELV 120V TRI ³ - TRIAC 120V ³ Available with 120V only.	FLS ⁵ - Flat square canopy, 4" octagonal junction box DS - Deep square canopy, driver in canopy CDS - Conduit feed, square canopy ⁴ See page 4 for details. ⁵ Not available with 3" cuboid height when specified with integral driver.	FTMW - Textured matte white FTMB - Textured matte black CF# - Custom finish, specify RAL#	STEM ⁶ BKS##IN - Textured black stem WHS##IN - Textured white stem CF#S##IN ⁷ - Custom finish stem ⁶ Min 18" - max 48", specify length (##) in inches. ⁷ Specify RAL#.
REMOTE	DO NOT SPECIFY FOR REMOTE. SEE "REMOTE DRIVER BOX" SECTION BELOW.					

REMOTE DRIVER BOX

Ordered separately. Specify each required remote driver box on a separate line.

REMOTE DRIVER ⁸	LUMINAIRE QTY. ⁹	LUMINAIRE ID	VOLTAGE	LUMEN PACKAGE ¹⁰	DIMMING ¹²												
RDB# - Remote driver box	#X - Number of luminaires	CLU22P - Cluster 2x2 Pendant CLU33P - Cluster 3x3 Pendant	120V - 120V 277V - 277V UNV - 120V-277V	<table border="1"> <tr> <td></td> <td>Low¹¹</td> <td>Medium¹¹</td> <td>High</td> </tr> <tr> <td>CLU22P</td> <td>203LM - 203 lm</td> <td>507LM - 507 lm</td> <td>811LM - 811 lm</td> </tr> <tr> <td>CLU33P</td> <td>436LM - 436 lm</td> <td>1089LM - 1089 lm</td> <td>1743LM - 1743 lm</td> </tr> </table> ¹⁰ Watts and lumen per watts will vary based on the number of lighting units per remote driver as well as on the type of driver selected. ¹¹ Not available with RELV and RTRI dimming options.		Low ¹¹	Medium ¹¹	High	CLU22P	203LM - 203 lm	507LM - 507 lm	811LM - 811 lm	CLU33P	436LM - 436 lm	1089LM - 1089 lm	1743LM - 1743 lm	RD1 - 1% 0-10V RELV ¹³ - ELV 120V RTRI ¹³ - TRIAC 120V RDA ¹⁴ - DALI RLDE1 ¹⁴ - Lutron Hi-Lume 1% Eco ELD1 - eldoLED 1% EcoDrive 0-10V ELDO - eldoLED 0.1% SOLOdrive 0-10V ¹² For configurations involving different cluster sizes on a remote driver, please consult factory. ¹³ Available with 120V only. ¹⁴ On-site commissioning is required.
	Low ¹¹	Medium ¹¹	High														
CLU22P	203LM - 203 lm	507LM - 507 lm	811LM - 811 lm														
CLU33P	436LM - 436 lm	1089LM - 1089 lm	1743LM - 1743 lm														
⁸ Specify an RDB number (#) for each required remote driver box.	⁹ Specify number (#) of luminaires per remote driver.																

EXAMPLE CODE:

INTEGRAL DRIVER

LIGHT	CLU22P-3IN-FTMW-CON-MF01-FTMW-SW-SOF-NFL-90CRI-35K-INTEGRAL-120V-811LM-DI-DS-FTMW-BKS18IN	REMOTE DRIVER	N/A
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REMOTE DRIVER

LIGHT	CLU22P-3IN-FTMW-CON-MF01-FTMW-SW-SOF-NFL-90CRI-35K-REMOTE-FLS-FTMW-BKS18IN	REMOTE DRIVER	RDB1-6X-CLU22P-120V-507LM-RD1 RDB2-2X-CLU22P-120V-507LM-RD1
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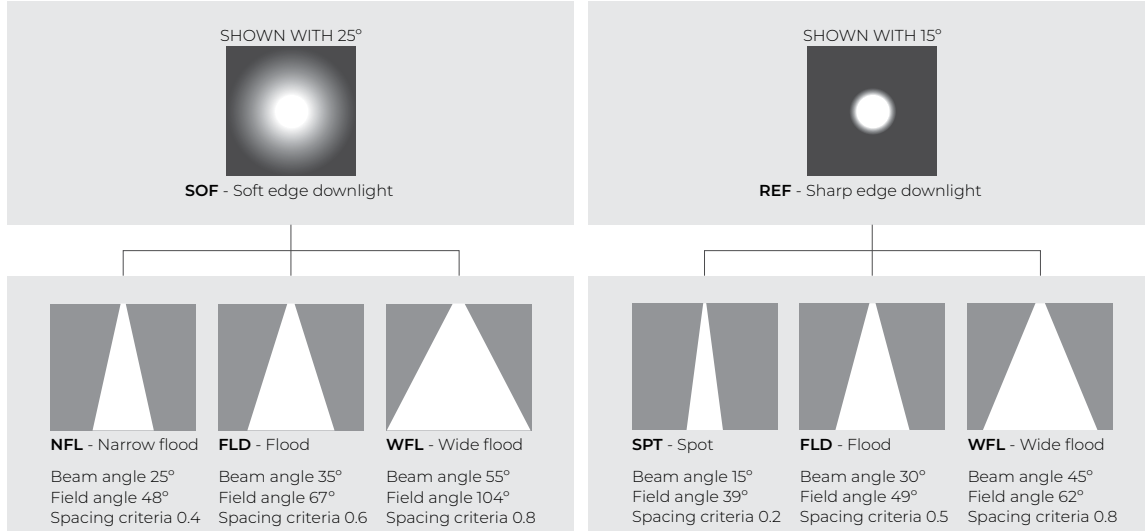


CLUSTER
PENDANT PLANAR

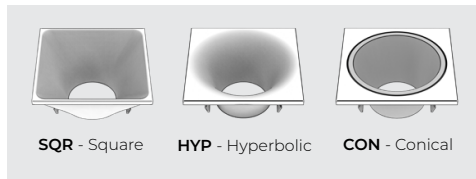
LUMENWERX

LIGHT

OPTICS & BEAM ANGLE

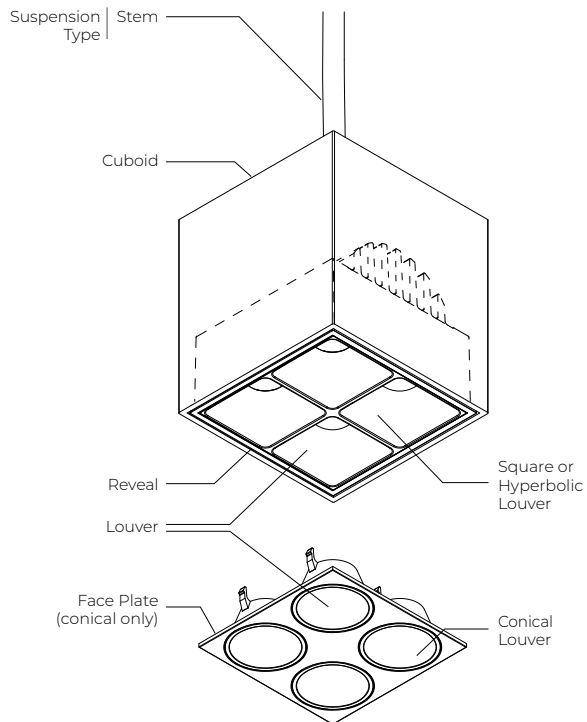


LOUVER SHAPE



LOUVER FINISH

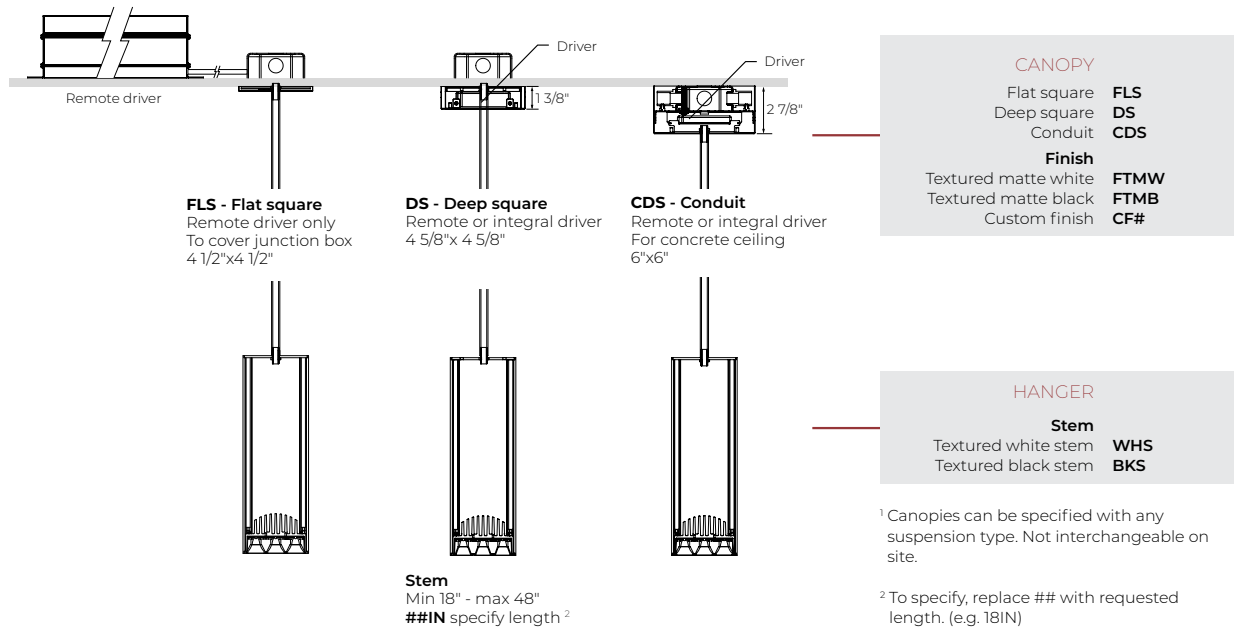
Louvers are injection molded with integral texture and color



CLUSTER
PENDANT PLANAR

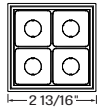
LUMENWERX

MOUNTING ¹

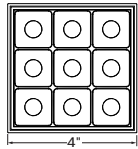


BOTTOM VIEW

CLUP22



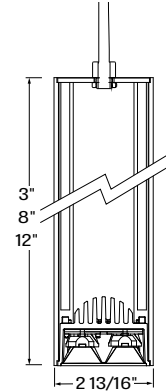
CLUP33



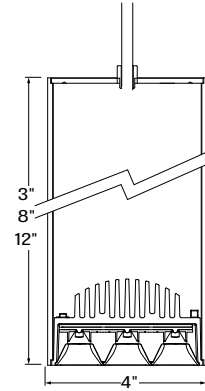
See linear spec sheet for more sizes

CROSS SECTION

CLUP22



CLUP33



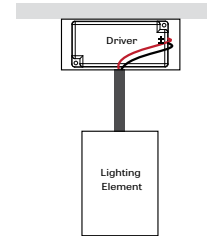
CLUSTER
PENDANT PLANAR

LUMENWERX

DRIVER

INTEGRAL CANOPY DRIVER

The integral driver is sized to the lighting unit and is connected directly with Class 2 wiring and quick-splice connectors. The driver is accessible for service through the canopy.



MULTIPLIER

GENERAL LUMEN OUTPUT MULTIPLIER AT 90 CRI

OPTICS	2700K						3000K						3500K						4000K					
	SOFT			SHARP			SOFT			SHARP			SOFT			SHARP			SOFT			SHARP		
BEAM ANGLE	25	35	55	15	30	45	25	35	55	15	30	45	25	35	55	15	30	45	25	35	55	15	30	45
LUMEN OUTPUT MULTIPLIER	0.87	0.92	0.82	0.80	0.84	0.86	0.93	0.99	0.87	0.86	0.89	0.92	1	1.06	0.94	0.92	0.96	0.99	1.03	1.09	0.97	0.95	0.99	1.02

LUMEN PACKAGE (AT 3500K, SOFT 25° BEAM) - INTEGRAL DRIVER

LUMINAIRE ID	LUMEN OUTPUT	WATTS	EFFICACY LM/W
CLUP22	811 lm	10.4W	78 lm/W
CLUP33	1743 lm	21.5W	81 lm/W

LUMEN PACKAGE	VOLTAGE	INTEGRAL DRIVER
Use the multiplier tables to calculate the lumen package	120 - 120V 277 - 277V	D1 - 1% 0-10V ELV ¹ - ELV 120V TRI ¹ - TRIAC 120V ¹ Available with 120V only.

REMOTE DRIVER

The remote driver can power several lighting units, depending on their total power. The minimum and maximum number of lighting units and driver type are shown in the table below and must be observed. The remote driver and lighting units are wired together through connection boxes, which are furnished pre-wired to the driver enclosure. All wiring is Class 2 with quick-splice connectors. The remote driver requires access from above the ceiling (or an access panel).

LUMEN PACKAGE¹ (AT 3500K, SOFT 25° BEAM) - REMOTE DRIVER

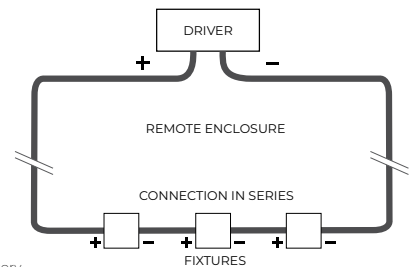
LUMINAIRE ID	LUMEN PACKAGE ²			VOLTAGE	REMOTE DRIVER	NUMBER OF LIGHTING UNITS PER DRIVER
CLUP22 CLUP33	LOW 203 lm 436 lm	MEDIUM 507 lm 1089 lm	HIGH 811 lm 1743 lm	120 - 120V 277 - 277V UNV - 120V-277V	RDI - 1% 0-10V RELV ³ - ELV 120V RTRI ³ - TRIAC 120V RDA ⁴ - DALI RLDEI ⁴ - Lutron Hi-lume 1% Eco ³ Available with 120V only. ⁴ On-site commissioning is required.	See table below for maximum and minimum possible number of lighting units per each driver. For configurations involving different cluster sizes on a remote driver, please consult factory.

¹ Watts and lumen per watts will vary based on the number of lighting units per remote driver as well as on the type of driver selected.

NUMBER OF LIGHTING UNITS PER DRIVER - MINIMUM AND MAXIMUM

DRIVER TYPE	CLUP22	CLUP33
D1 - 1% 0-10V	2 - 6	1 - 2
ELV - ELV 120V	3	1
TRI - TRIAC 120V	3	1
DA - DALI	2 - 6	1 - 2
LDEI - Lutron Hi-lume 1% Eco	2 - 4	1

For any quantities of lighting units per driver that fall outside the minimum and maximum listed above, please consult factory.



CLUSTER

PENDANT PLANAR

LUMENWERX

OPTICS

SOFT-EDGED FEATHERED BEAM (SOF)

The Soft-Edged Feathered Beam blends the light into darker areas for a gentle brightness transition. Each LED emitter directs light through a single, custom molded circular optic using total internal reflection (TIR) to shape the light. A 0.5" reflective square louver provides a cut off with a UGR of 10. Three different TIR elements create a choice of beam spread: 25° narrow flood (NFL), 35° flood (FLD), or 55° wide flood (WFL).

SHARP-EDGED CUT-OFF BEAM (REF)

The Sharp-Edged Cut-Off Beam creates dramatic impact, limiting the spread of light outside of the primary beam. A molded conical reflector redirects light from each emitter into the desired beam angle. A 0.5" reflective square louver provides a cut off with a UGR of 10. Three different TIR elements create a choice of beam spread: 15° spot (SPT), 30° flood (FLD), or 45° wide flood (WFL).

LIGHT SOURCE

Custom array of high-flux LEDs mounted onto aluminum-backed circuitry. Available in 2700K, 3000K, 3500K and 4000K with a minimum 90 CRI with elevated R9 value. Color consistency is maintained to within 3 SDCM. All LEDs have been tested in accordance with IESNA LM-80-08 and the results have shown L80 lumen maintenance greater than 60,000 hours. Absolute product photometry is measured and presented in accordance with IESNA LM-79, unless otherwise indicated.

WEIGHT

	BODY		CUBOID 3"		CUBOID 8"		CUBOID 12"	
	Lb	Kg	Lb	Kg	Lb	Kg	Lb	Kg
CLUP22	0.70	0.30	0.38	0.17	0.87	0.40	1.27	0.58
CLUP33	1.10	0.50	0.55	0.25	1.17	0.53	1.67	0.76

CONSTRUCTION

Housing - Die-cast aluminum (0.95" nominal)

Optics - Polycarbonate

Cuboid - Aluminum extrusion

Cover pendant - 18 gauge aluminum sheet

Extension bar - Galvanized steel

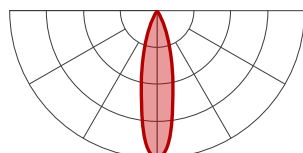
CERTIFICATIONS

ETL - Rated for indoor dry/damp locations. Conforms to UL 1598 Standard and certified to CAN/CSA Standard C22.2 No. 250.0

WARRANTY

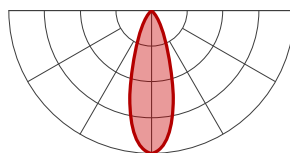
Lumenwerx provides a five-year limited warranty on electrical and mechanical performance of the luminaires, including the LED boards, drivers, and auxiliary electronics. Lumenwerx will repair or replace defective luminaires or components at our discretion, provided they have been installed and operated in accordance with our specifications. Other limitations apply, please refer to the full warranty on our website.

SOFT-EDGE DOWNLIGHT



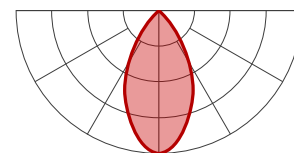
NFL - Narrow flood

Beam angle 25°
Field angle 48°
Spacing criteria 0.4



FLD - Flood

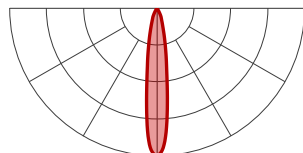
Beam angle 35°
Field angle 67°
Spacing criteria 0.6



WFL - Wide flood

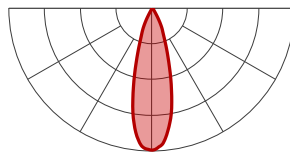
Beam angle 55°
Field angle 104°
Spacing criteria 0.8

SHARP-EDGE DOWNLIGHT



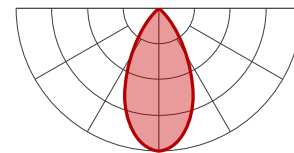
SPT - Spot

Beam angle 15°
Field angle 39°
Spacing criteria 0.2



FLD - Flood

Beam angle 30°
Field angle 49°
Spacing criteria 0.5



WFL - Wide flood

Beam angle 45°
Field angle 62°
Spacing criteria 0.8



Project name: _____ L7

Fixture type: _____

Date: _____

Other Manufacturers:
LIGHTHEADED "MINNO" Series
ZANIBONI "LUNA 1" Series

1" Round Recessed Architectural Oak™ Downlight

Small aperture downlight delivers up to 1000 lumens. More than a traditional 50W MR16 halogen lamp. Style options, beam options and color finish options offer maximum flexibility in design. Drivers and housings are specified separately for maximum flexibility per your project's needs. The patented engine offers auto-release clips that make installation a breeze.



Features

- IC Airtight for use with Direct Contact to insulation
- Works with compatible ceilings up to 1¼"
- Height allows for use in ceilings with under 2" depth. Ceiling thickness can be reduced from fixture depth.
- Remodel requires no frame. New construction E1LDWN1 frame available
- 38° Standard beam with optional 28° and 50°
- Wet Location Rated for Indoor and Outdoor Use
- JA8-2022-E, UL Listed, and Energy Star Qualified
- Life Span 50,000 Hours L70

Specifications

Wattage	8W
Lumens	850 lm - 1000 lm
Color Temp.	2700K - SunsetK
Lamp Type	LED
Beam Angle	28° - 50°
CRI	93+
Wet Location	Listed

Options



Technical Details

Optics: PC Lens for even light distribution. Standard 38° lens. Optional 28° (EP713C) and 50° (EP715C) available.

Construction: Diecast construction for lasting quality and greater heat dissipation. High-quality powder coat finish prevents rust and paint cracking.

Installation: Hole cutout size: 2" (50 mm). Oak™ LED Light engines require driver. Can be utilized in new construction and remodel applications.

LED Technology: Extremely accurate color rendering with 93+ CRI. Efficacy of up to 104 lumens per watt. Lumen Maintenance of 50,000 hours L70 based on LM80. Superior Thermal Management by utilizing diecast aluminum body as heat sink.

Sunset: Sunset color temperature is our dim-to-warm LED technology that allows the color temperature to become warmer as the product is dimmed. Our SUNSET items start at 3000K and go as low as 1800K when dimmed. For Sunset dim technology be sure to order an item with "Sunset" in the Color Temperature (CCT) attribute.

Electrical: Requires driver. Driver and housing can be specified with voltage (120V or 120/277V) and dimming (ELV/Triac or 0-10V/Triac/ELV)

Compatible Housings/Delivered Lumens: Architectural Oak™ Light Engines are compatible with 120/277V 0-10V/Triac/ELV or 120V Triac/ELV Architectural Oak™ Housings.

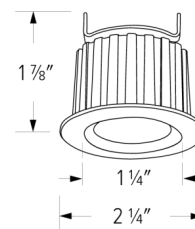
• **Delivered Lumens:** 2700K: 850 lm, 3000K: 900 lm, 3500K: 950 lm, 4000K: 1000 lm, Sunset: 850 lm

Dimming: See Oak™ Housings and drivers for specific dimming information.

Listings: cUL Listed. UL Listed for WET Location. UL Listed for direct contact with insulation. Airtight per ASTM E-283. ENERGY STAR® Qualified. California Title 24 (JA8-2016-E).

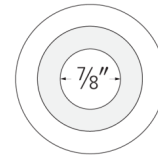
Warranty: ELCO Products are built to last with a 5-year Limited warranty.

Dimensions



Aperture Dimensions

L7



Product Number Builder Example: **E1AK02F27B**

1" Architectural Oak Downlight	Style	Beam Angle	Color Temperature	Finish
E1AK	02 Round	F 38° NF 28° WF 50°	27 2700K 30 3000K 35 3500K 40 4000K SD Sunset ¹	W All White BB All Black BZ All Bronze B Black with White Trim H Haze with White Trim

¹ Sunset, Dim to Warm technology, automatically transitions from 3000K to 1800K when dimmed

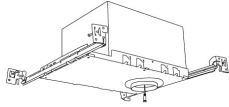
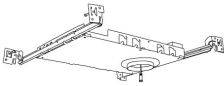
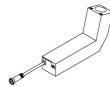
L7

Compatible Products

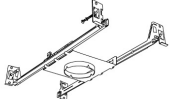
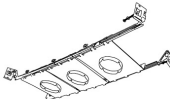


For use with 1" Oak™ Architectural Recessed Downlights

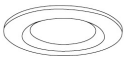
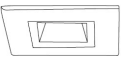

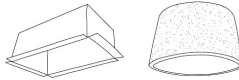
1" Oak™ New Construction Housings, Frames & Power Packs

 <p>R-60 IC Airtight Housing - Driver Included - New Construction</p>	 <p>IC Rated Frame - Driver Included - New Construction</p>	 <p>IC Rated Power Pack - Fits through 2" hole - Remodel</p>																		
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1" Oak™ Accessories

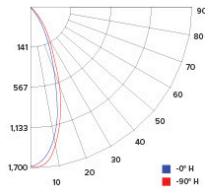
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Photometric Report

1" Round Recessed Architectural Oak™ Downlight

PHOTOMETRIC REPORT

Product #: E1AK02F27
Wattage / Lumens: 7.9W / 850 lm
Luminaire LPW: 107.6 lm/W



CANDLE POWER SUMMARY

Degree Vertical	0°
0	1673
5	1579
15	1102
25	454
35	167
45	41
55	17
65	9
75	6
85	1
90	0

ILLUMINANCE AT A DISTANCE

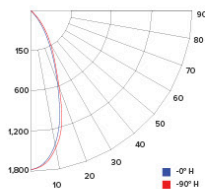
Distance to Target Plane	Center Beam Footcandles	Beam Diameter
4'	105	2.8'
6'	46.5	4.1'
8'	26.1	5.5'
10'	16.7	6.9'

ZONAL LUMEN SUMMARY

Zone	Lumens	%Luminaire
0-30°	671.4	79.3
0-40°	780.4	92.2
0-60°	830.6	98.1
0-90°	846.6	100

PHOTOMETRIC REPORT

Product #: E1AK02F30
Wattage / Lumens: 8.1W / 900 lm
Luminaire LPW: 111 lm/W



CANDLE POWER SUMMARY

Degree Vertical	0°
0	1761
5	1662
15	1160
25	478
35	176
45	43
55	18
65	10
75	6
85	1
90	0

ILLUMINANCE AT A DISTANCE

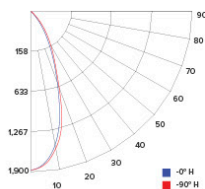
Distance to Target Plane	Center Beam Footcandles	Beam Diameter
4'	110	2.8'
6'	48.9	4.1'
8'	27.5	5.5'
10'	17.6	6.9'

ZONAL LUMEN SUMMARY

Zone	Lumens	%Luminaire
0-30°	706.7	79.3
0-40°	821.4	92.2
0-60°	874.4	98.1
0-90°	891.1	100

PHOTOMETRIC REPORT

Product #: E1AK02F35
Wattage / Lumens: 8.1W / 950 lm
Luminaire LPW: 117 lm/W



CANDLE POWER SUMMARY

Degree Vertical	0°
0	1870
5	1765
15	1232
25	508
35	186
45	46
55	19
65	11
75	6
85	1
90	0

ILLUMINANCE AT A DISTANCE

Distance to Target Plane	Center Beam Footcandles	Beam Diameter
4'	117	2.8'
6'	51.9	4.1'
8'	29.2	5.5'
10'	18.7	6.9'

ZONAL LUMEN SUMMARY

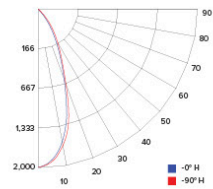
Zone	Lumens	%Luminaire
0-30°	750.2	79.3
0-40°	872.0	92.2
0-60°	928.2	98.1
0-90°	946.0	100

Photometric Report

1" Round Recessed Architectural Oak™ Downlight

PHOTOMETRIC REPORT

Product #: E1AK02F40
Wattage / Lumens: 8.1W / 1012 lm
Luminaire LPW: 124.9 lm/W



CANDLE POWER SUMMARY

Degress Vertical	0°
0	1978
5	1867
15	1303
25	537
35	197
45	48
55	20
65	11
75	7
85	1
90	0

ILLUMINANCE AT A DISTANCE

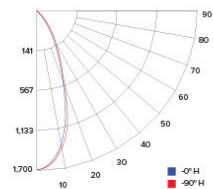
Distance to Target Plane	Center Beam Footcandles	Beam Diameter
4'	124	2.8'
6'	54.9	4.1'
8'	30.9	5.5'
10'	19.8	6.9'

ZONAL LUMEN SUMMARY

Zone	Lumens	%Luminaire
0-30°	793.7	79.3
0-40°	922.5	92.2
0-60°	982.0	98.1
0-90°	1,000.8	100

PHOTOMETRIC REPORT

Product #: E1AK02F5D
Wattage / Lumens: 7.9W / 850 lm
Luminaire LPW: 107.6 lm/W



CANDLE POWER SUMMARY

Degress Vertical	0°
0	1667
5	1573
15	1098
25	453
35	166
45	41
55	17
65	9
75	6
85	1
90	0

ILLUMINANCE AT A DISTANCE

Distance to Target Plane	Center Beam Footcandles	Beam Diameter
4'	104	2.8'
6'	46.3	4.1'
8'	26.0	5.5'
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ZONAL LUMEN SUMMARY

Zone	Lumens	%Luminaire
0-30°	668.6	79.3
0-40°	777.2	92.2
0-60°	827.3	98.1
0-90°	843.2	100



Project name: _____ L8

Fixture type: _____

Date: _____

Other Manufacturers:
LIGHTHEADED "MINNO" Series
ZANIBONI "LUNA 1 0" Series

1" Round Gimbal Recessed Architectural Oak™ Adjustable

Small aperture downlight delivers up to 900 lumens with 30° adjustability. More than a traditional 50W MR16 halogen lamp. Style options, beam options and color finish options offer maximum flexibility in design. Drivers and housings are specified separately for maximum flexibility per your project's needs. The patented engine offers auto-release clips that make installation a breeze.



Features

- IC Airtight for use with Direct Contact to insulation
- 30° gimbal adjustability
- Works with compatible ceilings up to 1¼"
- Height allows for use in ceilings with under 2" depth. Ceiling thickness can be reduced from fixture depth.
- Remodel requires no frame. New construction E1ATB08AJIC frame available
- 38° Standard beam with optional 28° and 50°
- Damp Location Rated
- JA8-2022-E, UL Listed, and Energy Star Qualified
- Life Span 50,000 Hours L70

Specifications

Wattage	8W
Lumens	850 lm - 900 lm
Color Temp.	2700K - 3000K
Lamp Type	LED
Beam Angle	28° - 50°
CRI	93+
Damp Location	Listed

Options



All White

All Black

Technical Details

Optics: PC Lens for even light distribution. Standard 38° lens. Optional 28° (EP713C) and 50° (EP715C) available.

Construction: Diecast construction for lasting quality and greater heat dissipation. High-quality powder coat finish prevents rust and paint cracking.

Installation: Hole cutout size: 2" (50 mm). Oak™ LED Light engines require driver. Can be utilized in new construction and remodel applications.

LED Technology: Extremely accurate color rendering with 93+ CRI. Efficacy of up to 104 lumens per watt. Lumen Maintenance of 50,000 hours L70 based on LM80. Superior Thermal Management by utilizing diecast aluminum body as heat sink.

Electrical: Requires driver. Driver and housing can be specified with voltage (120V or 120/277V) and dimming (ELV/Triac or 0-10V/Triac/ELV)

Compatible Housings/Delivered Lumens: Architectural Oak™ Light Engines are compatible with 120/277V 0-10V/Triac/ELV or 120V Triac/ELV Architectural Oak™ Housings.

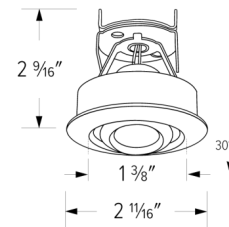
• **Delivered Lumens:** 2700K: 850 lm, 3000K: 900 lm

Dimming: See Oak™ Housings and drivers for specific dimming information.

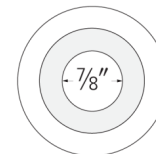
Listings: cUL Listed. UL Listed for Damp Location. UL Listed for direct contact with insulation. Airtight per ASTM E-283. ENERGY STAR® Qualified. California Title 24 (JA8-2016-E).

Warranty: ELCO Products are built to last with a 5-year Limited warranty.

Dimensions



Aperture Dimensions



L8

Product Number Builder Example: **E1AK32F27B**

1" Architectural Oak Downlight	Style	Beam Angle	Color Temperature	Finish
E1AK	32 Round Gimbal	F 38° NF 28° WF 50°	27 2700K 30 3000K 3500K	W All White B All Black

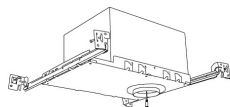
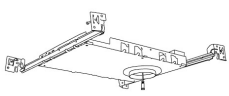
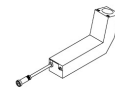
L8

Compatible Products

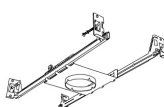
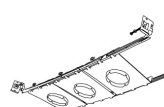


For use with 1" Oak™ Architectural Recessed Adjustables

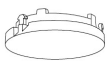

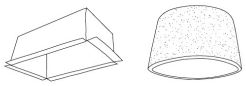
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1" Oak™ Accessories

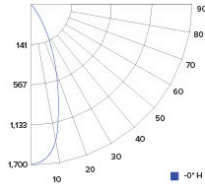
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Photometric Report

1" Round Gimbal Recessed Architectural Oak™ Adjustable

PHOTOMETRIC REPORT

Product #: E1AK32F27
Wattage / Lumens: 8.1W / 846 lm
Luminaire LPW: 104 lm/W



CANDLE POWER SUMMARY

Degree Vertical	0°
0	1685
5	1630
15	1133
25	489
35	136
45	42
55	18
65	10
75	5
85	1
90	0

ILLUMINANCE AT A DISTANCE

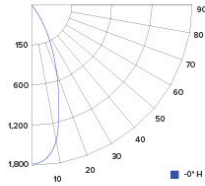
Distance to Target Plane	Center Beam Footcandles	Beam Diameter
4'	105	2.8'
6'	46.8	4.2'
8'	26.3	5.6'
10'	16.9	6.9'

ZONAL LUMEN SUMMARY

Zone	Lumens	%Luminaire
0-30°	682.9	81.2
0-40°	773.4	91.9
0-60°	824.0	98
0-90°	841.3	100

PHOTOMETRIC REPORT

Product #: E1AK32F30
Wattage / Lumens: 8.1W / 900 lm
Luminaire LPW: 111 lm/W



CANDLE POWER SUMMARY

Degree Vertical	0°
0	1795
5	1737
15	1207
25	521
35	145
45	45
55	19
65	11
75	6
85	1
90	0

ILLUMINANCE AT A DISTANCE

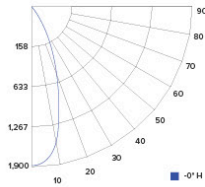
Distance to Target Plane	Center Beam Footcandles	Beam Diameter
4'	112	2.8'
6'	49.9	4.2'
8'	28.1	5.6'
10'	18.0	6.9'

ZONAL LUMEN SUMMARY

Zone	Lumens	%Luminaire
0-30°	727.4	81.2
0-40°	823.8	91.9
0-60°	877.8	98
0-90°	896.1	100

PHOTOMETRIC REPORT

Product #: E1AK32F35
Wattage / Lumens: 8.1W / 950 lm
Luminaire LPW: 117.2 lm/W



CANDLE POWER SUMMARY

Degree Vertical	0°
0	1895
5	1833
15	1274
25	550
35	153
45	47
55	20
65	11
75	6
85	1
90	0

ILLUMINANCE AT A DISTANCE

Distance to Target Plane	Center Beam Footcandles	Beam Diameter
4'	118	2.8'
6'	52.6	4.2'
8'	29.6	5.6'
10'	18.9	6.9'

ZONAL LUMEN SUMMARY

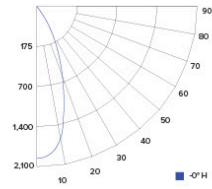
Zone	Lumens	%Luminaire
0-30°	767.7	81.2
0-40°	869.4	91.9
0-60°	926.4	98
0-90°	945.8	100

Photometric Report

1" Round Gimbal Recessed Architectural Oak™ Adjustable

PHOTOMETRIC REPORT

Product #: E1AK32F40
Wattage / Lumens: 8.1W / 1007 lm
Luminaire LPW: 124.3 lm/W



CANDLE POWER SUMMARY

Degress Vertical	0°
0	2015
5	1949
15	1355
25	585
35	162
45	50
55	22
65	12
75	7
85	1
90	0

ILLUMINANCE AT A DISTANCE

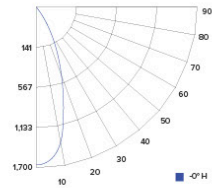
Distance to Target Plane	Center Beam Footcandles	Beam Diameter
4'	126	2.8'
6'	56.0	4.2'
8'	31.5	5.6'
10'	20.2	6.9'

ZONAL LUMEN SUMMARY

Zone	Lumens	%Luminaire
0-30°	816.5	81.2
0-40°	924.7	91.9
0-60°	985.2	98
0-90°	1,005.8	100

PHOTOMETRIC REPORT

Product #: E1AK32F5D
Wattage / Lumens: 8.1W / 850 lm
Luminaire LPW: 104.9 lm/W



CANDLE POWER SUMMARY

Degress Vertical	0°
0	1675
5	1620
15	1126
25	486
35	135
45	42
55	18
65	10
75	5
85	1
90	0

ILLUMINANCE AT A DISTANCE

Distance to Target Plane	Center Beam Footcandles	Beam Diameter
4'	105	2.8'
6'	46.5	4.2'
8'	26.2	5.6'
10'	16.7	6.9'

ZONAL LUMEN SUMMARY

Zone	Lumens	%Luminaire
0-30°	678.6	81.2
0-40°	768.6	91.9
0-60°	818.9	98
0-90°	836.0	100

M Series Commercial

Other Manufacturers:
LIGHTHEADED "CONTORTIONIST" Series
PRESCOLITE "LFR-4RD" Series
LUMENWERX "ECANA 4" Series

Project:	Type: L9
Product Code:	Date:

V091224



4" Round Downlight

Versatile Solution for all spaces providing high quality lighting ranging from 750lm all the way up to 3500lm

Expedited Install with our easily adjustable universal housing and bar hanger systems allowing for application in most ceiling types

Enhanced Serviceability is achieved through interchangeable modules, optics, and trims, all of which allow for ease of maintenance and implementation of design changes below the ceiling plane

Seamless Integration with several control systems allowing two-channel control dimming options down as low as 0.1%

INSTALLATION

Ceiling Thickness

New Construction: 1/2" up to 2"

Remodel: 1/2" up to 1 1/4"

Extension Collar: 5/8" to 3"

Ceiling Material

Drywall, Millwork

TRIMS

Aperture

4"

Shape

Round

Style

Standard, Hyperbolic, Pinhole, Wall Wash, Flangeless, Decorative, Vandal Proof/IP65

Finish

White, Black, Bronze, Clear Diffuse, Warm Diffuse

LIGHT OUTPUT & DISTRIBUTION

Module

Downlight

Lumens (Power)

750 lm (9.5W), 1000 lm (12.5W),
1250 lm (14.3W), 1500 lm (14.3W),
2000 lm (24.5W), 2500 lm (27.5W),
3000 lm (34.0W), 3500 lm (40.5W)

Color Quality

93 CRI, 2-step SDCM

Color Temperature

- 2700K
- 3000K
- 3500K
- 4000K
- Warm Dim (3000-1800K)
- Tunable White (4000-1800K)
- Tunable White (6500-2700K)

Beam Spread

- 15° Narrow Spot
- 60° Wide Flood
- 25° Spot
- 90°+ General
- 40° Flood

POWER & CONTROLS

Input Voltage

120/277V

Dimming

0-10V (1%), Lutron Athena Wireless Node (1%), DALI-2 (0.1%) (Coming Soon)

RATINGS & CERTIFICATIONS

Housing

RoHS Compliant

Module and Trim

Wet Location/IP65 Rated Configurations Available (Standard trims and covered areas only)

NSF Listed (White and black finish only)

IK10 Rated Option Available (Vandal Proof Trim)

Warranty

5 year limited warranty; 50,000 hours



Declare.



DMF LIGHTING 1118 E. 223rd St. Carson, CA 90745 323.934.7779 info@dmflighting.com dmflighting.com

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M Series Commercial

4" Round Downlight

L9

PRODUCT BUILDER | ROUND | DOWNLIGHT | EMBEDDED 0-10V

HOUSING

PRODUCT CODE	
<input type="text"/>	
M4NCRN	4" Round Housing, New Construction, Non-IC Rated
M4RMRN	4" Round Housing, Remodel, Non-IC Rated ¹

LIGHT MODULE

PRODUCT CODE		LUMENS	CRI	CCT		BEAM SPREAD		DIMMING
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
MD	Downlight Module	07	9	27	2700K	GA	General Ambient (90°+) ³	O
		10		30	3000K	NS	Narrow Spot (15°) ³	
		12		35	3500K	SP	Spot (25°)	
		15		40	4000K	FL	Flood (40°)	
		20		3W	Warm Dim (3000-1800K) ²	WF	Wide Flood (60°)	
		25						
		30						
		35						

TRIM | STANDARD

PRODUCT CODE		FINISH		OPTION	
<input type="text"/>		<input type="text"/>		<input type="text"/>	
M4TRS	Standard Trim	WH	White	[Blank]	None
M4TRL	Wall Wash/Sloped Ceiling Trim ⁴	BK	Black	FL	Flangeless ^{6,7}
M4TRP	Pinhole Trim ^{5,6}	BZ	Bronze	VP	Vandal Proof/IP65 ⁸
M4TRH	Hyperbolic Trim ⁶	CW	Clear Diffuse, White Flange		
		WW	Warm Diffuse, White Flange		FINISH TO BE SELECTED BY ARCHITECT
		CC	Custom Color		

TRIM | DECORATIVE (WHITE FINISH ONLY)

PRODUCT CODE	
<input type="text"/>	
M4TRSWHDOF	Decorative Open, Frosted ^{5,9}
M4TRSWHDCF	Decorative Closed, Frosted ^{5,9}
M4TRSWHDCC	Decorative Closed, Clear Frosted Side ^{5,9}
M4TRSWHDCCF	Decorative Closed, Clear Frosted Inside ^{5,9}

OPTICS

MDLX-GA	Low Lumen (750-2000LM) Downlight Optic GA 90° Beam Spread
MDLX-NS	Low Lumen (750-2000LM) Downlight Optic NS 15° Beam Spread
MDLX-SP	Low Lumen (750-2000LM) Downlight Optic SP 25° Beam Spread
MDLX-FL	Low Lumen (750-2000LM) Downlight Optic FL 40° Beam Spread
MDLX-WF	Low Lumen (750-2000LM) Downlight Optic WF 60° Beam Spread
MDHX-SP	High Lumen (2500-3500LM) Downlight Optic SP 25° Beam Spread
MDHX-FL	High Lumen (2500-3500LM) Downlight Optic FL 40° Beam Spread
MDHX-WF	High Lumen (2500-3500LM) Downlight Optic WF 60° Beam Spread

ACCESSORIES

M4XRMUD	Flangeless Mud Plate ¹⁰
M4KRTEMPLATE	Flangeless Wood Template ¹¹
M4CREXT	Round Extension Collar ¹²

¹ Not available with flangeless or vandal proof trim options nor extension collars

² Only available in 1000 lm; not available in Narrow Spot beam spread

³ Only available in 750-2000 lm

⁴ Recommended with WF Beam spread for general wall washing and SP for sloped ceilings. Not available in Custom Color

⁵ Only available in 750-1500 lm

⁶ Only available in White, Black, or Bronze finish

⁷ Mud plate required for FL installation, except for wood ceiling; Not compatible with remodel housing

⁸ Only available in Standard Style and White, Anti-Microbial Finish for installation in New Construction housing only.

Not compatible with extension collars

⁹ Recommended for use with General Ambient beam spread

¹⁰ Required for Flangeless Trim drywall installation

¹¹ Recommended for Flangeless Trim wood installation

¹² For New Construction Only - Ceiling Installations up to 3"



M Series Commercial

4" Round Downlight

L9

PRODUCT BUILDER | ROUND | DOWNLIGHT | ATHENA WIRELESS NODE/DALI-2

HOUSING

PRODUCT CODE		INSTALLATION		SHAPE		RATING		OUTPUT		DIMMING		WIRELESS	
M4		NC		R		N							
M4	4" Housing	NC	New Construction	R	Round	N	Non-IC	07	750 lm	O	0-10V (AWN Only)	[Blank]	None (DALI-2 Only)
								10	1000 lm	DS	DALI-2 (Static CCT) ² <i>(Coming Soon)</i>	AWN	Athena Wireless Node
								12	1250 lm	DT	DALI-2 (Tunable White) ^{1,3} <i>(Coming Soon)</i>		
								15	1500 lm				
								20	2000 lm				
								25	2500 lm				
								30	3000 lm				
								35	3500 lm				

LIGHT MODULE

PRODUCT CODE		LUMENS		CRI		CCT		BEAM SPREAD		DIMMING	
MD				9						A	
MD	Downlight Module	07	750 lm	9	93 CRI	27	2700K	GA	General Ambient (90°+) ³	A	Alternate
		10	1000 lm			30	3000K	NS	Narrow Spot (15°) ³		
		12	1250 lm			35	3500K	SP	Spot (25°)		
		15	1500 lm			40	4000K	FL	Flood (40°)		
		20	2000 lm			3W	Warm Dim (3000–1800K) ^{4,5}	WF	Wide Flood (60°)		
		25	2500 lm			T1	Tunable White (4000–1800K) ^{1,3,6} <i>(Coming Soon)</i>				
		30	3000 lm			T2	Tunable White (6500–2700K) ^{1,3,6} <i>(Coming Soon)</i>				
		35	3500 lm								

TRIM | STANDARD

PRODUCT CODE		FINISH		OPTION	
M4TRS	Standard Trim	WH	White	[Blank]	None
M4TRL	Wall Wash/Sloped Ceiling Trim ⁷	BK	Black	FL	Flangeless ^{9,10}
M4TRP	Pinhole Trim ^{8,9}	BZ	Bronze	VP	Vandal Proof/IP65 ¹¹
M4TRH	Hyperbolic Trim ⁹	CW	Clear Diffuse, White Flange		
		WW	Warm Diffuse, White Flange		
		CC	Custom Color		

TRIM | DECORATIVE (WHITE FINISH ONLY)

PRODUCT CODE	
M4TRSWHDOF	Decorative: Open, Frosted ^{8,12}
M4TRSWHDCF	Decorative: Closed, Frosted ^{8,12}
M4TRSWHDCC	Decorative: Closed, Clear Frosted Side ^{8,12}
M4TRSWHDCCF	Decorative: Closed, Clear Frosted Inside ^{8,12}

¹ Not available in NS or GA Beam Spreads

² Not available in 3500 lm

³ Only available in 750 - 2000 lm

⁴ Only available in 1000 lm

⁵ Not available in Narrow Spot beam spread

⁶ Only available in DALI-2 Dimming

⁷ Recommended with WF beam spread for standard wall washing and SP for sloped ceiling; Not available in custom color

⁸ Only available in 750 - 1500 lm

⁹ Only available in White, Black, or Bronze finish

¹⁰ Mud Plate required for FL Install except for wood ceiling

¹¹ Only available in Standard Style with White, Anti-Microbial Finish. Not compatible with extension collar

¹² Recommended with General Ambient beam spread



M Series Commercial

4" Round Downlight

L9

PRODUCT BUILDER | ROUND | DOWNLIGHT | ATHENA WIRELESS NODE/DALI-2

ACCESSORIES

M4XRMUD	Flangeless Mud Plate ¹³
M4KRTEMPLATE	Flangeless Wood Template ¹⁴
M4CREXT	Round Extension Collar ¹⁵

¹³ Required for Flangeless Trim drywall installation

¹⁴ Recommended for Flangeless Trim wood installation

¹⁵ For New Construction Only - Ceiling Installations up to 3"



M Series Commercial

4" Round Downlight

L9

PRODUCT BUILDER | ROUND | DOWNLIGHT | EMERGENCY LIGHTING

HOUSING

PRODUCT CODE	INSTALLATION	SHAPE	RATING	LUMEN	DIMMING	WIRELESS	OPTION
M4	NC	R	N				
M4 4" Housing	NC New Construction	R Round	N Non-IC	07 750 lm	O 0-10V for EM only	[Blank] None	EM Emergency driver, Integrated switch ³
				10 1000 lm	DS DALI-2 Static CCT ¹ (Coming Soon)	AWN Athena Wireless Node	EMS Emergency driver, Remote switch
				12 1250 lm	DT DALI-2 Tunable White CCT ^{2,4} (Coming Soon)		
				15 1500 lm			
				20 2000 lm			
				25 2500 lm			
				30 3000 lm			
				35 3500 lm			

LIGHT MODULE

PRODUCT CODE	LUMENS	CRI	CCT	BEAM SPREAD	DIMMING
MD		9			A
MD Downlight Module	07 750 lm	9 93 CRI	27 2700K	GA General Ambient (90°+) ⁴	A Alternate
	10 1000 lm		30 3000K	NS Narrow Spot (15°) ⁴	
	12 1250 lm		35 3500K	SP Spot (25°)	
	15 1500 lm		40 4000K	FL Flood (40°)	
	20 2000 lm		3W Warm Dim (3000-1800K) ^{6,7}	WF Wide Flood (60°)	
	25 2500 lm		T1 Tunable White (4000-1800K) ^{2,4,8}		
	30 3000 lm		T2 Tunable White (6500-2700K) ^{2,4,8}		
	35 3500 lm				

TRIM | STANDARD

PRODUCT CODE	FINISH	OPTION
M4TRS Standard Trim	WH White	[Blank] None
M4TRL Wall Wash/ Sloped Ceiling ⁷	BK Black	FL Flangeless ^{9,11}
M4TRP Pinhole Trim ^{9,10}	BZ Bronze	EM Integrated test switch ^{9,12}
M4TRH Hyperbolic Trim ⁹	CW Clear Diffuse, White Flange	VP Vandal Proof/IP65 ¹³
	WW Warm Diffuse, White Flange	
	CC Custom Color	

TRIM | DECORATIVE (WHITE FINISH ONLY)

PRODUCT CODE	
M4TRSWHDOF	Decorative: Open, Frosted ^{10,14}
M4TRSWHDCF	Decorative: Closed, Frosted ^{10,14}
M4TRSWHDCC	Decorative: Closed, Clear Frosted Side ^{10,14}
M4TRSWHDCCF	Decorative: Closed, Clear Frosted Inside ^{10,14}

¹ Not available in 3500 lm

² Not available with GA or NS Beam Spread

³ Integrated test switch must be selected for both housing and trim

⁴ Only available in 750 - 2000 lm

⁵ Only available in 1000 lm

⁶ Not available in Narrow Spot beam Spread

⁷ Recommended with WF beam spread for general wall washing and SP beam spread for sloped ceiling. Not available in custom color

⁸ Only available in DALI-2 Dimming

⁹ Only available in White, Black, or Bronze finish

¹⁰ Only available 750-1500 lm

¹¹ Mud Plate required for FL Install except for wood ceiling

¹² Only available in Standard Style and White, Clear Diffuse or Warm Diffuse

¹³ Only available in Standard Style and White, Anti-Microbial Finish not compatible with extension collar

¹⁴ Recommended in General Ambient beam spread



M Series Commercial

4" Round Downlight

L9

PRODUCT BUILDER | ROUND | DOWNLIGHT | EMERGENCY LIGHTING

ACCESSORIES

M4XRMUD	Flangeless Mud Plate ¹⁵
M4KRTEMPLATE	Flangeless Wood Template ¹⁶
M4CREXT	Round Extension Collar ¹⁷

¹⁵ Required for Flangeless Trim drywall installation

¹⁶ Recommended for Flangeless Trim wood installation

¹⁷ For New Construction Only - Ceiling Installations up to 3"



M Series Commercial

4" Round Downlight

L9

MODULE



4" Downlight

MD

SUMMARY

INPUT VOLTAGE: 120/277V, 50/60Hz

COLOR QUALITY: 93 CRI ¹

MAX INPUT CURRENT (120V): 0.350 amps

MAX INPUT CURRENT (277V): 0.165 amps

AC CONNECTOR: 6 pin Molex

DC CONNECTOR: Male 4-Pin Low Voltage Connector

POWER FACTOR: Greater than 0.9

TOTAL HARMONIC DISTORTION: Less than 20%

AMBIENT OPERATING TEMPERATURE: -20°C to 40°C

LISTINGS: ENERGY STAR[®] qualified ², UL Listed for Wet Location (Under covered ceilings only), UL Certified US•CA, Declare, RoHS Compliant, NSF/ANSI 2 listed, suitable for splash zone ³, DALI-2 Compliant, Compliant to FCC Title 47 Part 15; Class B

SPECIAL LISTINGS (VANDAL PROOF TRIM): IK10 Rating, IP65 Listing, Anti-Microbial

WARRANTY: 5 year limited warranty; 50,000 hours at 70% lumen maintenance

¹ Tested in accordance to IESNA LM-79-2008

² Refer to ENERGY STAR Certified light fixtures database

³ White and Black Finish only



M Series Commercial

4" Round Downlight

L9

MODULE PERFORMANCE

Based on 93 CRI, 3000K Module + STD White + Trim (M4TRSWH)

(Please refer to IES files for other trim types)

		STATIC CCT								WARM DIM	T1	T2
LED CHIP		CREE 93 CRI								Bridgelux 93 CRI		
SDCM		2-STEP								3-STEP		
		07	10	12	15	20	25	30	35	10	10	10
NS	Lumens	718	983	1111	1278	2163	N/A					
	LPW ¹	75.5	78.6	77.7	77.4	90.1	N/A					
	CBCP ²	6227	8530	9639	11089	18766	N/A					
	UGR ³	13	14.1	14.5	15	16.8	N/A					
SP	Lumens	696	953	1077	1239	2097	2603	3044	3709	848	994	1094
	LPW	73.2	76.2	75.3	75.1	87.4	94.7	89.5	91.6	67.9	68.6	75.4
	CBCP	2131	2919	3298	3795	6421	12861	15037	18327	2598	2254	2479
	UGR	13.2	14.3	14.7	15.2	17	12.2	12.8	13.5	13.8	16.5	16.8
FL	Lumens	685	939	1061	1221	2066	2545	2976	3627	836	981	1079
	LPW	72.2	75.1	74.2	74	86.1	92.5	87.5	89.5	66.9	67.7	74.4
	CBCP	1196	1638	1851	2130	3604	9094	10634	12960	1458	1257	1382
	UGR	14.9	16	16.4	16.9	18.8	12.6	13.1	13.8	15.6	17.4	17.7
WF	Lumens	677.5	928	1049	1206	2042	2453	2868	3495.5	826	956	1052
	LPW	71.3	74.2	73.3	73.1	85.1	89.2	84.4	86.3	66.1	66	72.6
	CBCP	696	953	1077	1239	2096	1926	2252	2745	848	1090	1199
	UGR	17.3	18.4	18.8	19.3	21.1	22.4	23	23.7	18	17.8	18.1
GA	Lumens	654	896	1012	1165	1971	N/A			797	1031	1134
	LPW	68.9	71.7	70.8	70.6	82.1	N/A			63.8	71.1	78.2
	CBCP	264	362	409	470	796	N/A			322	595	655
	UGR	22.1	23.2	23.6	24.1	25.9	N/A			22.8	21.8	22.2

CCT	STATIC				WARM DIM		T1 TUNABLE WHITE			T2 TUNABLE WHITE		
	2700K	3000K	3500K	4000K	1800K	3000K	1800K	3000K	4000K	2700K	3000K	6500K
MULTIPLIER	0.93	1	1.05	1.07	0.05	1	0.73	1	1.12	0.96	1	1.07
EMERGENCY BATTERY MULTIPLIER	LPW x 5											

¹ LPW: Lumens per watt

² CBCP: Center beam candlepower

³ UGR: Unified glare ratio (0.7/0.5/0.2, 4H/8H)



M Series Commercial

4" Round Downlight

L9

HOUSING



New Construction

M4NCRN

SUMMARY

JUNCTION BOX: Equipped with 6 knockouts: two 1/2" and two 3/4" trade size knockouts on top, two 1/2" trade size knockouts on side. Approved for 8 (four in, four out) #12 AWG 70°C.

BAR HANGER MOUNTING: Adjustable Bar Hangers for 14"-24" joist spacing. Compatible with traditional joists, Armstrong™ ceiling, Hat Channel, T-Bar.

CEILING: 1/2" up to 2"

CUTOUT: 4 1/4" (107mm) round opening

WARRANTY: 5 year limited warranty

ALTERNATE DIMMING SPECIFICATIONS

INPUT VOLTAGE: 120/277V, 50/60Hz

MAX INPUT CURRENT (120V): 0.130 amps

MAX INPUT CURRENT (277V): 0.065 amps

POWER FACTOR: Greater than 0.9

TOTAL HARMONIC DISTORTION: Less than 20%

LISTINGS: Compliant to FCC Title 47 Part 15; Class B

EMERGENCY BATTERY SPECIFICATIONS

EMERGENCY BATTERY : Emergency Battery Back up is designed to provide output for 90 minutes when in an emergency state

INPUT VOLTAGE: 120/277V 50/60Hz

ILLUMINATION TIME: 90min

WATTAGE IN EM STATE: 5W

LUMEN OUTPUT IN EM STATE: LPW x 5

TEST SWITCH OPTIONS:

- **INTEGRATED TEST SWITCH (-EM HOUSING):** Requires Compatible trim - Flanged, Standard Style trim Only
- **REMOTE TEST SWITCH(-EMS HOUSING):** Must be installed according to local code can be used with any flanged, flangeless, or decorative trim type



M Series Commercial

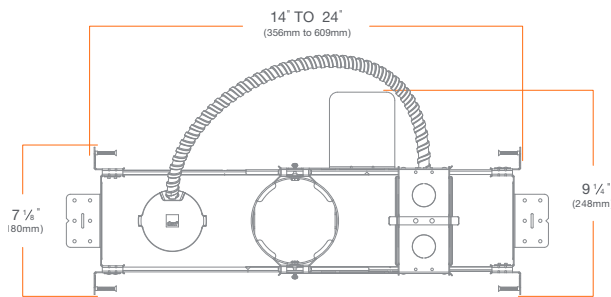
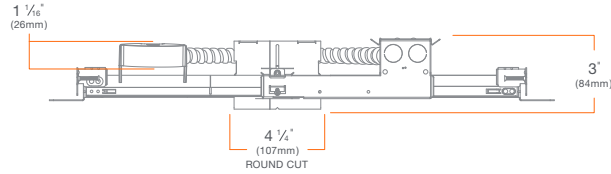
4" Round Downlight

L9

New Construction

M4NCRN

(Dimensions not including module)

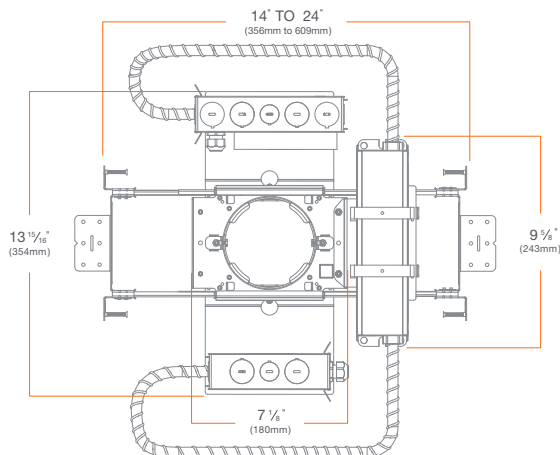
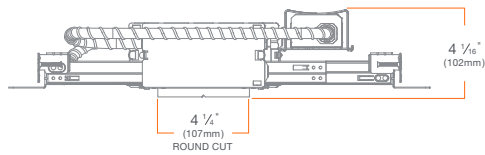


Emergency Lighting

M4NCRNxxxEM

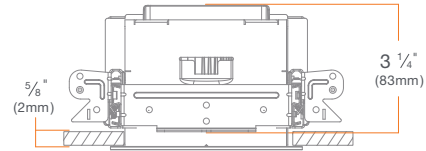
M4NCRNxxxAWNEM

(Dimensions not including module)



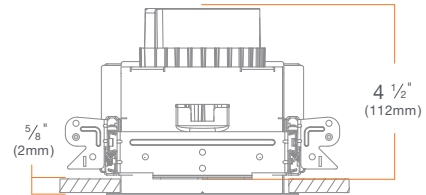
Total Height in Plenum

750LM-1500LM



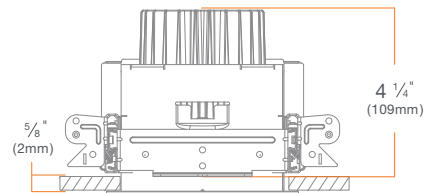
Bar Hanger Vertically Adjustable
from 1/2" to 2" (13 to 51mm)

2000LM



Bar Hanger Vertically Adjustable
from 1/2" to 2" (13 to 51mm)

2500LM-3500LM/DALI-2



Bar Hanger Vertically Adjustable
from 1/2" to 2" (13 to 51mm)



M Series Commercial

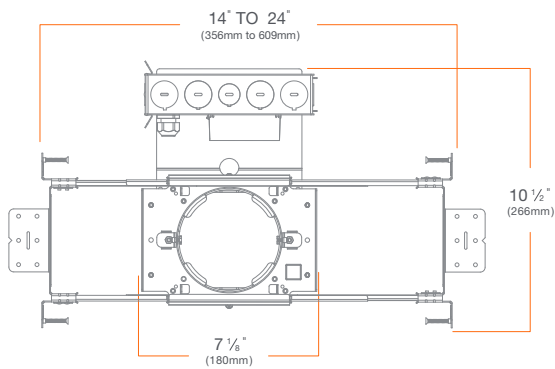
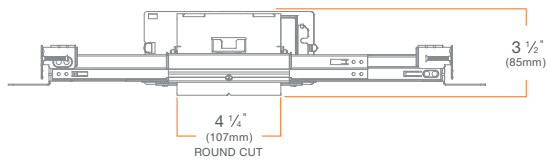
4" Round Downlight

L9

New Construction Static DALI/Lutron Athena Node

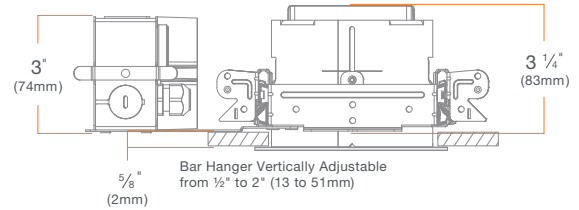
M4NCRNxxDS
M4NCRNxxOAWN
M4NCRNxxDSAWN

(Dimensions not including module)

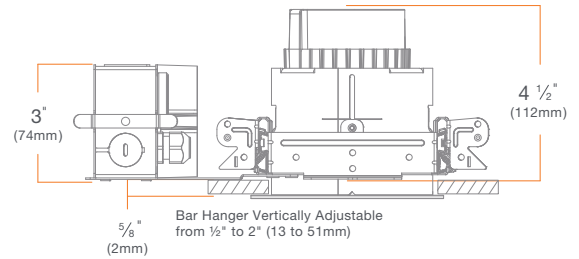


Total Height in Plenum

750LM-1500LM



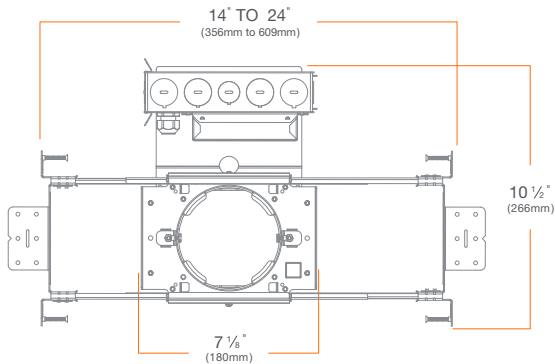
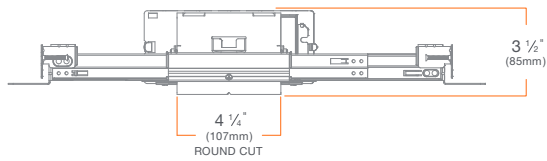
2000LM



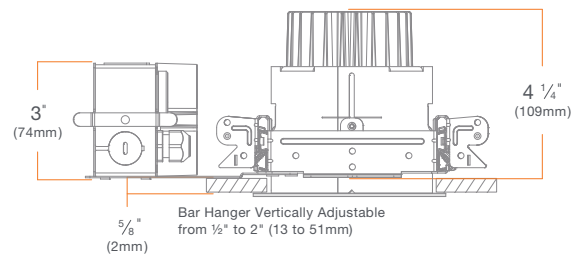
New Construction Tunable White DALI-2

M4NCRNxxDT

(Dimensions not including module)



2500LM-3500LM/DALI-2





M Series Commercial

4" Round Downlight

L9

HOUSING



Remodel

M4RMRN

SUMMARY

JUNCTION BOX: Equipped with 3 knockouts: two 1/2" trade size and one 3/4" trade size knockouts #12 AWG 70°C. Approved for 4 (2 in and 2 out)

CEILING: 1/2" up to 1 1/4"

CUTOUT: 4 3/8" (111mm) round opening

WARRANTY: 5 year limited warranty



M Series Commercial

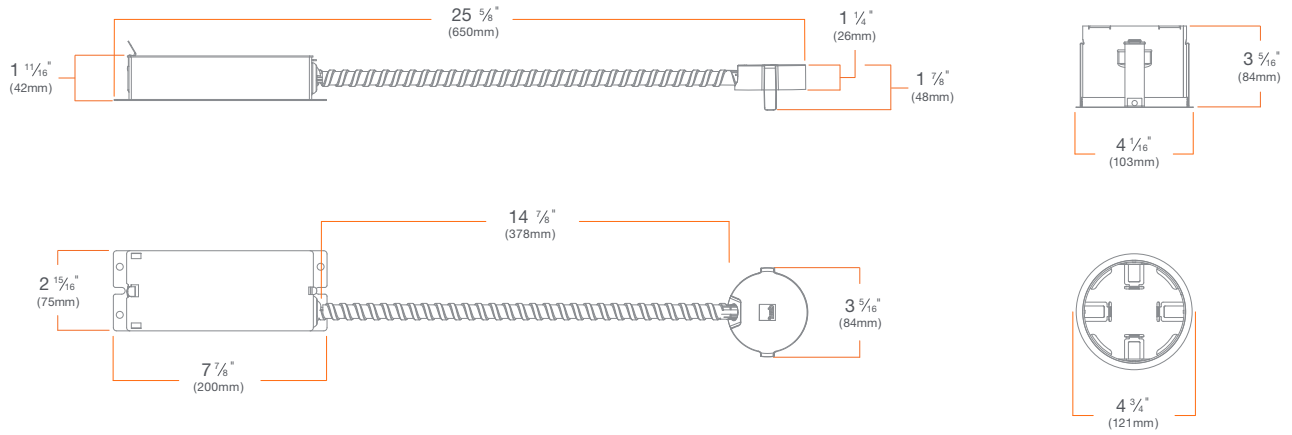
4" Round Downlight

L9

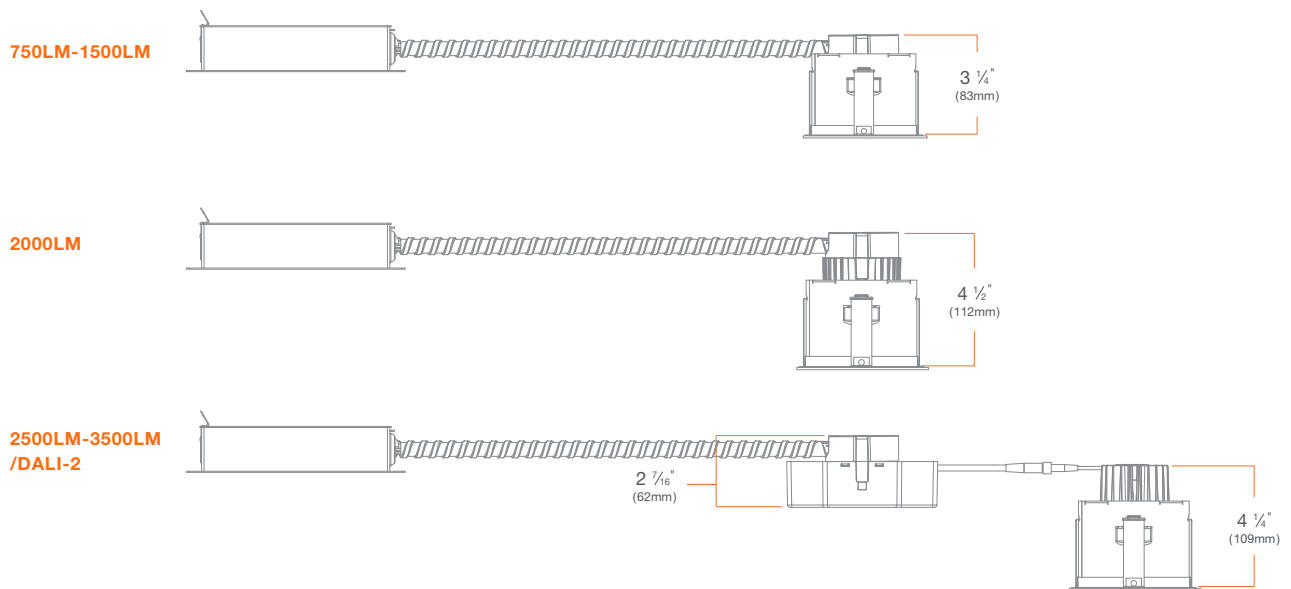
Standard

M4RMRN

(Dimensions not including module)



Total Height in Plenum





M Series Commercial

4" Round Downlight

L9

TRIMS



4" Round Trims

M4TR

SUMMARY

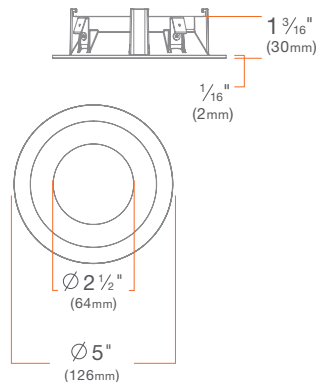
CONSTRUCTION: Die-cast aluminum

DECORATIVE: Acrylic diffuser

INSTALLATION: Twist & Lock

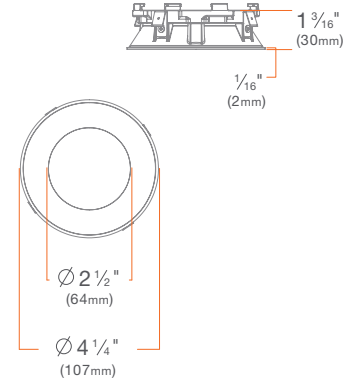
Standard

M4TRSWH



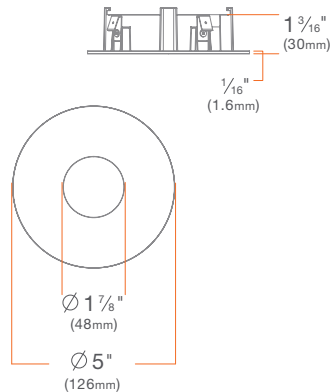
Flangeless

M4TRSWHFL



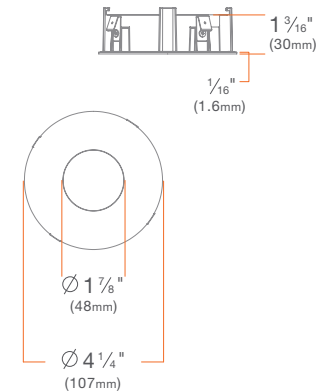
Pinhole

M4TRPWH



Flangeless Pinhole

M4TRPWHFL





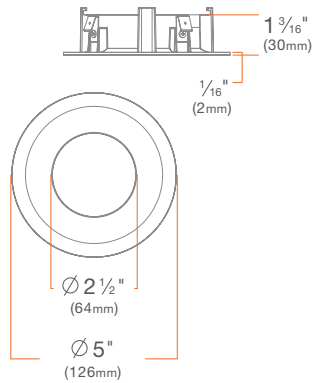
M Series Commercial

4" Round Downlight

L9

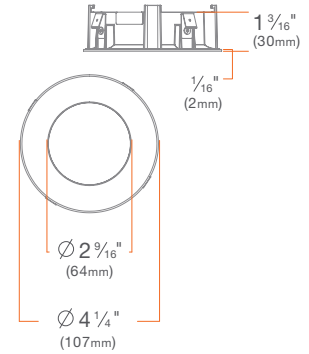
Hyperbolic

M4TRHWH



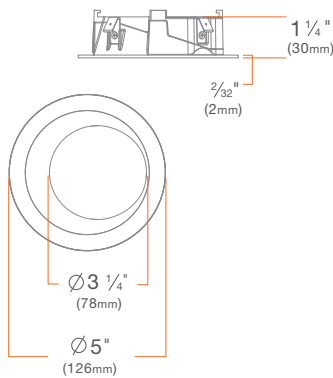
Flangeless Hyperbolic

M4TRHWHFL



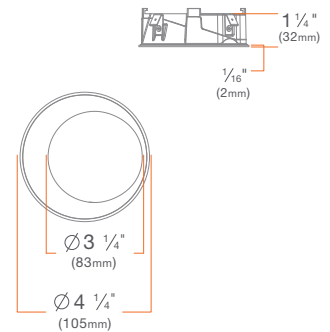
Wall Wash

M4TRLWH



Flangeless Wall Wash

M4TRLWHFL

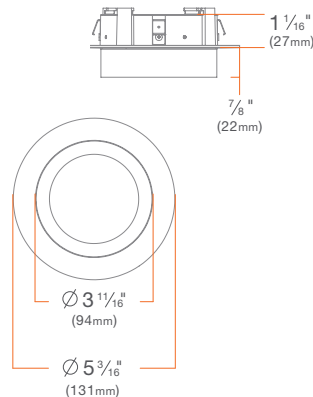


Decorative Closed

Frosted: M4TRSWHDCF

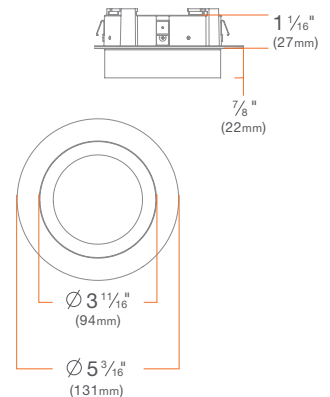
Clear, Frosted Inside: M4TRSWHDCC

Clear, Frosted Sides: M4TRSWHDCCF



Decorative Open

Frosted: M4TRSWHDOF





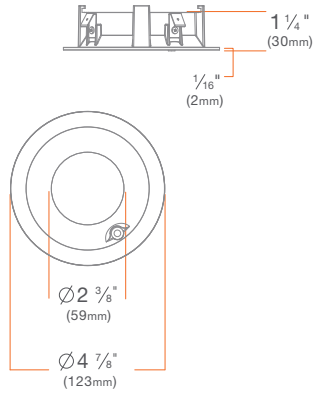
M Series Commercial

4" Round Downlight

L9

Emergency with Integrated Test Switch

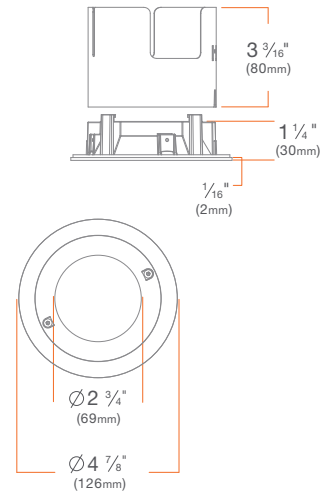
M4TRSWHEM



Vandal Proof/IP65

*For use with Standard New Construction Only

M4TRSWHVP





M Series Commercial

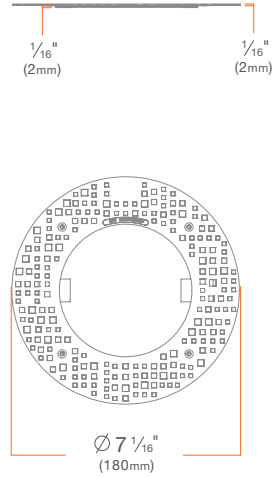
4" Round Downlight

L9

ACCESSORIES

Flangeless Mud Plate

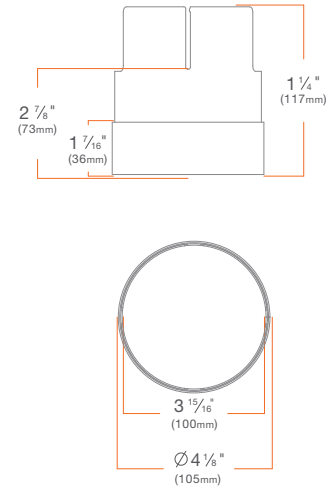
M4XRMUD



Extension Collar

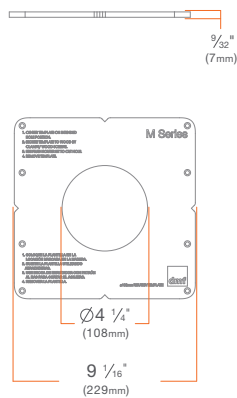
**For use with Standard New Construction Only*

M4CREXT



Router Template

M4KRTEMPLATE





M Series Commercial

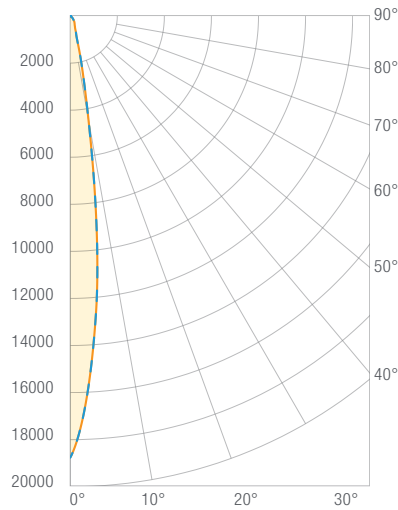
4" Round Downlight

L9

PHOTOMETRY

MD 2000 lm, 3000K, Narrow Spot

MD20930NS | M4TRSWH



cd — C0 - C180 — C90 - C270 2052 lm

Luminous Intensity

Gamma	C 0°
0°	18766
5°	12609
10°	4461
15°	1402
20°	682
25°	466
30°	372
35°	304
40°	221
45°	162
50°	116
55°	81
60°	53
65°	30
70°	13
75°	8
80°	5
85°	2
90°	0

Values in candela

Zonal Lumen Summary

Zone	Lumens	Luminaire %
0-30	1625	79
0-40	1810	88
0-60	2010	98
0-90	2052	100
0-180	2052	100

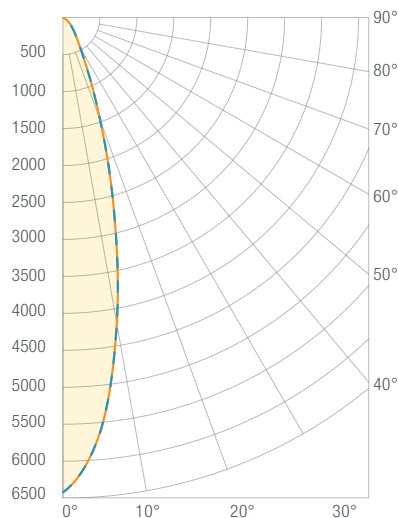
Illuminance Chart

Distance from LED	Foot Candles	Diameter
3'	2085.2	0.7'
6'	521.3	1.5'
9'	231.7	2.2'
12'	130.3	2.9'

Beam Angle: 14°

MD 2000 lm, 3000K, Spot

MD20930SP | M4TRSWH



cd — C0 - C180 — C90 - C270 2060 lm

Luminous Intensity

Gamma	C 0°
0°	6422
5°	5661
10°	4202
15°	2653
20°	1478
25°	799
30°	472
35°	319
40°	227
45°	166
50°	119
55°	82
60°	50
65°	29
70°	13
75°	8
80°	4
85°	2
90°	0

Values in candela

Zonal Lumen Summary

Zone	Lumens	Luminaire %
0-30	1612	78
0-40	1817	88
0-60	2020	98
0-90	2060	100
0-180	2060	100

Illuminance Chart

Distance from LED	Foot Candles	Diameter
3'	713.5	1.4'
6'	178.4	2.8'
9'	79.3	4.2'
12'	44.6	5.6'

Beam Angle: 26°



M Series Commercial

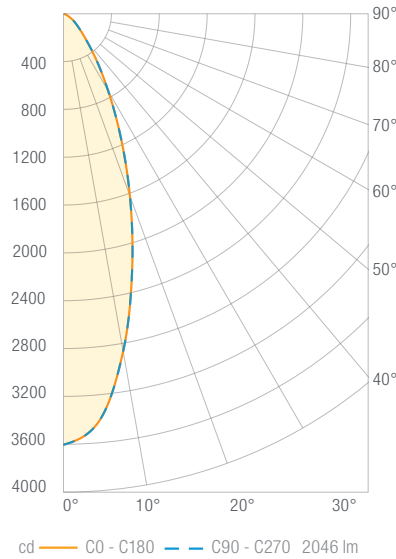
4" Round Downlight

L9

PHOTOMETRY

MD 2000 Im, 3000K, Flood

MD20930FL | M4TRSWH



Luminous Intensity

Gamma	C 0°
0°	3604
5°	3418
10°	2867
15°	2215
20°	1620
25°	1123
30°	746
35°	487
40°	309
45°	204
50°	141
55°	98
60°	57
65°	34
70°	15
75°	10
80°	6
85°	3
90°	0

Values in candela

Zonal Lumen Summary

Zone	Lumens	Luminaire %
0-30	1438	70
0-40	1748	85
0-60	1998	98
0-90	2046	100
0-180	2046	100

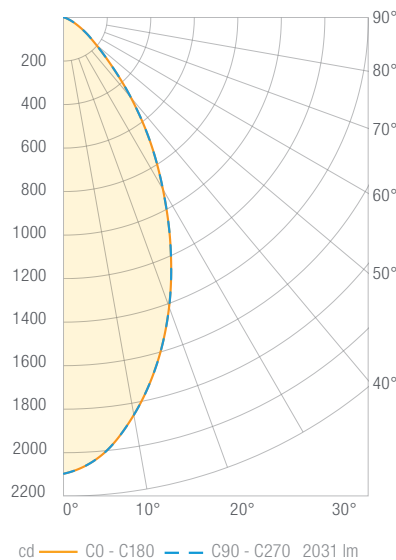
Illuminance Chart

Distance from LED	Foot Candles	Diameter
3'	400.5	2.0'
6'	100.1	4.0'
9'	44.5	6.0'
12'	25.0	8.0'

Beam Angle: 37°

MD 2000 Im, 3000K, Wide Flood

MD20930WF | M4TRSWH



Luminous Intensity

Gamma	C 0°
0°	2096
5°	2018
10°	1855
15°	1651
20°	1416
25°	1162
30°	912
35°	689
40°	480
45°	307
50°	195
55°	129
60°	78
65°	45
70°	22
75°	12
80°	7
85°	4
90°	1

Values in candela

Zonal Lumen Summary

Zone	Lumens	Luminaire %
0-30	1179	58
0-40	1605	79
0-60	1967	97
0-90	2031	100
0-180	2031	100

Illuminance Chart

Distance from LED	Foot Candles	Diameter
3'	232.9	3.1'
6'	58.2	6.2'
9'	25.9	9.3'
12'	14.6	12.4'

Beam Angle: 55°



M Series Commercial

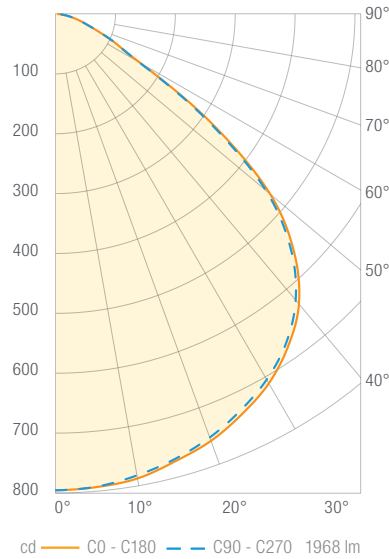
4" Round Downlight

L9

PHOTOMETRY

MD 2000 Im, 3000K, General Ambient

MD20930GA



Luminous Intensity

Gamma	C 0°
0°	796
5°	793
10°	788
15°	773
20°	759
25°	737
30°	712
35°	677
40°	632
45°	564
50°	468
55°	318
60°	163
65°	103
70°	62
75°	41
80°	24
85°	11
90°	3

Values in candela

Zonal Lumen Summary

Zone	Lumens	Luminaire %
0-30	640	32
0-40	1067	54
0-60	1798	91
0-90	1968	100
0-180	1968	100

Illuminance Chart

Distance from LED	Foot Candles	Diameter
3'	88.4	7.8'
6'	22.1	15.5'
9'	9.8	23.3'
12'	5.5	31.1'

Beam Angle: 105° x 104°

M Series Commercial

Other Manufacturers:
LIGHTHEADED "CONTORTIONIST" Series
PRESCOLITE "LFR-4RD" Series
LUMENWERX "ECANA 4" Series

Project:	Type: L10
Product Code:	Date:

V091224



4" Round Downlight

Versatile Solution for all spaces providing high quality lighting ranging from 750lm all the way up to 3500lm

Expedited Install with our easily adjustable universal housing and bar hanger systems allowing for application in most ceiling types

Enhanced Serviceability is achieved through interchangeable modules, optics, and trims, all of which allow for ease of maintenance and implementation of design changes below the ceiling plane

Seamless Integration with several control systems allowing two-channel control dimming options down as low as 0.1%

INSTALLATION

Ceiling Thickness

New Construction: 1/2" up to 2"

Remodel: 1/2" up to 1 1/4"

Extension Collar: 5/8" to 3"

Ceiling Material

Drywall, Millwork

TRIMS

Aperture

4"

Shape

Round

Style

Standard, Hyperbolic, Pinhole, Wall Wash, Flangeless, Decorative, Vandal Proof/IP65

Finish

White, Black, Bronze, Clear Diffuse, Warm Diffuse

LIGHT OUTPUT & DISTRIBUTION

Module

Downlight

Lumens (Power)

750 lm (9.5W), 1000 lm (12.5W),
1250 lm (14.3W), 1500 lm (14.3W),
2000 lm (24.5W), 2500 lm (27.5W),
3000 lm (34.0W), 3500 lm (40.5W)






Color Quality

93 CRI, 2-step SDCM

Color Temperature

- 2700K ● 3000K ● 3500K
- 4000K ● Warm Dim (3000-1800K)
- Tunable White (4000-1800K) ● Tunable White (6500-2700K)

Beam Spread

-  15° Narrow Spot  60° Wide Flood
-  25° Spot  90°+ General
-  40° Flood

POWER & CONTROLS

Input Voltage

120 / 277V

Dimming


0-10V (1%), Lutron Athena Wireless Node (1%), DALI-2 (0.1%) (Coming Soon)


RATINGS & CERTIFICATIONS


Housing

 RoHS Compliant

Module and Trim

 Wet Location/IP65 Rated Configurations Available (Standard trims and covered areas only)

 NSF Listed (White and black finish only)

 IK10 Rated Option Available (Vandal Proof Trim)

Warranty

5 year limited warranty; 50,000 hours



DMF LIGHTING 1118 E. 223rd St. Carson, CA 90745 323.934.7779 info@dmflighting.com dmflighting.com

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M Series Commercial

4" Round Downlight

L10

PRODUCT BUILDER | ROUND | DOWNLIGHT | EMBEDDED 0-10V

HOUSING

PRODUCT CODE	
<input type="text"/>	
M4NCRN	4" Round Housing, New Construction, Non-IC Rated
M4RMRN	4" Round Housing, Remodel, Non-IC Rated ¹

LIGHT MODULE

PRODUCT CODE		LUMENS		CRI	CCT	BEAM SPREAD		DIMMING			
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>			
MD	Downlight Module	07	750 lm	9	93 CRI	27	2700K	GA	General Ambient (90°+) ³	O	0-10V
		10	1000 lm			30	3000K	NS	Narrow Spot (15°) ³		
		12	1250 lm			35	3500K	SP	Spot (25°)		
		15	1500 lm			40	4000K	FL	Flood (40°)		
		20	2000 lm			3W	Warm Dim (3000-1800K) ²	WF	Wide Flood (60°)		
		25	2500 lm								
		30	3000 lm								
		35	3500 lm								

TRIM | STANDARD

PRODUCT CODE		FINISH		OPTION	
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
M4TRS	Standard Trim	WH	White	[Blank]	None
M4TRL	Wall Wash/Sloped Ceiling Trim ⁴	BK	Black	FL	Flangeless ^{6,7}
M4TRP	Pinhole Trim ^{5,6}	BZ	Bronze	VP	Vandal Proof/IP65 ⁸
M4TRH	Hyperbolic Trim ⁶	CW	Clear Diffuse, White Flange		
		WW	Warm Diffuse, White Flange	FINISH TO BE SELECTED BY ARCHITECT	
		CC	Custom Color		

TRIM | DECORATIVE (WHITE FINISH ONLY)

PRODUCT CODE	
<input type="text"/>	<input type="text"/>
M4TRSWHDOF	Decorative Open, Frosted ^{5,9}
M4TRSWHDCF	Decorative Closed, Frosted ^{5,9}
M4TRSWHDCC	Decorative Closed, Clear Frosted Side ^{5,9}
M4TRSWHDCCF	Decorative Closed, Clear Frosted Inside ^{5,9}

OPTICS

MDLX-GA	Low Lumen (750-2000LM) Downlight Optic GA 90° Beam Spread
MDLX-NS	Low Lumen (750-2000LM) Downlight Optic NS 15° Beam Spread
MDLX-SP	Low Lumen (750-2000LM) Downlight Optic SP 25° Beam Spread
MDLX-FL	Low Lumen (750-2000LM) Downlight Optic FL 40° Beam Spread
MDLX-WF	Low Lumen (750-2000LM) Downlight Optic WF 60° Beam Spread
MDHX-SP	High Lumen (2500-3500LM) Downlight Optic SP 25° Beam Spread
MDHX-FL	High Lumen (2500-3500LM) Downlight Optic FL 40° Beam Spread
MDHX-WF	High Lumen (2500-3500LM) Downlight Optic WF 60° Beam Spread

ACCESSORIES

M4XRMUD	Flangeless Mud Plate ¹⁰
M4KRTEMPLATE	Flangeless Wood Template ¹¹
M4CREXT	Round Extension Collar ¹²

¹ Not available with flangeless or vandal proof trim options nor extension collars

² Only available in 1000 lm; not available in Narrow Spot beam spread

³ Only available in 750-2000 lm

⁴ Recommended with WF Beam spread for general wall washing and SP for sloped ceilings. Not available in Custom Color

⁵ Only available in 750-1500 lm

⁶ Only available in White, Black, or Bronze finish

⁷ Mud plate required for FL installation, except for wood ceiling; Not compatible with remodel housing

⁸ Only available in Standard Style and White, Anti-Microbial Finish for Installation in New Construction housing only. Not compatible with extension collars

⁹ Recommended for use with General Ambient beam spread

¹⁰ Required for Flangeless Trim drywall installation

¹¹ Recommended for Flangeless Trim wood installation

¹² For New Construction Only - Ceiling Installations up to 3"



M Series Commercial

4" Round Downlight

L10

PRODUCT BUILDER | ROUND | DOWNLIGHT | ATHENA WIRELESS NODE/DALI-2

HOUSING

PRODUCT CODE		INSTALLATION		SHAPE		RATING		OUTPUT		DIMMING		WIRELESS	
M4		NC		R		N							
M4	4" Housing	NC	New Construction	R	Round	N	Non-IC	07	750 lm	O	0-10V (AWN Only)	[Blank]	None (DALI-2 Only)
								10	1000 lm	DS	DALI-2 (Static CCT) ² <i>(Coming Soon)</i>	AWN	Athena Wireless Node
								12	1250 lm	DT	DALI-2 (Tunable White) ^{1,3} <i>(Coming Soon)</i>		
								15	1500 lm				
								20	2000 lm				
								25	2500 lm				
								30	3000 lm				
								35	3500 lm				

LIGHT MODULE

PRODUCT CODE		LUMENS		CRI		CCT		BEAM SPREAD		DIMMING	
MD				9						A	
MD	Downlight Module	07	750 lm	9	93 CRI	27	2700K	GA	General Ambient (90°+) ³	A	Alternate
		10	1000 lm			30	3000K	NS	Narrow Spot (15°) ³		
		12	1250 lm			35	3500K	SP	Spot (25°)		
		15	1500 lm			40	4000K	FL	Flood (40°)		
		20	2000 lm			3W	Warm Dim (3000-1800K) ^{4,5}	WF	Wide Flood (60°)		
		25	2500 lm			T1	Tunable White (4000-1800K) ^{1,3,6} <i>(Coming Soon)</i>				
		30	3000 lm			T2	Tunable White (6500-2700K) ^{1,3,6} <i>(Coming Soon)</i>				
		35	3500 lm								

TRIM | STANDARD

PRODUCT CODE		FINISH		OPTION	
M4TRS	Standard Trim	WH	White	[Blank]	None
M4TRL	Wall Wash/Sloped Ceiling Trim ⁷	BK	Black	FL	Flangeless ^{9,10}
M4TRP	Pinhole Trim ^{8,9}	BZ	Bronze	VP	Vandal Proof/IP65 ¹¹
M4TRH	Hyperbolic Trim ⁹	CW	Clear Diffuse, White Flange		
		WW	Warm Diffuse, White Flange		
		CC	Custom Color		

TRIM | DECORATIVE (WHITE FINISH ONLY)

PRODUCT CODE	
M4TRSWHDOF	Decorative: Open, Frosted ^{8,12}
M4TRSWHDCF	Decorative: Closed, Frosted ^{8,12}
M4TRSWHDCC	Decorative: Closed, Clear Frosted Side ^{8,12}
M4TRSWHDCCF	Decorative: Closed, Clear Frosted Inside ^{8,12}

¹ Not available in NS or GA Beam Spreads

² Not available in 3500 lm

³ Only available in 750 - 2000 lm

⁴ Only available in 1000 lm

⁵ Not available in Narrow Spot beam spread

⁶ Only available in DALI-2 Dimming

⁷ Recommended with WF beam spread for standard wall washing and SP for sloped ceiling; Not available in custom color

⁸ Only available in 750 - 1500 lm

⁹ Only available in White, Black, or Bronze finish

¹⁰ Mud Plate required for FL Install except for wood ceiling

¹¹ Only available in Standard Style with White, Anti-Microbial Finish. Not compatible with extension collar

¹² Recommended with General Ambient beam spread



M Series Commercial

4" Round Downlight

L10

PRODUCT BUILDER | ROUND | DOWNLIGHT | ATHENA WIRELESS NODE/DALI-2

ACCESSORIES

M4XRMUD	Flangeless Mud Plate ¹³
M4KRTEMPLATE	Flangeless Wood Template ¹⁴
M4CREXT	Round Extension Collar ¹⁵

¹³ Required for Flangeless Trim drywall installation

¹⁴ Recommended for Flangeless Trim wood installation

¹⁵ For New Construction Only - Ceiling Installations up to 3"



M Series Commercial

4" Round Downlight

L10

PRODUCT BUILDER | ROUND | DOWNLIGHT | EMERGENCY LIGHTING

HOUSING

PRODUCT CODE	INSTALLATION	SHAPE	RATING	LUMEN	DIMMING	WIRELESS	OPTION								
M4	NC	R	N												
M4	4" Housing	NC	New Construction	R	Round	N	Non-IC	07	750 lm	O	0-10V for EM only	[Blank]	None	EM	Emergency driver, Integrated switch ³
								10	1000 lm	DS	DALI-2 Static CCT ¹ (Coming Soon)	AWN	Athena Wireless Node	EMS	Emergency driver, Remote switch
								12	1250 lm	DT	DALI-2 Tunable White CCT ^{2,4} (Coming Soon)				
								15	1500 lm						
								20	2000 lm						
								25	2500 lm						
								30	3000 lm						
								35	3500 lm						

LIGHT MODULE

PRODUCT CODE	LUMENS	CRI	CCT	BEAM SPREAD	DIMMING						
MD		9			A						
MD	Downlight Module	07	750 lm	9	93 CRI	27	2700K	GA	General Ambient (90°+) ⁴	A	Alternate
		10	1000 lm			30	3000K	NS	Narrow Spot (15°) ⁴		
		12	1250 lm			35	3500K	SP	Spot (25°)		
		15	1500 lm			40	4000K	FL	Flood (40°)		
		20	2000 lm			3W	Warm Dim (3000-1800K) ^{6,7}	WF	Wide Flood (60°)		
		25	2500 lm			T1	Tunable White (4000-1800K) ^{2,4,8}				
		30	3000 lm			T2	Tunable White (6500-2700K) ^{2,4,8}				
		35	3500 lm								

TRIM | STANDARD

PRODUCT CODE	FINISH	OPTION
M4TRS	Standard Trim	WH White
M4TRL	Wall Wash/ Sloped Ceiling ⁷	BK Black
M4TRP	Pinhole Trim ^{9,10}	BZ Bronze
M4TRH	Hyperbolic Trim ⁹	CW Clear Diffuse, White Flange
		WW Warm Diffuse, White Flange
		CC Custom Color

TRIM | DECORATIVE (WHITE FINISH ONLY)

PRODUCT CODE	OPTION
M4TRSWHDOF	Decorative: Open, Frosted ^{10,14}
M4TRSWHDCF	Decorative: Closed, Frosted ^{10,14}
M4TRSWHDCC	Decorative: Closed, Clear Frosted Side ^{10,14}
M4TRSWHDCCF	Decorative: Closed, Clear Frosted Inside ^{10,14}

¹ Not available in 3500 lm

² Not available with GA or NS Beam Spread

³ Integrated test switch must be selected for both housing and trim

⁴ Only available in 750 - 2000 lm

⁵ Only available in 1000 lm

⁶ Not available in Narrow Spot beam Spread

⁷ Recommended with WF beam spread for general wall washing and SP beam spread for sloped ceiling. Not available in custom color

⁸ Only available in DALI-2 Dimming

⁹ Only available in White, Black, or Bronze finish

¹⁰ Only available 750-1500 lm

¹¹ Mud Plate required for FL Install except for wood ceiling

¹² Only available in Standard Style and White, Clear Diffuse or Warm Diffuse

¹³ Only available in Standard Style and White, Anti-Microbial Finish not compatible with extension collar

¹⁴ Recommended in General Ambient beam spread



M Series Commercial

4" Round Downlight

L10

PRODUCT BUILDER | ROUND | DOWNLIGHT | EMERGENCY LIGHTING

ACCESSORIES

M4XRMUD	Flangeless Mud Plate ¹⁵
M4KRTEMPLATE	Flangeless Wood Template ¹⁶
M4CREXT	Round Extension Collar ¹⁷

¹⁵ Required for Flangeless Trim drywall installation

¹⁶ Recommended for Flangeless Trim wood installation

¹⁷ For New Construction Only - Ceiling Installations up to 3"



M Series Commercial

4" Round Downlight

L10

MODULE



4" Downlight

MD

SUMMARY

INPUT VOLTAGE: 120/277V, 50/60Hz

COLOR QUALITY: 93 CRI ¹

MAX INPUT CURRENT (120V): 0.350 amps

MAX INPUT CURRENT (277V): 0.165 amps

AC CONNECTOR: 6 pin Molex

DC CONNECTOR: Male 4-Pin Low Voltage Connector

POWER FACTOR: Greater than 0.9

TOTAL HARMONIC DISTORTION: Less than 20%

AMBIENT OPERATING TEMPERATURE: -20°C to 40°C

LISTINGS: ENERGY STAR[®] qualified ², UL Listed for Wet Location (Under covered ceilings only), UL Certified US•CA, Declare, RoHS Compliant, NSF/ANSI 2 listed, suitable for splash zone ³, DALI-2 Compliant, Compliant to FCC Title 47 Part 15; Class B

SPECIAL LISTINGS (VANDAL PROOF TRIM): IK10 Rating, IP65 Listing, Anti-Microbial

WARRANTY: 5 year limited warranty; 50,000 hours at 70% lumen maintenance

¹ Tested in accordance to IESNA LM-79-2008

² Refer to ENERGY STAR Certified light fixtures database

³ White and Black Finish only



M Series Commercial

4" Round Downlight

L10

MODULE PERFORMANCE

Based on 93 CRI, 3000K Module + STD White + Trim (M4TRSWH)

(Please refer to IES files for other trim types)

		STATIC CCT							WARM DIM	T1	T2	
LED CHIP		CREE 93 CRI							Bridgelux 93 CRI			
SDCM		2-STEP							3-STEP			
		07	10	12	15	20	25	30	35	10	10	10
NS	Lumens	718	983	1111	1278	2163	N/A					
	LPW ¹	75.5	78.6	77.7	77.4	90.1						
	CBCP ²	6227	8530	9639	11089	18766						
	UGR ³	13	14.1	14.5	15	16.8						
SP	Lumens	696	953	1077	1239	2097	2603	3044	3709	848	994	1094
	LPW	73.2	76.2	75.3	75.1	87.4	94.7	89.5	91.6	67.9	68.6	75.4
	CBCP	2131	2919	3298	3795	6421	12861	15037	18327	2598	2254	2479
	UGR	13.2	14.3	14.7	15.2	17	12.2	12.8	13.5	13.8	16.5	16.8
FL	Lumens	685	939	1061	1221	2066	2545	2976	3627	836	981	1079
	LPW	72.2	75.1	74.2	74	86.1	92.5	87.5	89.5	66.9	67.7	74.4
	CBCP	1196	1638	1851	2130	3604	9094	10634	12960	1458	1257	1382
	UGR	14.9	16	16.4	16.9	18.8	12.6	13.1	13.8	15.6	17.4	17.7
WF	Lumens	677.5	928	1049	1206	2042	2453	2868	3495.5	826	956	1052
	LPW	71.3	74.2	73.3	73.1	85.1	89.2	84.4	86.3	66.1	66	72.6
	CBCP	696	953	1077	1239	2096	1926	2252	2745	848	1090	1199
	UGR	17.3	18.4	18.8	19.3	21.1	22.4	23	23.7	18	17.8	18.1
GA	Lumens	654	896	1012	1165	1971	N/A			797	1031	1134
	LPW	68.9	71.7	70.8	70.6	82.1				63.8	71.1	78.2
	CBCP	264	362	409	470	796				322	595	655
	UGR	22.1	23.2	23.6	24.1	25.9				22.8	21.8	22.2

CCT	STATIC				WARM DIM		T1 TUNABLE WHITE			T2 TUNABLE WHITE		
	2700K	3000K	3500K	4000K	1800K	3000K	1800K	3000K	4000K	2700K	3000K	6500K
MULTIPLIER	0.93	1	1.05	1.07	0.05	1	0.73	1	1.12	0.96	1	1.07
EMERGENCY BATTERY MULTIPLIER	LPW x 5											

¹ LPW: Lumens per watt

² CBCP: Center beam candlepower

³ UGR: Unified glare ratio (0.7/0.5/0.2, 4H/8H)



M Series Commercial

4" Round Downlight

L10

HOUSING



New Construction

M4NCRN

SUMMARY

JUNCTION BOX: Equipped with 6 knockouts: two 1/2" and two 3/4" trade size knockouts on top, two 1/2" trade size knockouts on side. Approved for 8 (four in, four out) #12 AWG 70°C.

BAR HANGER MOUNTING: Adjustable Bar Hangers for 14"-24" joist spacing. Compatible with traditional joists, Armstrong™ ceiling, Hat Channel, T-Bar.

CEILING: 1/2" up to 2"

CUTOUT: 4 1/4" (107mm) round opening

WARRANTY: 5 year limited warranty

ALTERNATE DIMMING SPECIFICATIONS

INPUT VOLTAGE: 120/277V, 50/60Hz

MAX INPUT CURRENT (120V): 0.130 amps

MAX INPUT CURRENT (277V): 0.065 amps

POWER FACTOR: Greater than 0.9

TOTAL HARMONIC DISTORTION: Less than 20%

LISTINGS: Compliant to FCC Title 47 Part 15; Class B

EMERGENCY BATTERY SPECIFICATIONS

EMERGENCY BATTERY : Emergency Battery Back up is designed to provide output for 90 minutes when in an emergency state

INPUT VOLTAGE: 120/277V 50/60Hz

ILLUMINATION TIME: 90min

WATTAGE IN EM STATE: 5W

LUMEN OUTPUT IN EM STATE: LPW x 5

TEST SWITCH OPTIONS:

- **INTEGRATED TEST SWITCH (-EM HOUSING):** Requires Compatible trim - Flanged, Standard Style trim Only
- **REMOTE TEST SWITCH(-EMS HOUSING):** Must be installed according to local code can be used with any flanged, flangeless, or decorative trim type



M Series Commercial

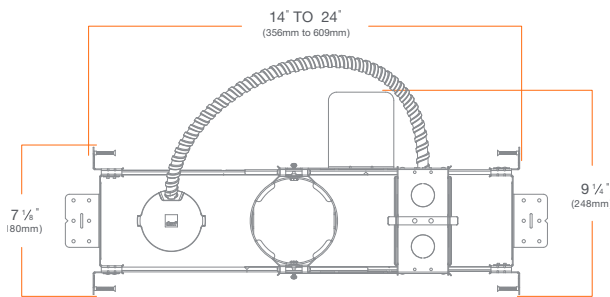
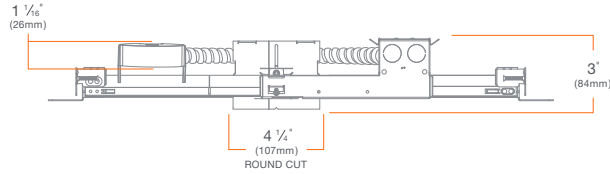
4" Round Downlight

L10

New Construction

M4NCRN

(Dimensions not including module)

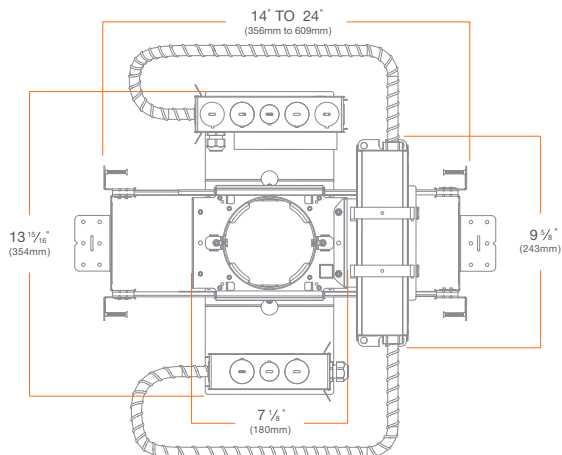
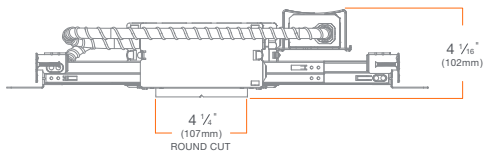


Emergency Lighting

M4NCRNxxxEM

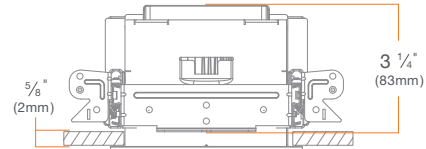
M4NCRNxxxAWNEM

(Dimensions not including module)



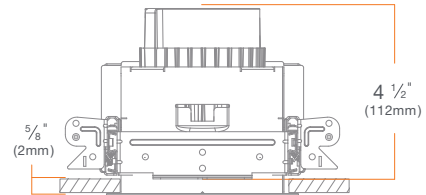
Total Height in Plenum

750LM-1500LM



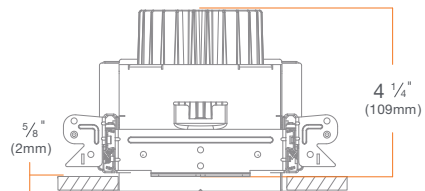
Bar Hanger Vertically Adjustable
from 1/2" to 2" (13 to 51mm)

2000LM



Bar Hanger Vertically Adjustable
from 1/2" to 2" (13 to 51mm)

2500LM-3500LM/DALI-2



Bar Hanger Vertically Adjustable
from 1/2" to 2" (13 to 51mm)



M Series Commercial

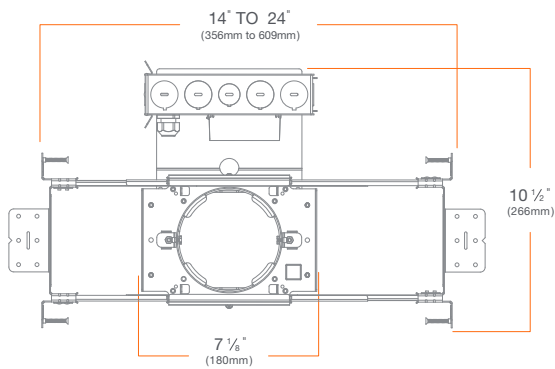
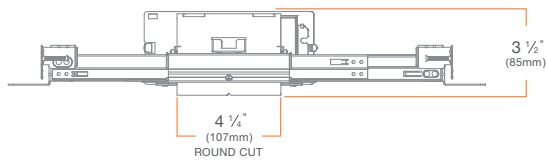
4" Round Downlight

L10

New Construction Static DALI/Lutron Athena Node

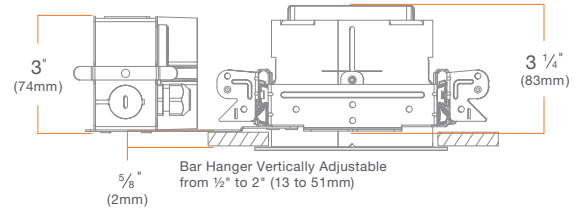
M4NCRNxxDS
M4NCRNxxOAWN
M4NCRNxxDSAWN

(Dimensions not including module)

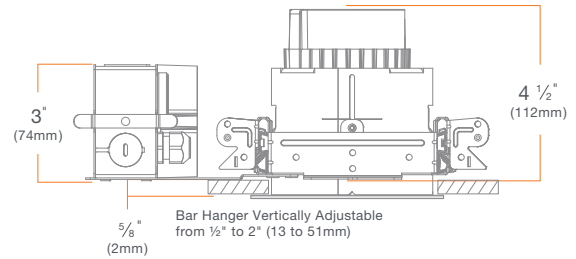


Total Height in Plenum

750LM-1500LM



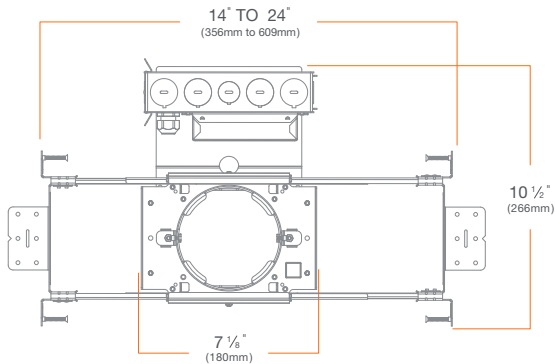
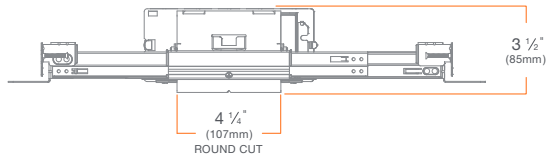
2000LM



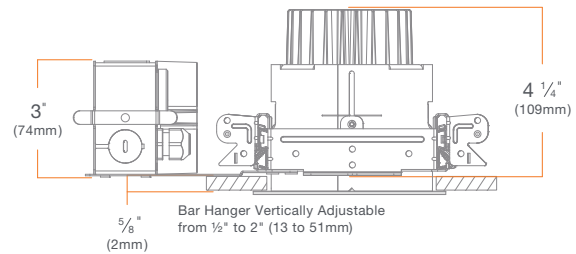
New Construction Tunable White DALI-2

M4NCRNxxDT

(Dimensions not including module)



2500LM-3500LM/DALI-2





M Series Commercial

4" Round Downlight

L10

HOUSING



Remodel

M4RMRN

SUMMARY

JUNCTION BOX: Equipped with 3 knockouts: two 1/2" trade size and one 3/4" trade size knockouts #12 AWG 70°C. Approved for 4 (2 in and 2 out)

CEILING: 1/2" up to 1 1/4"

CUTOUT: 4 3/8" (111mm) round opening

WARRANTY: 5 year limited warranty



M Series Commercial

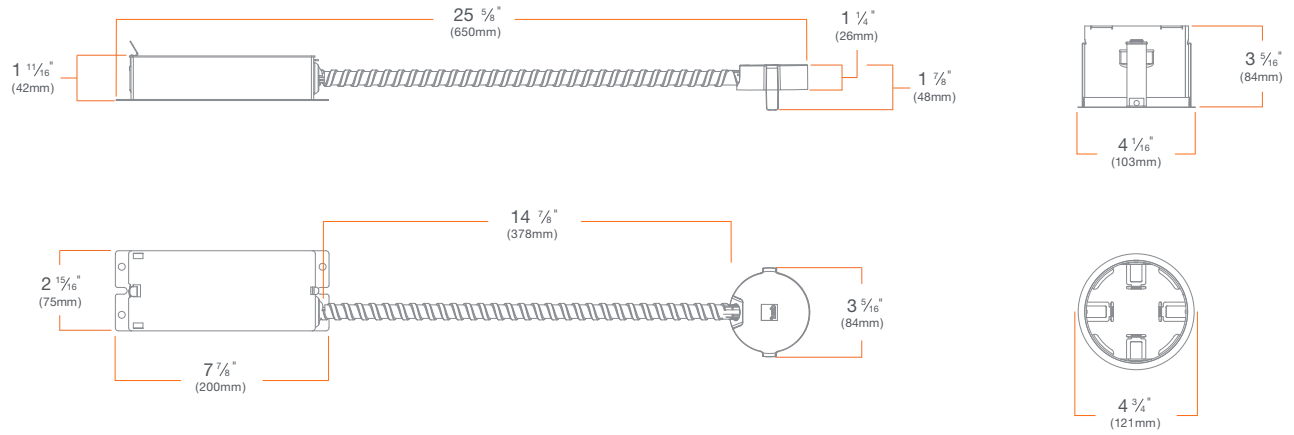
4" Round Downlight

L10

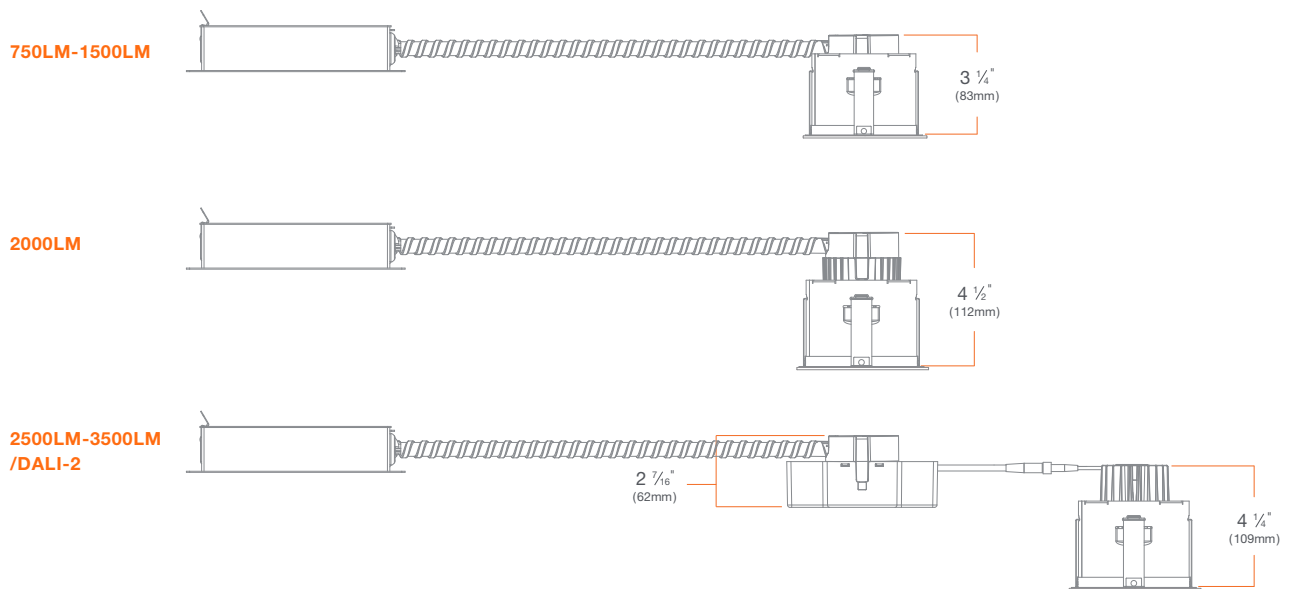
Standard

M4RMRN

(Dimensions not including module)



Total Height in Plenum





M Series Commercial

4" Round Downlight

L10

TRIMS



4" Round Trims

M4TR

SUMMARY

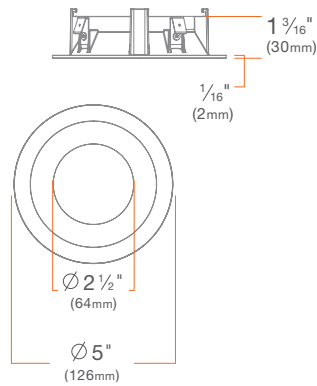
CONSTRUCTION: Die-cast aluminum

DECORATIVE: Acrylic diffuser

INSTALLATION: Twist & Lock

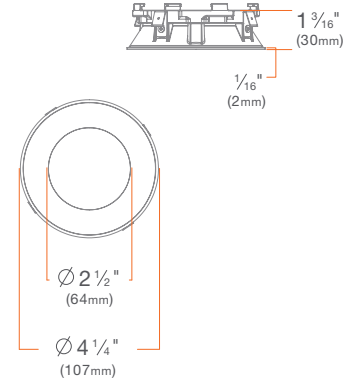
Standard

M4TRSWH



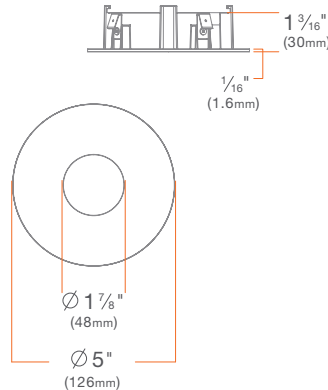
Flangeless

M4TRSWHFL



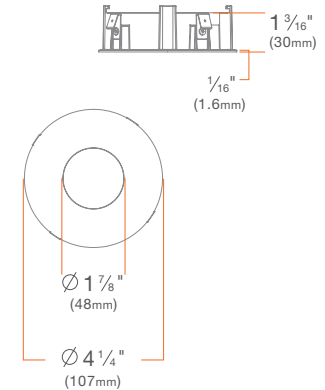
Pinhole

M4TRPWH



Flangeless Pinhole

M4TRPWHFL





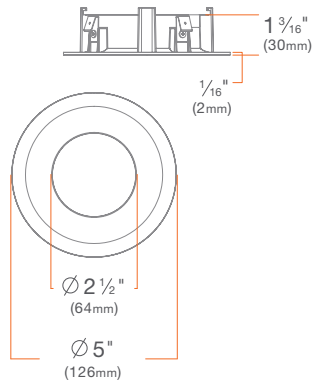
M Series Commercial

4" Round Downlight

L10

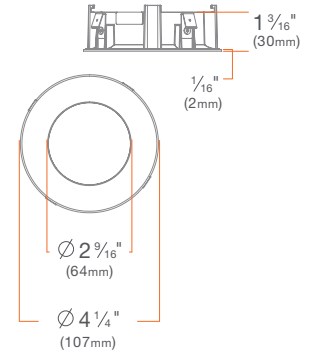
Hyperbolic

M4TRHWH



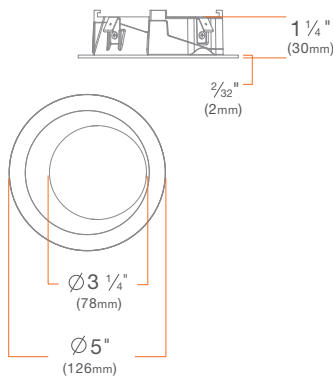
Flangeless Hyperbolic

M4TRHWHFL



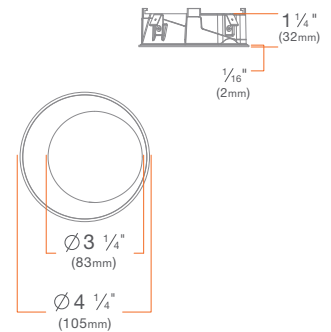
Wall Wash

M4TRLWH



Flangeless Wall Wash

M4TRLWHFL

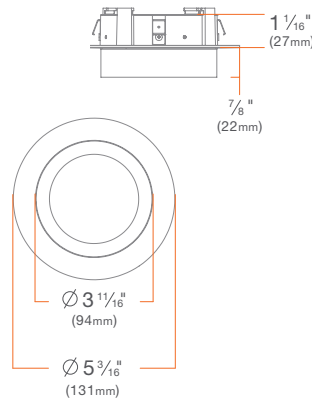


Decorative Closed

Frosted: **M4TRSWHDCF**

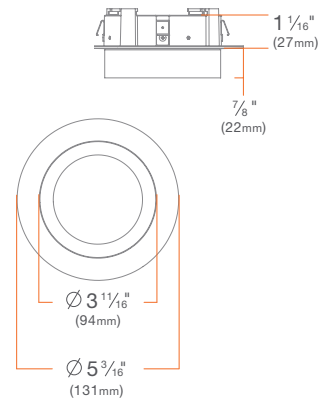
Clear, Frosted Inside: **M4TRSWHDC**

Clear, Frosted Sides: **M4TRSWHDCCF**



Decorative Open

Frosted: **M4TRSWHDOF**





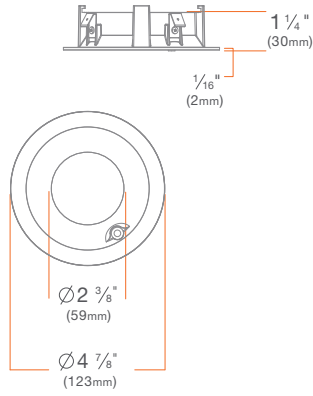
M Series Commercial

4" Round Downlight

L10

Emergency with Integrated Test Switch

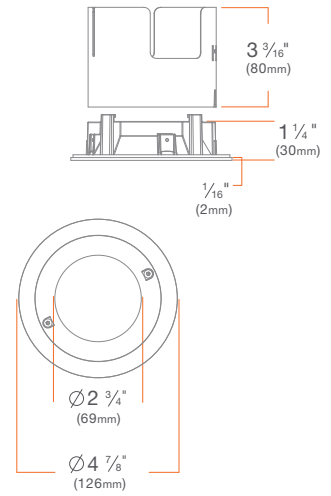
M4TRSWHEM



Vandal Proof/IP65

**For use with Standard New Construction Only*

M4TRSWHVP





M Series Commercial

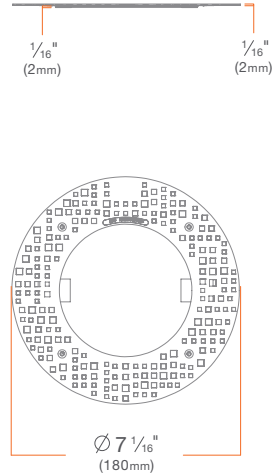
4" Round Downlight

L10

ACCESSORIES

Flangeless Mud Plate

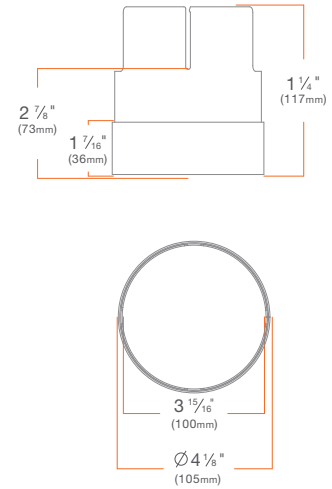
M4XRMUD



Extension Collar

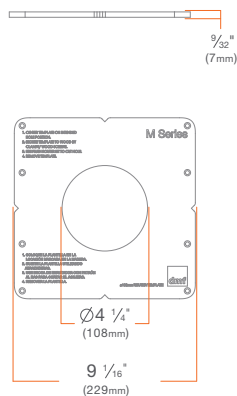
**For use with Standard New Construction Only*

M4CREXT



Router Template

M4KRTEMPLATE





M Series Commercial

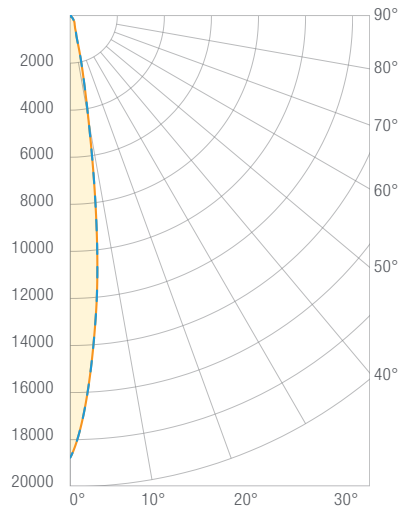
4" Round Downlight

L10

PHOTOMETRY

MD 2000 lm, 3000K, Narrow Spot

MD20930NS | M4TRSWH



cd — C0 - C180 — C90 - C270 2052 lm

Luminous Intensity

Gamma	C 0°
0°	18766
5°	12609
10°	4461
15°	1402
20°	682
25°	466
30°	372
35°	304
40°	221
45°	162
50°	116
55°	81
60°	53
65°	30
70°	13
75°	8
80°	5
85°	2
90°	0

Values in candela

Zonal Lumen Summary

Zone	Lumens	Luminaire %
0-30	1625	79
0-40	1810	88
0-60	2010	98
0-90	2052	100
0-180	2052	100

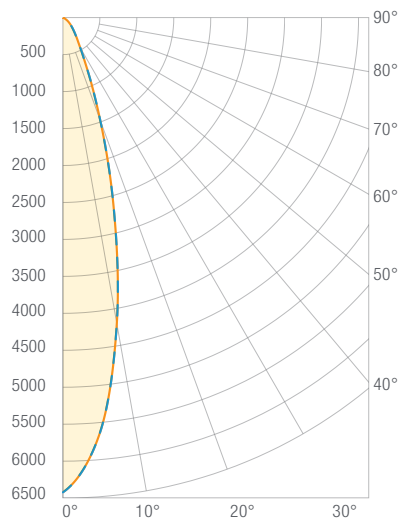
Illuminance Chart

Distance from LED	Foot Candles	Diameter
3'	2085.2	0.7'
6'	521.3	1.5'
9'	231.7	2.2'
12'	130.3	2.9'

Beam Angle: 14°

MD 2000 lm, 3000K, Spot

MD20930SP | M4TRSWH



cd — C0 - C180 — C90 - C270 2060 lm

Luminous Intensity

Gamma	C 0°
0°	6422
5°	5661
10°	4202
15°	2653
20°	1478
25°	799
30°	472
35°	319
40°	227
45°	166
50°	119
55°	82
60°	50
65°	29
70°	13
75°	8
80°	4
85°	2
90°	0

Values in candela

Zonal Lumen Summary

Zone	Lumens	Luminaire %
0-30	1612	78
0-40	1817	88
0-60	2020	98
0-90	2060	100
0-180	2060	100

Illuminance Chart

Distance from LED	Foot Candles	Diameter
3'	713.5	1.4'
6'	178.4	2.8'
9'	79.3	4.2'
12'	44.6	5.6'

Beam Angle: 26°



M Series Commercial

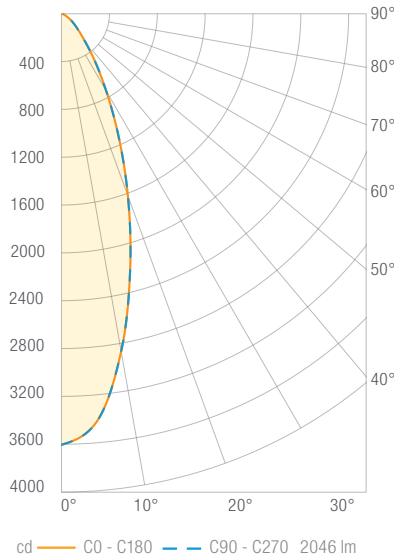
4" Round Downlight

L10

PHOTOMETRY

MD 2000 Im, 3000K, Flood

MD20930FL | M4TRSWH



Luminous Intensity

Gamma	C 0°
0°	3604
5°	3418
10°	2867
15°	2215
20°	1620
25°	1123
30°	746
35°	487
40°	309
45°	204
50°	141
55°	98
60°	57
65°	34
70°	15
75°	10
80°	6
85°	3
90°	0

Values in candela

Zonal Lumen Summary

Zone	Lumens	Luminaire %
0-30	1438	70
0-40	1748	85
0-60	1998	98
0-90	2046	100
0-180	2046	100

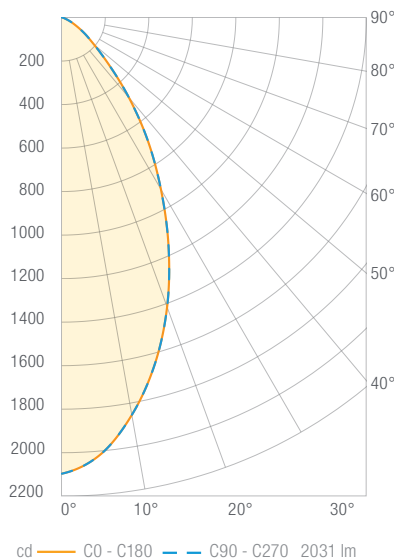
Illuminance Chart

Distance from LED	Foot Candles	Diameter
3'	400.5	2.0'
6'	100.1	4.0'
9'	44.5	6.0'
12'	25.0	8.0'

Beam Angle: 37°

MD 2000 Im, 3000K, Wide Flood

MD20930WF | M4TRSWH



Luminous Intensity

Gamma	C 0°
0°	2096
5°	2018
10°	1855
15°	1651
20°	1416
25°	1162
30°	912
35°	689
40°	480
45°	307
50°	195
55°	129
60°	78
65°	45
70°	22
75°	12
80°	7
85°	4
90°	1

Values in candela

Zonal Lumen Summary

Zone	Lumens	Luminaire %
0-30	1179	58
0-40	1605	79
0-60	1967	97
0-90	2031	100
0-180	2031	100

Illuminance Chart

Distance from LED	Foot Candles	Diameter
3'	232.9	3.1'
6'	58.2	6.2'
9'	25.9	9.3'
12'	14.6	12.4'

Beam Angle: 55°



M Series Commercial

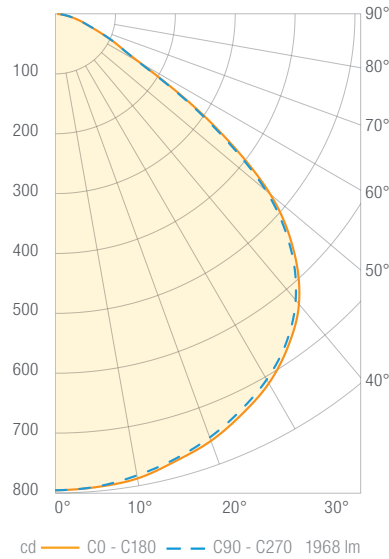
4" Round Downlight

L10

PHOTOMETRY

MD 2000 Im, 3000K, General Ambient

MD20930GA



Luminous Intensity

Gamma	C 0°
0°	796
5°	793
10°	788
15°	773
20°	759
25°	737
30°	712
35°	677
40°	632
45°	564
50°	468
55°	318
60°	163
65°	103
70°	62
75°	41
80°	24
85°	11
90°	3

Values in candela

Zonal Lumen Summary

Zone	Lumens	Luminaire %
0-30	640	32
0-40	1067	54
0-60	1798	91
0-90	1968	100
0-180	1968	100

Illuminance Chart

Distance from LED	Foot Candles	Diameter
3'	88.4	7.8'
6'	22.1	15.5'
9'	9.8	23.3'
12'	5.5	31.1'

Beam Angle: 105° x 104°

M Series Commercial

Other Manufacturers:
LIGHTHEADED "CONTORTIONIST" Series
PRESCOLITE "LFR-4RD" Series
LUMENWERX "ECANA 4" Series

Project:	Type: L11
Product Code:	Date:

V091224



4" Round Downlight

Versatile Solution for all spaces providing high quality lighting ranging from 750lm all the way up to 3500lm

Expedited Install with our easily adjustable universal housing and bar hanger systems allowing for application in most ceiling types

Enhanced Serviceability is achieved through interchangeable modules, optics, and trims, all of which allow for ease of maintenance and implementation of design changes below the ceiling plane

Seamless Integration with several control systems allowing two-channel control dimming options down as low as 0.1%

INSTALLATION

Ceiling Thickness

New Construction: 1/2" up to 2"

Remodel: 1/2" up to 1 1/4"

Extension Collar: 5/8" to 3"

Ceiling Material

Drywall, Millwork

TRIMS

Aperture

4"

Shape

Round

Style

Standard, Hyperbolic, Pinhole, Wall Wash, Flangeless, Decorative, Vandal Proof/IP65

Finish

White, Black, Bronze, Clear Diffuse, Warm Diffuse

LIGHT OUTPUT & DISTRIBUTION

Module

Downlight

Lumens (Power)

750 lm (9.5W), 1000 lm (12.5W),
1250 lm (14.3W), 1500 lm (14.3W),
2000 lm (24.5W), 2500 lm (27.5W),
3000 lm (34.0W), 3500 lm (40.5W)

Color Quality

93 CRI, 2-step SDCM

Color Temperature

- 2700K
- 3000K
- 3500K
- 4000K
- Warm Dim (3000-1800K)
- Tunable White (4000-1800K)
- Tunable White (6500-2700K)

Beam Spread

- 15° Narrow Spot
- 60° Wide Flood
- 25° Spot
- 90°+ General
- 40° Flood

POWER & CONTROLS

Input Voltage

120 / 277V

Dimming

0-10V (1%), Lutron Athena Wireless Node (1%), DALI-2 (0.1%) (Coming Soon)

RATINGS & CERTIFICATIONS

Housing

RoHS Compliant

Module and Trim

Wet Location/IP65 Rated Configurations Available (Standard trims and covered areas only)

NSF Listed (White and black finish only)

IK10 Rated Option Available (Vandal Proof Trim)

Warranty

5 year limited warranty; 50,000 hours



Declare.



DMF LIGHTING 1118 E. 223rd St. Carson, CA 90745 323.934.7779 info@dmflighting.com dmflighting.com

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M Series Commercial

4" Round Downlight

L11

PRODUCT BUILDER | ROUND | DOWNLIGHT | EMBEDDED 0-10V

HOUSING

PRODUCT CODE	
<input type="text"/>	
M4NCRN	4" Round Housing, New Construction, Non-IC Rated
M4RMRN	4" Round Housing, Remodel, Non-IC Rated ¹

LIGHT MODULE

PRODUCT CODE		LUMENS		CRI	CCT		BEAM SPREAD		DIMMING		
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>		
MD	Downlight Module	07	750 lm	9	93 CRI	27	2700K	GA	General Ambient (90°+) ³	O	0-10V
		10	1000 lm			30	3000K	NS	Narrow Spot (15°) ³		
		12	1250 lm			35	3500K	SP	Spot (25°)		
		15	1500 lm			40	4000K	FL	Flood (40°)		
		20	2000 lm			3W	Warm Dim (3000-1800K) ²	WF	Wide Flood (60°)		
		25	2500 lm								
		30	3000 lm								
		35	3500 lm								

TRIM | STANDARD

PRODUCT CODE		FINISH		OPTION	
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
M4TRS	Standard Trim	WH	White	[Blank]	None
M4TRL	Wall Wash/Sloped Ceiling Trim ⁴	BK	Black	FL	Flangeless ^{6,7}
M4TRP	Pinhole Trim ^{5,6}	BZ	Bronze	VP	Vandal Proof/IP65 ⁸
M4TRH	Hyperbolic Trim ⁶	CW	Clear Diffuse, White Flange		
		WW	Warm Diffuse, White Flange	FINISH TO BE SELECTED BY ARCHITECT	
		CC	Custom Color		

TRIM | DECORATIVE (WHITE FINISH ONLY)

PRODUCT CODE	
<input type="text"/>	<input type="text"/>
M4TRSWHDOF	Decorative Open, Frosted ^{5,9}
M4TRSWHDCF	Decorative Closed, Frosted ^{5,9}
M4TRSWHDCC	Decorative Closed, Clear Frosted Side ^{5,9}
M4TRSWHDCCF	Decorative Closed, Clear Frosted Inside ^{5,9}

OPTICS

MDLX-GA	Low Lumen (750-2000LM) Downlight Optic GA 90° Beam Spread
MDLX-NS	Low Lumen (750-2000LM) Downlight Optic NS 15° Beam Spread
MDLX-SP	Low Lumen (750-2000LM) Downlight Optic SP 25° Beam Spread
MDLX-FL	Low Lumen (750-2000LM) Downlight Optic FL 40° Beam Spread
MDLX-WF	Low Lumen (750-2000LM) Downlight Optic WF 60° Beam Spread
MDHX-SP	High Lumen (2500-3500LM) Downlight Optic SP 25° Beam Spread
MDHX-FL	High Lumen (2500-3500LM) Downlight Optic FL 40° Beam Spread
MDHX-WF	High Lumen (2500-3500LM) Downlight Optic WF 60° Beam Spread

ACCESSORIES

M4XRMUD	Flangeless Mud Plate ¹⁰
M4KRTEMPLATE	Flangeless Wood Template ¹¹
M4CREXT	Round Extension Collar ¹²

¹ Not available with flangeless or vandal proof trim options nor extension collars

² Only available in 1000 lm; not available in Narrow Spot beam spread

³ Only available in 750-2000 lm

⁴ Recommended with WF Beam spread for general wall washing and SP for sloped ceilings. Not available in Custom Color

⁵ Only available in 750-1500 lm

⁶ Only available in White, Black, or Bronze finish

⁷ Mud plate required for FL installation, except for wood ceiling; Not compatible with remodel housing

⁸ Only available in Standard Style and White, Anti-Microbial Finish for installation in New Construction housing only. Not compatible with extension collars

⁹ Recommended for use with General Ambient beam spread

¹⁰ Required for Flangeless Trim drywall installation

¹¹ Recommended for Flangeless Trim wood installation

¹² For New Construction Only - Ceiling Installations up to 3"



M Series Commercial

4" Round Downlight

L11

PRODUCT BUILDER | ROUND | DOWNLIGHT | ATHENA WIRELESS NODE/DALI-2

HOUSING

PRODUCT CODE		INSTALLATION		SHAPE		RATING		OUTPUT		DIMMING		WIRELESS	
M4		NC		R		N							
M4	4" Housing	NC	New Construction	R	Round	N	Non-IC	07	750 lm	O	0-10V (AWN Only)	[Blank]	None (DALI-2 Only)
								10	1000 lm	DS	DALI-2 (Static CCT) ² <i>(Coming Soon)</i>	AWN	Athena Wireless Node
								12	1250 lm	DT	DALI-2 (Tunable White) ^{1,3} <i>(Coming Soon)</i>		
								15	1500 lm				
								20	2000 lm				
								25	2500 lm				
								30	3000 lm				
								35	3500 lm				

LIGHT MODULE

PRODUCT CODE		LUMENS		CRI		CCT		BEAM SPREAD		DIMMING	
MD				9						A	
MD	Downlight Module	07	750 lm	9	93 CRI	27	2700K	GA	General Ambient (90°+) ³	A	Alternate
		10	1000 lm			30	3000K	NS	Narrow Spot (15°) ³		
		12	1250 lm			35	3500K	SP	Spot (25°)		
		15	1500 lm			40	4000K	FL	Flood (40°)		
		20	2000 lm			3W	Warm Dim (3000–1800K) ^{4,5}	WF	Wide Flood (60°)		
		25	2500 lm			T1	Tunable White (4000–1800K) ^{1,3,6} <i>(Coming Soon)</i>				
		30	3000 lm			T2	Tunable White (6500–2700K) ^{1,3,6} <i>(Coming Soon)</i>				
		35	3500 lm								

TRIM | STANDARD

PRODUCT CODE		FINISH		OPTION	
M4TRS	Standard Trim	WH	White	[Blank]	None
M4TRL	Wall Wash/Sloped Ceiling Trim ⁷	BK	Black	FL	Flangeless ^{9,10}
M4TRP	Pinhole Trim ^{8,9}	BZ	Bronze	VP	Vandal Proof/IP65 ¹¹
M4TRH	Hyperbolic Trim ⁹	CW	Clear Diffuse, White Flange		
		WW	Warm Diffuse, White Flange		
		CC	Custom Color		

TRIM | DECORATIVE (WHITE FINISH ONLY)

PRODUCT CODE	
M4TRSWHDOF	Decorative: Open, Frosted ^{8,12}
M4TRSWHDCF	Decorative: Closed, Frosted ^{8,12}
M4TRSWHDCC	Decorative: Closed, Clear Frosted Side ^{8,12}
M4TRSWHDCCF	Decorative: Closed, Clear Frosted Inside ^{8,12}

¹ Not available in NS or GA Beam Spreads

² Not available in 3500 lm

³ Only available in 750 - 2000 lm

⁴ Only available in 1000 lm

⁵ Not available in Narrow Spot beam spread

⁶ Only available in DALI-2 Dimming

⁷ Recommended with WF beam spread for standard wall washing and SP for sloped ceiling; Not available in custom color

⁸ Only available in 750 - 1500 lm

⁹ Only available in White, Black, or Bronze finish

¹⁰ Mud Plate required for FL Install except for wood ceiling

¹¹ Only available in Standard Style with White, Anti-Microbial Finish. Not compatible with extension collar

¹² Recommended with General Ambient beam spread



M Series Commercial

4" Round Downlight

L11

PRODUCT BUILDER | ROUND | DOWNLIGHT | ATHENA WIRELESS NODE/DALI-2

ACCESSORIES

M4XRMUD	Flangeless Mud Plate ¹³
M4KRTEMPLATE	Flangeless Wood Template ¹⁴
M4CREXT	Round Extension Collar ¹⁵

¹³ Required for Flangeless Trim drywall installation

¹⁴ Recommended for Flangeless Trim wood installation

¹⁵ For New Construction Only - Ceiling Installations up to 3"



M Series Commercial

4" Round Downlight

L11

PRODUCT BUILDER | ROUND | DOWNLIGHT | EMERGENCY LIGHTING

HOUSING

PRODUCT CODE	INSTALLATION	SHAPE	RATING	LUMEN	DIMMING	WIRELESS	OPTION								
M4	NC	R	N												
M4	4" Housing	NC	New Construction	R	Round	N	Non-IC	07	750 lm	O	0-10V for EM only	[Blank]	None	EM	Emergency driver, Integrated switch ³
								10	1000 lm	DS	DALI-2 Static CCT ¹ (Coming Soon)	AWN	Athena Wireless Node	EMS	Emergency driver, Remote switch
								12	1250 lm	DT	DALI-2 Tunable White CCT ^{2,4} (Coming Soon)				
								15	1500 lm						
								20	2000 lm						
								25	2500 lm						
								30	3000 lm						
								35	3500 lm						

LIGHT MODULE

PRODUCT CODE	LUMENS	CRI	CCT	BEAM SPREAD	DIMMING						
MD		9			A						
MD	Downlight Module	07	750 lm	9	93 CRI	27	2700K	GA	General Ambient (90°+) ⁴	A	Alternate
		10	1000 lm			30	3000K	NS	Narrow Spot (15°) ⁴		
		12	1250 lm			35	3500K	SP	Spot (25°)		
		15	1500 lm			40	4000K	FL	Flood (40°)		
		20	2000 lm			3W	Warm Dim (3000-1800K) ^{6,7}	WF	Wide Flood (60°)		
		25	2500 lm			T1	Tunable White (4000-1800K) ^{2,4,8}				
		30	3000 lm			T2	Tunable White (6500-2700K) ^{2,4,8}				
		35	3500 lm								

TRIM | STANDARD

PRODUCT CODE	FINISH	OPTION
M4TRS	Standard Trim	WH White [Blank] None
M4TRL	Wall Wash/ Sloped Ceiling ⁷	BK Black FL Flangeless ^{9,11}
M4TRP	Pinhole Trim ^{9,10}	BZ Bronze EM Integrated test switch ^{9,12}
M4TRH	Hyperbolic Trim ⁹	CW Clear Diffuse, White Flange VP Vandal Proof/IP65 ¹³
		WW Warm Diffuse, White Flange
		CC Custom Color

TRIM | DECORATIVE (WHITE FINISH ONLY)

PRODUCT CODE	OPTION
M4TRSWHDOF	Decorative: Open, Frosted ^{10,14}
M4TRSWHDCF	Decorative: Closed, Frosted ^{10,14}
M4TRSWHDCC	Decorative: Closed, Clear Frosted Side ^{10,14}
M4TRSWHDCCF	Decorative: Closed, Clear Frosted Inside ^{10,14}

¹ Not available in 3500 lm

² Not available with GA or NS Beam Spread

³ Integrated test switch must be selected for both housing and trim

⁴ Only available in 750 - 2000 lm

⁵ Only available in 1000 lm

⁶ Not available in Narrow Spot beam Spread

⁷ Recommended with WF beam spread for general wall washing and SP beam spread for sloped ceiling. Not available in custom color

⁸ Only available in DALI-2 Dimming

⁹ Only available in White, Black, or Bronze finish

¹⁰ Only available 750-1500 lm

¹¹ Mud Plate required for FL Install except for wood ceiling

¹² Only available in Standard Style and White, Clear Diffuse or Warm Diffuse

¹³ Only available in Standard Style and White, Anti-Microbial Finish not compatible with extension collar

¹⁴ Recommended in General Ambient beam spread



M Series Commercial

4" Round Downlight

L11

PRODUCT BUILDER | ROUND | DOWNLIGHT | EMERGENCY LIGHTING

ACCESSORIES

M4XRMUD	Flangeless Mud Plate ¹⁵
M4KRTEMPLATE	Flangeless Wood Template ¹⁶
M4CREXT	Round Extension Collar ¹⁷

¹⁵ Required for Flangeless Trim drywall installation

¹⁶ Recommended for Flangeless Trim wood installation

¹⁷ For New Construction Only - Ceiling Installations up to 3"



M Series Commercial

4" Round Downlight

L11

MODULE



4" Downlight

MD

SUMMARY

INPUT VOLTAGE: 120/277V, 50/60Hz

COLOR QUALITY: 93 CRI ¹

MAX INPUT CURRENT (120V): 0.350 amps

MAX INPUT CURRENT (277V): 0.165 amps

AC CONNECTOR: 6 pin Molex

DC CONNECTOR: Male 4-Pin Low Voltage Connector

POWER FACTOR: Greater than 0.9

TOTAL HARMONIC DISTORTION: Less than 20%

AMBIENT OPERATING TEMPERATURE: -20°C to 40°C

LISTINGS: ENERGY STAR[®] qualified ², UL Listed for Wet Location (Under covered ceilings only), UL Certified US•CA, Declare, RoHS Compliant, NSF/ANSI 2 listed, suitable for splash zone ³, DALI-2 Compliant, Compliant to FCC Title 47 Part 15; Class B

SPECIAL LISTINGS (VANDAL PROOF TRIM): IK10 Rating, IP65 Listing, Anti-Microbial

WARRANTY: 5 year limited warranty; 50,000 hours at 70% lumen maintenance

¹ Tested in accordance to IESNA LM-79-2008

² Refer to ENERGY STAR Certified light fixtures database

³ White and Black Finish only



M Series Commercial

4" Round Downlight

L11

MODULE PERFORMANCE

Based on 93 CRI, 3000K Module + STD White + Trim (M4TRSWH)

(Please refer to IES files for other trim types)

		STATIC CCT								WARM DIM	T1	T2
LED CHIP		CREE 93 CRI								Bridgelux 93 CRI		
SDCM		2-STEP								3-STEP		
		07	10	12	15	20	25	30	35	10	10	10
NS	Lumens	718	983	1111	1278	2163	N/A					
	LPW ¹	75.5	78.6	77.7	77.4	90.1						
	CBCP ²	6227	8530	9639	11089	18766						
	UGR ³	13	14.1	14.5	15	16.8						
SP	Lumens	696	953	1077	1239	2097	2603	3044	3709	848	994	1094
	LPW	73.2	76.2	75.3	75.1	87.4	94.7	89.5	91.6	67.9	68.6	75.4
	CBCP	2131	2919	3298	3795	6421	12861	15037	18327	2598	2254	2479
	UGR	13.2	14.3	14.7	15.2	17	12.2	12.8	13.5	13.8	16.5	16.8
FL	Lumens	685	939	1061	1221	2066	2545	2976	3627	836	981	1079
	LPW	72.2	75.1	74.2	74	86.1	92.5	87.5	89.5	66.9	67.7	74.4
	CBCP	1196	1638	1851	2130	3604	9094	10634	12960	1458	1257	1382
	UGR	14.9	16	16.4	16.9	18.8	12.6	13.1	13.8	15.6	17.4	17.7
WF	Lumens	677.5	928	1049	1206	2042	2453	2868	3495.5	826	956	1052
	LPW	71.3	74.2	73.3	73.1	85.1	89.2	84.4	86.3	66.1	66	72.6
	CBCP	696	953	1077	1239	2096	1926	2252	2745	848	1090	1199
	UGR	17.3	18.4	18.8	19.3	21.1	22.4	23	23.7	18	17.8	18.1
GA	Lumens	654	896	1012	1165	1971	N/A			797	1031	1134
	LPW	68.9	71.7	70.8	70.6	82.1				63.8	71.1	78.2
	CBCP	264	362	409	470	796				322	595	655
	UGR	22.1	23.2	23.6	24.1	25.9				22.8	21.8	22.2

CCT	STATIC				WARM DIM		T1 TUNABLE WHITE			T2 TUNABLE WHITE		
	2700K	3000K	3500K	4000K	1800K	3000K	1800K	3000K	4000K	2700K	3000K	6500K
MULTIPLIER	0.93	1	1.05	1.07	0.05	1	0.73	1	1.12	0.96	1	1.07
EMERGENCY BATTERY MULTIPLIER	LPW x 5											

¹ LPW: Lumens per watt

² CBCP: Center beam candlepower

³ UGR: Unified glare ratio (0.7/0.5/0.2, 4H/8H)



M Series Commercial

4" Round Downlight

L11

HOUSING



New Construction

M4NCRN

SUMMARY

JUNCTION BOX: Equipped with 6 knockouts: two 1/2" and two 3/4" trade size knockouts on top, two 1/2" trade size knockouts on side. Approved for 8 (four in, four out) #12 AWG 70°C.

BAR HANGER MOUNTING: Adjustable Bar Hangers for 14"-24" joist spacing. Compatible with traditional joists, Armstrong™ ceiling, Hat Channel, T-Bar.

CEILING: 1/2" up to 2"

CUTOUT: 4 1/4" (107mm) round opening

WARRANTY: 5 year limited warranty

ALTERNATE DIMMING SPECIFICATIONS

INPUT VOLTAGE: 120/277V, 50/60Hz

MAX INPUT CURRENT (120V): 0.130 amps

MAX INPUT CURRENT (277V): 0.065 amps

POWER FACTOR: Greater than 0.9

TOTAL HARMONIC DISTORTION: Less than 20%

LISTINGS: Compliant to FCC Title 47 Part 15; Class B

EMERGENCY BATTERY SPECIFICATIONS

EMERGENCY BATTERY : Emergency Battery Back up is designed to provide output for 90 minutes when in an emergency state

INPUT VOLTAGE: 120/277V 50/60Hz

ILLUMINATION TIME: 90min

WATTAGE IN EM STATE: 5W

LUMEN OUTPUT IN EM STATE: LPW x 5

TEST SWITCH OPTIONS:

- **INTEGRATED TEST SWITCH (-EM HOUSING):** Requires Compatible trim - Flanged, Standard Style trim Only
- **REMOTE TEST SWITCH(-EMS HOUSING):** Must be installed according to local code can be used with any flanged, flangeless, or decorative trim type



M Series Commercial

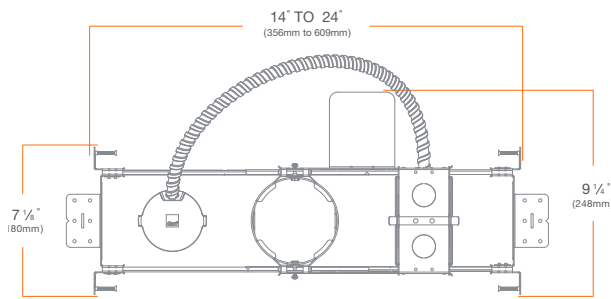
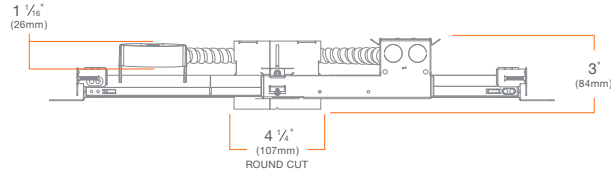
4" Round Downlight

L11

New Construction

M4NCRN

(Dimensions not including module)

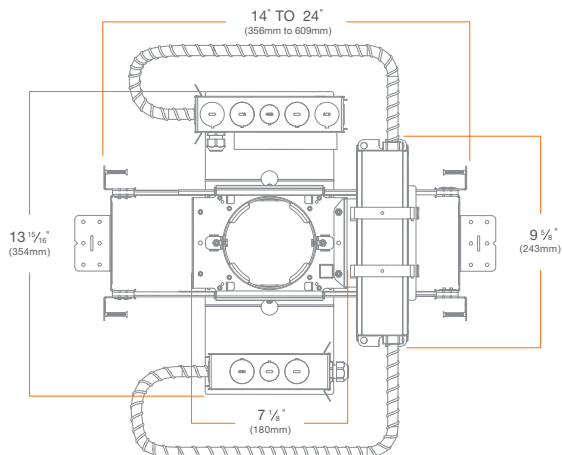
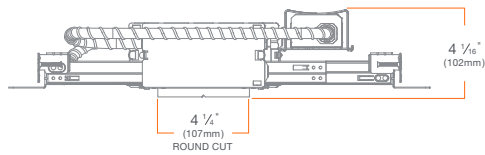


Emergency Lighting

M4NCRNxxxEM

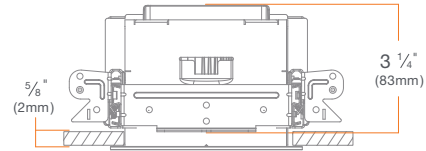
M4NCRNxxxAWNEM

(Dimensions not including module)



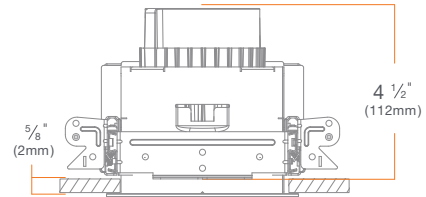
Total Height in Plenum

750LM-1500LM



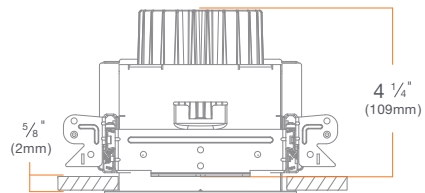
Bar Hanger Vertically Adjustable
from 1/2" to 2" (13 to 51mm)

2000LM



Bar Hanger Vertically Adjustable
from 1/2" to 2" (13 to 51mm)

2500LM-3500LM/DALI-2



Bar Hanger Vertically Adjustable
from 1/2" to 2" (13 to 51mm)



M Series Commercial

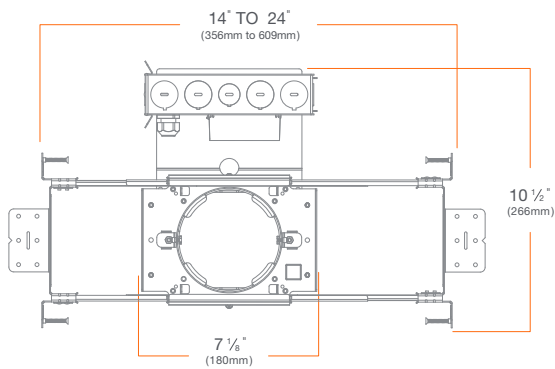
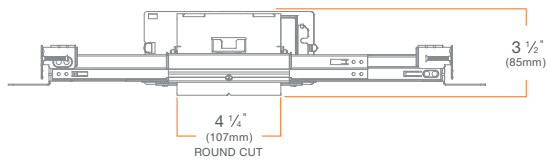
4" Round Downlight

L11

New Construction Static DALI/Lutron Athena Node

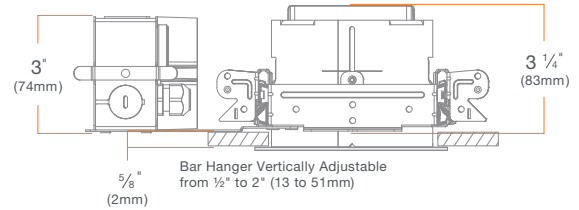
M4NCRNxxDS
M4NCRNxxOAWN
M4NCRNxxDSAWN

(Dimensions not including module)

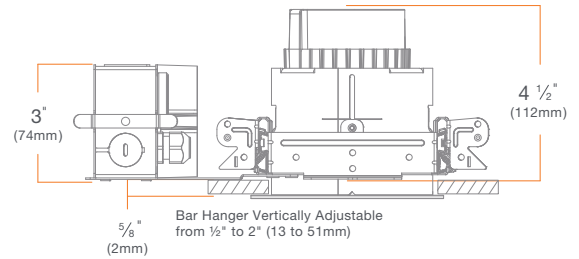


Total Height in Plenum

750LM-1500LM



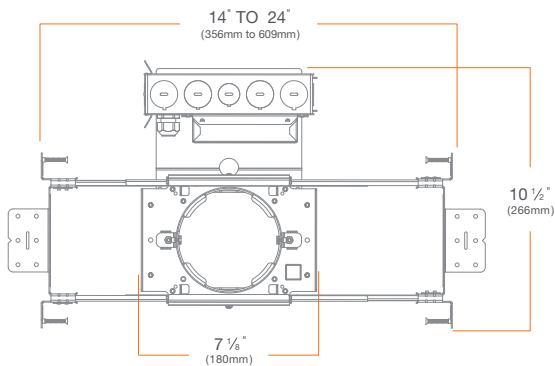
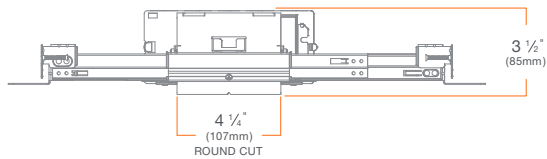
2000LM



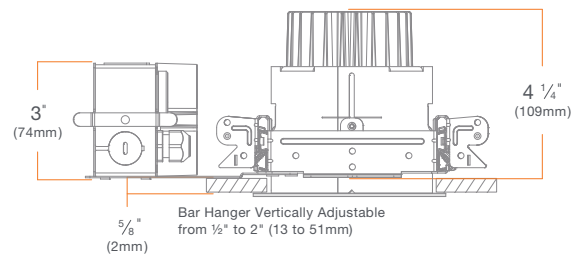
New Construction Tunable White DALI-2

M4NCRNxxDT

(Dimensions not including module)



2500LM-3500LM/DALI-2





M Series Commercial

4" Round Downlight

L11

HOUSING



Remodel

M4RMRN

SUMMARY

JUNCTION BOX: Equipped with 3 knockouts: two 1/2" trade size and one 3/4" trade size knockouts #12 AWG 70°C. Approved for 4 (2 in and 2 out)

CEILING: 1/2" up to 1 1/4"

CUTOUT: 4 3/8" (111mm) round opening

WARRANTY: 5 year limited warranty



M Series Commercial

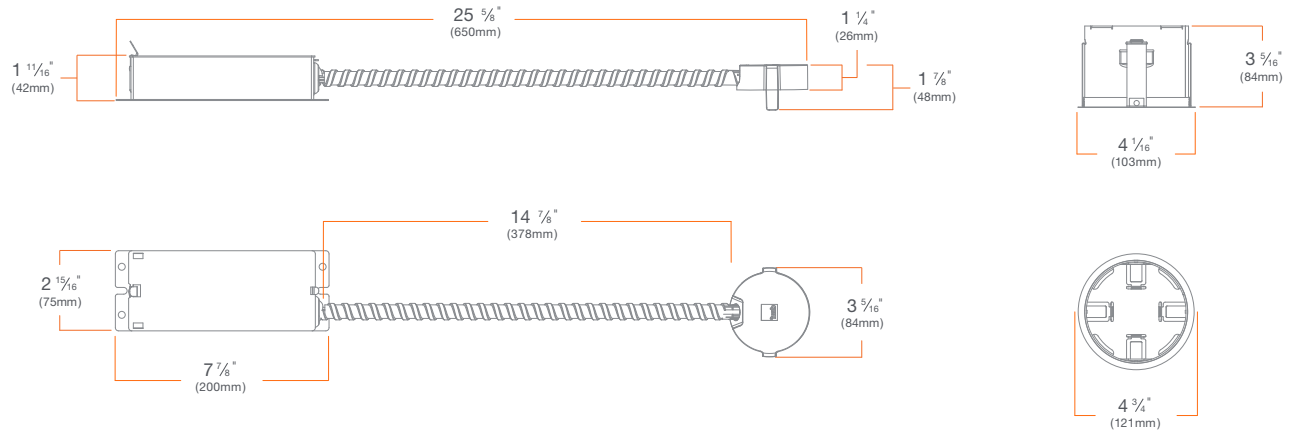
4" Round Downlight

L11

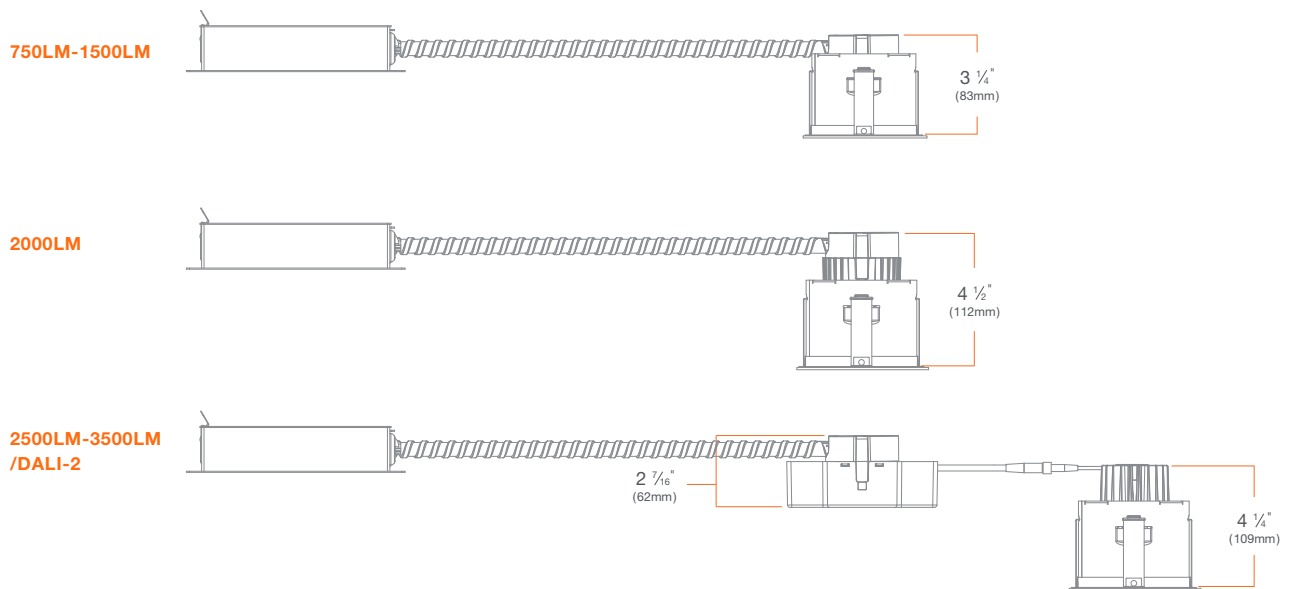
Standard

M4RMRN

(Dimensions not including module)



Total Height in Plenum





M Series Commercial

4" Round Downlight

L11

TRIMS



4" Round Trims

M4TR

SUMMARY

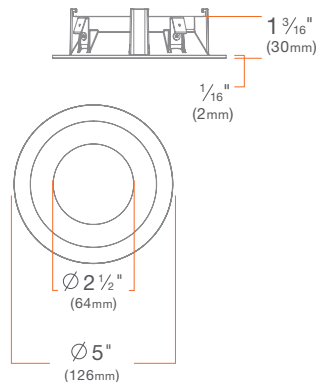
CONSTRUCTION: Die-cast aluminum

DECORATIVE: Acrylic diffuser

INSTALLATION: Twist & Lock

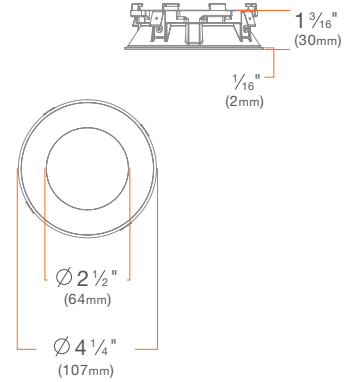
Standard

M4TRSWH



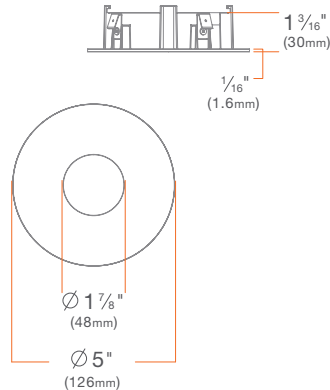
Flangeless

M4TRSWHFL



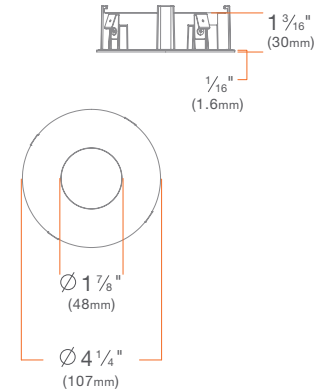
Pinhole

M4TRPWH



Flangeless Pinhole

M4TRPWHFL





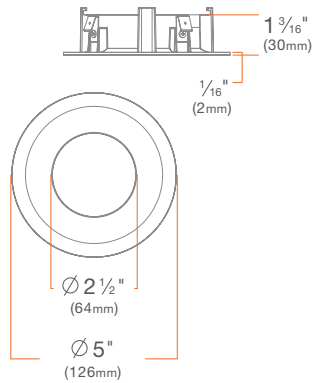
M Series Commercial

4" Round Downlight

L11

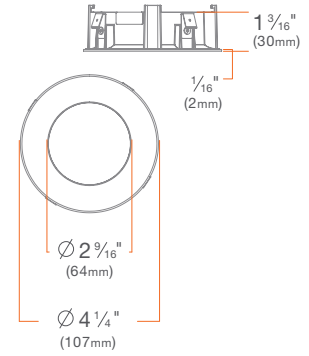
Hyperbolic

M4TRHWH



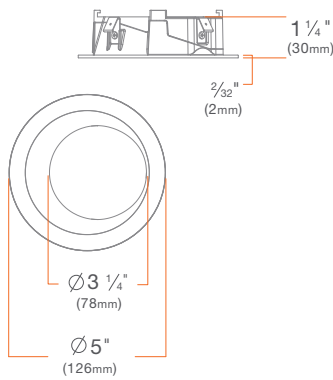
Flangeless Hyperbolic

M4TRHWHFL



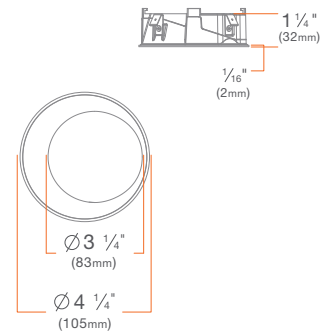
Wall Wash

M4TRLWH



Flangeless Wall Wash

M4TRLWHFL

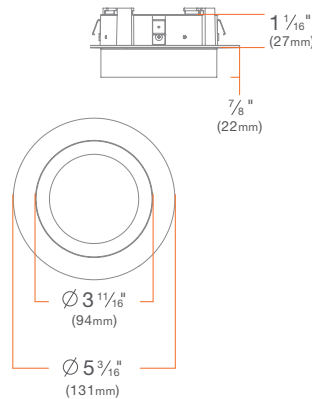


Decorative Closed

Frosted: M4TRSWHDCF

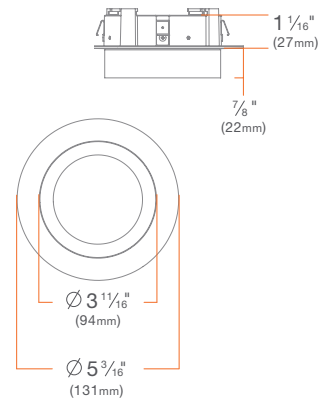
Clear, Frosted Inside: M4TRSWHDC

Clear, Frosted Sides: M4TRSWHDCCF



Decorative Open

Frosted: M4TRSWHDOF





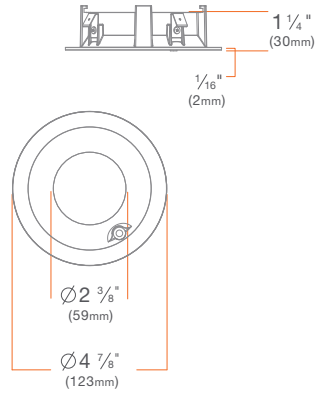
M Series Commercial

4" Round Downlight

L11

Emergency with Integrated Test Switch

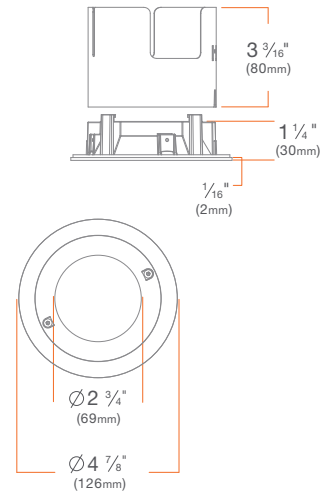
M4TRSWHEM



Vandal Proof/IP65

*For use with Standard New Construction Only

M4TRSWHVP





M Series Commercial

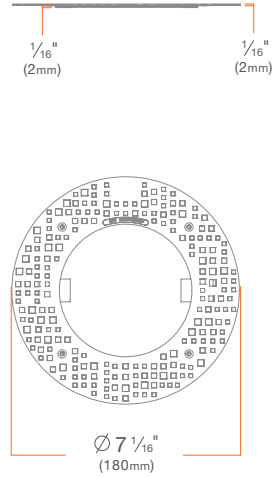
4" Round Downlight

L11

ACCESSORIES

Flangeless Mud Plate

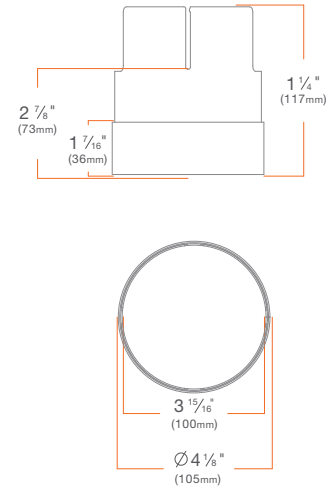
M4XRMUD



Extension Collar

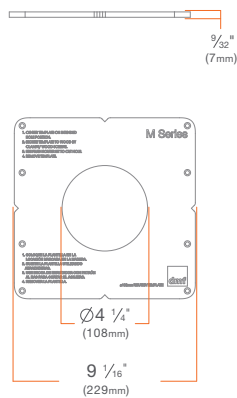
**For use with Standard New Construction Only*

M4CREXT



Router Template

M4KRTEMPLATE





M Series Commercial

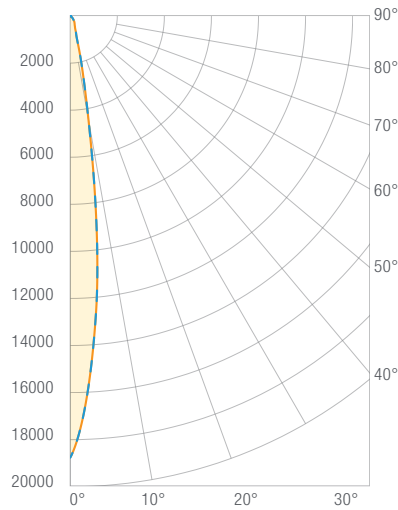
4" Round Downlight

L11

PHOTOMETRY

MD 2000 lm, 3000K, Narrow Spot

MD20930NS | M4TRSWH



cd — C0 - C180 — C90 - C270 2052 lm

Luminous Intensity

Gamma	C 0°
0°	18766
5°	12609
10°	4461
15°	1402
20°	682
25°	466
30°	372
35°	304
40°	221
45°	162
50°	116
55°	81
60°	53
65°	30
70°	13
75°	8
80°	5
85°	2
90°	0

Values in candela

Zonal Lumen Summary

Zone	Lumens	Luminaire %
0-30	1625	79
0-40	1810	88
0-60	2010	98
0-90	2052	100
0-180	2052	100

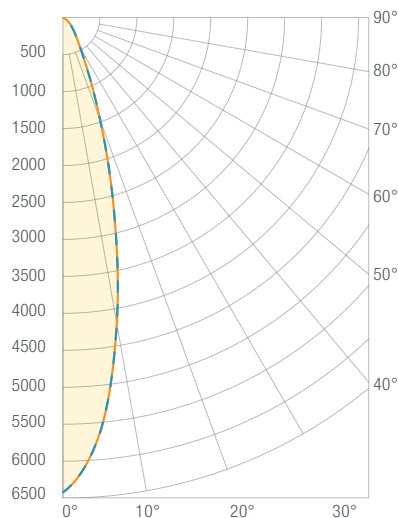
Illuminance Chart

Distance from LED	Foot Candles	Diameter
3'	2085.2	0.7'
6'	521.3	1.5'
9'	231.7	2.2'
12'	130.3	2.9'

Beam Angle: 14°

MD 2000 lm, 3000K, Spot

MD20930SP | M4TRSWH



cd — C0 - C180 — C90 - C270 2060 lm

Luminous Intensity

Gamma	C 0°
0°	6422
5°	5661
10°	4202
15°	2653
20°	1478
25°	799
30°	472
35°	319
40°	227
45°	166
50°	119
55°	82
60°	50
65°	29
70°	13
75°	8
80°	4
85°	2
90°	0

Values in candela

Zonal Lumen Summary

Zone	Lumens	Luminaire %
0-30	1612	78
0-40	1817	88
0-60	2020	98
0-90	2060	100
0-180	2060	100

Illuminance Chart

Distance from LED	Foot Candles	Diameter
3'	713.5	1.4'
6'	178.4	2.8'
9'	79.3	4.2'
12'	44.6	5.6'

Beam Angle: 26°



M Series Commercial

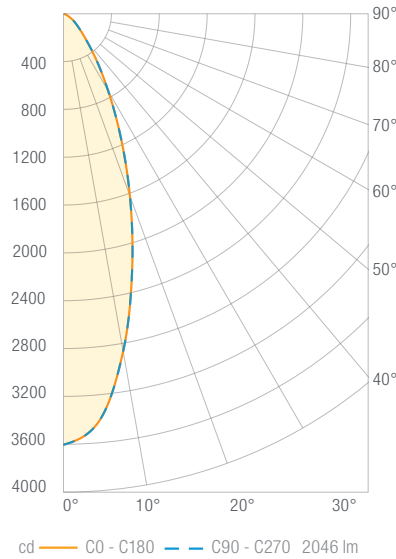
4" Round Downlight

L11

PHOTOMETRY

MD 2000 Im, 3000K, Flood

MD20930FL | M4TRSWH



Luminous Intensity

Gamma	C 0°
0°	3604
5°	3418
10°	2867
15°	2215
20°	1620
25°	1123
30°	746
35°	487
40°	309
45°	204
50°	141
55°	98
60°	57
65°	34
70°	15
75°	10
80°	6
85°	3
90°	0

Values in candela

Zonal Lumen Summary

Zone	Lumens	Luminaire %
0-30	1438	70
0-40	1748	85
0-60	1998	98
0-90	2046	100
0-180	2046	100

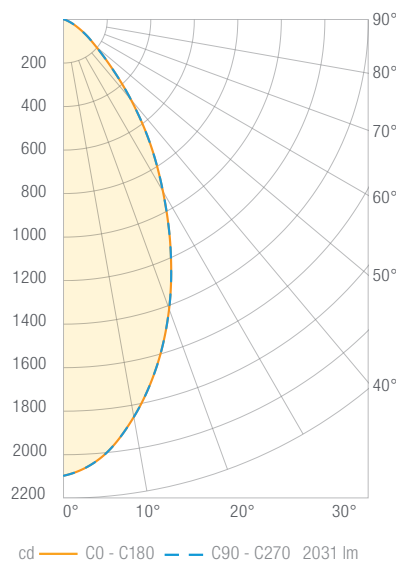
Illuminance Chart

Distance from LED	Foot Candles	Diameter
3'	400.5	2.0'
6'	100.1	4.0'
9'	44.5	6.0'
12'	25.0	8.0'

Beam Angle: 37°

MD 2000 Im, 3000K, Wide Flood

MD20930WF | M4TRSWH



Luminous Intensity

Gamma	C 0°
0°	2096
5°	2018
10°	1855
15°	1651
20°	1416
25°	1162
30°	912
35°	689
40°	480
45°	307
50°	195
55°	129
60°	78
65°	45
70°	22
75°	12
80°	7
85°	4
90°	1

Values in candela

Zonal Lumen Summary

Zone	Lumens	Luminaire %
0-30	1179	58
0-40	1605	79
0-60	1967	97
0-90	2031	100
0-180	2031	100

Illuminance Chart

Distance from LED	Foot Candles	Diameter
3'	232.9	3.1'
6'	58.2	6.2'
9'	25.9	9.3'
12'	14.6	12.4'

Beam Angle: 55°



M Series Commercial

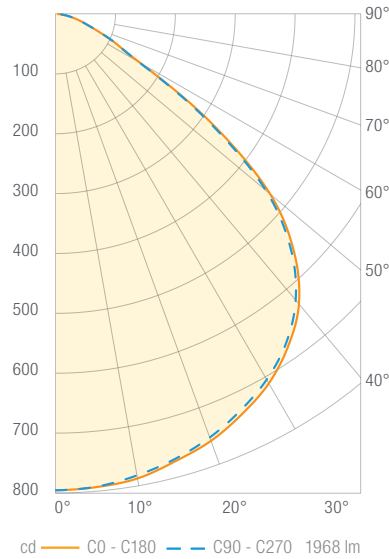
4" Round Downlight

L11

PHOTOMETRY

MD 2000 Im, 3000K, General Ambient

MD20930GA



Luminous Intensity

Gamma	C 0°
0°	796
5°	793
10°	788
15°	773
20°	759
25°	737
30°	712
35°	677
40°	632
45°	564
50°	468
55°	318
60°	163
65°	103
70°	62
75°	41
80°	24
85°	11
90°	3

Values in candela

Zonal Lumen Summary

Zone	Lumens	Luminaire %
0-30	640	32
0-40	1067	54
0-60	1798	91
0-90	1968	100
0-180	1968	100

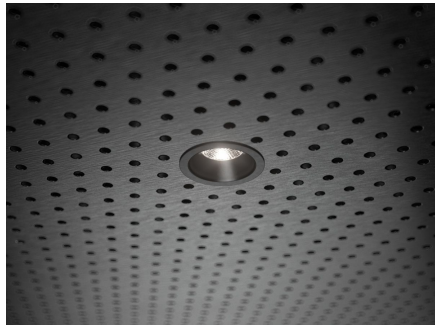
Illuminance Chart

Distance from LED	Foot Candles	Diameter
3'	88.4	7.8'
6'	22.1	15.5'
9'	9.8	23.3'
12'	5.5	31.1'

Beam Angle: 105° x 104°



MINI RX



- Downlight
- Round
- Fixed
- 1" Inner Aperture

Project:	L12
Type:	
Contact:	



Other Manufacturers:
LIGHTEADED "ACCENTS & MILLWORK" Series
LUMENWERX "PETITE 1" Series

ORDERING INFO

YO MINRX

MODEL	Wattage	Kelvin	CRI	Beam	Lens	Color	Converter	Type	I.P. Rating
MINRX: MINI RX	02: 02W	27: 2700K	A: 80	C: 60° Comfort Trim	C: Clear	WS: Matte White	V1: 24 VDC 1-Channel Converter *1 (Static/Warm Dim)	01: Ceiling Thickness 0-1"	D: Dry IP 20
	05: 05W	30: 3000K	B: 95	D: 36° Comfort Trim	F: Frosted	BK: Matte Black	V2: 24 VDC 2-Channel Converter *1 (Tunable White)	02: Ceiling Thickness 1-2"	
	07: 07W	35: 3500K		S: 60° Sparkle Trim		WK: White trim / Black Splay		03: Narrow Channel Armstrong	
		40: 4000K		T: 36° Sparkle Trim		WG: White Trim / Shadow Splay (Shadow Grey RAL 7001)			
		TD: Tunable White 2700K to 6500K (Daylight, Not possible with 2W)				BP: Black Pearl			
		TH: Tunable White 1800K to 4000K (Hospitality, Not possible with 2W)				SN: Satin Nickel			
		WD: Warm Dim 1800K to 3000K (Not possible with 2W, 5W)				BZ: Bronze			
						CC: Custom Color			

Notes:

*1: This is a 24V luminaire. Driver to be specified separately. For line-voltage control and dimming select the appropriate driver on spec sheet page 3. Drivers are designed with universal input voltage compatibility, accommodating a range from 120V to 277V.

SPECIFICATIONS

LED Source

Tool-free field-replaced LED module. Proprietary high performance aluminum extruded heatsink, anodized black for maximum LED life. 2 SDCM Binning for all static colors.

Beams

Computer-optimized reflector design, high reflected finish aluminum for 24°, 36° and 60°. For the 10° beam angle option a Total Internal Reflection technology is used.

Trim

We use CNC machining to precision-machine 6063 aluminum trims to tight tolerances. Then, we powder coat them in our in-house facility for a durable, long-lasting finish. This process ensures that our trims meet our high standards of quality and performance.

Fixture Retention

Please refer to installation instructions for fixture retention of the Mini family.

Life

L80(10K): 55,000+ hrs at 80% of initial lumens.

Label

ETL listed for US Canada. CE labeled. CCC label available on request.

Warranty

5 years limited warranty.

<https://zanibonilighting.com/terms-and-conditions.html>

Zaniboni lighting - Ph +1(727)213-0410 - Fx +1(727)683 - 9720 - zanibonilighting.com - 101 N Garden Ave Suite 230, Clearwater - FL 33755
The manufacture reserves the right to change or modify the design, dimensions, and photometric information at any time without notice. The manufacturer accepts no liability for consequential damage which is occasioned to the user based on the data provided.

Rev 2024-09-30
page 1

PERFORMANCE INFO

L12

3000K Power 80 CRI Performance

Performance Options	2W	5W	7W
Source Lumens [lm]	252	630	882
Delivered Lumens [lm]	152	448	612
Lumens / Watt [lm]	84	99	97
Current [mA]	100	250	350

CRI/CCT Multiplier

CRI/CCT Multiplier	2700°K	3000°K	3500°K	4000°K
80 CRI	0.94	1	1.02	1.03
90 CRI	0.81	0.85	0.85	0.86

Lens Multiplier

Nominal Optic	36°	60°
Clear	0.99	0.99
Frosted	0.92	0.84
Solite	0.93	0.91

Color Finish Multiplier

White	Shadow Gray	Black
1.00	0.95	0.92

Warm Dim

(CCT 1800K - 3000K) Values @ 3000K / 95CRI [7W]

Power Options	7W
Source Lumens [lm]	559
Delivered Lumens [lm]	503
Efficacy [lm / W]	84

Warm Dim

(CCT 1800K - 3000K) @ Different CCT 7W / 95CRI

CCT Value	1800K	2200K	2700K	3000K
Source Lumens [lm]	17	112	280	559
Delivered Lumens [lm]	15	101	252	503
Efficacy [lm / W]	84	84	84	84

Tunable White Hospitality

(CCT 1800K - 4000K) Values @ 3000K & 95CRI

Power Options	5W	7W
Source Lumens [lm]	498	667
Delivered Lumens [lm]	448	600
Efficacy [lm / W]	94	95

Tunable White Daylight

(CCT 2700K - 6500K) Values @ 3000K & 95CRI

Power Options	5W	7W
Source Lumens [lm]	520	695
Delivered Lumens [lm]	468	626
Efficacy [lm / W]	99	99

Tunable White Hospitality

(CCT 1800K - 4000K) @ Different CCT 7W 95CRI

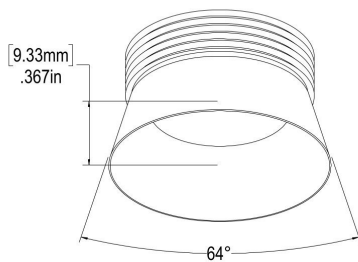
CCT Value	1800K	3000K	3500K	4000K
Source Lumens [lm]	442	670	684	704
Delivered Lumens [lm]	398	600	615	633
Efficacy [lm/W]	60	91	93	96

Tunable White Daylight

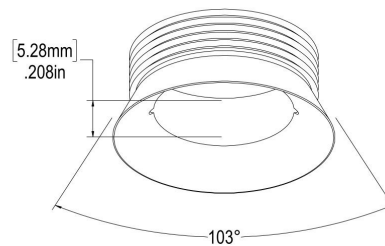
(CCT 2700K - 6500K) @ Different CCT 7W 95CRI

CCT Value	2700K	3000K	3500K	6500K
Source Lumens [lm]	662	695	732	787
Delivered Lumens [lm]	597	626	660	711
Efficacy [lm/W]	90	99	100	107

Splay Comparison



COMFORT TRIM

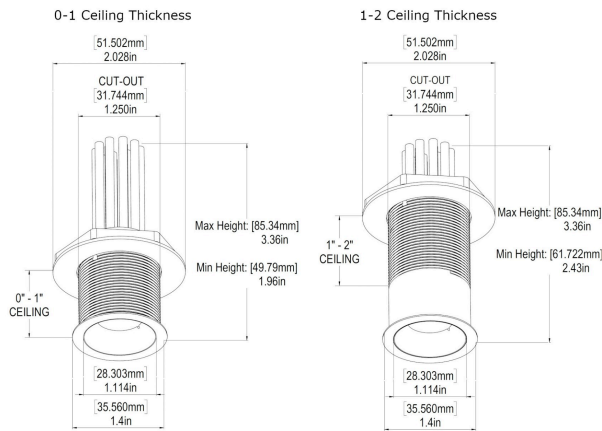


SPARKLE TRIM

DIMENSIONS / DRAWINGS

L12

Luminaire without housing



Product Height

Power Options	Lens	Height (in)
2W or 5W	Clear/Frosted	1.959"
	Solite	1.998"
7W	Clear/Frosted	3.321"
	Solite	3.360"

Wattage and accessories affect product height. See product height table

Electrical Data

Driver Selection		Power Supply 96W 24 VDC 1 Power Channel and 1 Dimming Channel	Power Supply 288W 24 VDC 3 Power Channel and 1 Dimming Channel
0-10 / ELV	Code	A1-MG96V-410LB-00-24-17-MULD	A1-MG288V-410LB-00-24-17-MULD
	Dimensions	7.2"x2.36"x1.4" (182.9mm x 60.0mm x 35.8mm)	9.9"x7.6"x1.9" (251.5mm x 193.1mm x 48.3mm)

Driver Selection		Power Supply 96W 24 VDC 1 Power Channel and 1 Dimming Channel	Power Supply 96W 24 VDC 2 Power Channel and 1 Dimming Channel
Bluetooth	Code	D-V4K-00-24-17-DL00	D-D4K-00-24-17-DL00
	Dimensions	14.75" x 3.125 x 1.75" (374.7mm x 79.4mm x 44.6mm)	7.5" x 2.125" x 1.5" (374.7mm x 79.4mm x 44.6mm)

96W Power Supplies

Power Option	Maximum number of light fixtures per Wattage
3W	25
5W	15
7W	10
9W	8

288W 3 Channel Power Supply

Power Option	Maximum number of light fixtures per Wattage
3W	25 / Channel per driver
5W	15 / Channel per driver
7W	10 / Channel per driver
9W	8 / Channel per driver

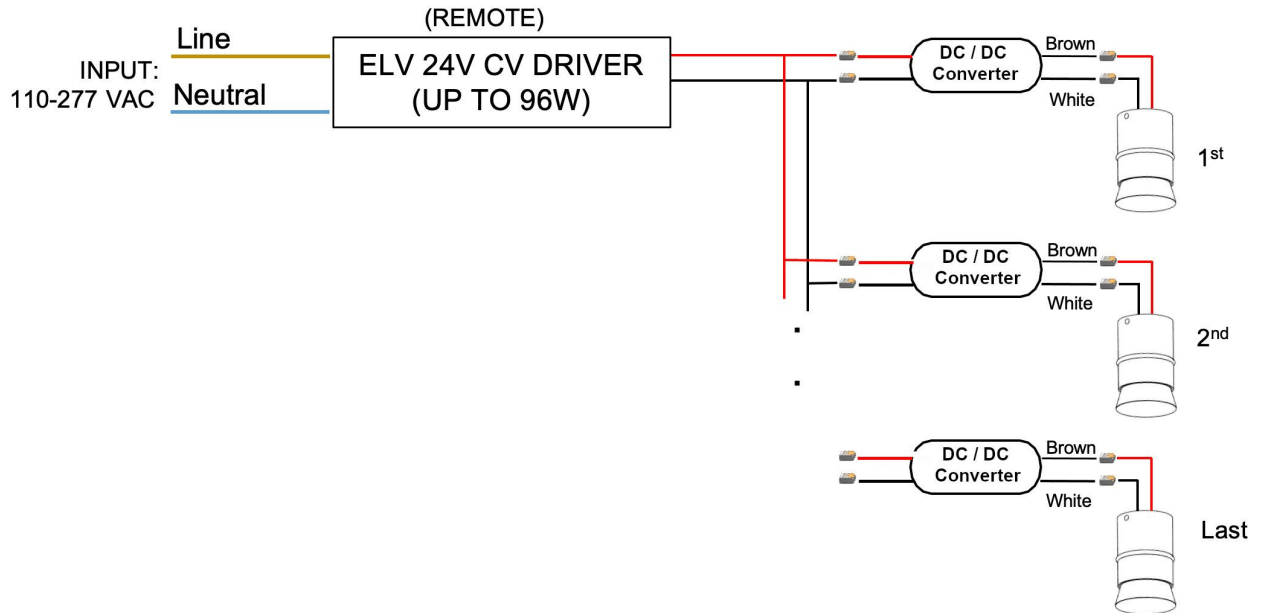
Drivers are not included in the price. Please select your driver on the [accessories page](#).

WIRING DIAGRAM

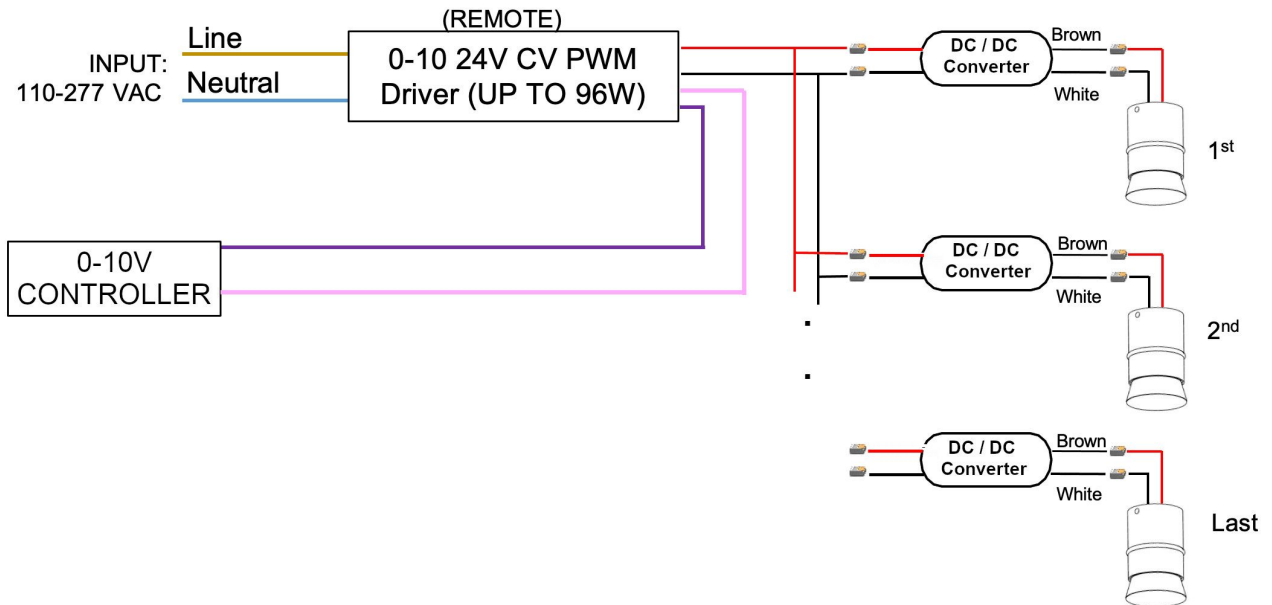
L12

Price does not include power supply.

ELV, Non-Dim, Bluetooth Driver



0-10V Driver





MINI RX

- Downlight
- Round
- Fixed
- 1" Inner Aperture

Project:	L13
Type:	
Contact:	



Other Manufacturers:
LIGHTEADED "ACCENTS & MILLWORK" Series
LUMENWERX "PETITE 1" Series

ORDERING INFO

YO MINRX

MODEL	Wattage	Kelvin	CRI	Beam	Lens	Color	Converter	Type	I.P. Rating
MINRX: MINI RX	02: 02W	27: 2700K	A: 80	C: 60° Comfort Trim	C: Clear	WS: Matte White	V1: 24 VDC 1-Channel Converter *1 (Static/Warm Dim)	01: Ceiling Thickness 0-1"	D: Dry IP 20
	05: 05W	30: 3000K	B: 95	D: 36° Comfort Trim	F: Frosted	BK: Matte Black			
	07: 07W	35: 3500K		S: 60° Sparkle Trim	S: Solite	WK: White trim / Black Splay	V2: 24 VDC 2-Channel Converter *1 (Tunable White)	02: Ceiling Thickness 1-2"	
		40: 4000K		T: 36° Sparkle Trim		WG: White Trim / Shadow Splay (Shadow Grey RAL 7001)		03: Narrow Channel Armstrong	
		TD: Tunable White 2700K to 6500K (Daylight, Not possible with 2W)				BP: Black Pearl			
		TH: Tunable White 1800K to 4000K (Hospitality, Not possible with 2W)				SN: Satin Nickel			
		WD: Warm Dim 1800K to 3000K (Not possible with 2W, 5W)				BZ: Bronze			
						CC: Custom Color			

Notes:

*1: This is a 24V luminaire. Driver to be specified separately. For line-voltage control and dimming select the appropriate driver on spec sheet page 3. Drivers are designed with universal input voltage compatibility, accommodating a range from 120V to 277V.

SPECIFICATIONS

LED Source

Tool-free field-replaced LED module. Proprietary high performance aluminum extruded heatsink, anodized black for maximum LED life. 2 SDCM Binning for all static colors.

Beams

Computer-optimized reflector design, high reflected finish aluminum for 24°, 36° and 60°. For the 10° beam angle option a Total Internal Reflection technology is used.

Trim

We use CNC machining to precision-machine 6063 aluminum trims to tight tolerances. Then, we powder coat them in our in-house facility for a durable, long-lasting finish. This process ensures that our trims meet our high standards of quality and performance.

Fixture Retention

Please refer to installation instructions for fixture retention of the Mini family.

Life

L80(10K): 55,000+ hrs at 80% of initial lumens.

Label

ETL listed for US Canada. CE labeled. CCC label available on request.

Warranty

5 years limited warranty.

<https://zanibonilighting.com/terms-and-conditions.html>

Zaniboni lighting - Ph +1(727)213-0410 - Fx +1(727)683 - 9720 - zanibonilighting.com - 101 N Garden Ave Suite 230, Clearwater - FL 33755
The manufacture reserves the right to change or modify the design, dimensions, and photometric information at any time without notice. The manufacturer accepts no liability for consequential damage which is occasioned to the user based on the data provided.

Rev 2024-09-30
page 1

PERFORMANCE INFO

3000K Power 80 CRI Performance

Performance Options	2W	5W	7W
Source Lumens [lm]	252	630	882
Delivered Lumens [lm]	152	448	612
Lumens / Watt [lm]	84	99	97
Current [mA]	100	250	350

CRI/CCT Multiplier

CRI/CCT Multiplier	2700°K	3000°K	3500°K	4000°K
80 CRI	0.94	1	1.02	1.03
90 CRI	0.81	0.85	0.85	0.86

Lens Multiplier

Nominal Optic	36°	60°
Clear	0.99	0.99
Frosted	0.92	0.84
Solite	0.93	0.91

Color Finish Multiplier

White	Shadow Gray	Black
1.00	0.95	0.92

Warm Dim

(CCT 1800K - 3000K) Values @ 3000K / 95CRI [7W]

Power Options	7W
Source Lumens [lm]	559
Delivered Lumens [lm]	503
Efficacy [lm / W]	84

Warm Dim

(CCT 1800K - 3000K) @ Different CCT 7W / 95CRI

CCT Value	1800K	2200K	2700K	3000K
Source Lumens [lm]	17	112	280	559
Delivered Lumens [lm]	15	101	252	503
Efficacy [lm / W]	84	84	84	84

Tunable White Hospitality

(CCT 1800K - 4000K) Values @ 3000K & 95CRI

Power Options	5W	7W
Source Lumens [lm]	498	667
Delivered Lumens [lm]	448	600
Efficacy [lm / W]	94	95

Tunable White Daylight

(CCT 2700K - 6500K) Values @ 3000K & 95CRI

Power Options	5W	7W
Source Lumens [lm]	520	695
Delivered Lumens [lm]	468	626
Efficacy [lm / W]	99	99

Tunable White Hospitality

(CCT 1800K - 4000K) @ Different CCT 7W 95CRI

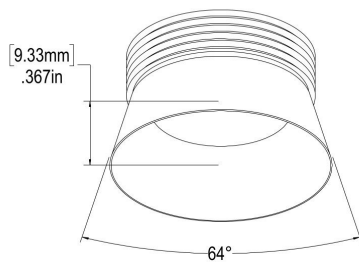
CCT Value	1800K	3000K	3500K	4000K
Source Lumens [lm]	442	670	684	704
Delivered Lumens [lm]	398	600	615	633
Efficacy [lm/W]	60	91	93	96

Tunable White Daylight

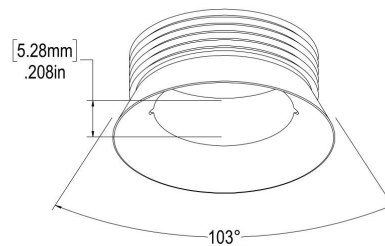
(CCT 2700K - 6500K) @ Different CCT 7W 95CRI

CCT Value	2700K	3000K	3500K	6500K
Source Lumens [lm]	662	695	732	787
Delivered Lumens [lm]	597	626	660	711
Efficacy [lm/W]	90	99	100	107

Splay Comparison



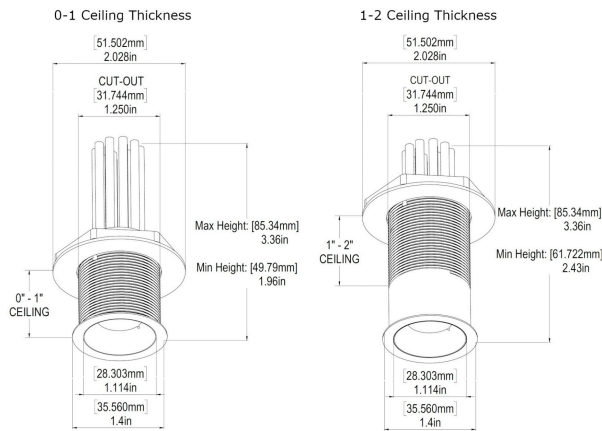
COMFORT TRIM



SPARKLE TRIM

DIMENSIONS / DRAWINGS

Luminaire without housing



Product Height

Power Options	Lens	Height (in)
2W or 5W	Clear/Frosted	1.959"
	Solite	1.998"
7W	Clear/Frosted	3.321"
	Solite	3.360"

Wattage and accessories affect product height. See product height table

Electrical Data

Driver Selection		Power Supply 96W 24 VDC 1 Power Channel and 1 Dimming Channel	Power Supply 288W 24 VDC 3 Power Channel and 1 Dimming Channel
0-10 / ELV	Code	A1-MG96V-410LB-00-24-17-MULD	A1-MG288V-410LB-00-24-17-MULD
	Dimensions	7.2"x2.36"x1.4" (182.9mm x 60.0mm x 35.8mm)	9.9"x7.6"x1.9" (251.5mm x 193.1mm x 48.3mm)
Driver Selection		Power Supply 96W 24 VDC 1 Power Channel and 1 Dimming Channel	Power Supply 96W 24 VDC 2 Power Channel and 1 Dimming Channel
Bluetooth	Code	D-V4K-00-24-17-DL00	D-D4K-00-24-17-DL00
	Dimensions	14.75" x 3.125 x 1.75" (374.7mm x 79.4mm x 44.6mm)	7.5" x 2.125" x 1.5" (374.7mm x 79.4mm x 44.6mm)

96W Power Supplies

Power Option	Maximum number of light fixtures per Wattage
3W	25
5W	15
7W	10
9W	8

288W 3 Channel Power Supply

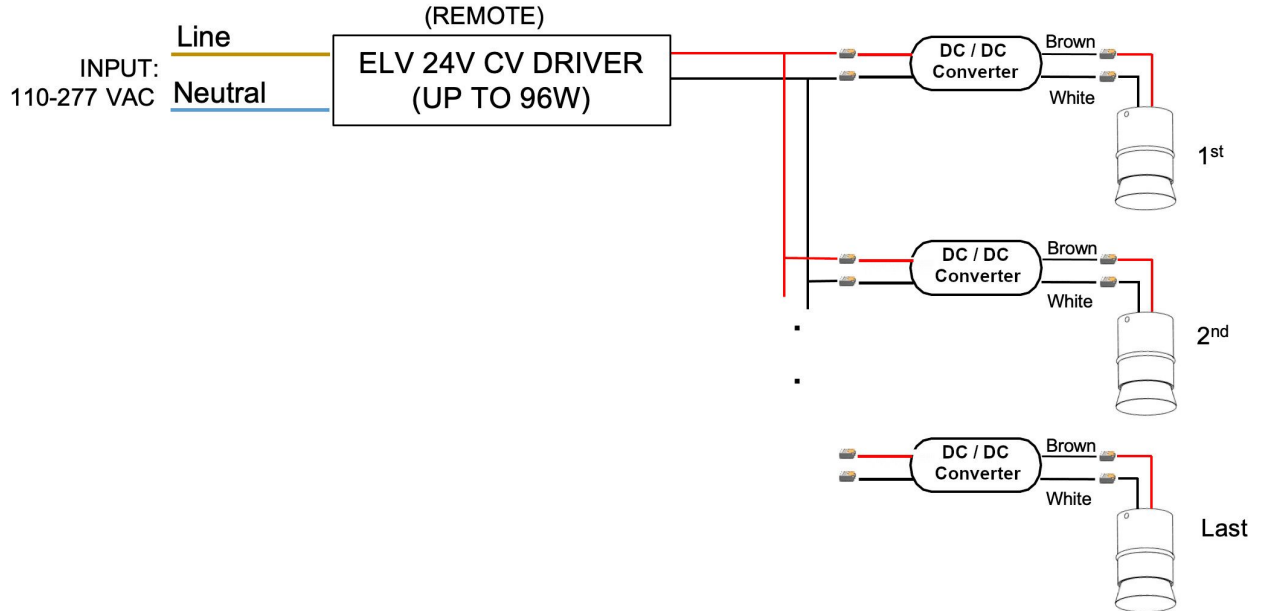
Power Option	Maximum number of light fixtures per Wattage
3W	25 / Channel per driver
5W	15 / Channel per driver
7W	10 / Channel per driver
9W	8 / Channel per driver

Drivers are not included in the price. Please select your driver on the [accessories page](#).

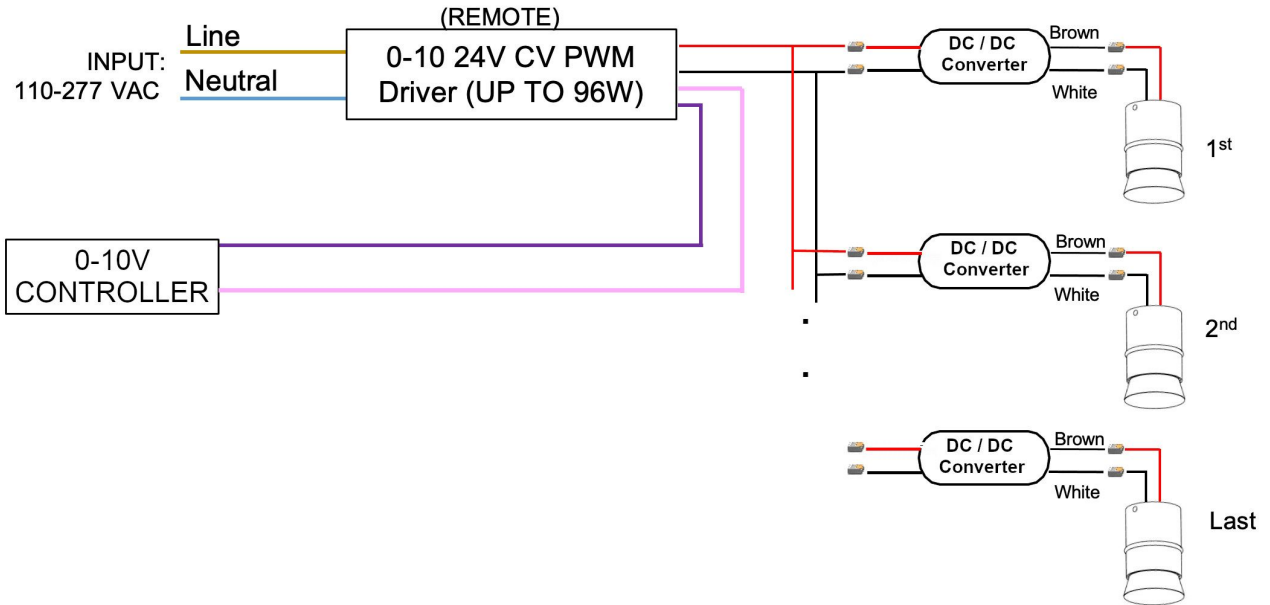
WIRING DIAGRAM

Price does not include power supply.

ELV, Non-Dim, Bluetooth Driver



0-10V Driver



Other Manufacturers:
LIGHTHEADED "MINIMALIST" Series
3G "3G-RMZ4SQ" Series

L14

LUMENWERX

CLUSTER

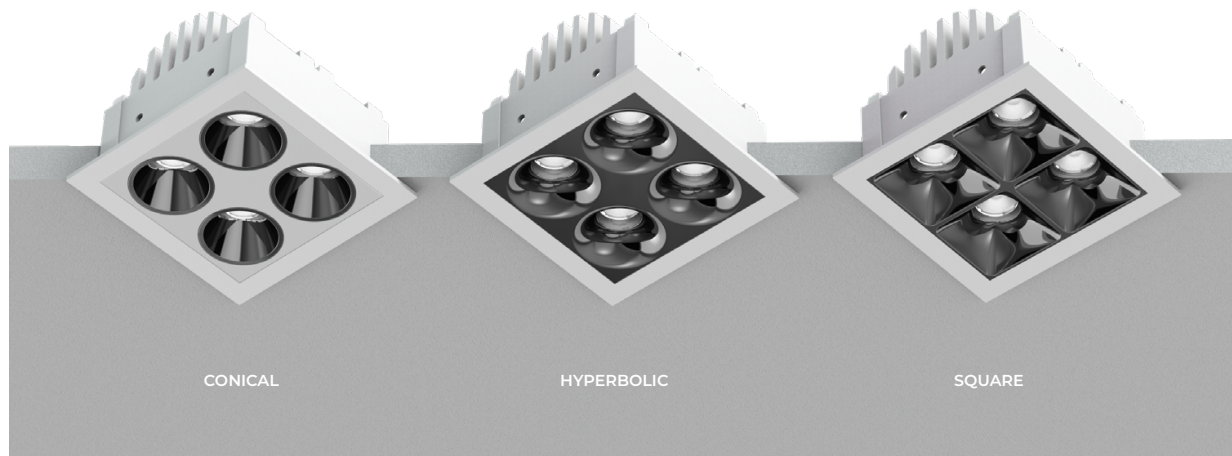
RECESSED PLANAR

DESCRIPTION

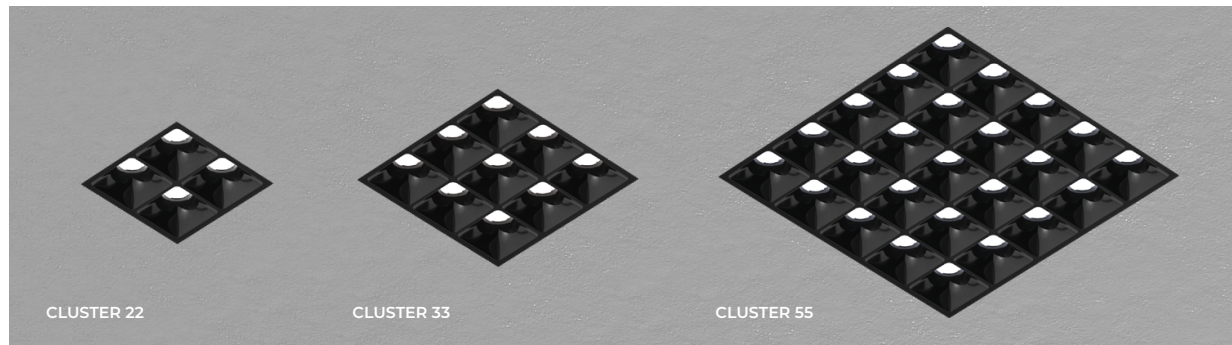
Cluster is the precise, and scalable family of downlights, wall washers, and adjustables, available in both linear and planar configurations and for recessed, pendant, and surface mounting. Based on a fundamental 1.2" square cell, Cluster delivers lighting that is optically sophisticated and aesthetically refined. Cluster recessed planar downlights are available in 2x2, 3x3, and 5x5 cell configurations, all with a choice of precision optics, beam spreads and subtle louver treatments. Nominal light output is 200 lumens per cell (5000 lumens in the 5x5 configuration) .



All recessed Cluster can install in a variety of ceiling types and materials, with either an integral driver or a remote driver that is capable of powering multiple luminaires.

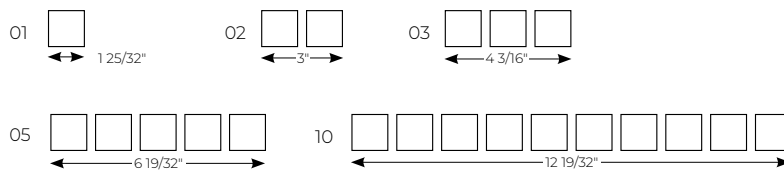


PLANAR SIZES



OTHER AVAILABLE LINEAR SIZES

See linear spec sheet



L14

CLUSTER
RECESSED PLANAR

LUMENWERX

Project: _____

Type: _____

Order Guide
1. HOUSING

IC RATED

Housing can be ordered separately.

LUMINAIRE ID	TRIM STYLE	LIGHT SOURCE	INSTALLATION TYPE	MOUNTING OPTION ¹	DRIVER	VOLTAGE	LUMEN PACKAGE ³	DIMMING
		SW						
CLU22R - Cluster 2x2 Recessed CLU33R - Cluster 3x3 Recessed CLU55R - Cluster 5x5 Recessed	TRM - Flanged trim TLM - Trimless drywall mudplate TLMW - Trimless millwork	SW - Static white	OF - Open Frame Type Non-IC IC - Type-IC RM - Remodel Type Non-IC CP - Chicago Plenum Type-IC (CCEA)	ASB ² - Adjustable standard bar hangers FMB ² - Flush mount bars ACB ² - Adjustable commercial bar hangers AHC ² - Adjustable hat channel bars NA - None	INTEGRAL	120V - 120V 277V - 277V	CLU22R - 811LM - 811 lm CLU33R - 1743LM - 1743 lm CLU55R - 4670LM - 4670 lm ³ Lumen packages shown at 3500K, with SDF-NFL 25°. For other, see lumen output multipliers on page 6.	DI - 1% 0-10V ELV ⁴ - ELV 120V TRI ⁴ - TRIAC 120V ⁴ Available with 120V only.
					REMOTE	DO NOT SPECIFY FOR REMOTE. SEE "REMOTE DRIVER BOX" SECTION BELOW.		

2. LIGHT

LUMINAIRE ID	TRIM STYLE	LIGHT SOURCE	OPTIC	BEAM	CRI	COLOR TEMP.	TRIM FINISH ⁵	LOUVER	LOUVER FINISH
		SW			90CRI				
CLU22RL - Cluster 2x2 Recessed CLU33RL - Cluster 3x3 Recessed CLU55RL - Cluster 5x5 Recessed	TRM - Flanged trim TLM - Trimless drywall mudplate TLMW - Trimless millwork	SW - Static white	SOF - Soft edge downlight REF - Sharp edge downlight	SQE NFL - Narrow flood FLD - Flood WFL - Wide flood BE SPT - Spot FLD - Flood WFL - Wide flood	90CRI - 90 CRI	27K - 2700K 30K - 3000K 35K - 3500K 40K - 4000K 50K - 5000K	FTMW - Textured matte white FTMB - Textured matte black CF# - Custom finish, specify RAL# ⁵ Applicable for trim and trimless. Body finish matches trim finish.	CON ⁶ - Conical HYP - Hyperbolic SQR - Square ⁶ Faceplate matches body finish black and white only.	MF01 - Matte white MF04 - Matte black BL05 - Black chrome CL06 - Gold CP06 - Copper

3. REMOTE DRIVER BOX

Ordered separately. Specify each required remote driver box on a separate line.

REMOTE DRIVER ⁷	LUMINAIRE QTY. ⁸	LUMINAIRE ID	VOLTAGE	LUMEN PACKAGE ⁹	DIMMING ¹¹																
RDB# - Remote driver box ⁷ Specify each required remote driver box on a separate line.	#X - Number of luminaires ⁸ Specify number (#) of luminaires per remote driver.	CLU22R - Cluster 2x2 Recessed CLU33R - Cluster 3x3 Recessed CLU55R - Cluster 5x5 Recessed	120V - 120V 277V - 277V UNV - 120V-277V	<table border="1"> <thead> <tr> <th></th> <th>Low¹⁰</th> <th>Medium¹⁰</th> <th>High</th> </tr> </thead> <tbody> <tr> <td>CLU22R</td> <td>203LM - 203 lm</td> <td>507LM - 507 lm</td> <td>811LM - 650 lm</td> </tr> <tr> <td>CLU33R</td> <td>436LM - 436 lm</td> <td>1089LM - 1089 lm</td> <td>1743LM - 1743 lm</td> </tr> <tr> <td>CLU55R</td> <td>1168LM - 1168 lm</td> <td>2920LM - 2920 lm</td> <td>4670LM - 4670 lm</td> </tr> </tbody> </table> ⁹ Watts and lumen per watts will vary based on the number of light units per remote driver as well as on the type of driver selected. ¹⁰ Not available with RELV and RTRI dimming options.		Low ¹⁰	Medium ¹⁰	High	CLU22R	203LM - 203 lm	507LM - 507 lm	811LM - 650 lm	CLU33R	436LM - 436 lm	1089LM - 1089 lm	1743LM - 1743 lm	CLU55R	1168LM - 1168 lm	2920LM - 2920 lm	4670LM - 4670 lm	RD1 - 1% 0-10V RELV ¹² - ELV 120V RTRI ¹² - TRIAC 120V RDA ¹³ - DALI RLDE1 ¹³ - Lutron Hi-lume 1% Eco RELD1 - eldoLED 1% EcoDrive 0-10V RELD0 - eldoLED 0.1% SOLOdrive 0-10V ¹¹ For configurations involving different cluster sizes on a remote driver, please consult factory. ¹² Available with 120V only. ¹³ On-site commissioning is required.
	Low ¹⁰	Medium ¹⁰	High																		
CLU22R	203LM - 203 lm	507LM - 507 lm	811LM - 650 lm																		
CLU33R	436LM - 436 lm	1089LM - 1089 lm	1743LM - 1743 lm																		
CLU55R	1168LM - 1168 lm	2920LM - 2920 lm	4670LM - 4670 lm																		

REMOTE DRIVER EXAMPLE CODE:

MOUNTING	CLU22R-TRM-SW-OF-FMB-REMOTE	REMOTE DRIVER	RDB1-4X-CLU22R-120V-507LM-RD1
LIGHT	CLU22RL-TRM-SW-SOF-NFL-90CRI-30K-FTMW-CON-MF01		RDB2-2X-CLU22R-120V-507LM-RD1



CLUSTER
RECESSED PLANAR

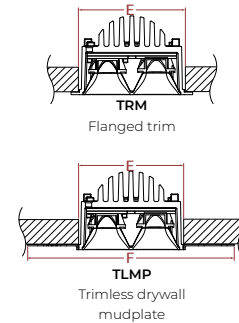
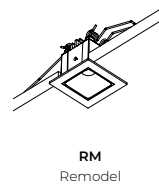
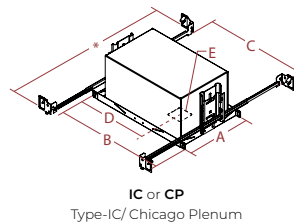
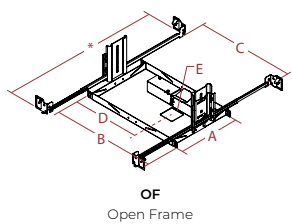
LUMENWERX

MOUNTING

Cluster can be installed in a wide range of ceiling conditions and with various ceiling trim options. Spring clips clamp the lighting unit to the mounting frame (or directly to the ceiling for remodel). Maximum ceiling thickness is 1.25".

INSTALLATION TYPE	MOUNTING OPTION ^{1,2}	TRIM TYPE
OF - Open Frame Type Non-IC IC - Type-IC RM - Remodel Type Non-IC CP - Chicago Plenum Type-IC (CCEA)	ASB - Adjustable standard bar hangers FMB - Flush mount bars ACB - Adjustable commercial bar hangers AHC - Adjustable hat channel bars NA - Not applicable ¹ For detailed mounting option dimensions, see page 4. ² Specify NA for remodel (RM) installation type.	TRM - Flanged trim TLMP - Trimless drywall mudplate TLMW - Trimless millwork

INSTALLATION TYPE ⁴



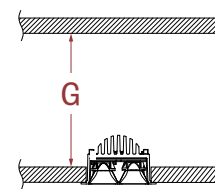
⁴ Drawings shown with adjustable standard bar hangers.

	A HOUSING WIDTH	B HOUSING LENGTH	C SPACING BETWEEN BARS	D DISTANCE FROM CUT-OUT
CLUR22	10 3/4"	12 1/16"	12 11/16"	7 15/32"
CLUR33	12 3/4"	14 1/16"	14 11/16"	9 13/16"
CLUR55	12 9/16"	17 13/16"	18 7/16"	11 3/4"

E CUT-OUT DIMENSIONS	F MUDPLATE DIMENSIONS
2 13/16" x 2 13/16"	5 1/8" x 5 1/8"
4" x 4"	6 5/16" x 6 5/16"
6 3/8" x 6 3/8"	8 11/16" x 8 11/16"

PLENUM CLEARANCE DIMENSIONS

	G PLENUM CLEARANCE HEIGHT			
	REMOTE & INTEGRAL		INTEGRAL	REMOTE
	OPEN FRAME	IC / CP	REMODEL	REMODEL
CLUR22	6"	6 1/8"	6"	1 15/16"
CLUR33	6"	6 1/8"	4"	2 13/32"
CLUR55	4 13/16"	6 1/8"	4"	2 13/32"



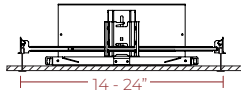
L14

CLUSTER

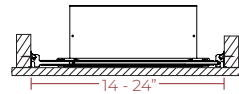
RECESSED PLANAR

LUMENWERX

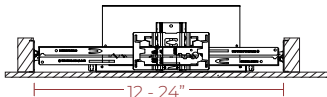
MOUNTING OPTIONS



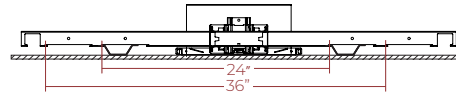
ASB - Adjustable standard bar hangers
Grid ceiling or drywall with variable height
(commercial applications)



FMB - Flush mount bracket
Drywall/metal/wood frame mounting
(residential applications)



ACB - Adjustable commercial bar hangers
Grid ceiling, drywall, metal, wood, frame mounting
(also openings for multiple hanging options such as hat channel, IC channel and metal tubing, supplied by others)



AHC - Adjustable hat channel bars
With adjustable height

FIXTURE DIMENSIONS

	BODY TYPE	
	TRM Flanged trim	TLMP Trimless drywall mudplate
CLURL02		
CLURL03		
CLURL05		

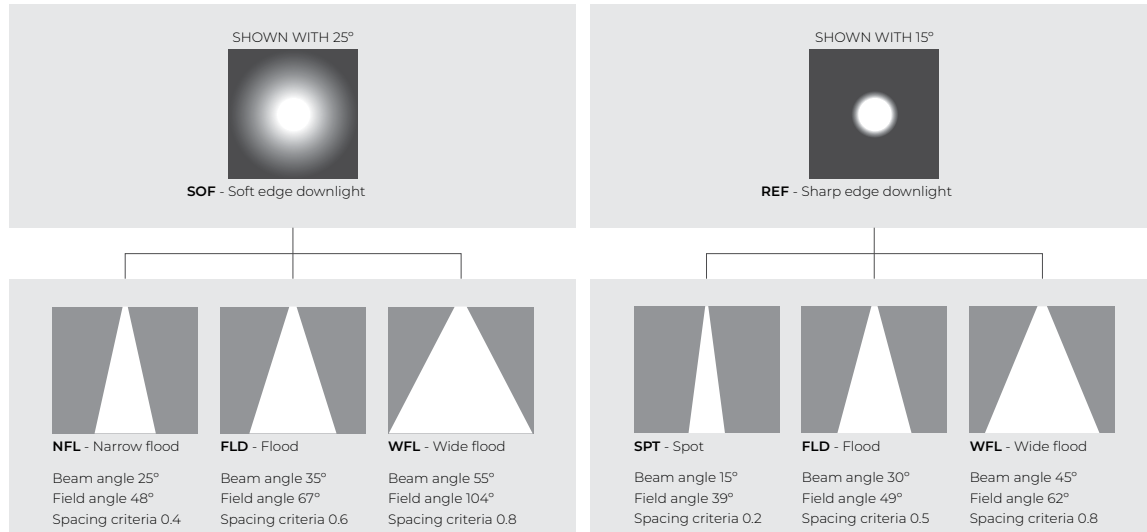
L14

CLUSTER
RECESSED PLANAR

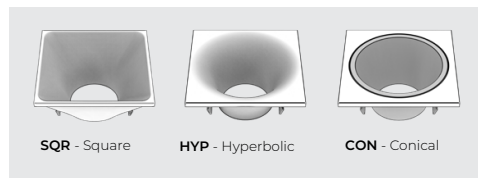
LUMENWERX

LIGHT

OPTICS & BEAM ANGLE

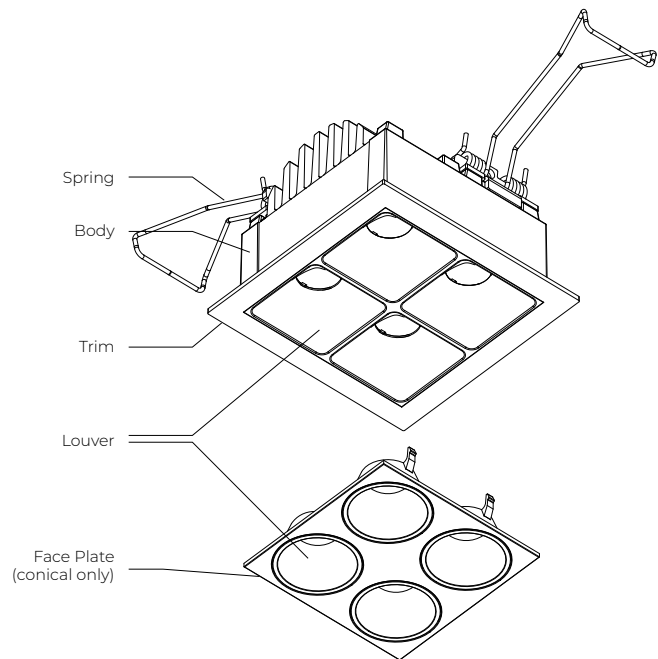


LOUVER SHAPE



LOUVER FINISH

Louver is injection molded with integral texture and color



L14

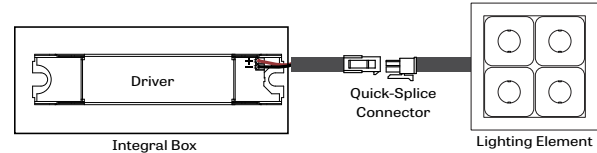
CLUSTER
RECESSED PLANAR

LUMENWERX

DRIVER

INTEGRAL DRIVER

The integral driver is sized to the lighting unit and is connected directly to it with Class 2 wiring and quick-splice connectors. The driver enclosure can be serviced through the ceiling by removing the lighting unit.



MULTIPLIER

GENERAL LUMEN OUTPUT MULTIPLIER AT 90 CRI

OPTICS	2700K						3000K						3500K						4000K					
	SOFT			SHARP			SOFT			SHARP			SOFT			SHARP			SOFT			SHARP		
BEAM ANGLE	25	35	55	15	30	45	25	35	55	15	30	45	25	35	55	15	30	45	25	35	55	15	30	45
LUMEN OUTPUT MULTIPLIER	0.87	0.92	0.82	0.80	0.84	0.86	0.93	0.99	0.87	0.86	0.89	0.92	1	1.06	0.94	0.92	0.96	0.99	1.03	1.09	0.97	0.95	0.99	1.02

LUMEN PACKAGE (AT 3500K, SOFT 25° BEAM) - INTEGRAL DRIVER

LUMINAIRE ID	LUMEN OUTPUT	WATTS	EFFICACY LM/W	LUMEN PACKAGE	VOLTAGE	INTEGRAL DRIVER
CLUR22	811 lm	10.4 W	78 lm/W	Use the multiplier tables to calculate the lumen package	120 - 120V 277 - 277V	D1 - 1% 0-10V ELV ¹ - ELV 120V TRI ¹ - TRIAC 120V
CLUR33	1743 lm	21.5 W	81 lm/W			
CLUR55	4670 lm	59 W	79 lm/W			

¹ Available with 120V only.

REMOTE DRIVER

The remote driver can power several lighting units, depending on their total power. The minimum and maximum number of lighting units and driver type are shown in the table below and must be observed. The remote driver and lighting units are wired together through connection boxes, which are furnished pre-wired to the driver enclosure. All wiring is Class 2 with quick-splice connectors. The remote driver requires access from above the ceiling (or an access panel).

LUMEN PACKAGE¹ (AT 3500K) - REMOTE DRIVER

LUMINAIRE ID	LUMEN PACKAGE ²			VOLTAGE	REMOTE DRIVER	NUMBER OF LIGHTING UNITS PER DRIVER
CLUR22 CLUR33 CLUR55	LOW 203 lm 436 lm 1168 lm	MEDIUM 507 lm 1089 lm 2920 lm	HIGH 811 lm 1743 lm 4670 lm	120 - 120V 277 - 277V UNV - 120V-277V	RD1 - 1% 0-10V RELV ³ - ELV 120V RTRI ³ - TRIAC 120V RDA ⁴ - DALI RLDEI ⁴ - Lutron Hi-lume 1% Eco	See table below for maximum and minimum possible number of lighting units per each driver. For configurations involving different cluster sizes on a remote driver, please consult factory.

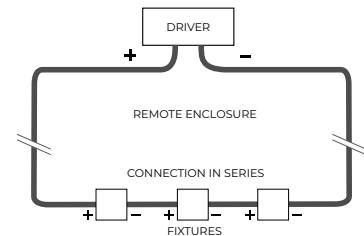
² Low and medium options are not available with RELV and RTRI.
³ Available with 120V only.
⁴ On-site commissioning is required.

¹ Watts and lumen per watts will vary based on the number of lighting units per remote driver as well as on the type of driver selected

NUMBER OF LIGHTING UNITS PER DRIVER - MINIMUM AND MAXIMUM

DRIVER TYPE	CLUR22	CLUR33	CLUR55
D1 - 1% 0-10V	2 - 6	1 - 2	1
ELV - ELV 120V	3	1	-
TRI - TRIAC 120V	3	1	-
DA - DALI	2 - 6	1 - 2	1
LDEI - Lutron Hi-lume 1% Eco	2 - 4	1	-

For any quantities of lighting units per driver that fall outside the minimum and maximum listed above, please consult factory.



L14

CLUSTER RECESSED PLANAR

LUMENWERX

OPTICS

SOFT-EDGED FEATHERED BEAM (SOF)

The Soft-Edged Feathered Beam blends the light into darker areas for a gentle brightness transition. Each LED emitter directs light through a single, custom molded circular optic using total internal reflection (TIR) to shape the light. A 0.5" reflective square louver provides a cut off with a UGR of 10. Three different TIR elements create a choice of beam spread: 25° narrow flood (NFL), 35° flood (FLD), or 55° wide flood (WFL).

SHARP-EDGED CUT-OFF BEAM (REF)

The Sharp-Edged Cut-Off Beam creates dramatic impact, limiting the spread of light outside of the primary beam. A molded conical reflector redirects light from each emitter into the desired beam angle. A 0.5" reflective square louver provides a cut off with a UGR of 10. Three different TIR elements create a choice of beam spread: 15° spot (SPT), 30° flood (FLD), or 45° wide flood (WFL).

LIGHT SOURCE

Custom array of high-flux LEDs mounted onto aluminum-backed circuitry. Available in 2700K, 3000K, 3500K and 4000K with a minimum 90 CRI with elevated R9 value. Color consistency is maintained to within 3 SDCM. All LEDs have been tested in accordance with IESNA LM-80-08 and the results have shown L80 lumen maintenance greater than 60,000 hours. Absolute product photometry is measured and presented in accordance with IESNA LM-79, unless otherwise indicated.

WEIGHT

	BODY		OPEN FRAME		TYPE-IC WITH CHICAGO PLENUM	
	Lb	Kg	Lb	Kg	Lb	Kg
CLUR22	0.70	0.30	2.44	1.11	5.97	2.71
CLUR33	1.10	0.50	3.48	1.58	7.72	3.50
CLUR55	3.00	1.40	4.13	1.87	9.69	4.40

CONSTRUCTION

Housing - Die-cast aluminum (0.95" nominal)

Optics - Polycarbonate

Mounting frame - 22 gauge galvanized sheet metal

Driver housing - 18 gauge galvanized sheet

Mounting clips - Ø1.0-1.4mm spring clips

CERTIFICATIONS

ETL - Rated for indoor dry/damp locations.

Conforms to UL 1598 Standard and certified to CAN/CSA Standard C22.2 No. 250.0

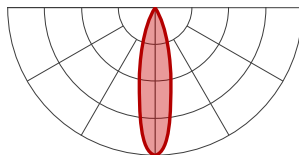
Chicago plenum - City of Chicago approved (CCEA) when specified with CP installation type option.

IC rated - Suitable for direct contact with insulation when specified with IC or CP installation type options.

WARRANTY

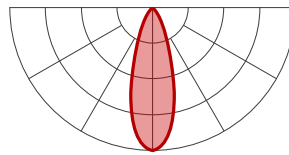
Lumenwerx provides a five-year limited warranty on electrical and mechanical performance of the luminaires, including the LED boards, drivers, and auxiliary electronics. Lumenwerx will repair or replace defective luminaires or components at our discretion, provided they have been installed and operated in accordance with our specifications. Other limitations apply, please refer to the full warranty on our website.

SOFT-EDGE DOWNLIGHT



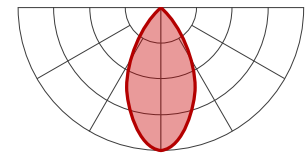
NFL - Narrow flood

Beam angle 25°
Field angle 48°
Spacing criteria 0.4



FLD - Flood

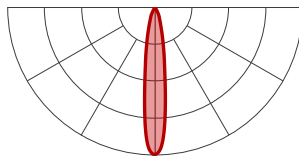
Beam angle 35°
Field angle 67°
Spacing criteria 0.6



WFL - Wide flood

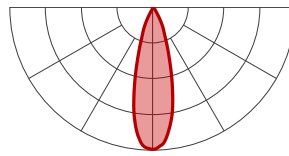
Beam angle 55°
Field angle 104°
Spacing criteria 0.8

SHARP-EDGE DOWNLIGHT



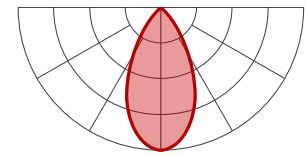
SPT - Spot

Beam angle 15°
Field angle 39°
Spacing criteria 0.2



FLD - Flood

Beam angle 30°
Field angle 49°
Spacing criteria 0.5



WFL - Wide flood

Beam angle 45°
Field angle 62°
Spacing criteria 0.8

M Series Commercial

Other Manufacturers:
LIGHTHEADED "CONTORTIONIST" Series
PRESCOLITE "LFR-4RD" Series
LUMENWERX "ECANA 4" Series

Project:	Type: L15
Product Code:	Date:

V091224



4" Round Downlight

Versatile Solution for all spaces providing high quality lighting ranging from 750lm all the way up to 3500lm

Expedited Install with our easily adjustable universal housing and bar hanger systems allowing for application in most ceiling types

Enhanced Serviceability is achieved through interchangeable modules, optics, and trims, all of which allow for ease of maintenance and implementation of design changes below the ceiling plane

Seamless Integration with several control systems allowing two-channel control dimming options down as low as 0.1%

INSTALLATION

Ceiling Thickness

New Construction: 1/2" up to 2"

Remodel: 1/2" up to 1 1/4"

Extension Collar: 5/8" to 3"

Ceiling Material

Drywall, Millwork

TRIMS

Aperture

4"

Shape

Round

Style

Standard, Hyperbolic, Pinhole, Wall Wash, Flangeless, Decorative, Vandal Proof/IP65

Finish

White, Black, Bronze, Clear Diffuse, Warm Diffuse

LIGHT OUTPUT & DISTRIBUTION

Module

Downlight

Lumens (Power)

750 lm (9.5W), 1000 lm (12.5W),
1250 lm (14.3W), 1500 lm (14.3W),
2000 lm (24.5W), 2500 lm (27.5W),
3000 lm (34.0W), 3500 lm (40.5W)

Color Quality

93 CRI, 2-step SDCM

Color Temperature

- 2700K
- 3000K
- 3500K
- 4000K
- Warm Dim (3000-1800K)
- Tunable White (4000-1800K)
- Tunable White (6500-2700K)

Beam Spread

- 15° Narrow Spot
- 60° Wide Flood
- 25° Spot
- 90°+ General
- 40° Flood

POWER & CONTROLS

Input Voltage

120 / 277V

Dimming

0-10V (1%), Lutron Athena Wireless Node (1%), DALI-2 (0.1%) (Coming Soon)

RATINGS & CERTIFICATIONS

Housing

RoHS Compliant

Module and Trim

Wet Location/IP65 Rated Configurations Available (Standard trims and covered areas only)

NSF Listed (White and black finish only)

IK10 Rated Option Available (Vandal Proof Trim)

Warranty

5 year limited warranty; 50,000 hours



Declare.



DMF LIGHTING 1118 E. 223rd St. Carson, CA 90745 323.934.7779 info@dmflighting.com dmflighting.com

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M Series Commercial

4" Round Downlight

L15

PRODUCT BUILDER | ROUND | DOWNLIGHT | EMBEDDED 0-10V

HOUSING

PRODUCT CODE	
<input type="text"/>	
M4NCRN	4" Round Housing, New Construction, Non-IC Rated
M4RMRN	4" Round Housing, Remodel, Non-IC Rated ¹

LIGHT MODULE

PRODUCT CODE		LUMENS		CRI	CCT		BEAM SPREAD		DIMMING		
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>		
MD	Downlight Module	07	750 lm	9	93 CRI	27	2700K	GA	General Ambient (90°+) ³	O	0-10V
		10	1000 lm			30	3000K	NS	Narrow Spot (15°) ³		
		12	1250 lm			35	3500K	SP	Spot (25°)		
		15	1500 lm			40	4000K	FL	Flood (40°)		
		20	2000 lm			3W	Warm Dim (3000-1800K) ²	WF	Wide Flood (60°)		
		25	2500 lm								
		30	3000 lm								
		35	3500 lm								

TRIM | STANDARD

PRODUCT CODE		FINISH		OPTION	
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
M4TRS	Standard Trim	WH	White	[Blank]	None
M4TRL	Wall Wash/Sloped Ceiling Trim ⁴	BK	Black	FL	Flangeless ^{6,7}
M4TRP	Pinhole Trim ^{5,6}	BZ	Bronze	VP	Vandal Proof/IP65 ⁸
M4TRH	Hyperbolic Trim ⁶	CW	Clear Diffuse, White Flange		
		WW	Warm Diffuse, White Flange	FINISH TO BE SELECTED BY ARCHITECT	
		CC	Custom Color		

TRIM | DECORATIVE (WHITE FINISH ONLY)

PRODUCT CODE	
<input type="text"/>	<input type="text"/>
M4TRSWHDOF	Decorative Open, Frosted ^{5,9}
M4TRSWHDCF	Decorative Closed, Frosted ^{5,9}
M4TRSWHDCC	Decorative Closed, Clear Frosted Side ^{5,9}
M4TRSWHDCCF	Decorative Closed, Clear Frosted Inside ^{5,9}

OPTICS

MDLX-GA	Low Lumen (750-2000LM) Downlight Optic GA 90° Beam Spread
MDLX-NS	Low Lumen (750-2000LM) Downlight Optic NS 15° Beam Spread
MDLX-SP	Low Lumen (750-2000LM) Downlight Optic SP 25° Beam Spread
MDLX-FL	Low Lumen (750-2000LM) Downlight Optic FL 40° Beam Spread
MDLX-WF	Low Lumen (750-2000LM) Downlight Optic WF 60° Beam Spread
MDHX-SP	High Lumen (2500-3500LM) Downlight Optic SP 25° Beam Spread
MDHX-FL	High Lumen (2500-3500LM) Downlight Optic FL 40° Beam Spread
MDHX-WF	High Lumen (2500-3500LM) Downlight Optic WF 60° Beam Spread

ACCESSORIES

M4XRMUD	Flangeless Mud Plate ¹⁰
M4KRTEMPLATE	Flangeless Wood Template ¹¹
M4CREXT	Round Extension Collar ¹²

¹ Not available with flangeless or vandal proof trim options nor extension collars

² Only available in 1000 lm; not available in Narrow Spot beam spread

³ Only available in 750-2000 lm

⁴ Recommended with WF Beam spread for general wall washing and SP for sloped ceilings. Not available in Custom Color

⁵ Only available in 750-1500 lm

⁶ Only available in White, Black, or Bronze finish

⁷ Mud plate required for FL installation, except for wood ceiling; Not compatible with remodel housing

⁸ Only available in Standard Style and White, Anti-Microbial Finish for Installation in New Construction housing only. Not compatible with extension collars

⁹ Recommended for use with General Ambient beam spread

¹⁰ Required for Flangeless Trim drywall installation

¹¹ Recommended for Flangeless Trim wood installation

¹² For New Construction Only - Ceiling Installations up to 3"



M Series Commercial

4" Round Downlight

L15

PRODUCT BUILDER | ROUND | DOWNLIGHT | ATHENA WIRELESS NODE/DALI-2

HOUSING

PRODUCT CODE		INSTALLATION		SHAPE		RATING		OUTPUT		DIMMING		WIRELESS	
M4		NC		R		N							
M4	4" Housing	NC	New Construction	R	Round	N	Non-IC	07	750 lm	O	0-10V (AWN Only)	[Blank]	None (DALI-2 Only)
								10	1000 lm	DS	DALI-2 (Static CCT) ² <i>(Coming Soon)</i>	AWN	Athena Wireless Node
								12	1250 lm	DT	DALI-2 (Tunable White) ^{1,3} <i>(Coming Soon)</i>		
								15	1500 lm				
								20	2000 lm				
								25	2500 lm				
								30	3000 lm				
								35	3500 lm				

LIGHT MODULE

PRODUCT CODE		LUMENS		CRI		CCT		BEAM SPREAD		DIMMING	
MD				9						A	
MD	Downlight Module	07	750 lm	9	93 CRI	27	2700K	GA	General Ambient (90°+) ³	A	Alternate
		10	1000 lm			30	3000K	NS	Narrow Spot (15°) ³		
		12	1250 lm			35	3500K	SP	Spot (25°)		
		15	1500 lm			40	4000K	FL	Flood (40°)		
		20	2000 lm			3W	Warm Dim (3000-1800K) ^{4,5}	WF	Wide Flood (60°)		
		25	2500 lm			T1	Tunable White (4000-1800K) ^{1,3,6} <i>(Coming Soon)</i>				
		30	3000 lm			T2	Tunable White (6500-2700K) ^{1,3,6} <i>(Coming Soon)</i>				
		35	3500 lm								

TRIM | STANDARD

PRODUCT CODE		FINISH		OPTION	
M4TRS	Standard Trim	WH	White	[Blank]	None
M4TRL	Wall Wash/Sloped Ceiling Trim ⁷	BK	Black	FL	Flangeless ^{9,10}
M4TRP	Pinhole Trim ^{8,9}	BZ	Bronze	VP	Vandal Proof/IP65 ¹¹
M4TRH	Hyperbolic Trim ⁹	CW	Clear Diffuse, White Flange		
		WW	Warm Diffuse, White Flange		
		CC	Custom Color		

TRIM | DECORATIVE (WHITE FINISH ONLY)

PRODUCT CODE	
M4TRSWHDOF	Decorative: Open, Frosted ^{8,12}
M4TRSWHDCF	Decorative: Closed, Frosted ^{8,12}
M4TRSWHDCC	Decorative: Closed, Clear Frosted Side ^{8,12}
M4TRSWHDCCF	Decorative: Closed, Clear Frosted Inside ^{8,12}

¹ Not available in NS or GA Beam Spreads

² Not available in 3500 lm

³ Only available in 750 - 2000 lm

⁴ Only available in 1000 lm

⁵ Not available in Narrow Spot beam spread

⁶ Only available in DALI-2 Dimming

⁷ Recommended with WF beam spread for standard wall washing and SP for sloped ceiling; Not available in custom color

⁸ Only available in 750 - 1500 lm

⁹ Only available in White, Black, or Bronze finish

¹⁰ Mud Plate required for FL Install except for wood ceiling

¹¹ Only available in Standard Style with White, Anti-Microbial Finish. Not compatible with extension collar

¹² Recommended with General Ambient beam spread



M Series Commercial

4" Round Downlight

L15

PRODUCT BUILDER | ROUND | DOWNLIGHT | ATHENA WIRELESS NODE/DALI-2

ACCESSORIES

M4XRMUD	Flangeless Mud Plate ¹³
M4KRTEMPLATE	Flangeless Wood Template ¹⁴
M4CREXT	Round Extension Collar ¹⁵

¹³ Required for Flangeless Trim drywall installation

¹⁴ Recommended for Flangeless Trim wood installation

¹⁵ For New Construction Only - Ceiling Installations up to 3"



M Series Commercial

4" Round Downlight

L15

PRODUCT BUILDER | ROUND | DOWNLIGHT | EMERGENCY LIGHTING

HOUSING

PRODUCT CODE	INSTALLATION	SHAPE	RATING	LUMEN	DIMMING	WIRELESS	OPTION								
M4	NC	R	N												
M4	4" Housing	NC	New Construction	R	Round	N	Non-IC	07	750 lm	O	0-10V for EM only	[Blank]	None	EM	Emergency driver, Integrated switch ³
								10	1000 lm	DS	DALI-2 Static CCT ¹ (Coming Soon)	AWN	Athena Wireless Node	EMS	Emergency driver, Remote switch
								12	1250 lm	DT	DALI-2 Tunable White CCT ^{2,4} (Coming Soon)				
								15	1500 lm						
								20	2000 lm						
								25	2500 lm						
								30	3000 lm						
								35	3500 lm						

LIGHT MODULE

PRODUCT CODE	LUMENS	CRI	CCT	BEAM SPREAD	DIMMING						
MD		9			A						
MD	Downlight Module	07	750 lm	9	93 CRI	27	2700K	GA	General Ambient (90°+) ⁴	A	Alternate
		10	1000 lm			30	3000K	NS	Narrow Spot (15°) ⁴		
		12	1250 lm			35	3500K	SP	Spot (25°)		
		15	1500 lm			40	4000K	FL	Flood (40°)		
		20	2000 lm			3W	Warm Dim (3000-1800K) ^{6,7}	WF	Wide Flood (60°)		
		25	2500 lm			T1	Tunable White (4000-1800K) ^{2,4,8}				
		30	3000 lm			T2	Tunable White (6500-2700K) ^{2,4,8}				
		35	3500 lm								

TRIM | STANDARD

PRODUCT CODE	FINISH	OPTION
M4TRS	Standard Trim	WH White [Blank] None
M4TRL	Wall Wash/ Sloped Ceiling ⁷	BK Black FL Flangeless ^{9,11}
M4TRP	Pinhole Trim ^{9,10}	BZ Bronze EM Integrated test switch ^{9,12}
M4TRH	Hyperbolic Trim ⁹	CW Clear Diffuse, White Flange VP Vandal Proof/IP65 ¹³
		WW Warm Diffuse, White Flange
		CC Custom Color

TRIM | DECORATIVE (WHITE FINISH ONLY)

PRODUCT CODE	OPTION
M4TRSWHDOF	Decorative: Open, Frosted ^{10,14}
M4TRSWHDCF	Decorative: Closed, Frosted ^{10,14}
M4TRSWHDCC	Decorative: Closed, Clear Frosted Side ^{10,14}
M4TRSWHDCCF	Decorative: Closed, Clear Frosted Inside ^{10,14}

¹ Not available in 3500 lm

² Not available with GA or NS Beam Spread

³ Integrated test switch must be selected for both housing and trim

⁴ Only available in 750 - 2000 lm

⁵ Only available in 1000 lm

⁶ Not available in Narrow Spot beam Spread

⁷ Recommended with WF beam spread for general wall washing and SP beam spread for sloped ceiling. Not available in custom color

⁸ Only available in DALI-2 Dimming

⁹ Only available in White, Black, or Bronze finish

¹⁰ Only available 750-1500 lm

¹¹ Mud Plate required for FL Install except for wood ceiling

¹² Only available in Standard Style and White, Clear Diffuse or Warm Diffuse

¹³ Only available in Standard Style and White, Anti-Microbial Finish not compatible with extension collar

¹⁴ Recommended in General Ambient beam spread



M Series Commercial

4" Round Downlight

L15

PRODUCT BUILDER | ROUND | DOWNLIGHT | EMERGENCY LIGHTING

ACCESSORIES

M4XRMUD	Flangeless Mud Plate ¹⁵
M4KRTEMPLATE	Flangeless Wood Template ¹⁶
M4CREXT	Round Extension Collar ¹⁷

¹⁵ Required for Flangeless Trim drywall installation

¹⁶ Recommended for Flangeless Trim wood installation

¹⁷ For New Construction Only - Ceiling Installations up to 3"



M Series Commercial

4" Round Downlight

L15

MODULE



4" Downlight

MD

SUMMARY

INPUT VOLTAGE: 120/277V, 50/60Hz

COLOR QUALITY: 93 CRI ¹

MAX INPUT CURRENT (120V): 0.350 amps

MAX INPUT CURRENT (277V): 0.165 amps

AC CONNECTOR: 6 pin Molex

DC CONNECTOR: Male 4-Pin Low Voltage Connector

POWER FACTOR: Greater than 0.9

TOTAL HARMONIC DISTORTION: Less than 20%

AMBIENT OPERATING TEMPERATURE: -20°C to 40°C

LISTINGS: ENERGY STAR[®] qualified ², UL Listed for Wet Location (Under covered ceilings only), UL Certified US•CA, Declare, RoHS Compliant, NSF/ANSI 2 listed, suitable for splash zone ³, DALI-2 Compliant, Compliant to FCC Title 47 Part 15; Class B

SPECIAL LISTINGS (VANDAL PROOF TRIM): IK10 Rating, IP65 Listing, Anti-Microbial

WARRANTY: 5 year limited warranty; 50,000 hours at 70% lumen maintenance

¹ Tested in accordance to IESNA LM-79-2008

² Refer to ENERGY STAR Certified light fixtures database

³ White and Black Finish only



M Series Commercial

4" Round Downlight

L15

MODULE PERFORMANCE

Based on 93 CRI, 3000K Module + STD White + Trim (M4TRSWH)

(Please refer to IES files for other trim types)

		STATIC CCT							WARM DIM	T1	T2	
LED CHIP		CREE 93 CRI							Bridgelux 93 CRI			
SDCM		2-STEP							3-STEP			
		07	10	12	15	20	25	30	35	10	10	10
NS	Lumens	718	983	1111	1278	2163	N/A					
	LPW ¹	75.5	78.6	77.7	77.4	90.1						
	CBCP ²	6227	8530	9639	11089	18766						
	UGR ³	13	14.1	14.5	15	16.8						
SP	Lumens	696	953	1077	1239	2097	2603	3044	3709	848	994	1094
	LPW	73.2	76.2	75.3	75.1	87.4	94.7	89.5	91.6	67.9	68.6	75.4
	CBCP	2131	2919	3298	3795	6421	12861	15037	18327	2598	2254	2479
	UGR	13.2	14.3	14.7	15.2	17	12.2	12.8	13.5	13.8	16.5	16.8
FL	Lumens	685	939	1061	1221	2066	2545	2976	3627	836	981	1079
	LPW	72.2	75.1	74.2	74	86.1	92.5	87.5	89.5	66.9	67.7	74.4
	CBCP	1196	1638	1851	2130	3604	9094	10634	12960	1458	1257	1382
	UGR	14.9	16	16.4	16.9	18.8	12.6	13.1	13.8	15.6	17.4	17.7
WF	Lumens	677.5	928	1049	1206	2042	2453	2868	3495.5	826	956	1052
	LPW	71.3	74.2	73.3	73.1	85.1	89.2	84.4	86.3	66.1	66	72.6
	CBCP	696	953	1077	1239	2096	1926	2252	2745	848	1090	1199
	UGR	17.3	18.4	18.8	19.3	21.1	22.4	23	23.7	18	17.8	18.1
GA	Lumens	654	896	1012	1165	1971	N/A			797	1031	1134
	LPW	68.9	71.7	70.8	70.6	82.1				63.8	71.1	78.2
	CBCP	264	362	409	470	796				322	595	655
	UGR	22.1	23.2	23.6	24.1	25.9				22.8	21.8	22.2

CCT	STATIC				WARM DIM		T1 TUNABLE WHITE			T2 TUNABLE WHITE		
	2700K	3000K	3500K	4000K	1800K	3000K	1800K	3000K	4000K	2700K	3000K	6500K
MULTIPLIER	0.93	1	1.05	1.07	0.05	1	0.73	1	1.12	0.96	1	1.07
EMERGENCY BATTERY MULTIPLIER	LPW x 5											

¹ LPW: Lumens per watt

² CBCP: Center beam candlepower

³ UGR: Unified glare ratio (0.7/0.5/0.2, 4H/8H)



M Series Commercial

4" Round Downlight

L15

HOUSING



New Construction

M4NCRN

SUMMARY

JUNCTION BOX: Equipped with 6 knockouts: two 1/2" and two 3/4" trade size knockouts on top, two 1/2" trade size knockouts on side. Approved for 8 (four in, four out) #12 AWG 70°C.

BAR HANGER MOUNTING: Adjustable Bar Hangers for 14"-24" joist spacing. Compatible with traditional joists, Armstrong™ ceiling, Hat Channel, T-Bar.

CEILING: 1/2" up to 2"

CUTOUT: 4 1/4" (107mm) round opening

WARRANTY: 5 year limited warranty

ALTERNATE DIMMING SPECIFICATIONS

INPUT VOLTAGE: 120/277V, 50/60Hz

MAX INPUT CURRENT (120V): 0.130 amps

MAX INPUT CURRENT (277V): 0.065 amps

POWER FACTOR: Greater than 0.9

TOTAL HARMONIC DISTORTION: Less than 20%

LISTINGS: Compliant to FCC Title 47 Part 15; Class B

EMERGENCY BATTERY SPECIFICATIONS

EMERGENCY BATTERY : Emergency Battery Back up is designed to provide output for 90 minutes when in an emergency state

INPUT VOLTAGE: 120/277V 50/60Hz

ILLUMINATION TIME: 90min

WATTAGE IN EM STATE: 5W

LUMEN OUTPUT IN EM STATE: LPW x 5

TEST SWITCH OPTIONS:

- **INTEGRATED TEST SWITCH (-EM HOUSING):** Requires Compatible trim - Flanged, Standard Style trim Only
- **REMOTE TEST SWITCH(-EMS HOUSING):** Must be installed according to local code can be used with any flanged, flangeless, or decorative trim type



M Series Commercial

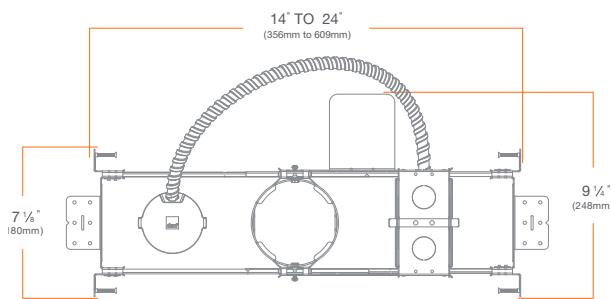
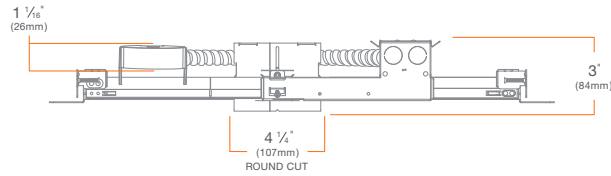
4" Round Downlight

L15

New Construction

M4NCRN

(Dimensions not including module)

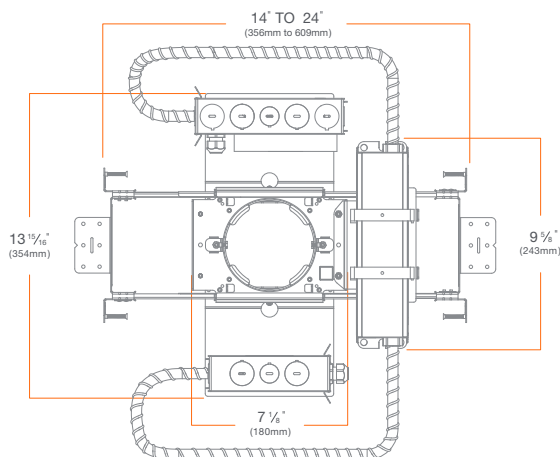
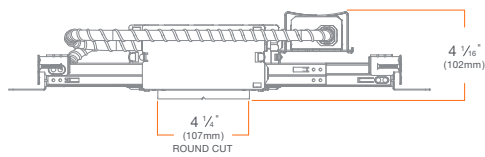


Emergency Lighting

M4NCRNxxxEM

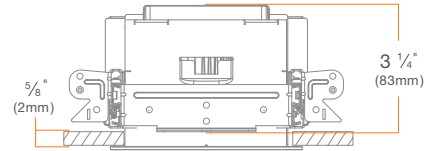
M4NCRNxxxAWNEM

(Dimensions not including module)



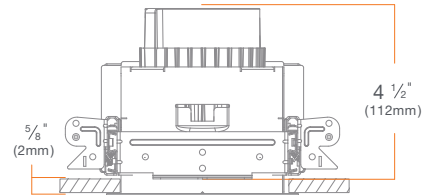
Total Height in Plenum

750LM-1500LM



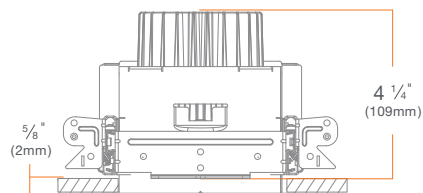
Bar Hanger Vertically Adjustable
from $\frac{1}{2}$ " to 2" (13 to 51mm)

2000LM



Bar Hanger Vertically Adjustable
from $\frac{1}{2}$ " to 2" (13 to 51mm)

2500LM-3500LM/DALI-2



Bar Hanger Vertically Adjustable
from $\frac{1}{2}$ " to 2" (13 to 51mm)



M Series Commercial

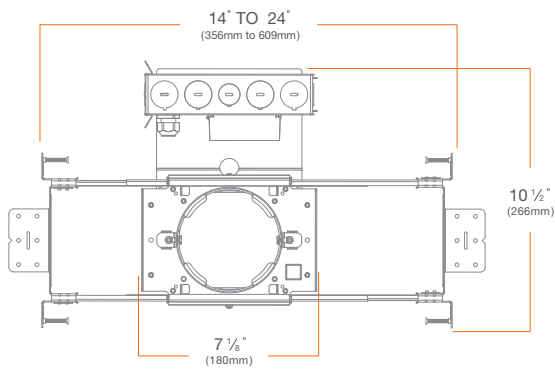
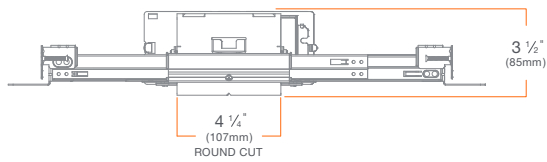
4" Round Downlight

L15

New Construction Static DALI/Lutron Athena Node

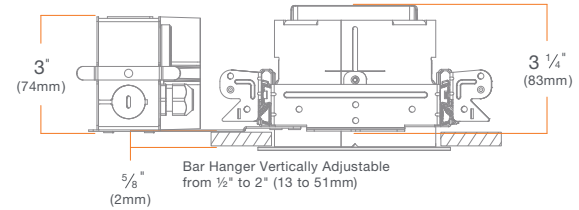
M4NCRNxxDS
M4NCRNxxOAWN
M4NCRNxxDSAWN

(Dimensions not including module)

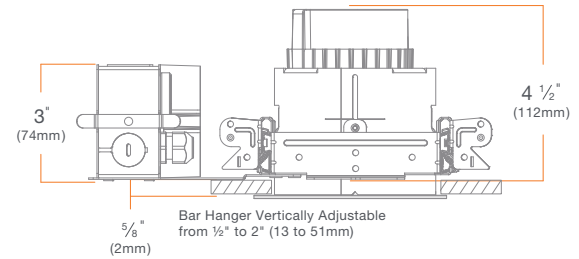


Total Height in Plenum

750LM-1500LM



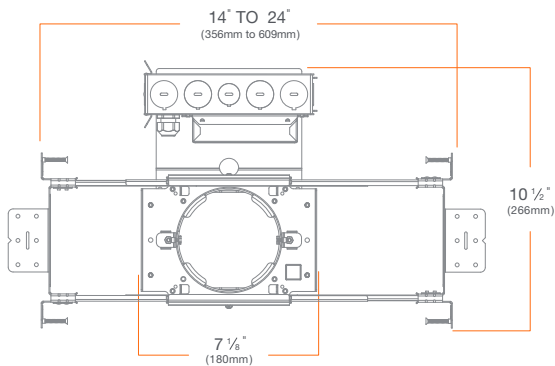
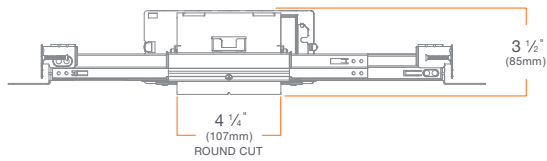
2000LM



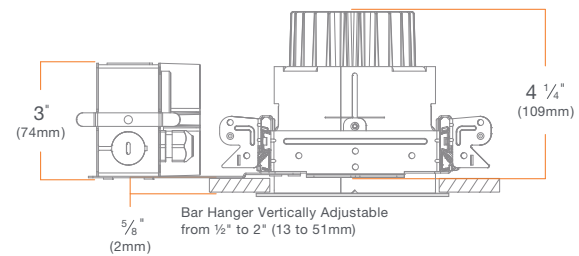
New Construction Tunable White DALI-2

M4NCRNxxDT

(Dimensions not including module)



2500LM-3500LM/DALI-2





M Series Commercial

4" Round Downlight

L15

HOUSING



Remodel

M4RMRN

SUMMARY

JUNCTION BOX: Equipped with 3 knockouts: two 1/2" trade size and one 3/4" trade size knockouts #12 AWG 70°C. Approved for 4 (2 in and 2 out)

CEILING: 1/2" up to 1 1/4"

CUTOUT: 4 3/8" (111mm) round opening

WARRANTY: 5 year limited warranty



M Series Commercial

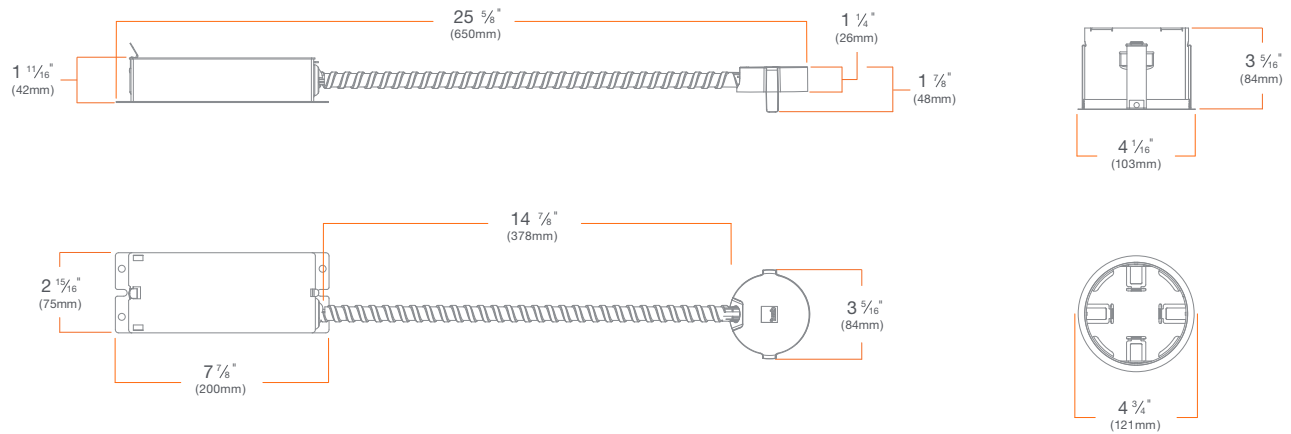
4" Round Downlight

L15

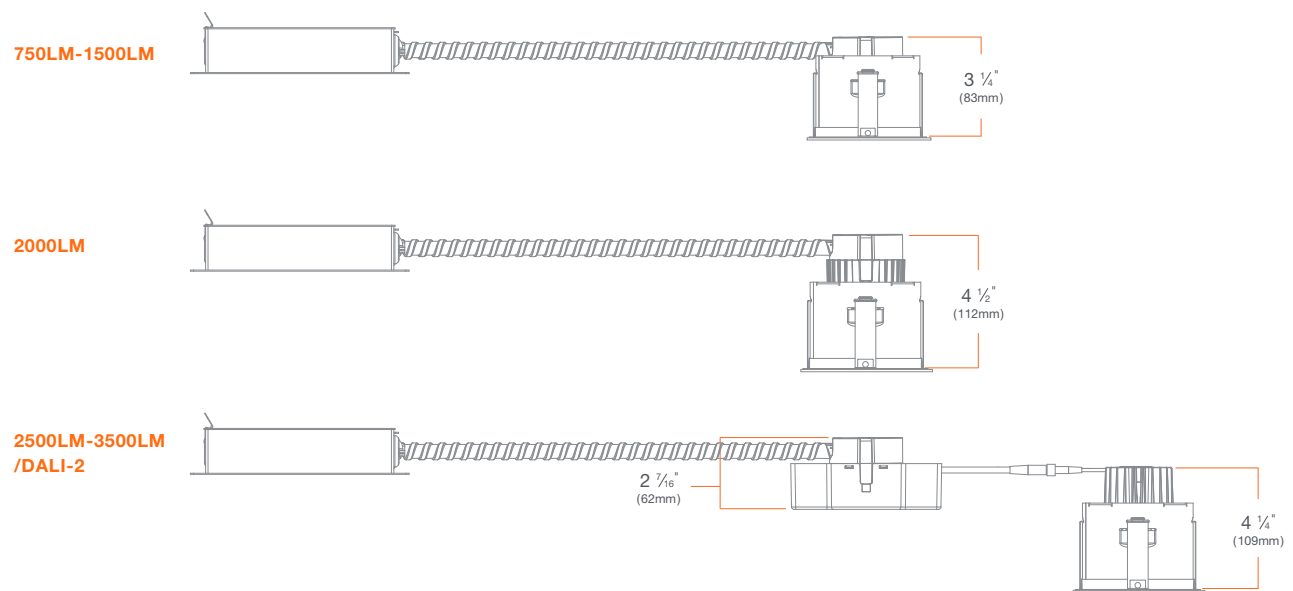
Standard

M4RMRN

(Dimensions not including module)



Total Height in Plenum





M Series Commercial

4" Round Downlight

L15

TRIMS



4" Round Trims

M4TR

SUMMARY

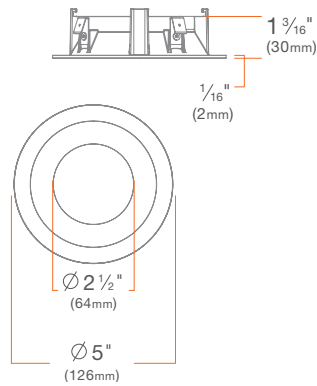
CONSTRUCTION: Die-cast aluminum

DECORATIVE: Acrylic diffuser

INSTALLATION: Twist & Lock

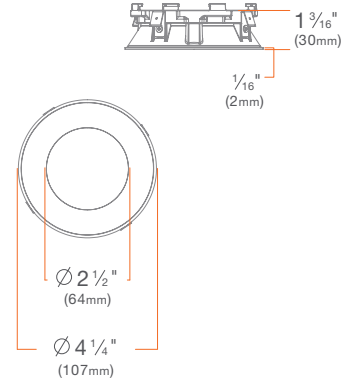
Standard

M4TRSWH



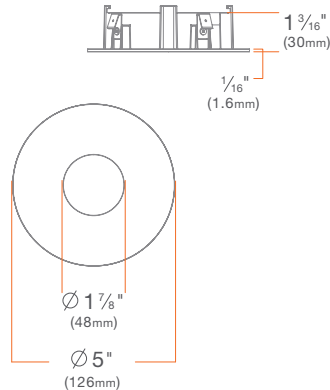
Flangeless

M4TRSWHFL



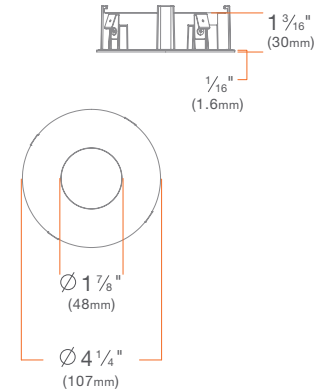
Pinhole

M4TRPWH



Flangeless Pinhole

M4TRPWHFL





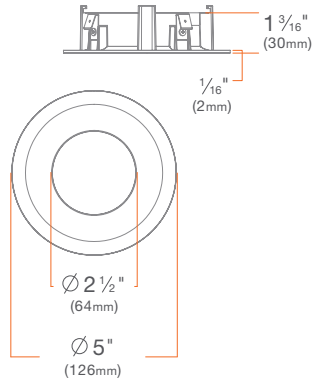
M Series Commercial

4" Round Downlight

L15

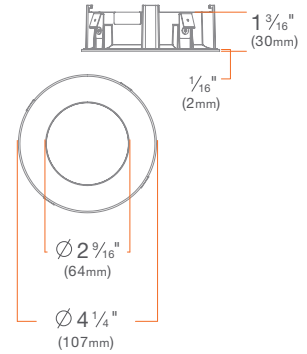
Hyperbolic

M4TRHWH



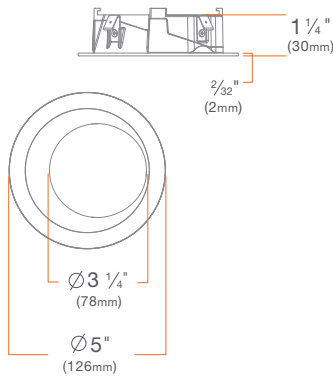
Flangeless Hyperbolic

M4TRHWHFL



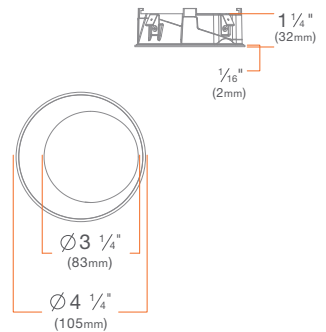
Wall Wash

M4TRLWH



Flangeless Wall Wash

M4TRLWHFL

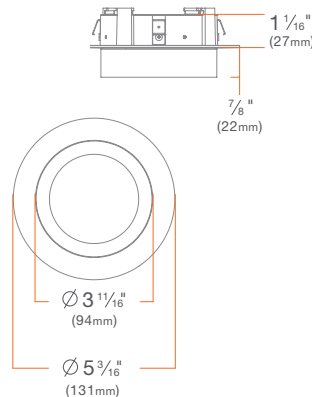


Decorative Closed

Frosted: M4TRSWHDCF

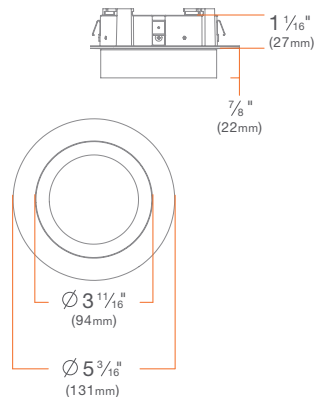
Clear, Frosted Inside: M4TRSWHDC

Clear, Frosted Sides: M4TRSWHDCCF



Decorative Open

Frosted: M4TRSWHDOF





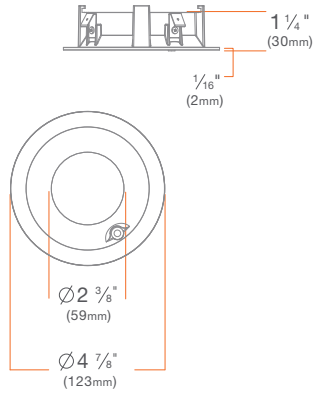
M Series Commercial

4" Round Downlight

L15

Emergency with Integrated Test Switch

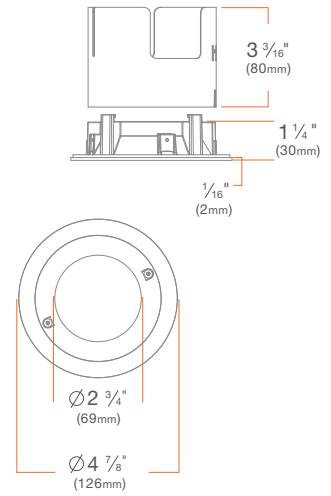
M4TRSWHEM



Vandal Proof/IP65

*For use with Standard New Construction Only

M4TRSWHVP





M Series Commercial

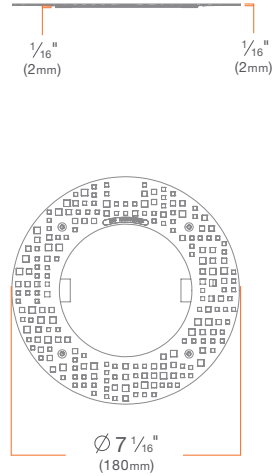
4" Round Downlight

L15

ACCESSORIES

Flangeless Mud Plate

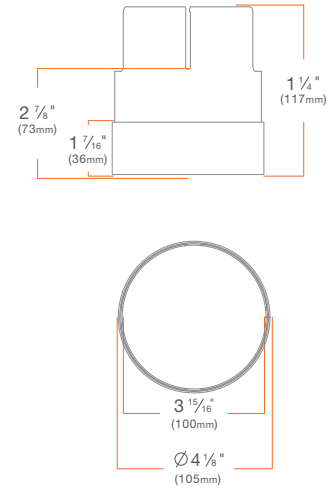
M4XRMUD



Extension Collar

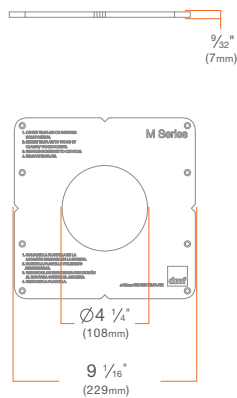
**For use with Standard New Construction Only*

M4CREXT



Router Template

M4KRTEMPLATE





M Series Commercial

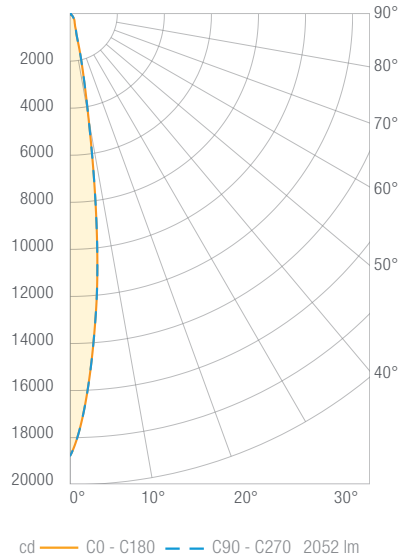
4" Round Downlight

L15

PHOTOMETRY

MD 2000 lm, 3000K, Narrow Spot

MD20930NS | M4TRSWH



Luminous Intensity

Gamma	C 0°
0°	18766
5°	12609
10°	4461
15°	1402
20°	682
25°	466
30°	372
35°	304
40°	221
45°	162
50°	116
55°	81
60°	53
65°	30
70°	13
75°	8
80°	5
85°	2
90°	0

Values in candela

Zonal Lumen Summary

Zone	Lumens	Luminaire %
0-30	1625	79
0-40	1810	88
0-60	2010	98
0-90	2052	100
0-180	2052	100

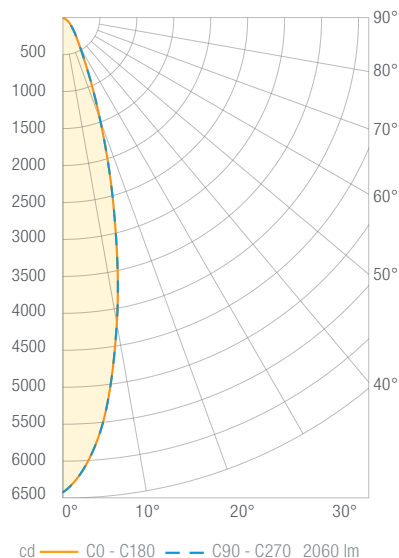
Illuminance Chart

Distance from LED	Foot Candles	Diameter
3'	2085.2	0.7'
6'	521.3	1.5'
9'	231.7	2.2'
12'	130.3	2.9'

Beam Angle: 14°

MD 2000 lm, 3000K, Spot

MD20930SP | M4TRSWH



Luminous Intensity

Gamma	C 0°
0°	6422
5°	5661
10°	4202
15°	2653
20°	1478
25°	799
30°	472
35°	319
40°	227
45°	166
50°	119
55°	82
60°	50
65°	29
70°	13
75°	8
80°	4
85°	2
90°	0

Values in candela

Zonal Lumen Summary

Zone	Lumens	Luminaire %
0-30	1612	78
0-40	1817	88
0-60	2020	98
0-90	2060	100
0-180	2060	100

Illuminance Chart

Distance from LED	Foot Candles	Diameter
3'	713.5	1.4'
6'	178.4	2.8'
9'	79.3	4.2'
12'	44.6	5.6'

Beam Angle: 26°



M Series Commercial

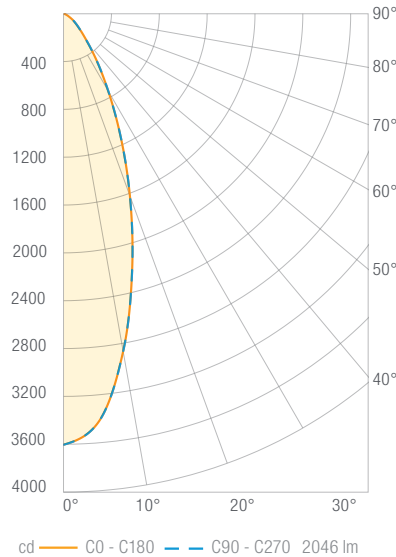
4" Round Downlight

L15

PHOTOMETRY

MD 2000 Im, 3000K, Flood

MD20930FL | M4TRSWH



Luminous Intensity

Gamma	C 0°
0°	3604
5°	3418
10°	2867
15°	2215
20°	1620
25°	1123
30°	746
35°	487
40°	309
45°	204
50°	141
55°	98
60°	57
65°	34
70°	15
75°	10
80°	6
85°	3
90°	0

Values in candela

Zonal Lumen Summary

Zone	Lumens	Luminaire %
0-30	1438	70
0-40	1748	85
0-60	1998	98
0-90	2046	100
0-180	2046	100

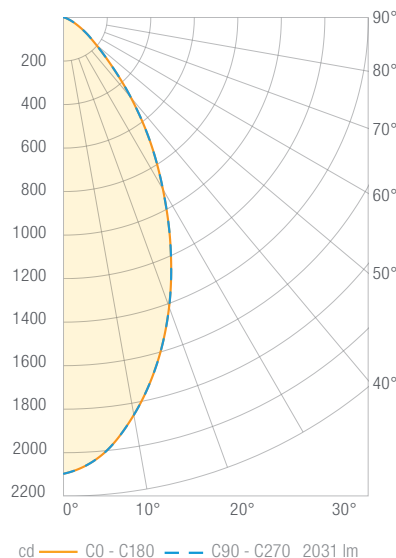
Illuminance Chart

Distance from LED	Foot Candles	Diameter
3'	400.5	2.0'
6'	100.1	4.0'
9'	44.5	6.0'
12'	25.0	8.0'

Beam Angle: 37°

MD 2000 Im, 3000K, Wide Flood

MD20930WF | M4TRSWH



Luminous Intensity

Gamma	C 0°
0°	2096
5°	2018
10°	1855
15°	1651
20°	1416
25°	1162
30°	912
35°	689
40°	480
45°	307
50°	195
55°	129
60°	78
65°	45
70°	22
75°	12
80°	7
85°	4
90°	1

Values in candela

Zonal Lumen Summary

Zone	Lumens	Luminaire %
0-30	1179	58
0-40	1605	79
0-60	1967	97
0-90	2031	100
0-180	2031	100

Illuminance Chart

Distance from LED	Foot Candles	Diameter
3'	232.9	3.1'
6'	58.2	6.2'
9'	25.9	9.3'
12'	14.6	12.4'

Beam Angle: 55°



M Series Commercial

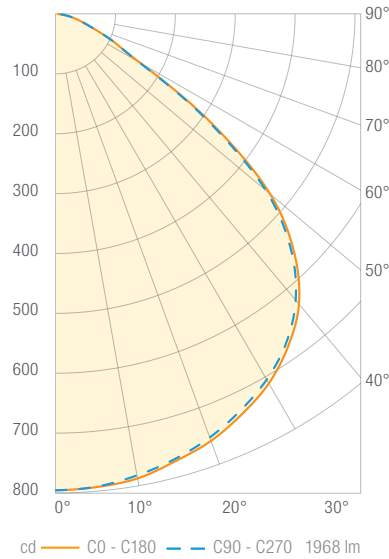
4" Round Downlight

L15

PHOTOMETRY

MD 2000 Im, 3000K, General Ambient

MD20930GA



Luminous Intensity

Gamma	C 0°
0°	796
5°	793
10°	788
15°	773
20°	759
25°	737
30°	712
35°	677
40°	632
45°	564
50°	468
55°	318
60°	163
65°	103
70°	62
75°	41
80°	24
85°	11
90°	3

Values in candela

Zonal Lumen Summary

Zone	Lumens	Luminaire %
0-30	640	32
0-40	1067	54
0-60	1798	91
0-90	1968	100
0-180	1968	100

Illuminance Chart

Distance from LED	Foot Candles	Diameter
3'	88.4	7.8'
6'	22.1	15.5'
9'	9.8	23.3'
12'	5.5	31.1'

Beam Angle: 105° x 104°

Other Manufacturers:
STARFIRE "SAX1-L" Series
INSIGHT "STRUCTURE MINI ROUND" Series

SPILIGHTING

PROJECT DETAILS

Styk Wall - Bracket

SIW12138 1.60 in

JOB NAME:

TYPE:

NOTES:

L16

DESCRIPTION

Styk was built to provide the most lumens with the smallest luminaire package, while optimizing life. Not limited to decorative lighting, effective functional lighting is provided through the optimal light control in this minimal package. It's three optical offerings enable tremendous flexibility including wall washing, wall grazing, and asymmetric lighting solutions. The family features wall, ceiling, and pendant models in a variety of stylish, clean mounting options. Available in 1' to 8' lengths, Styk can be mounted individually or configured in runs.

FEATURES & BENEFITS

- Sleek 1.5" diameter housing
- A forward throw optic, for even wall wash illumination, is standard
- Symmetrical optic options are available for more volumetric illumination
- Lamp body can be rotated up to 330° and locks into position for precise fixture alignment
- Up to 1,450 lumens per foot delivered (with Forward Throw distribution)
- Up to 18" projection with no vertical support needed
- Anodized finish provides durable corrosion protection
- All visible fasteners are flush mounted, providing a clean design
- Handcrafted in USA, BABA Compliant



SPECIFICATIONS

- **LIGHT SOURCE:** White LED light engine
- **CRI:** 80+ or 90+
- **LUMEN MAINTENANCE:** L70 = >50,000 Hrs.
- **EFFICACY:** 102 lm/W delivered (with Forward Throw distribution)
- **CCT:** 2700K, 3000K, 3500K, 4000K, 5000K
- **VOLTAGE:** 120-277V standard
- **DRIVER:** Includes one remote Class 2 power supply and enclosure, except 8FT-L113W which has two. 36" lead length standard; black power cord standard unless otherwise

SPILIGHTING

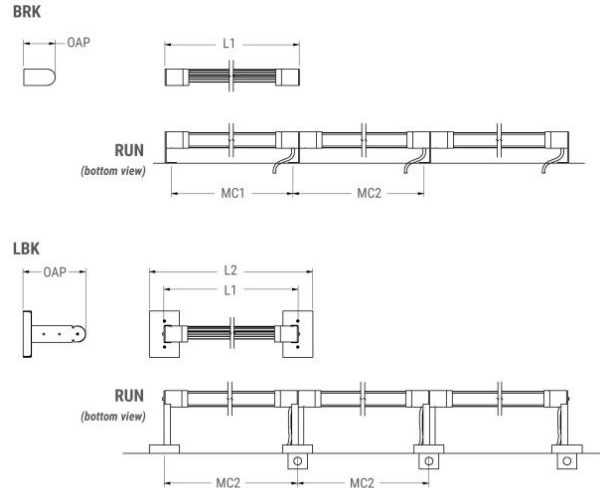
P:262.242.1420 | SPIteam@spilighting.com | Last Revised: 8/16/2024 | Design Rights Reserved | SIW12138 | 1 of 7

L16

specified. Max distance to the driver (including OAP) is: #18 AWG = 50', #16 AWG = 75', #14 AWG = 100'. For extended distances, contact factory.

- **DIMMING:** 1% minimum dim level standard
- **CONTROLS:** 0-10V standard. Lutron Athena, Current NX, and nLight AIR optional. Contact factory for other controls (e.g., Enlighted, Encelium, Wattstopper, WaveLinx, or Casambi)
- **EMERGENCY:** Remote battery option is provided with 10W Constant Power Battery back-up, providing 90 Minutes of Emergency operation. Contact factory for other Emergency options.
- **INTEGRATED SURGE PROTECTION:** LED components are protected against minor surge events
- **CONSTRUCTION:** Extruded aluminum construction provides durable protection for internal components and is recyclable
- **FINISH:** Housing available in anodized finishes only. End caps and mounting components painted to match.
- **MODIFICATIONS:** Consult factory for all modification requests, including RGB and static LED colors
- **APPROVALS:** ETL listed to UL standards (US & Canada) for use in damp locations; not recommended for exterior applications

DIMENSIONS



1FT	L1 16.4 in 41.7 cm	L2 19.3 in 49 cm	MC1 15.2 in 38.6 cm	MC2 16.3 in 41.4 cm
-----	--------------------------	------------------------	---------------------------	---------------------------

Mounting Weight: Approximate: 5 lb (3 kg)

2FT	L1 28.2 in 71.6 cm	L2 31.1 in 79 cm	MC1 26.9 in 68.3 cm	MC2 28.1 in 71.4 cm
-----	--------------------------	------------------------	---------------------------	---------------------------

Mounting Weight: Approximate: 5 lb (3 kg)

3FT	L1 39.9 in 101.3 cm	L2 42.8 in 108.7 cm	MC1 38.7 in 98.3 cm	MC2 39.8 in 101.1 cm
-----	---------------------------	---------------------------	---------------------------	----------------------------

Mounting Weight: Approximate: 5 lb (3 kg)

4FT	L1 51.4 in 130.6 cm	L2 54.3 in 137.9 cm	MC1 50.2 in 127.5 cm	MC2 51.3 in 130.3 cm
-----	---------------------------	---------------------------	----------------------------	----------------------------

Mounting Weight: Approximate: 5 lb (3 kg)

5FT	L1 63.4 in 161 cm	L2 66.3 in 168.4 cm	MC1 62.2 in 158 cm	MC2 63.3 in 160.8 cm
-----	-------------------------	---------------------------	--------------------------	----------------------------

Mounting Weight: Approximate: 10 lb (5 kg)

6FT	L1 77.2 in 196.1 cm	L2 80.1 in 203.5 cm	MC1 75.9 in 192.8 cm	MC2 77.1 in 195.8 cm
-----	---------------------------	---------------------------	----------------------------	----------------------------

Mounting Weight: Approximate: 10 lb (5 kg)

8FT	L1 101.2 in 257 cm	L2 104.1 in 264.4 cm	MC1 99.9 in 253.7 cm	MC2 101.1 in 256.8 cm
-----	--------------------------	----------------------------	----------------------------	-----------------------------

Mounting Weight: Approximate: 10 lb (5 kg)

CONFIGURATOR

To configure your spec sheet online, go to www.spilighting.com/SIW12138. Not all options are available in all configurations; consult factory for details.

Required Field *

Catalog	Light Source*	Primary Finish*	Voltage*	Lamp Options*	CRI*	Controls*	Mounting*	Linear Run	Emergency	Optical Distribution*	Options
SIW12138	A		B	C	D	E	F	G	H	I	J

A - LIGHT SOURCE *

To ensure color consistency, SPI uses precise bin selection and strict quality processes to maintain a 3-step (MacAdam) SDCM on all white LED lampings. Published LED luminaire wattages are calculated using a typical power supply efficiency of 88%; exact wattages may vary based on application. Alternative wattages available upon request. Delivered lumens shown below are for Forward Throw distribution.

1 FOOT NOMINAL FIXTURE

- 1FT-L4W** | White 4W LED Light Engine | Delivered Lumens: 407
- 1FT-L7W** | White 7W LED Light Engine | Delivered Lumens: 712
- 1FT-L14W** | White 14W LED Light Engine | Delivered Lumens: 1,424

2 FOOT NOMINAL FIXTURE

- 2FT-L8W** | White 8W LED Light Engine | Delivered Lumens: 814

L16

2FT-L14W | White 14W LED Light Engine | Delivered Lumens: 1,424

2FT-L28W | White 28W LED Light Engine | Delivered Lumens: 2,848

3 FOOT NOMINAL FIXTURE

3FT-L12W | White 12W LED Light Engine | Delivered Lumens: 1,220

3FT-L21W | White 21W LED Light Engine | Delivered Lumens: 2,136

3FT-L42W | White 42W LED Light Engine | Delivered Lumens: 4,271

4 FOOT NOMINAL FIXTURE

4FT-L16W | White 16W LED Light Engine | Delivered Lumens: 1,627

4FT-L28W | White 28W LED Light Engine | Delivered Lumens: 2,848

4FT-L56W | White 56W LED Light Engine | Delivered Lumens: 5,695

5 FOOT NOMINAL FIXTURE

5FT-L20W | White 20W LED Light Engine | Delivered Lumens: 2,034

5FT-L35W | White 35W LED Light Engine | Delivered Lumens: 3,560

5FT-L71W | White 71W LED Light Engine | Delivered Lumens: 7,221

6 FOOT NOMINAL FIXTURE

6FT-L24W | White 24W LED Light Engine | Delivered Lumens: 2,441

6FT-L42W | White 42W LED Light Engine | Delivered Lumens: 4,271

6FT-L85W | White 85W LED Light Engine | Delivered Lumens: 8,645

8 FOOT NOMINAL FIXTURE

8FT-L32W | White 32W LED Light Engine | Delivered Lumens: 3,254

8FT-L56W | White 56W LED Light Engine | Delivered Lumens: 5,695

8FT-L113W | White 113W LED Light Engine | Delivered Lumens: 11,492

See last page for finish options

B - VOLTAGE *

120-277V | Universal Voltage

C - LAMP OPTIONS *

Apply multiplier from chart for delivered lumens at other CCT's and CRI's.

2700K | 2700K CCT

3000K | 3000K CCT

3500K | 3500K CCT

4000K | 4000K CCT

5000K | 5000K CCT

	80 CRI	90 CRI
2700K	1.00	0.84
3000K	1.00	0.84
3500K	1.00	0.84
4000K	1.00	0.84
5000K	1.00	0.84

D - CRI *

- DF_80 | (default)
- 90

E - CONTROLS *

Extended lead times may apply for controls other than 0-10V. Contact factory for additional control options such as Enlighted, Encelium, Wattstopper, WaveLinx, Casambi, or others.

- DF_DIM1 | 0-10V Control, 1% Dimming (default)
- AWRN | Lutron Athena Wireless Node, 1% Dimming
- NX | Current NX Wireless, 1% Dimming
- NLTA | Acuity nLight Air, 1% Dimming

F - MOUNTING *

BRK is limited to 3" OAP. For longer projections, choose LBK. LBK mounts to standard 2" x 4" switch box. Additional mounting structure and hardware required (by others). The 8FT-L113W option has a power cord exiting from both sides of the fixture.

- DF_BRK | Bracket Mount - 3" OAP (default)
- LBK6 | 3" x 4.5" Switch Box Cover with Fixed Bracket - 6" OAP
- LBK12 | 3" x 4.5" Switch Box Cover with Fixed Bracket - 12" OAP
- LBK18 | 3" x 4.5" Switch Box Cover with Fixed Bracket - 18" OAP



G - LINEAR RUN

Select this option only for runs longer than 8'. Continuous runs with the LBK mounting are supported by a single arm at each mounting location. Continuous runs are supplied with one power supply per fixture, except 8FT-L113W which has two. INSTALLATION NOTES: During installation the contractor is responsible to use actual fixtures to ensure accurate mounting centers from one fixture to the next along the length of the linear run.

- RUN ¹ | Continuous Run OAL | Specify Length of Run

¹ For a take-off and pricing, contact factory

H - EMERGENCY

10W, Constant Power Battery Back-up, with 90 minutes of emergency operation. EMR includes damp location enclosure for Battery back-up. When specifying EMR with RUN, the first fixture in the run will be the emergency unit. If other or different Emergency units are needed, contact factory. Additional Power feed location will be required to power non-emergency sections.

EMR | Emergency Battery Remote

I - OPTICAL DISTRIBUTION *

See IES zip file for photometrics for each distribution.

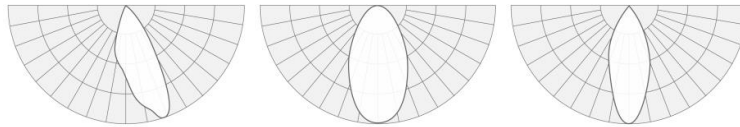
DF_FT | Forward Throw (default)

SMA² | Symmetric 60 Degree Beam - 120 Degree spread

SMB³ | Symmetric 30 Degree Beam - 60 Degree spread

² Delivered lumens are 90% of the output shown under Light Source; see IES file

³ Delivered lumens are 104% of the output shown under Light Source; see IES file



FT

SMA

SMB

J - OPTIONS

F | Fusing

Standard Finishes

The colors shown are representative. Their actual appearance may vary due to differences in display settings. You can request color chips by emailing contact@spilighting.com. Please note, finishes may not be available in all configurations.

Anodized



Specialty Finishes



More RAL®, Pantone®, and custom finishes are available upon request. Setup fee and additional lead time applies. Call factory for details.

Other Manufacturers:
STARFIRE "SAX1-L" Series
INSIGHT "STRUCTURE MINI ROUND" Series

SPILIGHTING

PROJECT DETAILS

Styk Wall - Bracket

SIW12138 1.60 in

JOB NAME:

TYPE:

NOTES:

L17

DESCRIPTION

Styk was built to provide the most lumens with the smallest luminaire package, while optimizing life. Not limited to decorative lighting, effective functional lighting is provided through the optimal light control in this minimal package. It's three optical offerings enable tremendous flexibility including wall washing, wall grazing, and asymmetric lighting solutions. The family features wall, ceiling, and pendant models in a variety of stylish, clean mounting options. Available in 1' to 8' lengths, Styk can be mounted individually or configured in runs.

FEATURES & BENEFITS

- Sleek 1.5" diameter housing
- A forward throw optic, for even wall wash illumination, is standard
- Symmetrical optic options are available for more volumetric illumination
- Lamp body can be rotated up to 330° and locks into position for precise fixture alignment
- Up to 1,450 lumens per foot delivered (with Forward Throw distribution)
- Up to 18" projection with no vertical support needed
- Anodized finish provides durable corrosion protection
- All visible fasteners are flush mounted, providing a clean design
- Handcrafted in USA, BABA Compliant

SPECIFICATIONS

- **LIGHT SOURCE:** White LED light engine
- **CRI:** 80+ or 90+
- **LUMEN MAINTENANCE:** L70 = >50,000 Hrs.
- **EFFICACY:** 102 lm/W delivered (with Forward Throw distribution)
- **CCT:** 2700K, 3000K, 3500K, 4000K, 5000K
- **VOLTAGE:** 120-277V standard
- **DRIVER:** Includes one remote Class 2 power supply and enclosure, except 8FT-L113W which has two. 36" lead length standard; black power cord standard unless otherwise



SPILIGHTING

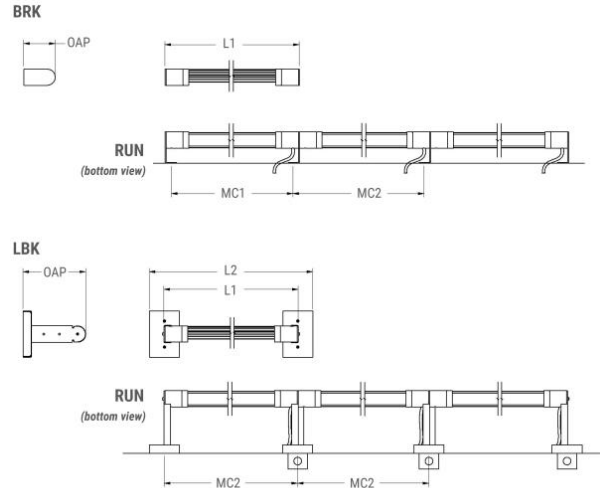
P:262.242.1420 | SPIteam@spilighting.com | Last Revised: 8/16/2024 | Design Rights Reserved | SIW12138 | 1 of 7

L17

specified. Max distance to the driver (including OAP) is: #18 AWG = 50', #16 AWG = 75', #14 AWG = 100'. For extended distances, contact factory.

- **DIMMING:** 1% minimum dim level standard
- **CONTROLS:** 0-10V standard. Lutron Athena, Current NX, and nLight AIR optional. Contact factory for other controls (e.g., Enlighted, Encelium, Wattstopper, WaveLinx, or Casambi)
- **EMERGENCY:** Remote battery option is provided with 10W Constant Power Battery back-up, providing 90 Minutes of Emergency operation. Contact factory for other Emergency options.
- **INTEGRATED SURGE PROTECTION:** LED components are protected against minor surge events
- **CONSTRUCTION:** Extruded aluminum construction provides durable protection for internal components and is recyclable
- **FINISH:** Housing available in anodized finishes only. End caps and mounting components painted to match.
- **MODIFICATIONS:** Consult factory for all modification requests, including RGB and static LED colors
- **APPROVALS:** ETL listed to UL standards (US & Canada) for use in damp locations; not recommended for exterior applications

DIMENSIONS



1FT	L1 16.4 in 41.7 cm	L2 19.3 in 49 cm	MC1 15.2 in 38.6 cm	MC2 16.3 in 41.4 cm
-----	--------------------------	------------------------	---------------------------	---------------------------

Mounting Weight: Approximate: 5 lb (3 kg)

2FT	L1 28.2 in 71.6 cm	L2 31.1 in 79 cm	MC1 26.9 in 68.3 cm	MC2 28.1 in 71.4 cm
-----	--------------------------	------------------------	---------------------------	---------------------------

Mounting Weight: Approximate: 5 lb (3 kg)

3FT	L1 39.9 in 101.3 cm	L2 42.8 in 108.7 cm	MC1 38.7 in 98.3 cm	MC2 39.8 in 101.1 cm
-----	---------------------------	---------------------------	---------------------------	----------------------------

Mounting Weight: Approximate: 5 lb (3 kg)

4FT	L1 51.4 in 130.6 cm	L2 54.3 in 137.9 cm	MC1 50.2 in 127.5 cm	MC2 51.3 in 130.3 cm
-----	---------------------------	---------------------------	----------------------------	----------------------------

Mounting Weight: Approximate: 5 lb (3 kg)

5FT	L1 63.4 in 161 cm	L2 66.3 in 168.4 cm	MC1 62.2 in 158 cm	MC2 63.3 in 160.8 cm
-----	-------------------------	---------------------------	--------------------------	----------------------------

Mounting Weight: Approximate: 10 lb (5 kg)

6FT	L1 77.2 in 196.1 cm	L2 80.1 in 203.5 cm	MC1 75.9 in 192.8 cm	MC2 77.1 in 195.8 cm
-----	---------------------------	---------------------------	----------------------------	----------------------------

Mounting Weight: Approximate: 10 lb (5 kg)

8FT	L1 101.2 in 257 cm	L2 104.1 in 264.4 cm	MC1 99.9 in 253.7 cm	MC2 101.1 in 256.8 cm
-----	--------------------------	----------------------------	----------------------------	-----------------------------

Mounting Weight: Approximate: 10 lb (5 kg)

CONFIGURATOR

To configure your spec sheet online, go to www.spilighting.com/SIW12138. Not all options are available in all configurations; consult factory for details.

Required Field *

Catalog	Light Source*	Primary Finish*	Voltage*	Lamp Options*	CRI*	Controls*	Mounting*	Linear Run	Emergency	Optical Distribution*	Options
SIW12138	A		B	C	D	E	F	G	H	I	J

A - LIGHT SOURCE *

To ensure color consistency, SPI uses precise bin selection and strict quality processes to maintain a 3-step (MacAdam) SDCM on all white LED lampings. Published LED luminaire wattages are calculated using a typical power supply efficiency of 88%; exact wattages may vary based on application. Alternative wattages available upon request. Delivered lumens shown below are for Forward Throw distribution.

1 FOOT NOMINAL FIXTURE

- 1FT-L4W** | White 4W LED Light Engine | Delivered Lumens: 407
- 1FT-L7W** | White 7W LED Light Engine | Delivered Lumens: 712
- 1FT-L14W** | White 14W LED Light Engine | Delivered Lumens: 1,424

2 FOOT NOMINAL FIXTURE

- 2FT-L8W** | White 8W LED Light Engine | Delivered Lumens: 814

L17

- 2FT-L14W** | White 14W LED Light Engine | Delivered Lumens: 1,424
- 2FT-L28W** | White 28W LED Light Engine | Delivered Lumens: 2,848

3 FOOT NOMINAL FIXTURE

- 3FT-L12W** | White 12W LED Light Engine | Delivered Lumens: 1,220
- 3FT-L21W** | White 21W LED Light Engine | Delivered Lumens: 2,136
- 3FT-L42W** | White 42W LED Light Engine | Delivered Lumens: 4,271

4 FOOT NOMINAL FIXTURE

- 4FT-L16W** | White 16W LED Light Engine | Delivered Lumens: 1,627
- 4FT-L28W** | White 28W LED Light Engine | Delivered Lumens: 2,848
- 4FT-L56W** | White 56W LED Light Engine | Delivered Lumens: 5,695

5 FOOT NOMINAL FIXTURE

- 5FT-L20W** | White 20W LED Light Engine | Delivered Lumens: 2,034
- 5FT-L35W** | White 35W LED Light Engine | Delivered Lumens: 3,560
- 5FT-L71W** | White 71W LED Light Engine | Delivered Lumens: 7,221

6 FOOT NOMINAL FIXTURE

- 6FT-L24W** | White 24W LED Light Engine | Delivered Lumens: 2,441
- 6FT-L42W** | White 42W LED Light Engine | Delivered Lumens: 4,271
- 6FT-L85W** | White 85W LED Light Engine | Delivered Lumens: 8,645

8 FOOT NOMINAL FIXTURE

- 8FT-L32W** | White 32W LED Light Engine | Delivered Lumens: 3,254
- 8FT-L56W** | White 56W LED Light Engine | Delivered Lumens: 5,695
- 8FT-L113W** | White 113W LED Light Engine | Delivered Lumens: 11,492

See last page for finish options

B - VOLTAGE *

- 120-277V** | Universal Voltage

C - LAMP OPTIONS *

Apply multiplier from chart for delivered lumens at other CCT's and CRI's.

- 2700K** | 2700K CCT
- 3000K** | 3000K CCT
- 3500K** | 3500K CCT
- 4000K** | 4000K CCT
- 5000K** | 5000K CCT

	80 CRI	90 CRI
2700K	1.00	0.84
3000K	1.00	0.84
3500K	1.00	0.84
4000K	1.00	0.84
5000K	1.00	0.84

D - CRI *

- DF_80 | (default)
- 90

E - CONTROLS *

Extended lead times may apply for controls other than 0-10V. Contact factory for additional control options such as Enlighted, Encelium, Wattstopper, WaveLinx, Casambi, or others.

- DF_DIM1 | 0-10V Control, 1% Dimming (default)
- AWRN | Lutron Athena Wireless Node, 1% Dimming
- NX | Current NX Wireless, 1% Dimming
- NLTA | Acuity nLight Air, 1% Dimming

F - MOUNTING *

BRK is limited to 3" OAP. For longer projections, choose LBK. LBK mounts to standard 2" x 4" switch box. Additional mounting structure and hardware required (by others). The 8FT-L113W option has a power cord exiting from both sides of the fixture.

- DF_BRK | Bracket Mount - 3" OAP (default)
- LBK6 | 3" x 4.5" Switch Box Cover with Fixed Bracket - 6" OAP
- LBK12 | 3" x 4.5" Switch Box Cover with Fixed Bracket - 12" OAP
- LBK18 | 3" x 4.5" Switch Box Cover with Fixed Bracket - 18" OAP



G - LINEAR RUN

Select this option only for runs longer than 8'. Continuous runs with the LBK mounting are supported by a single arm at each mounting location. Continuous runs are supplied with one power supply per fixture, except 8FT-L113W which has two. INSTALLATION NOTES: During installation the contractor is responsible to use actual fixtures to ensure accurate mounting centers from one fixture to the next along the length of the linear run.

- RUN¹ | Continuous Run OAL | Specify Length of Run Length:

¹ For a take-off and pricing, contact factory

H - EMERGENCY

10W, Constant Power Battery Back-up, with 90 minutes of emergency operation. EMR includes damp location enclosure for Battery back-up. When specifying EMR with RUN, the first fixture in the run will be the emergency unit. If other or different Emergency units are needed, contact factory. Additional Power feed location will be required to power non-emergency sections.

EMR | Emergency Battery Remote

I - OPTICAL DISTRIBUTION *

See IES zip file for photometrics for each distribution.

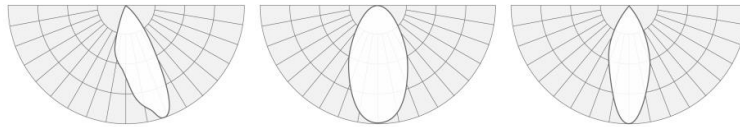
DF_FT | Forward Throw (default)

SMA² | Symmetric 60 Degree Beam - 120 Degree spread

SMB³ | Symmetric 30 Degree Beam - 60 Degree spread

² Delivered lumens are 90% of the output shown under Light Source; see IES file

³ Delivered lumens are 104% of the output shown under Light Source; see IES file



FT

SMA

SMB

J - OPTIONS

F | Fusing

Standard Finishes

The colors shown are representative. Their actual appearance may vary due to differences in display settings. You can request color chips by emailing contact@spilighting.com. Please note, finishes may not be available in all configurations.

Anodized



Specialty Finishes

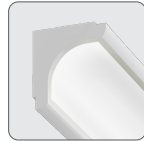
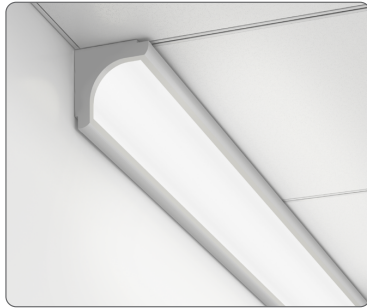


More RAL®, Pantone®, and custom finishes are available upon request. Setup fee and additional lead time applies. Call factory for details.

ELLE Ceiling Line

Horizontal Wall Mount

L18



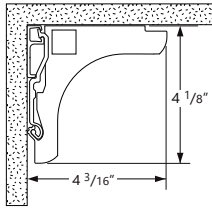
Flat end cap shown



Field cuttable end cap extension



Step end cap shown



Section view - Ceiling-to-Wall Corner Mount



Other Manufacturers:
STARFIRE "SB2-L" Series
LUMENWERX "CUBITO" Series

Notes

- Curved illuminated surface enabled by patent-pending CLS lightguide technology
- InstaHinge™ wall-to-ceiling corner mounting mechanism for easy installation and access. See page 2 for more details.
- Tunable white or static CCT options
- Hairline joiner for continuously illuminated runs
- Integral Axis mini constant current driver, 0-10V dimming standard
- Individual lengths up to 8 ft
- End cap extensions in lengths up to 4 ft allow wall-to-wall installation.
- Drywall surface mounted track may be shimmed to account for a bevel in the wall, providing a true surface for mounting.



Ordering Guide

ELSC	AR	NOM. LUMENS/FT		CRI	COLOR TEMP.	CLS	TOTAL LENGTH
PRODUCT ID	LINE	350	1000	80	27	CLS Curved Lens	2
ELSC Elle Ceiling Line Wall Mount	AR architectural	350 lm/ft - Min	1000 lm/ft - Max	80 80 CRI	27 2700 K*		2' - min*
				90 90 CRI	30 3000 K		8' - max*
		750 LM/FT			35 3500 K		S(L) system run
					40 4000 K		
					TW2750 2700-5000 K - Tunable White**		
					TW2765 2700-6500 K - Tunable White**		
		Outputs between listed min and max are available. Consult factory for outputs outside of the listed range.			* Consult factory for 90 CRI. ** Consult Axitune technical sheet for more information of color technology. ** Remote driver only		* Specify length, 0.5 ft increments available. 2 ft minimum and up to 8 ft for stand alone. For all other lengths and related outputs, please consult factory.

FINISH	VOLTAGE	DRIVER	CIRCUITS	MOUNTING/SUSPENSION	END CAP
AP aluminum paint	120 120 V	DP dimming (0-10V) 1% - integral*	1 1 circuit	MT mounting track for drywall and solid surfaces	FL flat
W white	277 277 V	LT Lutron - remote **	+E(#) emergency circuit*		ST step
BLK black	347 347 V*	O other - remote**			NA no end cap*
C custom	UNV universal	TW(#) tunable white drivers**			
	DC low voltage**	POE(#) POE drivers - remote**			
ARCHITECT TO SELECT FINISH	* Remote driver only. ** Only available with POE drivers.	* Not available with 347V ** Specify system, see page 2. Remote only. *** Please consult factory, see page 2	* Specify quantity		* NA - no end cap selection with EXTB end extension option selection is required.

END CAP EXTENSION	BATTERY - REMOTE (OPTIONAL)	CUSTOM (OPTIONAL)
EXTL(L) left side extension (length)*	BR(#) remote battery pack	C custom
EXTR(L) right side extension (length)*		
EXTB(L) extensions both sides (length)**		
NA no extensions		
* Specify length (L) for end cap extensions up to 4 ft in 0.5 ft increments. Extensions are field-cuttable to a minimum length of 1.5". For longer extensions, please consult factory.	Remote only	Please specify
** (2) extensions of the specified length (L) for installation on left and right sides		

Product design and development is an ongoing process at Axis Lighting. We reserve the right to change specifications. Contact Axis for the latest product information.

1 / 4
April 16, 2024

FILE NAME: ELSC.SPEC_

© 2016 Axis Lighting Inc.
1.800.263.2947
[T] 514.948.6272



ELLE Ceiling Line

Horizontal Wall Mount

L18

● SPECIFICATIONS

CONSTRUCTION

Housing	Extruded aluminum (0.075" nominal) Up to 70% recycled content
End Cap	Cast aluminum
Interior Brackets	Die formed sheet steel (24 gauge)
Lenses	Dual optical system with curved PMMA light guide and polycarbonate lens for added impact protection
End Cap Extension	Extruded aluminum

● ELECTRICAL

Lutron driver	LDE1 - Hi-lume 1% EcoSystem with Soft-on, Fade-to-Black
Other drivers**	DALI - Digital Addressable Lighting Interface DMX - Digital Multiplex Xitanium SR - For wireless sensor
Tunable White TW driver options (remote only)	DALIDT6 - DALI Type 6 (Two DALI Addresses) DALIDT8 - DALI Type 8 (One DALI Address) DPTW - two channel 0-10V dimming; one channel for brightness, one channel for CCT. LDTW - Lutron DALI Type 8 (One DALI address) Tunable White series
Power over Ethernet POE drivers* UL2108 certified for integral or remote driver	MOLEX IGOR SMARTENGINE O - Other (Consult factory)
Emergency	Remote emergency battery pack or emergency circuit optional.
Input Voltage	120V, 277V, 347V, UNV, DC.

*Choose driver from available options.

i Incorporating these components may have limitations or affect the length of the luminaire. Please contact factory for more details.

● LED SYSTEM

CRI	Minimum 80 or 90 color rendering index.
CCT Single Color	Choice of 2700K, 3000K, 3500K and 4000K color temperature with a great color consistency (within 3-step MacAdam ellipse). Both within fixture and fixture to fixture.
CCT Axitune Systems	Consult Axitune technical sheet for more information on color technology.
LED life	Minimum 50,000h with 85% of lumen maintenance in 25°C ambient temperature, in compliance with IES LM-80 testing measurements.
Thermal Management	Aluminum housing acting as the heat sink to maximize life.
Environment	Dry and damp rated for indoor use only in operating ambient temperatures of 0-40°C (32-104F).

● WEIGHT

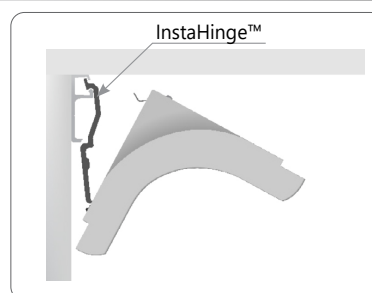
4 ft	9.7 lbs / 4.4 kg
8 ft	19.4 lbs / 8.8 kg

● OPTICS

CLS (Curved Luminous Surface)

Patent pending Curved Luminous Surface optic (CLS) allows for visual comfort through controlled luminance while offering superior lens uniformity.

● MOUNTING DETAILS

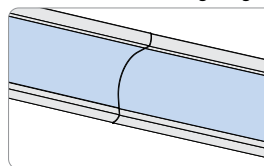


MT SURFACE CORNER MOUNT

Drywall surface InstaHinge™ corner mounting track. The InstaHinge is a revolutionary 2-step system for mounting Elle luminaire in wall to ceiling and wall to wall configurations. Anchored to a track fixed on the drywall surface, the InstaHinge secures the luminaire while allowing for easy serviceability. (1) Deactivate the lock spring by prying down the lip at the top of the luminaire. (2) Hinge the fixture down to access the driver cavity at the back.

● SYSTEM S(L)

ELLE linear systems, with the use of a strong profile, allow for a nearly hair thin connection system of continuous runs. Lengths of 2', 3', 4', 8' as well as custom lengths are available. Runs of ELLE that are greater than 8' in length are designated as systems (S(L)). This means that the run is comprised of a combination of 4' to 8' sections to be assembled on site using our joining system. For more information on systems and joining, please refer to the ELLE installation sheets available for download at www.axislighting.com.



● WARRANTY

Limited 5-year warranty is available. Warranty is valid provided luminaires are installed and used according to specifications. For full terms and conditions, please consult warranty section at axislighting.com.

ELLE Ceiling Line

Horizontal Wall Mount

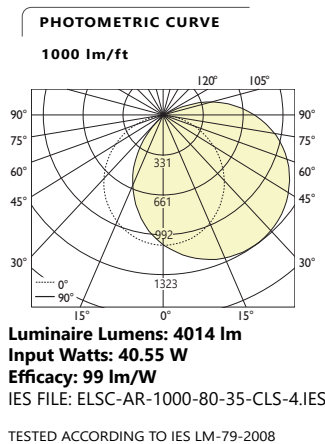
L18

PERFORMANCE AT 3500K FOR 4 FOOT LUMINAIRE

NOMINAL LUMEN OUTPUT	LUMINAIRE LUMENS	INPUT WATTS*	EFFICACY	Estd. L85 LED Life (hrs.)
350 lm/ft	1405 lm	14.20 W	99 lm/W	50000, min
750 lm/ft	3011 lm	30.42 W	99 lm/W	50000, min
1000 lm/ft	4014 lm	40.55 W	99 lm/W	50000, min

Please consult factory for custom lumen output and wattage.

PHOTOMETRIC DATA



CANDELA DISTRIBUTION

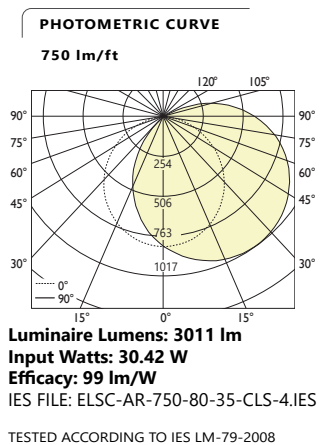
Vertical Angle	Horizontal Angles				
	0	22.5	45	67.5	90
0	973	973	973	973	973
5	962	995	1024	1045	1054
15	919	1014	1097	1156	1185
25	848	1005	1142	1231	1280
35	750	964	1152	1280	1338
45	625	891	1120	1291	1356
55	485	786	1059	1255	1334
65	335	657	969	1190	1273
75	185	514	846	1086	1173
85	50	364	697	943	1036
90	3	289	612	859	951
95	0	215	523	764	852
105	0	84	345	558	637
115	0	0	150	333	396
125	0	0	35	95	139
135	0	0	0	0	2

ZONAL LUMENS

Zone	Lumens
0	
0-10	91
10-20	260
20-30	392
30-40	471
40-50	498
50-60	502
60-70	478
70-80	425
80-90	351
90	
90-100	263
100-110	173
110-120	86
120-130	23
130-140	1

LUMINANCE DATA (cd/m²)

Vertical Angle	Horizontal Angles		
	0	45	90
45	7245	12978	15712
55	6934	15125	19059
65	6502	18790	24688
75	5847	26784	37129
85	4672	65515	97425



CANDELA DISTRIBUTION

Vertical Angle	Horizontal Angles				
	0	22.5	45	67.5	90
0	729	729	729	729	729
5	721	746	768	784	791
15	689	761	822	867	889
25	636	754	856	923	960
35	563	723	864	960	1004
45	469	668	840	968	1017
55	364	589	794	941	1001
65	252	492	727	893	955
75	139	385	635	815	880
85	37	273	523	708	777
90	2	217	459	644	714
95	0	161	392	573	639
105	0	63	258	419	478
115	0	0	112	250	297
125	0	0	26	71	104
135	0	0	0	0	2

ZONAL LUMENS

Zone	Lumens
0	
0-10	69
10-20	195
20-30	294
30-40	353
40-50	374
50-60	376
60-70	358
70-80	318
80-90	263
90	
90-100	197
100-110	130
110-120	65
120-130	17
130-140	1

LUMINANCE DATA (cd/m²)

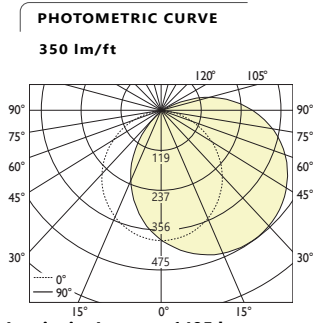
Vertical Angle	Horizontal Angles		
	0	45	90
45	5433	9733	11784
55	5201	11344	14294
65	4877	14093	18516
75	4385	20088	27846
85	3505	49136	73069

i All IES files are available for download at: www.axislighting.com

ELLE Ceiling Line

Horizontal Wall Mount (5/8" min drywall)

L18



Luminaire Lumens: 1405 lm
Input Watts: 14.2 W
Efficacy: 99 lm/W
IES FILE: ELSC-AR-350-80-35-CLS-4.IES

TESTED ACCORDING TO IES LM-79-2008

CANDELA DISTRIBUTION

Vertical Angle	Horizontal Angles				
	0	22.5	45	67.5	90
0	340	340	340	340	340
5	337	348	358	366	369
15	322	355	384	405	415
25	297	352	400	431	448
35	263	338	403	448	468
45	219	312	392	452	475
55	170	275	371	439	467
65	117	230	339	417	446
75	65	180	296	380	411
85	17	127	244	330	363
90	1	101	214	301	333
95	0	75	183	267	298
105	0	29	121	195	223
115	0	0	52	117	139
125	0	0	12	33	49
135	0	0	0	0	1

ZONAL LUMENS

Zone	Lumens
0	
0-10	32
10-20	91
20-30	137
30-40	165
40-50	174
50-60	176
60-70	167
70-80	149
80-90	123
90	
90-100	92
100-110	61
110-120	30
120-130	8

LUMINANCE DATA (cd/m²)

Vertical Angle	Horizontal Angles		
	0	45	90
45	2536	4542	5499
55	2427	5294	6671
65	2276	6577	8641
75	2047	9374	12995
85	1636	22930	34099

M Series Commercial

Other Manufacturers:
LIGHTHEADED "CONTORTIONIST" Series
PRESCOLITE "LFR-4RD" Series
LUMENWERX "ECANA 4" Series

Project:	Type: L19
Product Code:	Date:

V091224



4" Round Downlight

Versatile Solution for all spaces providing high quality lighting ranging from 750lm all the way up to 3500lm

Expedited Install with our easily adjustable universal housing and bar hanger systems allowing for application in most ceiling types

Enhanced Serviceability is achieved through interchangeable modules, optics, and trims, all of which allow for ease of maintenance and implementation of design changes below the ceiling plane

Seamless Integration with several control systems allowing two-channel control dimming options down as low as 0.1%

INSTALLATION

Ceiling Thickness

New Construction: 1/2" up to 2"

Remodel: 1/2" up to 1 1/4"

Extension Collar: 5/8" to 3"

Ceiling Material

Drywall, Millwork

TRIMS

Aperture

4"

Shape

Round

Style

Standard, Hyperbolic, Pinhole, Wall Wash, Flangeless, Decorative, Vandal Proof/IP65

Finish

White, Black, Bronze, Clear Diffuse, Warm Diffuse

LIGHT OUTPUT & DISTRIBUTION

Module

Downlight

Lumens (Power)

750 lm (9.5W), 1000 lm (12.5W),
1250 lm (14.3W), 1500 lm (14.3W),
2000 lm (24.5W), 2500 lm (27.5W),
3000 lm (34.0W), 3500 lm (40.5W)

Color Quality

93 CRI, 2-step SDCM

Color Temperature

- 2700K
- 3000K
- 3500K
- 4000K
- Warm Dim (3000-1800K)
- Tunable White (4000-1800K)
- Tunable White (6500-2700K)

Beam Spread

- 15° Narrow Spot
- 60° Wide Flood
- 25° Spot
- 90°+ General
- 40° Flood

POWER & CONTROLS

Input Voltage

120 / 277V

Dimming

0-10V (1%), Lutron Athena Wireless Node (1%), DALI-2 (0.1%) (Coming Soon)

RATINGS & CERTIFICATIONS

Housing

RoHS Compliant

Module and Trim

Wet Location/IP65 Rated Configurations Available (Standard trims and covered areas only)

NSF Listed (White and black finish only)

IK10 Rated Option Available (Vandal Proof Trim)

Warranty

5 year limited warranty; 50,000 hours



Declare.



DMF LIGHTING 1118 E. 223rd St. Carson, CA 90745 323.934.7779 info@dmflighting.com dmflighting.com

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M Series Commercial

4" Round Downlight

L19

PRODUCT BUILDER | ROUND | DOWNLIGHT | EMBEDDED 0-10V

HOUSING

PRODUCT CODE	
<input type="text"/>	
M4NCRN	4" Round Housing, New Construction, Non-IC Rated
M4RMRN	4" Round Housing, Remodel, Non-IC Rated ¹

LIGHT MODULE

PRODUCT CODE	LUMENS	CRI	CCT	BEAM SPREAD	DIMMING
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
MD		9			O
MD	Downlight Module	07 750 lm	9 93 CRI	27 2700K	GA General Ambient (90°+) ³
		10 1000 lm		30 3000K	NS Narrow Spot (15°) ³
		12 1250 lm		35 3500K	SP Spot (25°)
		15 1500 lm		40 4000K	FL Flood (40°)
		20 2000 lm		3W Warm Dim (3000-1800K) ²	WF Wide Flood (60°)
		25 2500 lm			
		30 3000 lm			
		35 3500 lm			

TRIM | STANDARD

PRODUCT CODE	FINISH	OPTION
<input type="text"/>	<input type="text"/>	<input type="text"/>
M4TRS	Standard Trim	[Blank] None
M4TRL	Wall Wash/Sloped Ceiling Trim ⁴	FL Flangeless ^{6,7}
M4TRP	Pinhole Trim ^{5,6}	VP Vandal Proof/IP65 ⁸
M4TRH	Hyperbolic Trim ⁶	
	WH White	FINISH TO BE SELECTED BY ARCHITECT
	BK Black	
	BZ Bronze	
	CW Clear Diffuse, White Flange	
	WW Warm Diffuse, White Flange	
	CC Custom Color	

TRIM | DECORATIVE (WHITE FINISH ONLY)

PRODUCT CODE	
<input type="text"/>	
M4TRSWHDOF	Decorative Open, Frosted ^{5,9}
M4TRSWHDCF	Decorative Closed, Frosted ^{5,9}
M4TRSWHDCC	Decorative Closed, Clear Frosted Side ^{5,9}
M4TRSWHDCCF	Decorative Closed, Clear Frosted Inside ^{5,9}

OPTICS

MDLX-GA	Low Lumen (750-2000LM) Downlight Optic GA 90° Beam Spread
MDLX-NS	Low Lumen (750-2000LM) Downlight Optic NS 15° Beam Spread
MDLX-SP	Low Lumen (750-2000LM) Downlight Optic SP 25° Beam Spread
MDLX-FL	Low Lumen (750-2000LM) Downlight Optic FL 40° Beam Spread
MDLX-WF	Low Lumen (750-2000LM) Downlight Optic WF 60° Beam Spread
MDHX-SP	High Lumen (2500-3500LM) Downlight Optic SP 25° Beam Spread
MDHX-FL	High Lumen (2500-3500LM) Downlight Optic FL 40° Beam Spread
MDHX-WF	High Lumen (2500-3500LM) Downlight Optic WF 60° Beam Spread

ACCESSORIES

M4XRMUD	Flangeless Mud Plate ¹⁰
M4KRTEMPLATE	Flangeless Wood Template ¹¹
M4CREXT	Round Extension Collar ¹²

¹ Not available with flangeless or vandal proof trim options nor extension collars

² Only available in 1000 lm; not available in Narrow Spot beam spread

³ Only available in 750-2000 lm

⁴ Recommended with WF Beam spread for general wall washing and SP for sloped ceilings. Not available in Custom Color

⁵ Only available in 750-1500 lm

⁶ Only available in White, Black, or Bronze finish

⁷ Mud plate required for FL installation, except for wood ceiling; Not compatible with remodel housing

⁸ Only available in Standard Style and White, Anti-Microbial Finish for Installation in New Construction housing only.

Not compatible with extension collars

⁹ Recommended for use with General Ambient beam spread

¹⁰ Required for Flangeless Trim drywall installation

¹¹ Recommended for Flangeless Trim wood installation

¹² For New Construction Only - Ceiling Installations up to 3"



M Series Commercial

4" Round Downlight

L19

PRODUCT BUILDER | ROUND | DOWNLIGHT | ATHENA WIRELESS NODE/DALI-2

HOUSING

PRODUCT CODE		INSTALLATION		SHAPE		RATING		OUTPUT		DIMMING		WIRELESS	
M4		NC		R		N							
M4	4" Housing	NC	New Construction	R	Round	N	Non-IC	07	750 lm	O	0-10V (AWN Only)	[Blank]	None (DALI-2 Only)
								10	1000 lm	DS	DALI-2 (Static CCT) ² <i>(Coming Soon)</i>	AWN	Athena Wireless Node
								12	1250 lm	DT	DALI-2 (Tunable White) ^{1,3} <i>(Coming Soon)</i>		
								15	1500 lm				
								20	2000 lm				
								25	2500 lm				
								30	3000 lm				
								35	3500 lm				

LIGHT MODULE

PRODUCT CODE		LUMENS		CRI		CCT		BEAM SPREAD		DIMMING	
MD				9						A	
MD	Downlight Module	07	750 lm	9	93 CRI	27	2700K	GA	General Ambient (90°+) ³	A	Alternate
		10	1000 lm			30	3000K	NS	Narrow Spot (15°) ³		
		12	1250 lm			35	3500K	SP	Spot (25°)		
		15	1500 lm			40	4000K	FL	Flood (40°)		
		20	2000 lm			3W	Warm Dim (3000–1800K) ^{4,5}	WF	Wide Flood (60°)		
		25	2500 lm			T1	Tunable White (4000–1800K) ^{1,3,6} <i>(Coming Soon)</i>				
		30	3000 lm			T2	Tunable White (6500–2700K) ^{1,3,6} <i>(Coming Soon)</i>				
		35	3500 lm								

TRIM | STANDARD

PRODUCT CODE		FINISH		OPTION	
M4TRS	Standard Trim	WH	White	[Blank]	None
M4TRL	Wall Wash/Sloped Ceiling Trim ⁷	BK	Black	FL	Flangeless ^{9,10}
M4TRP	Pinhole Trim ^{8,9}	BZ	Bronze	VP	Vandal Proof/IP65 ¹¹
M4TRH	Hyperbolic Trim ⁹	CW	Clear Diffuse, White Flange		
		WW	Warm Diffuse, White Flange		
		CC	Custom Color		

TRIM | DECORATIVE (WHITE FINISH ONLY)

PRODUCT CODE	
M4TRSWHDOF	Decorative: Open, Frosted ^{8,12}
M4TRSWHDCF	Decorative: Closed, Frosted ^{8,12}
M4TRSWHDCC	Decorative: Closed, Clear Frosted Side ^{8,12}
M4TRSWHDCCF	Decorative: Closed, Clear Frosted Inside ^{8,12}

¹ Not available in NS or GA Beam Spreads

² Not available in 3500 lm

³ Only available in 750 - 2000 lm

⁴ Only available in 1000 lm

⁵ Not available in Narrow Spot beam spread

⁶ Only available in DALI-2 Dimming

⁷ Recommended with WF beam spread for standard wall washing and SP for sloped ceiling; Not available in custom color

⁸ Only available in 750 - 1500 lm

⁹ Only available in White, Black, or Bronze finish

¹⁰ Mud Plate required for FL Install except for wood ceiling

¹¹ Only available in Standard Style with White, Anti-Microbial Finish. Not compatible with extension collar

¹² Recommended with General Ambient beam spread



M Series Commercial

4" Round Downlight

L19

PRODUCT BUILDER | ROUND | DOWNLIGHT | ATHENA WIRELESS NODE/DALI-2

ACCESSORIES

M4XRMUD	Flangeless Mud Plate ¹³
M4KRTEMPLATE	Flangeless Wood Template ¹⁴
M4CREXT	Round Extension Collar ¹⁵

¹³ Required for Flangeless Trim drywall installation

¹⁴ Recommended for Flangeless Trim wood installation

¹⁵ For New Construction Only - Ceiling Installations up to 3"



M Series Commercial

4" Round Downlight

L19

PRODUCT BUILDER | ROUND | DOWNLIGHT | EMERGENCY LIGHTING

HOUSING

PRODUCT CODE	INSTALLATION	SHAPE	RATING	LUMEN	DIMMING	WIRELESS	OPTION
M4	NC	R	N				
M4 4" Housing	NC New Construction	R Round	N Non-IC	07 750 lm	O 0-10V for EM only	[Blank] None	EM Emergency driver, Integrated switch ³
				10 1000 lm	DS DALI-2 Static CCT ¹ (Coming Soon)	AWN Athena Wireless Node	EMS Emergency driver, Remote switch
				12 1250 lm	DT DALI-2 Tunable White CCT ^{2,4} (Coming Soon)		
				15 1500 lm			
				20 2000 lm			
				25 2500 lm			
				30 3000 lm			
				35 3500 lm			

LIGHT MODULE

PRODUCT CODE	LUMENS	CRI	CCT	BEAM SPREAD	DIMMING
MD		9			A
MD Downlight Module	07 750 lm	9 93 CRI	27 2700K	GA General Ambient (90°+) ⁴	A Alternate
	10 1000 lm		30 3000K	NS Narrow Spot (15°) ⁴	
	12 1250 lm		35 3500K	SP Spot (25°)	
	15 1500 lm		40 4000K	FL Flood (40°)	
	20 2000 lm		3W Warm Dim (3000-1800K) ^{6,7}	WF Wide Flood (60°)	
	25 2500 lm		T1 Tunable White (4000-1800K) ^{2,4,8}		
	30 3000 lm		T2 Tunable White (6500-2700K) ^{2,4,8}		
	35 3500 lm				

TRIM | STANDARD

PRODUCT CODE	FINISH	OPTION
M4TRS Standard Trim	WH White	[Blank] None
M4TRL Wall Wash/ Sloped Ceiling ⁷	BK Black	FL Flangeless ^{9,11}
M4TRP Pinhole Trim ^{9,10}	BZ Bronze	EM Integrated test switch ^{9,12}
M4TRH Hyperbolic Trim ⁹	CW Clear Diffuse, White Flange	VP Vandal Proof/IP65 ¹³
	WW Warm Diffuse, White Flange	
	CC Custom Color	

TRIM | DECORATIVE (WHITE FINISH ONLY)

PRODUCT CODE	
M4TRSWHDOF	Decorative: Open, Frosted ^{10,14}
M4TRSWHDCF	Decorative: Closed, Frosted ^{10,14}
M4TRSWHDCC	Decorative: Closed, Clear Frosted Side ^{10,14}
M4TRSWHDCCF	Decorative: Closed, Clear Frosted Inside ^{10,14}

¹ Not available in 3500 lm

² Not available with GA or NS Beam Spread

³ Integrated test switch must be selected for both housing and trim

⁴ Only available in 750 - 2000 lm

⁵ Only available in 1000 lm

⁶ Not available in Narrow Spot beam Spread

⁷ Recommended with WF beam spread for general wall washing and SP beam spread for sloped ceiling. Not available in custom color

⁸ Only available in DALI-2 Dimming

⁹ Only available in White, Black, or Bronze finish

¹⁰ Only available 750-1500 lm

¹¹ Mud Plate required for FL Install except for wood ceiling

¹² Only available in Standard Style and White, Clear Diffuse or Warm Diffuse

¹³ Only available in Standard Style and White, Anti-Microbial Finish not compatible with extension collar

¹⁴ Recommended in General Ambient beam spread



M Series Commercial

4" Round Downlight

L19

PRODUCT BUILDER | ROUND | DOWNLIGHT | EMERGENCY LIGHTING

ACCESSORIES

M4XRMUD	Flangeless Mud Plate ¹⁵
M4KRTEMPLATE	Flangeless Wood Template ¹⁶
M4CREXT	Round Extension Collar ¹⁷

¹⁵ Required for Flangeless Trim drywall installation

¹⁶ Recommended for Flangeless Trim wood installation

¹⁷ For New Construction Only - Ceiling Installations up to 3"



M Series Commercial

4" Round Downlight

L19

MODULE



4" Downlight

MD

SUMMARY

INPUT VOLTAGE: 120/277V, 50/60Hz

COLOR QUALITY: 93 CRI ¹

MAX INPUT CURRENT (120V): 0.350 amps

MAX INPUT CURRENT (277V): 0.165 amps

AC CONNECTOR: 6 pin Molex

DC CONNECTOR: Male 4-Pin Low Voltage Connector

POWER FACTOR: Greater than 0.9

TOTAL HARMONIC DISTORTION: Less than 20%

AMBIENT OPERATING TEMPERATURE: -20°C to 40°C

LISTINGS: ENERGY STAR[®] qualified ², UL Listed for Wet Location (Under covered ceilings only), UL Certified US•CA, Declare, RoHS Compliant, NSF/ANSI 2 listed, suitable for splash zone ³, DALI-2 Compliant, Compliant to FCC Title 47 Part 15; Class B

SPECIAL LISTINGS (VANDAL PROOF TRIM): IK10 Rating, IP65 Listing, Anti-Microbial

WARRANTY: 5 year limited warranty; 50,000 hours at 70% lumen maintenance

¹ Tested in accordance to IESNA LM-79-2008

² Refer to ENERGY STAR Certified light fixtures database

³ White and Black Finish only



M Series Commercial

4" Round Downlight

L19

MODULE PERFORMANCE

Based on 93 CRI, 3000K Module + STD White + Trim (M4TRSWH)

(Please refer to IES files for other trim types)

		STATIC CCT							WARM DIM	T1	T2	
LED CHIP		CREE 93 CRI							Bridgelux 93 CRI			
SDCM		2-STEP							3-STEP			
		07	10	12	15	20	25	30	35	10	10	10
NS	Lumens	718	983	1111	1278	2163	N/A					
	LPW ¹	75.5	78.6	77.7	77.4	90.1						
	CBCP ²	6227	8530	9639	11089	18766						
	UGR ³	13	14.1	14.5	15	16.8						
SP	Lumens	696	953	1077	1239	2097	2603	3044	3709	848	994	1094
	LPW	73.2	76.2	75.3	75.1	87.4	94.7	89.5	91.6	67.9	68.6	75.4
	CBCP	2131	2919	3298	3795	6421	12861	15037	18327	2598	2254	2479
	UGR	13.2	14.3	14.7	15.2	17	12.2	12.8	13.5	13.8	16.5	16.8
FL	Lumens	685	939	1061	1221	2066	2545	2976	3627	836	981	1079
	LPW	72.2	75.1	74.2	74	86.1	92.5	87.5	89.5	66.9	67.7	74.4
	CBCP	1196	1638	1851	2130	3604	9094	10634	12960	1458	1257	1382
	UGR	14.9	16	16.4	16.9	18.8	12.6	13.1	13.8	15.6	17.4	17.7
WF	Lumens	677.5	928	1049	1206	2042	2453	2868	3495.5	826	956	1052
	LPW	71.3	74.2	73.3	73.1	85.1	89.2	84.4	86.3	66.1	66	72.6
	CBCP	696	953	1077	1239	2096	1926	2252	2745	848	1090	1199
	UGR	17.3	18.4	18.8	19.3	21.1	22.4	23	23.7	18	17.8	18.1
GA	Lumens	654	896	1012	1165	1971	N/A			797	1031	1134
	LPW	68.9	71.7	70.8	70.6	82.1				63.8	71.1	78.2
	CBCP	264	362	409	470	796				322	595	655
	UGR	22.1	23.2	23.6	24.1	25.9				22.8	21.8	22.2

CCT	STATIC				WARM DIM		T1 TUNABLE WHITE			T2 TUNABLE WHITE		
	2700K	3000K	3500K	4000K	1800K	3000K	1800K	3000K	4000K	2700K	3000K	6500K
MULTIPLIER	0.93	1	1.05	1.07	0.05	1	0.73	1	1.12	0.96	1	1.07
EMERGENCY BATTERY MULTIPLIER	LPW x 5											

¹ LPW: Lumens per watt

² CBCP: Center beam candlepower

³ UGR: Unified glare ratio (0.7/0.5/0.2, 4H/8H)



M Series Commercial

4" Round Downlight

L19

HOUSING



New Construction

M4NCRN

SUMMARY

JUNCTION BOX: Equipped with 6 knockouts: two 1/2" and two 3/4" trade size knockouts on top, two 1/2" trade size knockouts on side. Approved for 8 (four in, four out) #12 AWG 70°C.

BAR HANGER MOUNTING: Adjustable Bar Hangers for 14"-24" joist spacing. Compatible with traditional joists, Armstrong™ ceiling, Hat Channel, T-Bar.

CEILING: 1/2" up to 2"

CUTOUT: 4 1/4" (107mm) round opening

WARRANTY: 5 year limited warranty

ALTERNATE DIMMING SPECIFICATIONS

INPUT VOLTAGE: 120/277V, 50/60Hz

MAX INPUT CURRENT (120V): 0.130 amps

MAX INPUT CURRENT (277V): 0.065 amps

POWER FACTOR: Greater than 0.9

TOTAL HARMONIC DISTORTION: Less than 20%

LISTINGS: Compliant to FCC Title 47 Part 15; Class B

EMERGENCY BATTERY SPECIFICATIONS

EMERGENCY BATTERY : Emergency Battery Back up is designed to provide output for 90 minutes when in an emergency state

INPUT VOLTAGE: 120/277V 50/60Hz

ILLUMINATION TIME: 90min

WATTAGE IN EM STATE: 5W

LUMEN OUTPUT IN EM STATE: LPW x 5

TEST SWITCH OPTIONS:

- **INTEGRATED TEST SWITCH (-EM HOUSING):** Requires Compatible trim - Flanged, Standard Style trim Only
- **REMOTE TEST SWITCH(-EMS HOUSING):** Must be installed according to local code can be used with any flanged, flangeless, or decorative trim type



M Series Commercial

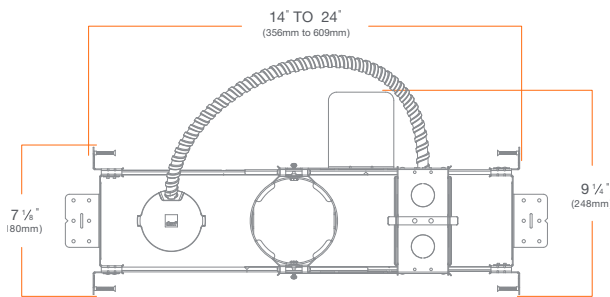
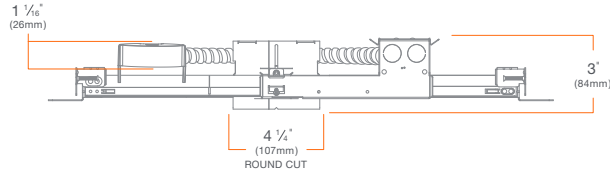
4" Round Downlight

L19

New Construction

M4NCRN

(Dimensions not including module)

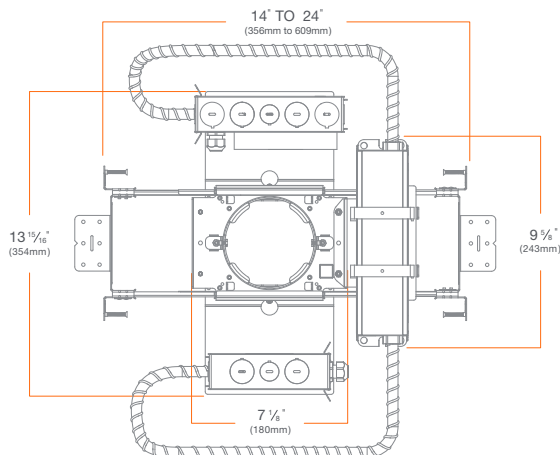
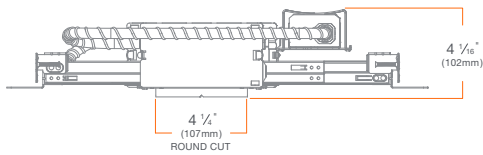


Emergency Lighting

M4NCRNxxxEM

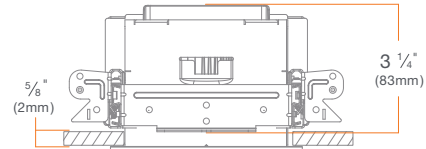
M4NCRNxxxAWNEM

(Dimensions not including module)



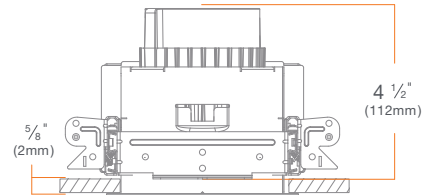
Total Height in Plenum

750LM-1500LM



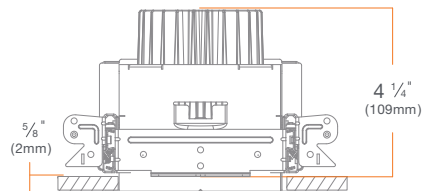
Bar Hanger Vertically Adjustable
from $\frac{1}{2}$ " to 2" (13 to 51mm)

2000LM



Bar Hanger Vertically Adjustable
from $\frac{1}{2}$ " to 2" (13 to 51mm)

2500LM-3500LM/DALI-2



Bar Hanger Vertically Adjustable
from $\frac{1}{2}$ " to 2" (13 to 51mm)



M Series Commercial

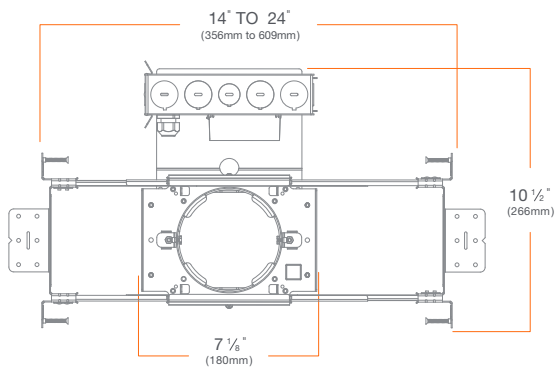
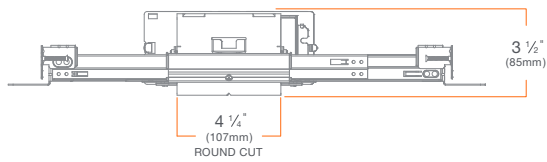
4" Round Downlight

L19

New Construction Static DALI/Lutron Athena Node

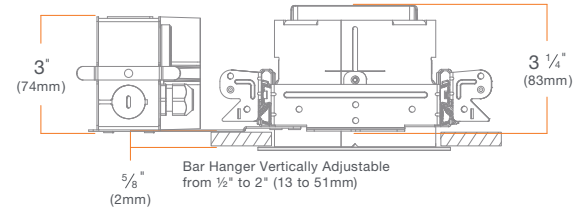
M4NCRNxxDS
M4NCRNxxOAWN
M4NCRNxxDSAWN

(Dimensions not including module)

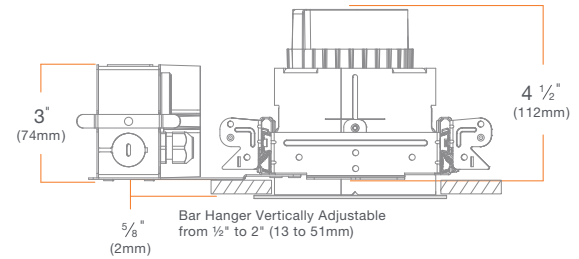


Total Height in Plenum

750LM-1500LM



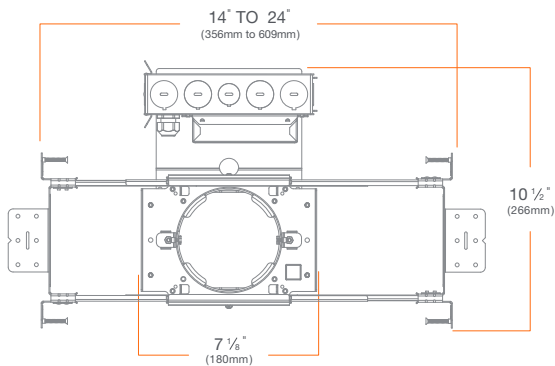
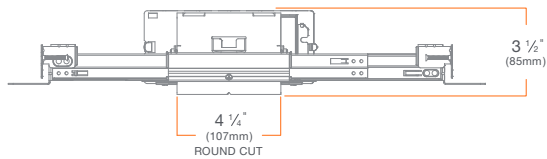
2000LM



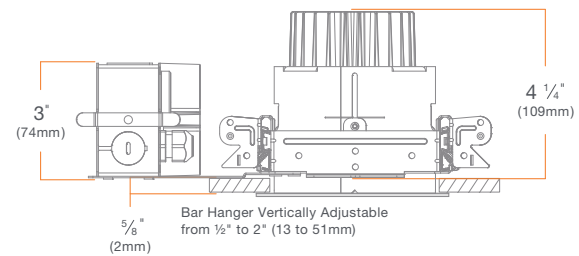
New Construction Tunable White DALI-2

M4NCRNxxDT

(Dimensions not including module)



2500LM-3500LM/DALI-2





M Series Commercial

4" Round Downlight

L19

HOUSING



Remodel

M4RMRN

SUMMARY

JUNCTION BOX: Equipped with 3 knockouts: two 1/2" trade size and one 3/4" trade size knockouts #12 AWG 70°C. Approved for 4 (2 in and 2 out)

CEILING: 1/2" up to 1 1/4"

CUTOUT: 4 3/8" (111mm) round opening

WARRANTY: 5 year limited warranty



M Series Commercial

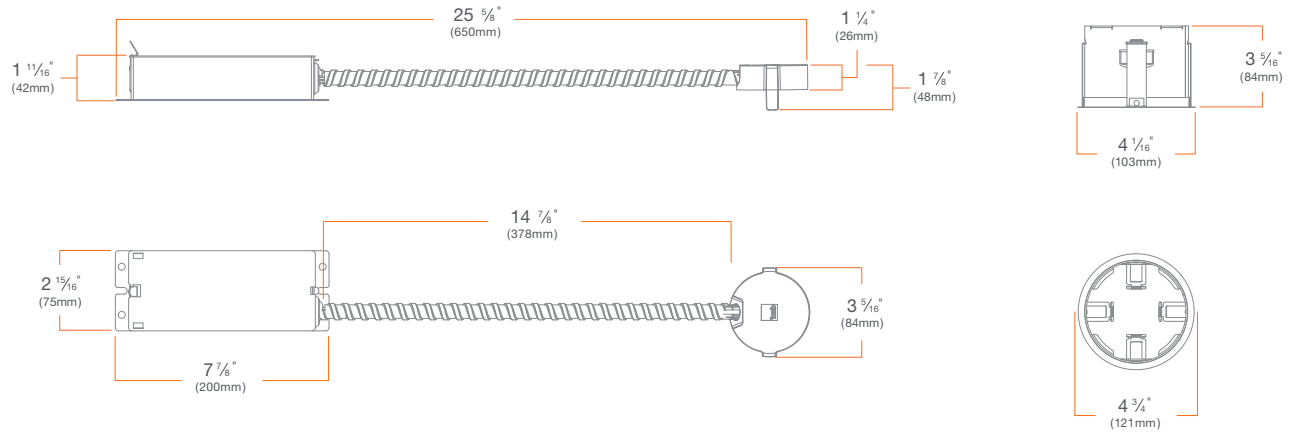
4" Round Downlight

L19

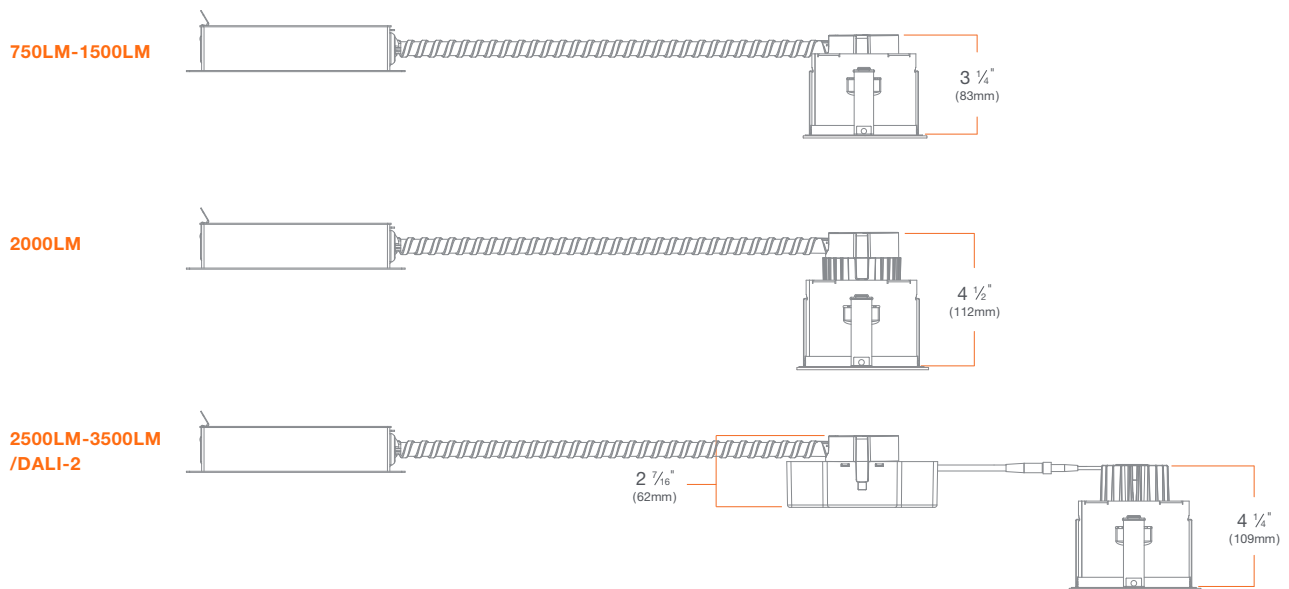
Standard

M4RMRN

(Dimensions not including module)



Total Height in Plenum





M Series Commercial

4" Round Downlight

L19

TRIMS



4" Round Trims

M4TR

SUMMARY

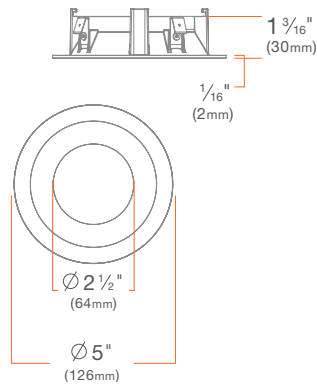
CONSTRUCTION: Die-cast aluminum

DECORATIVE: Acrylic diffuser

INSTALLATION: Twist & Lock

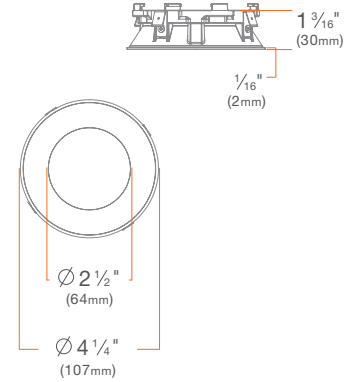
Standard

M4TRSWH



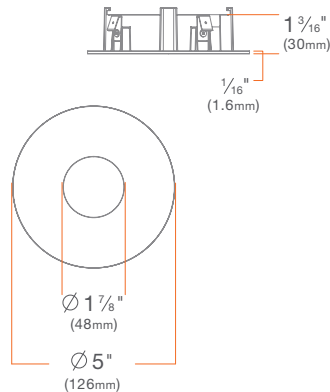
Flangeless

M4TRSWHFL



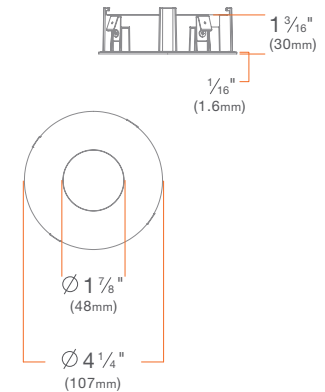
Pinhole

M4TRPWH



Flangeless Pinhole

M4TRPWHFL





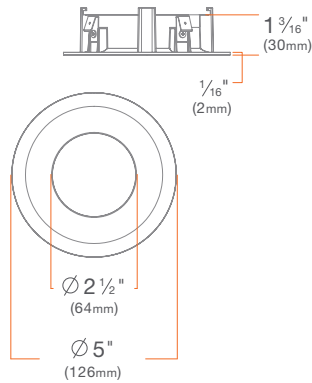
M Series Commercial

4" Round Downlight

L19

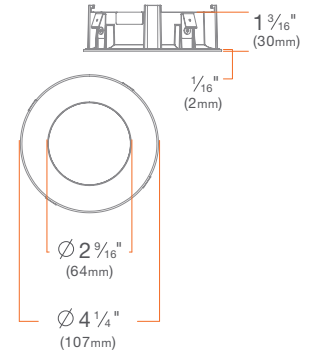
Hyperbolic

M4TRHWH



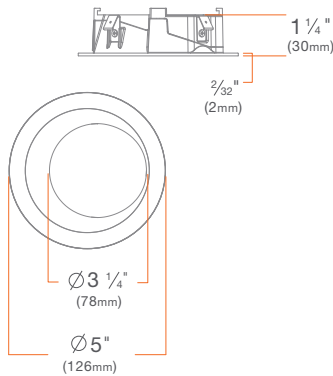
Flangeless Hyperbolic

M4TRHWHFL



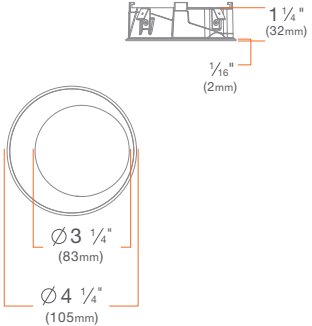
Wall Wash

M4TRLWH



Flangeless Wall Wash

M4TRLWHFL

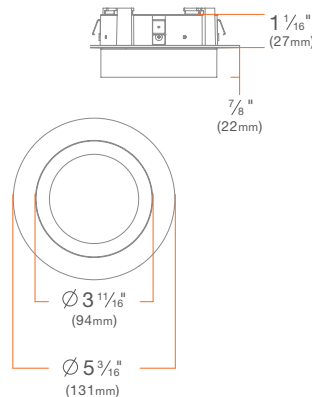


Decorative Closed

Frosted: M4TRSWHDCF

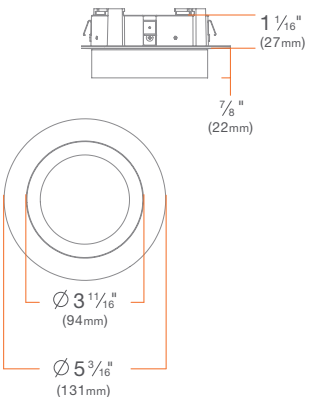
Clear, Frosted Inside: M4TRSWHDC

Clear, Frosted Sides: M4TRSWHDCCF



Decorative Open

Frosted: M4TRSWHDOF





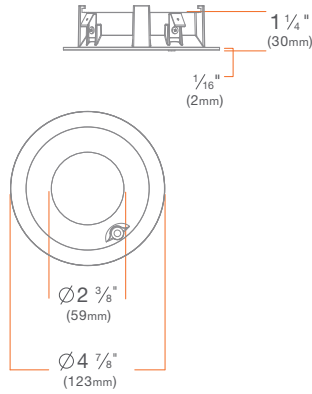
M Series Commercial

4" Round Downlight

L19

Emergency with Integrated Test Switch

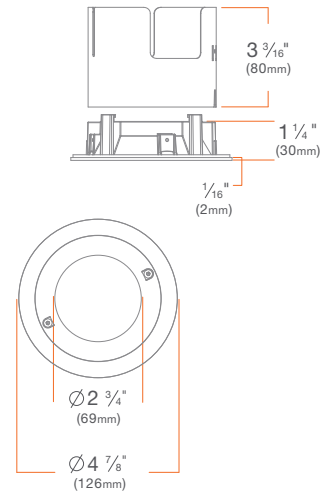
M4TRSWHEM



Vandal Proof/IP65

*For use with Standard New Construction Only

M4TRSWHVP





M Series Commercial

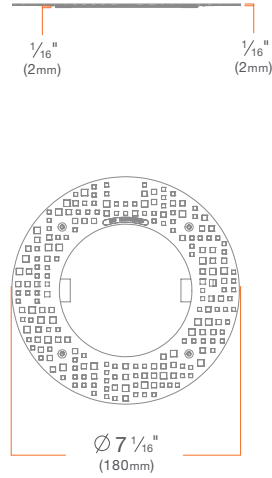
4" Round Downlight

L19

ACCESSORIES

Flangeless Mud Plate

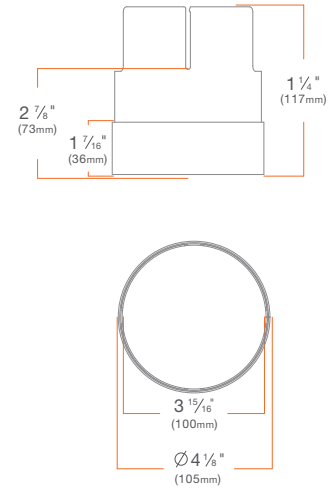
M4XRMUD



Extension Collar

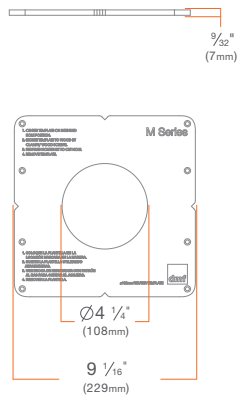
*For use with Standard New Construction Only

M4CREXT



Router Template

M4KRTEMPLATE





M Series Commercial

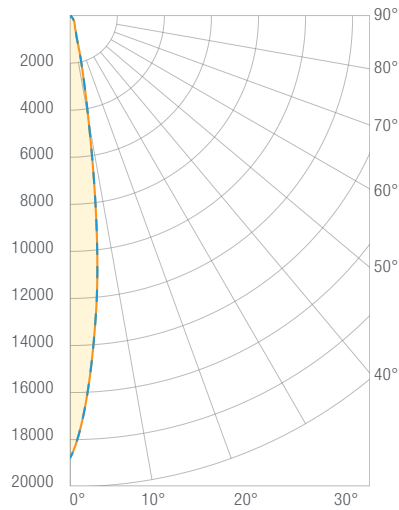
4" Round Downlight

L19

PHOTOMETRY

MD 2000 lm, 3000K, Narrow Spot

MD20930NS | M4TRSWH



cd — C0 - C180 — C90 - C270 2052 lm

Luminous Intensity

Gamma	C 0°
0°	18766
5°	12609
10°	4461
15°	1402
20°	682
25°	466
30°	372
35°	304
40°	221
45°	162
50°	116
55°	81
60°	53
65°	30
70°	13
75°	8
80°	5
85°	2
90°	0

Values in candela

Zonal Lumen Summary

Zone	Lumens	Luminaire %
0-30	1625	79
0-40	1810	88
0-60	2010	98
0-90	2052	100
0-180	2052	100

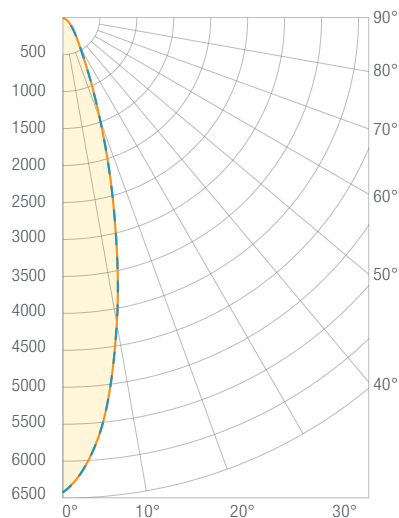
Illuminance Chart

Distance from LED	Foot Candles	Diameter
3'	2085.2	0.7'
6'	521.3	1.5'
9'	231.7	2.2'
12'	130.3	2.9'

Beam Angle: 14°

MD 2000 lm, 3000K, Spot

MD20930SP | M4TRSWH



cd — C0 - C180 — C90 - C270 2060 lm

Luminous Intensity

Gamma	C 0°
0°	6422
5°	5661
10°	4202
15°	2653
20°	1478
25°	799
30°	472
35°	319
40°	227
45°	166
50°	119
55°	82
60°	50
65°	29
70°	13
75°	8
80°	4
85°	2
90°	0

Values in candela

Zonal Lumen Summary

Zone	Lumens	Luminaire %
0-30	1612	78
0-40	1817	88
0-60	2020	98
0-90	2060	100
0-180	2060	100

Illuminance Chart

Distance from LED	Foot Candles	Diameter
3'	713.5	1.4'
6'	178.4	2.8'
9'	79.3	4.2'
12'	44.6	5.6'

Beam Angle: 26°



M Series Commercial

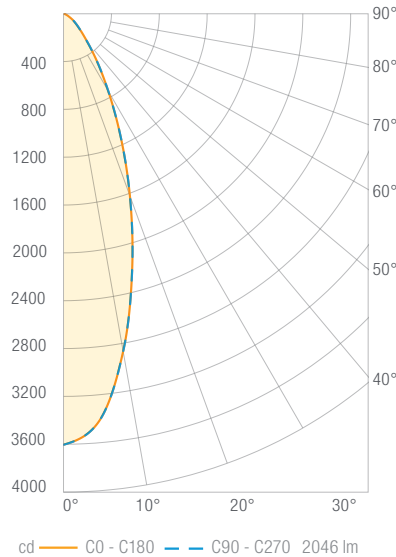
4" Round Downlight

L19

PHOTOMETRY

MD 2000 Im, 3000K, Flood

MD20930FL | M4TRSWH



Luminous Intensity

Gamma	C 0°
0°	3604
5°	3418
10°	2867
15°	2215
20°	1620
25°	1123
30°	746
35°	487
40°	309
45°	204
50°	141
55°	98
60°	57
65°	34
70°	15
75°	10
80°	6
85°	3
90°	0

Values in candela

Zonal Lumen Summary

Zone	Lumens	Luminaire %
0-30	1438	70
0-40	1748	85
0-60	1998	98
0-90	2046	100
0-180	2046	100

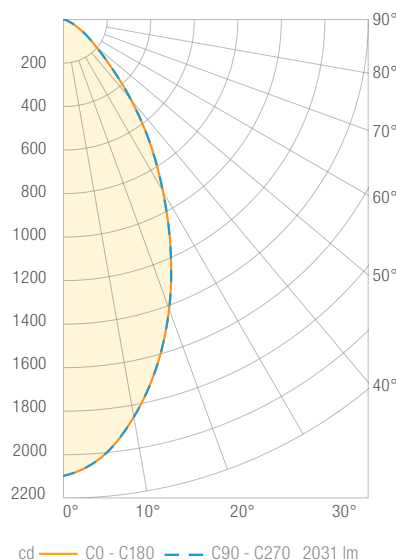
Illuminance Chart

Distance from LED	Foot Candles	Diameter
3'	400.5	2.0'
6'	100.1	4.0'
9'	44.5	6.0'
12'	25.0	8.0'

Beam Angle: 37°

MD 2000 Im, 3000K, Wide Flood

MD20930WF | M4TRSWH



Luminous Intensity

Gamma	C 0°
0°	2096
5°	2018
10°	1855
15°	1651
20°	1416
25°	1162
30°	912
35°	689
40°	480
45°	307
50°	195
55°	129
60°	78
65°	45
70°	22
75°	12
80°	7
85°	4
90°	1

Values in candela

Zonal Lumen Summary

Zone	Lumens	Luminaire %
0-30	1179	58
0-40	1605	79
0-60	1967	97
0-90	2031	100
0-180	2031	100

Illuminance Chart

Distance from LED	Foot Candles	Diameter
3'	232.9	3.1'
6'	58.2	6.2'
9'	25.9	9.3'
12'	14.6	12.4'

Beam Angle: 55°



M Series Commercial

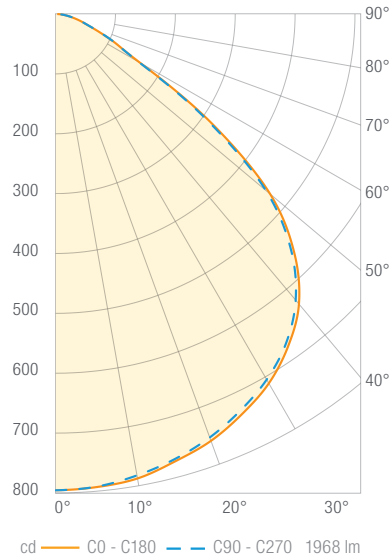
4" Round Downlight

L19

PHOTOMETRY

MD 2000 Im, 3000K, General Ambient

MD20930GA



Luminous Intensity

Gamma	C 0°
0°	796
5°	793
10°	788
15°	773
20°	759
25°	737
30°	712
35°	677
40°	632
45°	564
50°	468
55°	318
60°	163
65°	103
70°	62
75°	41
80°	24
85°	11
90°	3

Values in candela

Zonal Lumen Summary

Zone	Lumens	Luminaire %
0-30	640	32
0-40	1067	54
0-60	1798	91
0-90	1968	100
0-180	1968	100

Illuminance Chart

Distance from LED	Foot Candles	Diameter
3'	88.4	7.8'
6'	22.1	15.5'
9'	9.8	23.3'
12'	5.5	31.1'

Beam Angle: 105° x 104°

Other Manufacturers:
CONTECH "TLTAC" Series
JESCO "DL-AC-FLEX-FS" Series
OMNILIGHT "HVR" Series

L20

FIXTURE TYPE _____
PROJECT NAME _____
LOCATION _____



I Description

Offering up to 500 lumens per foot, Orex is a simple indoor/outdoor line voltage solution to long run lengths requiring high output levels.

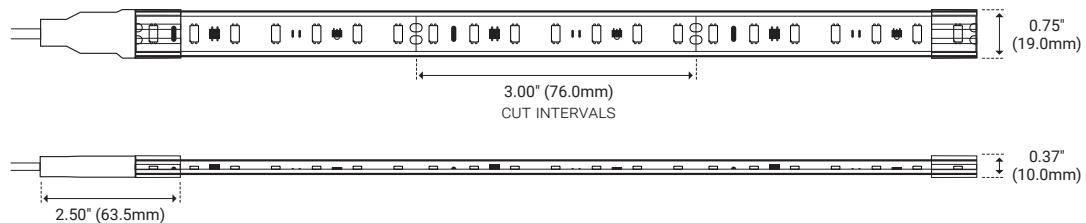
I Features

- 120V Line Voltage
- Integral AC/DC Rectifier
- ETL, Triac, 0–10V (with LCX-1041)
- Hardwire or Plug-in Installation
- IP65

I Series Spec

Series	RX
Temp/Colors	2400K–6500K
Input Voltage	120V AC
Watts per Foot	250 lm/ft = 3W/ft 500 lm/ft = 6W/ft
Beam Spread	120°
CRI	90+
Diode	3056
Orex Width	0.56" (14.3mm)
Orex Height	0.25" (6.5mm)
End Cap Length	2.50" (63.5mm)
End Cap Width	0.75" (19.0mm)
End Cap Height	0.37" (10.0mm)
Cut Intervals	3.00" (76.0mm)
Max Run Length	250 lm/ft = 120ft per Power Feed 500 lm/ft = 100ft per Power Feed
Dimming Protocol	0–10V (with LCX-1041) ¹ , Triac, and ELV
Operating Temp.	-4°F (-20°C) to 107°F (42°C)
Installation Temp.	32°F (0°C) to 107°F (42°C)
Storage Temp.	-4°F (-20°C) to 140°F (60°C)

I Dimensions



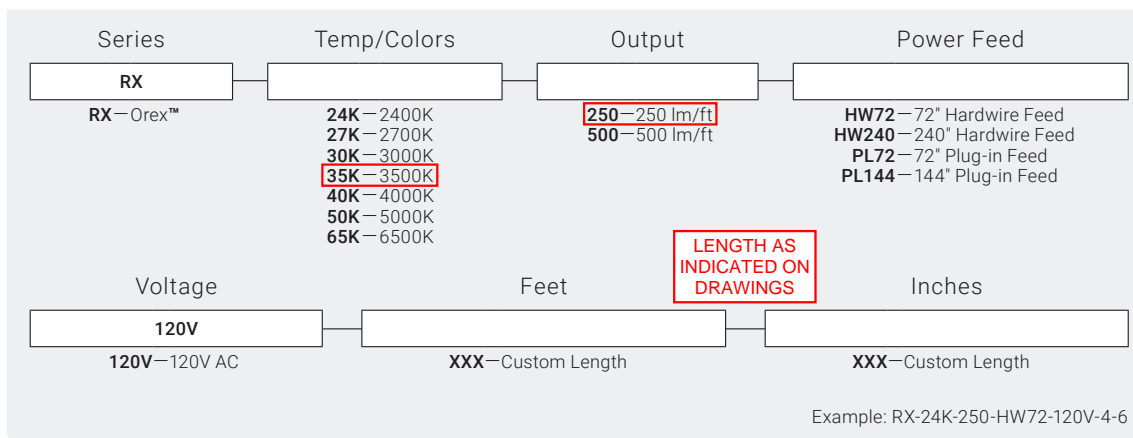
¹ See separate LCX-1041 spec sheet for more information.

Conforms to ANSI/UL Standard 1598
Certified to CAN/CSA Standard C22.2 NO. 250.0

L20



I Product Code Builder



I Series Data

	Configuration	2400K	2700K	3000K	3500K	4000K	5000K	6500K
Orex 250	Tape Only	222	251	256	263	268	276	279
	Tape, Channel, & Flat Lens	124	140	142	147	150	154	155
	Tape, Channel, & Square Lens	120	135	138	142	145	149	150
Orex 500	Tape Only	412	464	473	487	497	511	516
	Tape, Channel, & Flat Lens	237	267	272	281	286	294	297
	Tape, Channel, & Square Lens	245	275	281	290	295	304	306
% Difference from 30K	--	87%	98%	100%	103%	105%	108%	109%



I Mounting Options

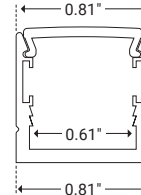
Flat Aluminum Channel



Channel & Lens Specifications

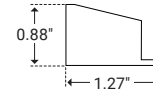
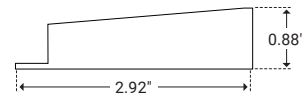
Model	RX-CH-TL-2-FL
Channel Material	Aluminum
Lens Material	Acrylic
Length	78.74" (2m)
Width	0.81" (20.0mm)
Internal Width	0.61" (15.6mm)
Light Transmission	57%

Includes 1 set of end caps, 5 mounting clips, and flat pixel free lens.



End Caps Specifications

Model	RX-EC-FL-SD
Start Cap Dimensions	
Length	2.92" (74.23mm)
Width	1.52" (38.82mm)
Height	0.88" (22.5mm)
Finish Cap Dimensions	
Length	1.27" (32.25mm)
Width	1.52" (38.82mm)
Height	0.88" (22.5mm)



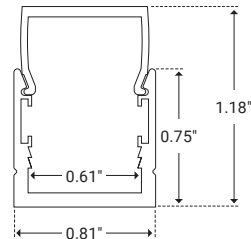
Square Aluminum Channel



Channel & Lens Specifications

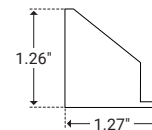
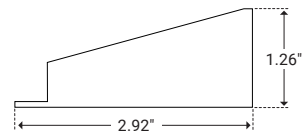
Model	RX-CH-TL-2-SQ
Channel Material	Aluminum
Lens Material	Acrylic
Length	78.74" (2m)
Width	0.81" (20.0mm)
Internal Width	0.61" (15.6mm)
Light Transmission	57%

Includes 1 set of end caps, 5 mounting clips, and square pixel free lens.



End Caps Specifications

Model	RX-EC-SQ-SD
Start Cap Dimensions	
Length	2.92" (74.2mm)
Width	1.52" (38.8mm)
Height	1.26" (32.0mm)
Finish Cap Dimensions	
Length	1.27" (32.0mm)
Width	1.52" (38.8mm)
Height	1.26" (32.0mm)





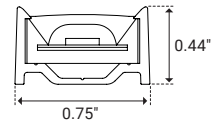
I Mounting Options

Plastic Mounting Base



Specifications

Model	RX-CH-PL-2M
Material	Polycarbonate
Length	78.74" (2m)
Width	0.75" (18.9mm)
Height	0.44" (11.3mm)



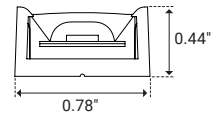
Mounting Clips



Specifications

Model	RX-CLP-F1-PAK-P
Material	Polycarbonate
Length	0.56" (15.0mm)
Width	0.78" (19.8mm)
Height	0.44" (11.3mm)

Includes 10 Clips



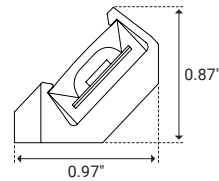
45° Mounting Clips



Specifications

Model	RX-CLP-A1-PAK-P
Material	ABS Plastic
Length	0.78" (19.7mm)
Width	0.97" (24.7mm)
Height	0.87" (22.0mm)

Includes 10 Clips



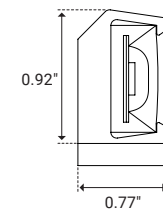
90° Mounting Clips



Specifications

Model	RX-CLP-V1-PAK-P
Material	ABS Plastic
Length	0.77" (19.6mm)
Width	0.52" (13.3mm)
Height	0.92" (23.3mm)

Includes 10 Dual Mounting Clips



Base Mount



Back Mount



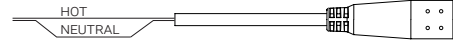
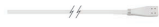
L20



I Hardwire Power & Connectors

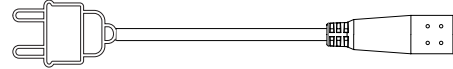
Hardwire Power Feed

Description	Ordering Codes
72" Length	HW72
240" Length	HW240



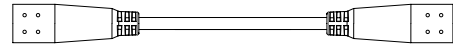
Plug-in Power Feed

Description	Ordering Codes
72" Length	PL72
144" Length	PL144

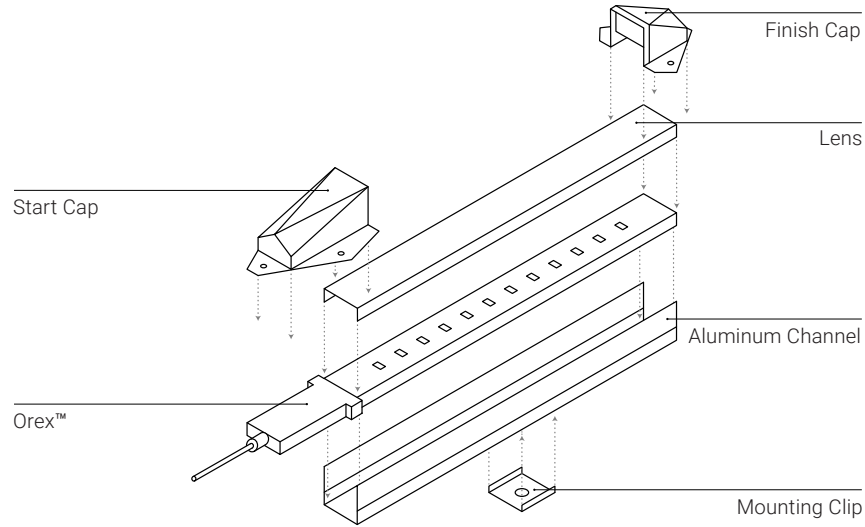


Jump Cables

Description	Ordering Codes
6" Length	RX-JP-6
24" Length	RX-JP-24
48" Length	RX-JP-48



Aluminum Channels Diagram



Project		Catalog #		Type	L21
Prepared by		Notes		Other Manufacturers: DAY-BRITE "FLUXSTREAM" Series COLUMBIA "MPS" Series LITHONIA "ZL1D" Series	



Metalux

SNLED Lensed

Lensed LED Strip Round and Square Lens

Typical Applications

Storage / Utility • Coves • Display Cases • Task and General Area

Interactive Menu

- Order Information [page 2](#)
- Photometric Data [page 3](#)
- Connected Systems [page 3](#)
- Product Warranty

Product Certification



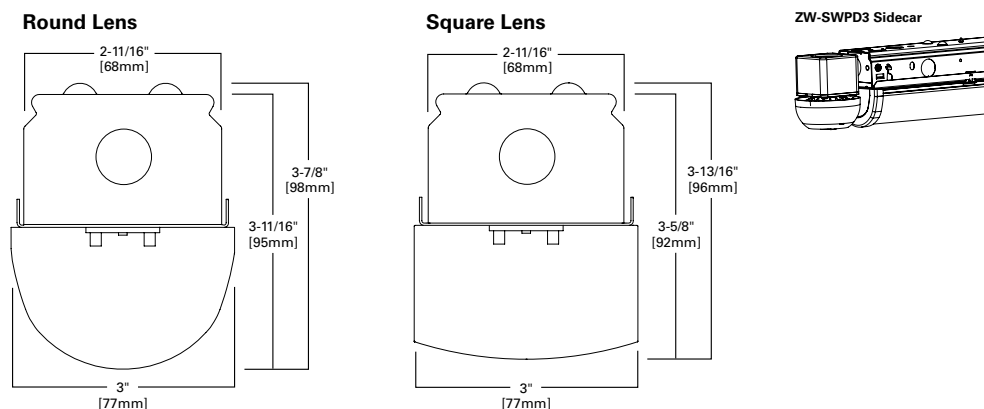
Product Features



Top Product Features

- Standard (SL) and High lumen/High Efficacy (HL) packages
- High efficiencies - up to 153 LPW
- Three different lens types for optical control
- Two different reflectors for precise distribution control
- Available CCT: 3000K, 3500K, 4000K and 5000K
- Minimum CRI of 80; 90 CRI available
- Options to meet Trade Agreements Act requirements

Dimensional Details



[additional product diagrams](#)

Metalux

SNLED Lensed

Order Information

SAMPLE ORDER NUMBER: **4SNLED-LD5-46SL-LN-UNV-L835-CD1-U**
8TNSLED-LD5-200HL-SLN-UNV-EL7W-L840-CD2-U

L21

Domestic Preferences ⁽¹⁹⁾	Length			Series	Lamp Type
[Blank]=Standard TAA=Trade Agreements Act	2=2 ft.	4=4 ft.	8T=8 ft.	SNLED=Commercial LED Striplight ⁽¹⁾	LD5=LED 5.0

LED Lumen Packages ⁽²⁾

2 ft. Round Lens			4 ft. Round Lens			8 ft. Round Lens			2 ft. Square Lens			4 ft. Square Lens			8 ft. Square Lens		
LC	LN	LW	LC	LN	LW	LC	LN	LW	SLC	SLN	SLW	SLC	SLN	SLW	SLC	SLN	SLW
18SL	18SL	16SL	18SL	18SL	16SL	60SL	60SL	54SL	19SL	19SL	16SL	19SL	19SL	15SL	60SL	64SL	50SL
22SL	22SL	20SL	22SL	22SL	20SL	68SL	68SL	61SL	24SL	24SL	20SL	23SL	23SL	19SL	70SL	70SL	58SL
26SL	26SL	23SL	26SL	26SL	23SL	75SL	75SL	67SL	27SL	27SL	22SL	27SL	27SL	22SL	78SL	77SL	64SL
34HL	32HL	30HL	30SL	30SL	27SL	83SL	83SL	74SL	37HL	37HL	30HL	30SL	30SL	25SL	84SL	84SL	70SL
Clear	Semi-frost narrow	Full frost wide	34SL	34SL	30SL	90SL	91SL	81SL	48HL	48HL	41HL	35SL	35SL	29SL	93SL	93SL	77SL
			37SL	37SL	33SL	98SL	98SL	88SL				39SL	39SL	32SL	100SL	100SL	83SL
			41SL	41SL	37SL	105SL ⁽³⁾	106SL	95SL	Clear	Semi-frost narrow	Full frost wide	42SL	42SL	35SL	108SL	108SL	90SL
			46SL	46SL	41SL	130HL ⁽³⁾	130HL ⁽³⁾	110HL				47SL	46SL	39SL	116SL	116SL	96SL
			49SL	53SL	44SL	170HL ⁽³⁾	170HL ⁽³⁾	150HL				50SL	50SL	41SL	125SL	125SL	104SL
			52SL	56SL	47SL	Clear	Semi-frost narrow	Full frost wide				54SL	54SL	45SL	131SL	130SL	108SL
			56SL	61SL	50SL							58SL	58SL	48SL	63SL	63SL	52SL
			63SL	64SL	56SL				63SL	63SL	52SL	65SL	65SL	54SL	170HL ⁽³⁾	170HL ⁽³⁾	170HL ⁽³⁾
			66SL	50HL	58SL				65SL	65SL	54SL	77SL	78SL	64SL	200HL	200HL	200HL
			52HL	54HL	44HL				77SL	78SL	64SL	Clear	Semi-frost narrow	Full frost wide			
			55HL	60HL	48HL				85SL	85SL	70SL						
			60HL	74HL	54HL				54HL	54HL	46HL						
			76HL		65HL				57HL	57HL	48HL						
			Clear	Semi-frost narrow	Full frost wide				62HL	62HL	52HL						
									68HL	68HL	57HL						
									82HL	82HL	69HL						
									97HL	97HL	81HL						
									Clear	Semi-frost narrow	Full frost wide						

SL denotes standard lumen output. HL denotes high lumen output. Additional LEDs to obtain lumen package.
For comparable lumen packages, HL efficacy is greater than SL efficacy.
26SL: 2600 delivered lumens, standard lumen output
170HL: 17000 delivered lumens, high output.

Same notes apply as round (column on left)

Notes: (1) DesignLights Consortium® Qualified and classified for both DLC Standard and DLC Premium, refer to www.designlights.org for details. (2) Nominal lumen values. See table for value and fixture length. (3) DALI and Step-dim versions require two drivers. (4) 4 ft. and 8 ft. only. (5) 347V CD driver is limited to 50W max output before requiring 2 drivers (no 85W 347V solution). (6) 347 SD Driver require qty 2 transformers for Dual switch legs can not offer with EBP due to space requirements for 3 ed transformer for EBP charge circuit. (7) All other drivers at 347V requires single transformer for Driver. If EBP is included, would require second transformer THD on PF affected by transformer (no DLC). (8) 4 ft. and 8 ft. only. (9) Motion Sensor offers dimmability. (10) With integral test switch/indicator/laser test. For approximate delivered lumens multiply the lumens per watt of the desired fixture by the wattage of the emergency battery pack (100 lm/W x 7=700 lumens). IES-format photometry for luminaire under emergency operation available. (11) Used to bypass local control during outage. Must be used in conjunction with UL 1008 device (provided by others). STR2 and ETR2 options include 2 relays on fixtures with dimming drivers. ETRD option only requires one relay when used on a dimming fixture. Must specify voltage as 120V or 277V when ordering these devices. (12) Most common C&P shown. Must specify location for cord. All "end" locations will be on the end with sensor installed. (13) Consult tech support on numerous options for this feature. (14) Sensors provided in separate externally mounted enclosure. See SRL spec sheet for fully integrated/connected sensors. (15) 4 ft. and 8 ft. only. (16) For a complete listing of Fifth Light products, visit www.cooperlighting.com (17) Black fixture and lens ends. Refer to Finish multiplier table for performance (page 3). (18) Accessories sold separately will be separately analyzed under domestic preference requirements. Consult factory for further information. (19) Only product configurations with this designated prefix are built to be compliant with the Trade Agreements Act of 1979 (TAA). Please refer to DOMESTIC PREFERENCES website for more information. Components shipped separately may be separately analyzed under domestic preference requirements. (21) Emergency component is UL924 classified. (22) WLSr provided in separate enclosure. (23) Not available in Mid-Row Configuration.

Integrated options must be used in conjunction with the associated system and may not be compatible with other options or accessories. Please refer to the following: (A) Consult WaveLinX system pages for additional details and compatibility. (B) Consult WaveLinX Lite system pages for additional details and compatibility.

Metalux

SNLED Lensed

Order Information

SAMPLE ORDER NUMBER: **4SNLED-LD5-46SL-LN-UNV-L835-CD1-U**

L21

8TSNLED-LD5-200HL-SLN-UNV-EL7W-L840-CD2-U

Lens	Voltage	Emergency	Wiring	Options	Color Temp / CCT
Round LC=Clear Lens LN=semi-Frost Lens - Narrow LW=Full Frost Lens - Wide Square SLC=Square / Flat Clear Lens SLN=Square / Flat Semi - Frost Lens - Narrow SLW=Square / Flat Full Frost Lens - Wide	UNV=Universal Voltage 120-277V 347=347V (8),(9),(17) 480=480V (4)	EL7W=7-watt, 120V-277V emergency battery pack installed (8),(10),(21) EL14W=14-watt 120V-277V emergency battery pack installed (8),(10),(21) GTR2=Bodine Generator Transfer Relay (11) ETRD=lota Emergency Transfer Relay with dimming control (11),(21)	PJ/CP1=Plug in and cross over plug in options (12) PC6/S15P=(NEMA 5-15P) 6 ft. Cord with NEMA Straight Plug (12),(13) PC6/L715=(NEMA L7-15P) 6 ft. Cord with NEMA Twist Plug (12),(13)	Motion Sensors (14) LB-ERMS360=360° Low Bay Motion Sensor - End of Row, 8' Mounting LB-MRMS360=360° Low Bay Motion Sensor - Middle of Row, 8' Mounting HB-ERMS360=360° High Bay Motion Sensor - End of Row, 15-40' Mounting (9) HB-MRMS360=360° High Bay Motion Sensor - Middle of Row, 15-40' Mounting (9) WLS (formerly WAB)=WaveLinx LITE Wireless Sensor, Occupancy w/ photocell, Independent & Networked (8) WPS (formerly WAA)=WaveLinx PRO Wireless Sensor, Occupancy w/ photocell, Networked (4) WLS4=WaveLinx LITE, Dimming Motion and Daylight, Bluetooth Programmable, 15' - 40' Mounting (22),(23),(8) WPS4=WaveLinx PRO, Dimming Motion and Daylight, WAC Programmable, 15' - 40' Mounting (4) ZW-SWP3=Integrated Wavelinx Wireless Sensor, 1200 sqft. coverage (22),(23),(8)	CCT/CRI L830=3000K, 80 CRI L835=3500K, 80 CRI L840=4000K, 80 CRI L850=5000K, 80 CRI L930=3000K, 90 CRI L935=3500K, 90 CRI L940=4000K, 90 CRI L950=5000K, 90 CRI

Drive Type	No. of Drivers	Paint Finish	Packaging	Accessories (Order Separately) (18)		
CD=0-10V Dimming Driver (10%-100% Dimming) HCD=0-10V Dimming Driver (1%-100% Dimming) SD=Step-dim (Bi Level) (15) SLTD=5th Light (DALI) Driver (15),(16)	1=1 Driver 2=2 Drivers	[blank]=Standard White BLK=PAF Black (17)	U=Unit Pack	AVC=Chain/Set=36" Chain Hanger (Use 1 set per fixture) SCF=Fixed Stem Set (Specify Length) SCS=Swivel Stem Set (Specify Length) SCA=Adjustable 48" Stem Set EYE-CHAIN/SET-B=Eye Bolt Chain (Use 1 set per fixture) WG/SNF-2FT=2 ft Wire Guard WG/SNF-4FT=4 ft Wire Guard A1B/Spacer-U=Spacer 1-1/2" to 2-1/2" from ceiling (Use 2 per fixture) TOGGLE=Single Toggle No. 2 (Specify Length) Y-TOGGLE-__2PK=(2) Y-Toggle Cable Kits (Specify 10 or 30 for length in feet) GRP-SNF-U=Gripper Hanger CLC-SNLED-EXT-B=SNLED Long Row Aligner Extension	Round Replacement Lenses SNLED-LENS-LW-2FT-U= Replacement Lens 2 ft, Full Frost SNLED-LENS-LN-2FT-U= Replacement Lens 2 ft, Semi Frost SNLED-LENS-LC-2FT-U= Replacement Lens 2 ft, Clear SNLED-LENS-LW-4FT-U= Replacement Lens 4 ft, Full Frost SNLED-LENS-LN-4FT-U= Replacement Lens 4 ft, Semi Frost SNLED-LENS-LC-4FT-U= Replacement Lens 4 ft, Clear	Square Replacement Lenses SNLED-SQLENS-SLW-2FT-U= Replacement Lens 2 ft, Full Frost SNLED-SQLENS-SLN-2FT-U= Replacement Lens 2 ft, Semi Frost SNLED-SQLENS-SLC-2FT-U= Replacement Lens 2 ft, Clear SNLED-SQLENS-SLW-4FT-U= Replacement Lens 4 ft, Full Frost SNLED-SQLENS-SLN-4FT-U= Replacement Lens 4 ft, Semi Frost SNLED-SQLENS-SLC-4FT-U= Replacement Lens 4 ft, Clear

Notes: (1) DesignLights Consortium® Qualified and classified for both DLC Standard and DLC Premium, refer to www.designlights.org for details. (2) Nominal lumen values. See table for value and fixture length. (3) DALI and Step-dim versions require two drivers. (4) 4 ft. and 8 ft. only. (5) 347V CD driver is limited to 50W max output before requiring 2 drivers (no 85W 347V solution). (6) 347 SD Driver require qty 2 transformers for Dual switch legs can not offer with EBP due to space requirements for 3 ed transformer for EBP charge circuit.(7) All other drivers at 347V requires single transformer for Driver. If EBP is included, would require second transformer THD a PF affected by transformer (no DLC). (8) 4 ft. and 8 ft. only. (9) Motion Sensor offers dimmability. (10) With integral test switch/ indicator/laser test. For approximate delivered lumens multiply the lumens per watt of the desired fixture by the wattage of the emergency battery pack (100 lm/W x 7-700 lumens). IES-format photometry for luminaire under emergency operation available. (11) Used to bypass local control during outage. Must be used in conjunction with UL 1008 device (provided by others). GTR2 and ETR2 options include 2 relays on fixtures with dimming drivers. ETRD option only requires one relay when used on a dimming fixture. Must specify voltage as 120V or 277V when ordering these devices. (12) Most common CIP shown. Must specify location for cord. All "end" locations will be on the end with sensor installed. (13) Consult tech support on numerous options for this feature. (14) Sensors provided in separate externally mounted enclosure. See SRL spec sheet for fully integrated/connected sensors. (15) 4 ft. and 8 ft. only. (16) For a complete listing of Fifth Light products, visit www.cooperlighting.com (17) Black fixture and lens ends. Refer to Finish multiplier table for performance (page 3). (18) Accessories sold separately will be separately analyzed under domestic preference requirements. Consult factory for further information. (19) Only product configurations with this designated prefix are built to be compliant with the Trade Agreements Act of 1979 (TAA). Please refer to [DOMESTIC PREFERENCES](#) website for more information. Components shipped separately may be separately analyzed under domestic preference requirements. (20) Wavelinx Lite devices are not currently compatible with the Wavelinx Pro Wireless Area Controller. (21) Emergency component is UL924 classified.



Metalux

SNLED Lensed

L21

Product Specifications

Construction

- Die-formed of cold rolled steel with numerous knockouts for easy installation
- Groove for Tong Hanger
- Convertible end plate for continuous row alignment
- Channel/wireway cover secured with sheet metal screws
- Surface, pendant or stem mounting

Controls

- Standard with 0-10V dimming driver (10% standard, 1% optional)
- Integrated WaveLinX sensor options provide wireless individual fixture control and enable code compliance, increased energy savings, grouping of fixtures, and connection to WaveLinX control systems
- DALI 2.0 and step-dimming available
- For motion control, reference sensor locations for both end and middle of the row applications

Electrical

- Long-life LED system with electrical driver for optimal performance
- LED's available in 3000K, 3500K, 4000K or 5000K with CRI of 80 standard or optional 90 CRI
- TM21 rating of L87>60,000 hours
- Electronic drivers available for 120-277V, 347V and 480 applications
- Operating temperatures of -20°C up to 50°C (refer to ambient temperature chart)

Emergency Battery Pack Option

- Optional 120V-277V integral emergency battery pack available in 7W or 14W
- 90-minute backup period for code compliance
- Generator transfer options available

Finish

- Multi-stage, iron phosphate pretreatment
- Highly reflective paint after fabrication
- Standard baked white enamel finish

Shielding

- Three round lensed optical distributions available: Clear with linear ribs (LC), semi-frost for narrow distribution (LN) and full frost for wide distribution (LW)
- Three square lensed optical distributions available: clear with linear ribs (SLC), semi-frost for narrow distribution (SLN) and full frost for wide distribution (SLW)

Compliance

- cULus Listed for damp locations
- State of California Title 24 high efficacy luminaire
- DesignLights Consortium® Qualified and classified for DLC Standard and DLC Premium (refer to www.designlights.org)
- Suitable for closet use when installed to NEC 410.16 spacings standards

Warranty

- Five year limited warranty

WaveLinX LITE devices are not currently compatible with the WaveLinX PRO Wireless Area Controller

Photometric Data

[View IES files](#)

Energy and Performance Data

CCT Table

Approximate Color Temperature	Multiplier
2700K	.93
3000K	.98
3500K	1.0
4000K	1.02
5000K	1.02

CRI

Lumen multiplier (80CRI to 90CRI)				
3000K	3500K	4000K	5000K	
0.805	0.840	0.846	0.901	

Shipping Data

Length	Wt.
2 ft.	4.3 lbs.
4 ft.	8.2 lbs.
8 ft.	15.1 lbs.

Ambient Temperature

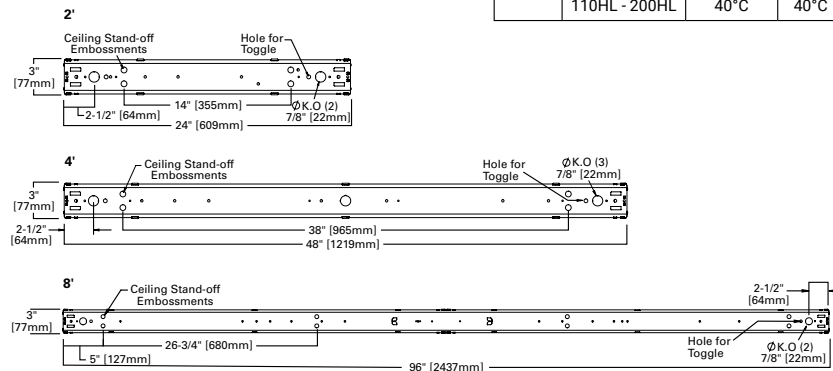
Length	Lumen Package	Standard	EM
2FT	16SL - 27SL	50°C	40°C
	30HL - 48HL	40°C	40°C
4FT	15SL - 54SL	50°C	40°C
	56SL - 97HL	40°C	40°C
8FT	50SL - 108SL	50°C	40°C
	110HL - 200HL	40°C	40°C

Control Solutions

- WaveLinX LITE wireless
- WaveLinX PRO wireless
- WaveLinX CAT wired
- WaveLinX Wired



Dimensional and Mounting Details



Metalux

SNLED Lensed

Energy and Performance Data

L21

Wattage: Round Clear Lens

SNLED Type	Lumen Type	Length	Catalog Number**	Nominal 3500K Lumens	Wattage	lm/W
Clear Lens (LC)	Standard	2 ft.	2SNLED-LD5-18SL-LC-UNV-L8XX-CD1-U	1960	14	137.4
Clear Lens (LC)	Standard	2 ft.	2SNLED-LD5-22SL-LC-UNV-L8XX-CD1-U	2420	18	133.7
Clear Lens (LC)	Standard	2 ft.	2SNLED-LD5-26SL-LC-UNV-L8XX-CD1-U	2747	21	131.1
Clear Lens (LC)	High	2 ft.	2SNLED-LD5-34HL-LC-UNV-L8XX-CD1-U	3487	27	131.2
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-18SL-LC-UNV-L8XX-CD1-U	1890	13	145.0
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-22SL-LC-UNV-L8XX-CD1-U	2344	16	146.4
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-26SL-LC-UNV-L8XX-CD1-U	2699	18	146.3
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-30SL-LC-UNV-L8XX-CD1-U	3077	21	145.4
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-34SL-LC-UNV-L8XX-CD1-U	3567	25	143.3
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-37SL-LC-UNV-L8XX-CD1-U	3924	28	141.6
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-41SL-LC-UNV-L8XX-CD1-U	4269	31	139.6
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-46SL-LC-UNV-L8XX-CD1-U	4718	35	136.8
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-49SL-LC-UNV-L8XX-CD1-U	5051	38	134.4
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-52SL-LC-UNV-L8XX-CD1-U	5478	41	133.3
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-56SL-LC-UNV-L8XX-CD1-U	5880	46	127.4
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-63SL-LC-UNV-L8XX-CD1-U	6358	52	123.1
Clear Lens (LC)	Standard	4 ft.	4SNLED-LD5-66SL-LC-UNV-L8XX-CD1-U	6628	55	120.2
Clear Lens (LC)	High	4 ft.	4SNLED-LD5-52HL-LC-UNV-L8XX-CD1-U	5171	37	139.5
Clear Lens (LC)	High	4 ft.	4SNLED-LD5-55HL-LC-UNV-L8XX-CD1-U	5409	39	138.5
Clear Lens (LC)	High	4 ft.	4SNLED-LD5-60HL-LC-UNV-L8XX-CD1-U	5893	43	136.7
Clear Lens (LC)	High	4 ft.	4SNLED-LD5-76HL-LC-UNV-L8XX-CD1-U	7774	62	125.1
Clear Lens (LC)	Standard	8 ft.	8TSNLED-LD5-60SL-LC-UNV-L8XX-CD1-U	6154	42	145.4
Clear Lens (LC)	Standard	8 ft.	8TSNLED-LD5-68SL-LC-UNV-L8XX-CD1-U	7134	50	143.3
Clear Lens (LC)	Standard	8 ft.	8TSNLED-LD5-75SL-LC-UNV-L8XX-CD1-U	7847	55	141.6
Clear Lens (LC)	Standard	8 ft.	8TSNLED-LD5-83SL-LC-UNV-L8XX-CD1-U	8537	61	139.6
Clear Lens (LC)	Standard	8 ft.	8TSNLED-LD5-90SL-LC-UNV-L8XX-CD1-U	9437	69	136.8
Clear Lens (LC)	Standard	8 ft.	8TSNLED-LD5-98SL-LC-UNV-L8XX-CD1-U	10101	75	134.4
Clear Lens (LC)	Standard	8 ft.	8TSNLED-LD5-105SL-LC-UNV-L8XX-CD1-U	10956	82	133.3
Clear Lens (LC)	High	8 ft.	8TSNLED-LD5-130HL-LC-UNV-L8XX-CD2-U	11786	86	136.7
Clear Lens (LC)	High	8 ft.	8TSNLED-LD5-170HL-LC-UNV-L8XX-CD2-U	15549	124	125.1

* Consult factory for stock availability. ** Lumen portion of catalog number may not match actual lumens.

Metalux

SNLED Lensed

Energy and Performance Data

L21

Wattage: Round Semi-frost Lens, Narrow

SNLED Type	Lumen Type	Length	Catalog Number**	Nominal 3500K Lumens	Wattage	lm/W
Semi-Frost Lens (LN)	Standard	2 ft.	2SNLED-LD5-18SL-LN-UNV-L8XX-CD1-U	1903	14	133.4
Semi-Frost Lens (LN)	Standard	2 ft.	2SNLED-LD5-22SL-LN-UNV-L8XX-CD1-U	2350	18	129.8
Semi-Frost Lens (LN)	Standard	2 ft.	2SNLED-LD5-26SL-LN-UNV-L8XX-CD1-U	2667	21	127.3
Semi-Frost Lens (LN)	High	2 ft.	2SNLED-LD5-32HL-LN-UNV-L8XX-CD1-U	3385	27	127.4
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-18SL-LN-UNV-L8XX-CD1-U	1835	13	140.8
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-22SL-LN-UNV-L8XX-CD1-U	2276	16	142.2
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-26SL-LN-UNV-L8XX-CD1-U	2620	18	142.0
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-30SL-LN-UNV-L8XX-CD1-U	2987	21	141.2
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-34SL-LN-UNV-L8XX-CD1-U	3463	25	139.2
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-37SL-LN-UNV-L8XX-CD1-U	3809	28	137.5
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-41SL-LN-UNV-L8XX-CD1-U	4144	31	135.6
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-46SL-LN-UNV-L8XX-CD1-U	4581	35	132.8
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-49SL-LN-UNV-L8XX-CD1-U	4903	38	130.4
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-53SL-LN-UNV-L8XX-CD1-U	5318	41	129.4
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-56SL-LN-UNV-L8XX-CD1-U	5708	46	123.7
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-61SL-LN-UNV-L8XX-CD1-U	6172	52	119.5
Semi-Frost Lens (LN)	Standard	4 ft.	4SNLED-LD5-64SL-LN-UNV-L8XX-CD1-U	6435	55	116.7
Semi-Frost Lens (LN)	High	4 ft.	4SNLED-LD5-50HL-LN-UNV-L8XX-CD1-U	5020	37	135.4
Semi-Frost Lens (LN)	High	4 ft.	4SNLED-LD5-54HL-LN-UNV-L8XX-CD1-U	5252	39	134.5
Semi-Frost Lens (LN)	High	4 ft.	4SNLED-LD5-60HL-LN-UNV-L8XX-CD1-U	5721	43	132.7
Semi-Frost Lens (LN)	High	4 ft.	4SNLED-LD5-74HL-LN-UNV-L8XX-CD1-U	7548	62	121.5
Semi-Frost Lens (LN)	Standard	8 ft.	8TSNLED-LD5-60SL-LN-UNV-L8XX-CD1-U	5975	42	141.2
Semi-Frost Lens (LN)	Standard	8 ft.	8TSNLED-LD5-68SL-LN-UNV-L8XX-CD1-U	6926	50	139.2
Semi-Frost Lens (LN)	Standard	8 ft.	8TSNLED-LD5-75SL-LN-UNV-L8XX-CD1-U	7619	55	137.5
Semi-Frost Lens (LN)	Standard	8 ft.	8TSNLED-LD5-83SL-LN-UNV-L8XX-CD1-U	8289	61	135.6
Semi-Frost Lens (LN)	Standard	8 ft.	8TSNLED-LD5-91SL-LN-UNV-L8XX-CD1-U	9162	69	132.8
Semi-Frost Lens (LN)	Standard	8 ft.	8TSNLED-LD5-98SL-LN-UNV-L8XX-CD1-U	9807	75	130.4
Semi-Frost Lens (LN)	Standard	8 ft.	8TSNLED-LD5-106SL-LN-UNV-L8XX-CD1-U	10636	82	129.4
Semi-Frost Lens (LN)	High	8 ft.	8TSNLED-LD5-130HL-LN-UNV-L8XX-CD2-U	11442	86	132.7
Semi-Frost Lens (LN)	High	8 ft.	8TSNLED-LD5-170HL-LN-UNV-L8XX-CD2-U	15095	124	121.5

* Consult factory for stock availability. ** Lumen portion of catalog number may not match actual lumens.

Metalux

SNLED Lensed

Energy and Performance Data

L21

Wattage: Round Full-frost Lens, Wide

SNLED Type	Lumen Type	Length	Catalog Number**	Nominal 3500K Lumens	Wattage	lm/W
Full Frost Lens (LW)	Standard	2 ft.	2SNLED-LD5-16SL-LW-UNV-L8XX-CD1-U	1750	14	122.7
Full Frost Lens (LW)	Standard	2 ft.	2SNLED-LD5-20SL-LW-UNV-L8XX-CD1-U	2162	18	119.4
Full Frost Lens (LW)	Standard	2 ft.	2SNLED-LD5-23SL-LW-UNV-L8XX-CD1-U	2453	21	117.1
Full Frost Lens (LW)	High	2 ft.	2SNLED-LD5-30HL-LW-UNV-L8XX-CD1-U	2975	27	112.0
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-16SL-LW-UNV-L8XX-CD1-U	1688	13	129.5
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-20SL-LW-UNV-L8XX-CD1-U	2093	16	130.8
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-23SL-LW-UNV-L8XX-CD1-U	2410	18	130.7
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-27SL-LW-UNV-L8XX-CD1-U	2748	21	129.8
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-30SL-LW-UNV-L8XX-CD1-U	3186	25	128.0
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-33SL-LW-UNV-L8XX-CD1-U	3504	28	126.5
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-37SL-LW-UNV-L8XX-CD1-U	3812	31	124.7
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-41SL-LW-UNV-L8XX-CD1-U	4214	35	122.1
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-44SL-LW-UNV-L8XX-CD1-U	4511	38	120.0
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-47SL-LW-UNV-L8XX-CD1-U	4892	41	119.1
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-50SL-LW-UNV-L8XX-CD1-U	5251	46	113.8
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-56SL-LW-UNV-L8XX-CD1-U	5678	52	109.9
Full Frost Lens (LW)	Standard	4 ft.	4SNLED-LD5-58SL-LW-UNV-L8XX-CD1-U	5920	55	107.3
Full Frost Lens (LW)	High	4 ft.	4SNLED-LD5-44HL-LW-UNV-L8XX-CD1-U	4412	37	119.0
Full Frost Lens (LW)	High	4 ft.	4SNLED-LD5-48HL-LW-UNV-L8XX-CD1-U	4615	39	118.2
Full Frost Lens (LW)	High	4 ft.	4SNLED-LD5-54HL-LW-UNV-L8XX-CD1-U	5028	43	116.6
Full Frost Lens (LW)	High	4 ft.	4SNLED-LD5-65HL-LW-UNV-L8XX-CD1-U	6633	62	106.7
Full Frost Lens (LW)	Standard	8 ft.	8TSNLED-LD5-54SL-LW-UNV-L8XX-CD1-U	5496	42	129.8
Full Frost Lens (LW)	Standard	8 ft.	8TSNLED-LD5-61SL-LW-UNV-L8XX-CD1-U	6371	50	128.0
Full Frost Lens (LW)	Standard	8 ft.	8TSNLED-LD5-67SL-LW-UNV-L8XX-CD1-U	6371	50	128.0
Full Frost Lens (LW)	Standard	8 ft.	8TSNLED-LD5-74SL-LW-UNV-L8XX-CD1-U	7625	61	124.7
Full Frost Lens (LW)	Standard	8 ft.	8TSNLED-LD5-81SL-LW-UNV-L8XX-CD1-U	8428	69	122.1
Full Frost Lens (LW)	Standard	8 ft.	8TSNLED-LD5-88SL-LW-UNV-L8XX-CD1-U	9022	75	120.0
Full Frost Lens (LW)	Standard	8 ft.	8TSNLED-LD5-95SL-LW-UNV-L8XX-CD1-U	9785	82	119.1
Full Frost Lens (LW)	High	8 ft.	8TSNLED-LD5-110HL-LW-UNV-L8XX-CD1-U	11356	103	109.9
Full Frost Lens (LW)	High	8 ft.	8TSNLED-LD5-150HL-LW-UNV-L8XX-CD2-U	15739	158	99.5

* Consult factory for stock availability. ** Lumen portion of catalog number may not match actual lumens.

Metalux

SNLED Lensed

Energy and Performance Data

L21

Wattage: Square Flat Clear Lens

SNLED Type	Lumen Type	Length	Catalog Number**	Nominal 3500K Lumens	Wattage	lm/W
Flat Clear Lens (SLC)	Standard	2 ft.	2SNLED-LD5-19SL-SLC-UNV-L8XX-CD1-U	1936	14	135.7
Flat Clear Lens (SLC)	Standard	2 ft.	2SNLED-LD5-24SL-SLC-UNV-L8XX-CD1-U	2391	18	132.1
Flat Clear Lens (SLC)	Standard	2 ft.	2SNLED-LD5-27SL-SLC-UNV-L8XX-CD1-U	2714	21	129.5
Flat Clear Lens (SLC)	High	2 ft.	2SNLED-LD5-37HL-SLC-UNV-L8XX-CD1-U	3669	27	138.1
Flat Clear Lens (SLC)	High	2 ft.	2SNLED-LD5-48HL-SLC-UNV-L8XX-CD1-U	4830	36	134.5
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-19SL-SLC-UNV-L8XX-CD1-U	1868	13	143.3
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-23SL-SLC-UNV-L8XX-CD1-U	2316	16	144.7
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-27SL-SLC-UNV-L8XX-CD1-U	2666	18	144.5
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-30SL-SLC-UNV-L8XX-CD1-U	3040	21	143.6
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-35SL-SLC-UNV-L8XX-CD1-U	3524	25	141.6
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-39SL-SLC-UNV-L8XX-CD1-U	3876	28	139.9
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-42SL-SLC-UNV-L8XX-CD1-U	4217	31	138.0
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-47SL-SLC-UNV-L8XX-CD1-U	4662	35	135.1
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-50SL-SLC-UNV-L8XX-CD1-U	4990	38	132.7
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-54SL-SLC-UNV-L8XX-CD1-U	5412	41	131.7
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-58SL-SLC-UNV-L8XX-CD1-U	5809	46	125.9
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-63SL-SLC-UNV-L8XX-CD1-U	6281	52	121.6
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-65SL-SLC-UNV-L8XX-CD1-U	6549	55	118.7
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-77SL-SLC-UNV-L8XX-CD1-U	7697	70	110.0
Flat Clear Lens (SLC)	Standard	4 ft.	4SNLED-LD5-85SL-SLC-UNV-L8XX-CD1-U	8490	85	100.4
Flat Clear Lens (SLC)	High	4 ft.	4SNLED-LD5-54HL-SLC-UNV-L8XX-CD1-U	5441	37	146.8
Flat Clear Lens (SLC)	High	4 ft.	4SNLED-LD5-57HL-SLC-UNV-L8XX-CD1-U	5692	39	145.7
Flat Clear Lens (SLC)	High	4 ft.	4SNLED-LD5-62HL-SLC-UNV-L8XX-CD1-U	6201	43	143.8
Flat Clear Lens (SLC)	High	4 ft.	4SNLED-LD5-68HL-SLC-UNV-L8XX-CD1-U	6795	48	140.8
Flat Clear Lens (SLC)	High	4 ft.	4SNLED-LD5-82HL-SLC-UNV-L8XX-CD1-U	8181	62	131.7
Flat Clear Lens (SLC)	High	4 ft.	4SNLED-LD5-97HL-SLC-UNV-L8XX-CD1-U	9705	79	122.7
Flat Clear Lens (SLC)	Standard	8 ft.	8TSNLED-LD5-60SL-SLC-UNV-L8XX-CD1-U	6080	42	143.6
Flat Clear Lens (SLC)	Standard	8 ft.	8TSNLED-LD5-70SL-SLC-UNV-L8XX-CD1-U	7048	50	141.6
Flat Clear Lens (SLC)	Standard	8 ft.	8TSNLED-LD5-78SL-SLC-UNV-L8XX-CD1-U	7753	50	139.9
Flat Clear Lens (SLC)	Standard	8 ft.	8TSNLED-LD5-84SL-SLC-UNV-L8XX-CD1-U	8435	61	138.0
Flat Clear Lens (SLC)	Standard	8 ft.	8TSNLED-LD5-93SL-SLC-UNV-L8XX-CD1-U	9323	69	135.1
Flat Clear Lens (SLC)	Standard	8 ft.	8TSNLED-LD5-100SL-SLC-UNV-L8XX-CD1-U	9980	75	132.7
Flat Clear Lens (SLC)	Standard	8 ft.	8TSNLED-LD5-108SL-SLC-UNV-L8XX-CD1-U	10824	82	131.7
Flat Clear Lens (SLC)	Standard	8 ft.	8TSNLED-LD5-116SL-SLC-UNV-L8XX-CD1-U	11618	61	125.9
Flat Clear Lens (SLC)	Standard	8 ft.	8TSNLED-LD5-125SL-SLC-UNV-L8XX-CD2-U	12562	69	121.6
Flat Clear Lens (SLC)	Standard	8 ft.	8TSNLED-LD5-131SL-SLC-UNV-L8XX-CD2-U	13097	75	118.7
Flat Clear Lens (SLC)	High	8 ft.	8TSNLED-LD5-130HL-SLC-UNV-L8XX-CD2-U	12402	82	143.8
Flat Clear Lens (SLC)	High	8 ft.	8TSNLED-LD5-170HL-SLC-UNV-L8XX-CD2-U	16361	103	131.7
Flat Clear Lens (SLC)	High	8 ft.	8TSNLED-LD5-200HL-SLC-UNV-L8XX-CD2-U	19411	158	122.7

* Consult factory for stock availability. ** Lumen portion of catalog number may not match actual lumens.



Metalux

SNLED Lensed

Energy and Performance Data

L21

Wattage: Square Flat Semi-frost Lens, Narrow

SNLED Type	Lumen Type	Length	Catalog Number**	Nominal 3500K Lumens	Wattage	lm/W
Flat Semi-frost Lens (SLN)	Standard	2 ft.	2SNLED-LD5-19SL-SLN-UNV-L8XX-CD1-U	1931	14	135.3
Flat Semi-frost Lens (SLN)	Standard	2 ft.	2SNLED-LD5-24SL-SLN-UNV-L8XX-CD1-U	2385	18	131.7
Flat Semi-frost Lens (SLN)	Standard	2 ft.	2SNLED-LD5-27SL-SLN-UNV-L8XX-CD1-U	2706	21	129.1
Flat Semi-frost Lens (SLN)	High	2 ft.	2SNLED-LD5-37HL-SLN-UNV-L8XX-CD1-U	3659	27	137.7
Flat Semi-frost Lens (SLN)	High	2 ft.	2SNLED-LD5-48HL-SLN-UNV-L8XX-CD1-U	4816	36	134.2
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-19SL-SLN-UNV-L8XX-CD1-U	1863	13	142.9
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-23SL-SLN-UNV-L8XX-CD1-U	2309	16	144.3
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-27SL-SLN-UNV-L8XX-CD1-U	2659	18	144.1
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-30SL-SLN-UNV-L8XX-CD1-U	3032	21	143.2
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-35SL-SLN-UNV-L8XX-CD1-U	3514	25	141.2
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-39SL-SLN-UNV-L8XX-CD1-U	3866	28	139.5
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-42SL-SLN-UNV-L8XX-CD1-U	4206	31	137.6
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-46SL-SLN-UNV-L8XX-CD1-U	4649	35	134.7
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-50SL-SLN-UNV-L8XX-CD1-U	4976	38	132.4
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-54SL-SLN-UNV-L8XX-CD1-U	5397	41	131.4
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-58SL-SLN-UNV-L8XX-CD1-U	5793	46	125.6
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-63SL-SLN-UNV-L8XX-CD1-U	6264	52	121.3
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-65SL-SLN-UNV-L8XX-CD1-U	6530	55	118.4
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-78SL-SLN-UNV-L8XX-CD1-U	7676	70	109.7
Flat Semi-frost Lens (SLN)	Standard	4 ft.	4SNLED-LD5-85SL-SLN-UNV-L8XX-CD1-U	8466	85	100.1
Flat Semi-frost Lens (SLN)	High	4 ft.	4SNLED-LD5-54HL-SLN-UNV-L8XX-CD1-U	5426	37	146.4
Flat Semi-frost Lens (SLN)	High	4 ft.	4SNLED-LD5-57HL-SLN-UNV-L8XX-CD1-U	5676	39	145.3
Flat Semi-frost Lens (SLN)	High	4 ft.	4SNLED-LD5-62HL-SLN-UNV-L8XX-CD1-U	6184	43	143.4
Flat Semi-frost Lens (SLN)	High	4 ft.	4SNLED-LD5-68HL-SLN-UNV-L8XX-CD1-U	6776	48	140.5
Flat Semi-frost Lens (SLN)	High	4 ft.	4SNLED-LD5-82HL-SLN-UNV-L8XX-CD1-U	8158	62	131.3
Flat Semi-frost Lens (SLN)	High	4 ft.	4SNLED-LD5-97HL-SLN-UNV-L8XX-CD1-U	9679	79	122.4
Flat Semi-frost Lens (SLN)	Standard	8 ft.	8TSNLED-LD5-64SL-SLN-UNV-L8XX-CD1-U	6063	42	143.2
Flat Semi-frost Lens (SLN)	Standard	8 ft.	8TSNLED-LD5-70SL-SLN-UNV-L8XX-CD1-U	7028	50	141.2
Flat Semi-frost Lens (SLN)	Standard	8 ft.	8TSNLED-LD5-77SL-SLN-UNV-L8XX-CD1-U	7731	55	139.5
Flat Semi-frost Lens (SLN)	Standard	8 ft.	8TSNLED-LD5-84SL-SLN-UNV-L8XX-CD1-U	8411	61	137.6
Flat Semi-frost Lens (SLN)	Standard	8 ft.	8TSNLED-LD5-93SL-SLN-UNV-L8XX-CD1-U	9297	69	134.7
Flat Semi-frost Lens (SLN)	Standard	8 ft.	8TSNLED-LD5-100SL-SLN-UNV-L8XX-CD1-U	9952	75	132.4
Flat Semi-frost Lens (SLN)	Standard	8 ft.	8TSNLED-LD5-108SL-SLN-UNV-L8XX-CD1-U	10794	82	131.4
Flat Semi-frost Lens (SLN)	Standard	8 ft.	8TSNLED-LD5-116SL-SLN-UNV-L8XX-CD1-U	11586	92	125.6
Flat Semi-frost Lens (SLN)	Standard	8 ft.	8TSNLED-LD5-125SL-SLN-UNV-L8XX-CD2-U	12527	103	121.3
Flat Semi-frost Lens (SLN)	Standard	8 ft.	8TSNLED-LD5-130SL-SLN-UNV-L8XX-CD2-U	13061	110	118.4
Flat Semi-frost Lens (SLN)	High	8 ft.	8TSNLED-LD5-130HL-SLN-UNV-L8XX-CD2-U	12368	86	143.4
Flat Semi-frost Lens (SLN)	High	8 ft.	8TSNLED-LD5-170HL-SLN-UNV-L8XX-CD2-U	16316	124	131.3
Flat Semi-frost Lens (SLN)	High	8 ft.	8TSNLED-LD5-200HL-SLN-UNV-L8XX-CD2-U	19357	158	122.4

* Consult factory for stock availability. ** Lumen portion of catalog number may not match actual lumens.



Metalux

SNLED Lensed

Energy and Performance Data

L21

Wattage: Square Flat Full-frost Lens, Wide

SNLED Type	Lumen Type	Length	Catalog Number**	Nominal 3500K Lumens	Wattage	lm/W
Flat Full-frost Lens (SLW)	Standard	2 ft.	2SNLED-LD5-16SL-SLW-UNV-L8XX-CD1-U	1604	14	112.4
Flat Full-frost Lens (SLW)	Standard	2 ft.	2SNLED-LD5-20SL-SLW-UNV-L8XX-CD1-U	1981	18	109.4
Flat Full-frost Lens (SLW)	Standard	2 ft.	2SNLED-LD5-22SL-SLW-UNV-L8XX-CD1-U	2248	21	107.3
Flat Full-frost Lens (SLW)	High	2 ft.	2SNLED-LD5-30HL-SLW-UNV-L8XX-CD1-U	3077	27	115.8
Flat Full-frost Lens (SLW)	High	2 ft.	2SNLED-LD5-41HL-SLW-UNV-L8XX-CD1-U	4051	36	
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-15SL-SLW-UNV-L8XX-CD1-U	1547	13	118.7
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-19SL-SLW-UNV-L8XX-CD1-U	1918	16	119.8
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-22SL-SLW-UNV-L8XX-CD1-U	2209	18	119.7
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-25SL-SLW-UNV-L8XX-CD1-U	2518	21	119.0
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-29SL-SLW-UNV-L8XX-CD1-U	2919	25	117.3
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-32SL-SLW-UNV-L8XX-CD1-U	3211	28	115.9
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-35SL-SLW-UNV-L8XX-CD1-U	3494	31	114.3
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-39SL-SLW-UNV-L8XX-CD1-U	3862	35	111.9
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-41SL-SLW-UNV-L8XX-CD1-U	4134	38	110.0
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-45SL-SLW-UNV-L8XX-CD1-U	4483	41	109.1
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-48SL-SLW-UNV-L8XX-CD1-U	4812	46	104.3
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-52SL-SLW-UNV-L8XX-CD1-U	5203	52	100.7
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-54SL-SLW-UNV-L8XX-CD1-U	5425	55	98.4
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-64SL-SLW-UNV-L8XX-CD1-U	6376	70	91.1
Flat Full-frost Lens (SLW)	Standard	4 ft.	4SNLED-LD5-70SL-SLW-UNV-L8XX-CD1-U	7033	48	83.1
Flat Full-frost Lens (SLW)	High	4 ft.	4SNLED-LD5-46HL-SLW-UNV-L8XX-CD1-U	4564	37	123.1
Flat Full-frost Lens (SLW)	High	4 ft.	4SNLED-LD5-48HL-SLW-UNV-L8XX-CD1-U	4774	39	122.2
Flat Full-frost Lens (SLW)	High	4 ft.	4SNLED-LD5-52HL-SLW-UNV-L8XX-CD1-U	5201	43	120.6
Flat Full-frost Lens (SLW)	High	4 ft.	4SNLED-LD5-57HL-SLW-UNV-L8XX-CD1-U	5699	48	118.1
Flat Full-frost Lens (SLW)	High	4 ft.	4SNLED-LD5-69HL-SLW-UNV-L8XX-CD1-U	6862	62	110.4
Flat Full-frost Lens (SLW)	High	4 ft.	4SNLED-LD5-81HL-SLW-UNV-L8XX-CD1-U	8141	79	102.9
Flat Full-frost Lens (SLW)	Standard	8 ft.	8TSNLED-LD5-50SL-SLW-UNV-L8XX-CD1-U	5037	42	119.0
Flat Full-frost Lens (SLW)	Standard	8 ft.	8TSNLED-LD5-58SL-SLW-UNV-L8XX-CD1-U	5838	50	117.3
Flat Full-frost Lens (SLW)	Standard	8 ft.	8TSNLED-LD5-64SL-SLW-UNV-L8XX-CD1-U	6422	55	115.9
Flat Full-frost Lens (SLW)	Standard	8 ft.	8TSNLED-LD5-70SL-SLW-UNV-L8XX-CD1-U	6987	61	114.3
Flat Full-frost Lens (SLW)	Standard	8 ft.	8TSNLED-LD5-77SL-SLW-UNV-L8XX-CD1-U	7723	69	111.9
Flat Full-frost Lens (SLW)	Standard	8 ft.	8TSNLED-LD5-83SL-SLW-UNV-L8XX-CD1-U	8267	75	110.0
Flat Full-frost Lens (SLW)	Standard	8 ft.	8TSNLED-LD5-90SL-SLW-UNV-L8XX-CD1-U	8966	82	109.1
Flat Full-frost Lens (SLW)	Standard	8 ft.	8TSNLED-LD5-96SL-SLW-UNV-L8XX-CD1-U	9624	92	104.3
Flat Full-frost Lens (SLW)	Standard	8 ft.	8TSNLED-LD5-104SL-SLW-UNV-L8XX-CD1-U	10406	103	100.7
Flat Full-frost Lens (SLW)	Standard	8 ft.	8TSNLED-LD5-108SL-SLW-UNV-L8XX-CD1-U	10850	110	98.4
Flat Full-frost Lens (SLW)	High	8 ft.	8TSNLED-LD5-130HL-SLW-UNV-L8XX-CD2-U	10402	86	120.6
Flat Full-frost Lens (SLW)	High	8 ft.	8TSNLED-LD5-170HL-SLW-UNV-L8XX-CD2-U	13723	124	110.4
Flat Full-frost Lens (SLW)	High	8 ft.	8TSNLED-LD5-200HL-SLW-UNV-L8XX-CD2-U	16281	158	102.9

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L22

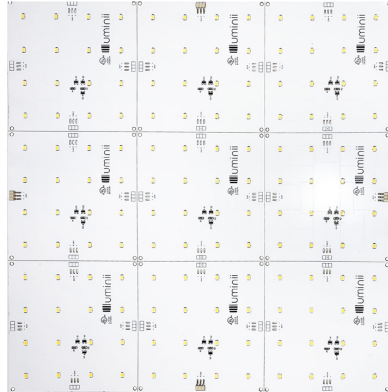
Matrix Plus & Matrix Mini Plus

High Efficacy Grid LED panel - 24 VDC

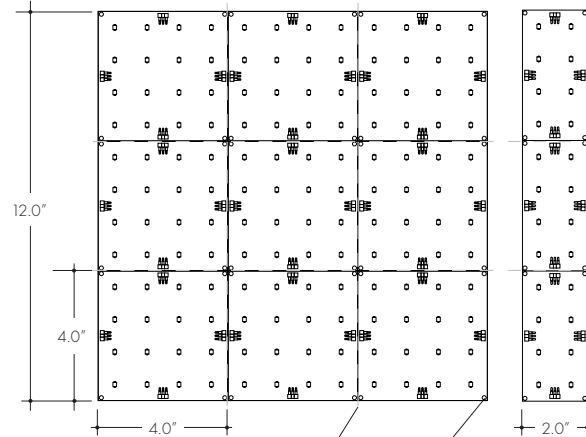


The Matrix Plus & Matrix Mini Plus is a small profile, modular, energy efficient, and flexible LED backlighting system that provides even backlight illumination with minimal cavity depth. The unique design allows it to be mounted directly on a surface. The Matrix Plus & Matrix Mini Plus is equipped with 3M™ adhesive transfer tape (9472LE), and secured in place with screws. The modular design allows for simple field installation in many different configurations. 5 year warranty. Lumen Maintenance: Calculated L90 at 173,000 hours for High Output.

Matrix Plus



Matrix Mini Plus



Cut along lines to separate into 9 sections for Matrix Plus & 3 sections Matrix Mini Plus. (Dash lines shown as reference)



Technical information

MODELS	Matrix Plus (LO)	Matrix Mini Plus (LO)	Matrix Plus (SO)	Matrix Mini Plus (SO)	Matrix Plus (HO)	Matrix Mini Plus (HO)
LEDs/unit	144	24	144	24	144	24
Lumens at 30K	430 lm	66 lm	832 lm	139 lm	1232 lm	213 lm
Power consumption	3.2 W	0.6 W	6.1 W	1.1 W	9.2 W	1.6 W
Lumens/Watt	134 lm/W	110 lm/W	136 lm/W	126 lm/W	134 lm/W	133 lm/W
Dimensions	12.00" W 12.00" L	12.00" W 2.00" L	12.00" W 12.00" L	12.00" W 2.00" L	12.00" W 12.00" L	12.00" W 2.00" L

CCT INFO/LUMEN MULTIPLIER		TM-30-15		
Color temperature	Multiplier (reference - 3000K)	CRI	R _f	R _g
3000K	1.00	93	91	100
3500K	1.06	93	90	100
4000K	1.11	93	87	96

Other Manufacturers:
JESCO "FLEX2" Series
Q-TRAN "QS23" Series

Ordering Code

MODEL	OUTPUT	COLOR TEMPERATURE
MP-Matrix Plus MMP-Matrix Mini Plus	LO-Low SO-Standard HO-High	30K-3000K 35K-3500K 40K-4000K

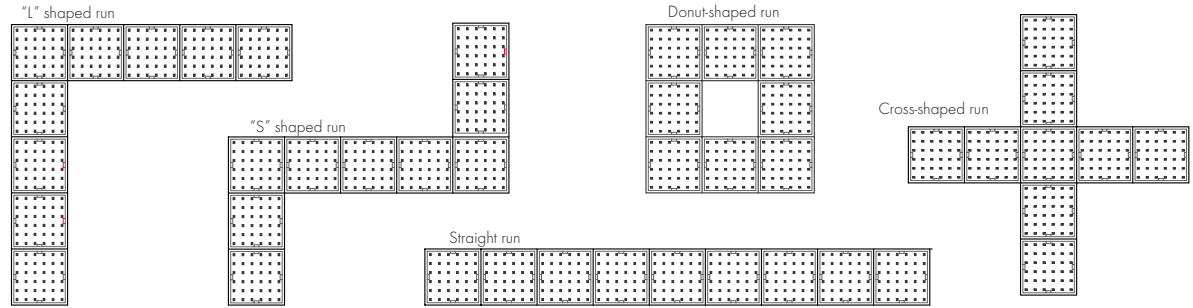
Matrix Plus & Matrix Mini Plus

High Efficacy Grid LED panel - 24 VDC

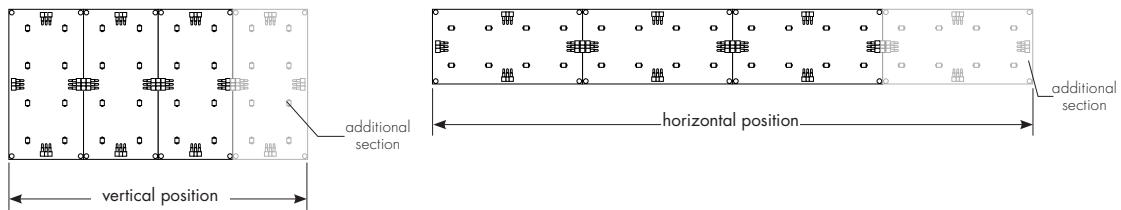


System Configurations

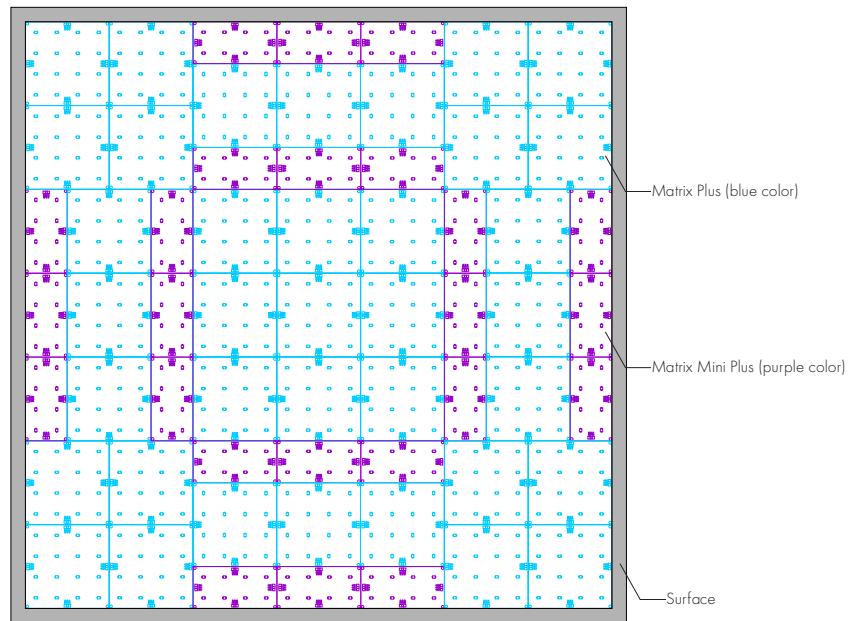
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- Matrix Mini Plus (not to scale)



- Matrix Plus & Matrix Mini Plus System (not to scale)

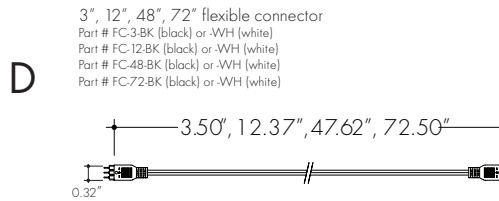
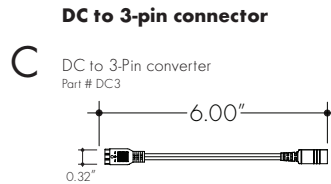
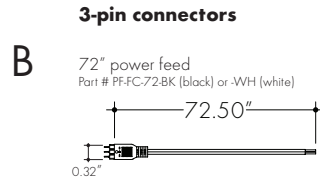
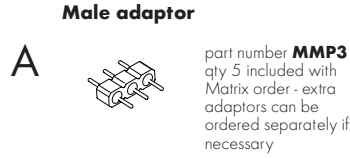


Matrix Plus & Matrix Mini Plus

High Efficacy Grid LED panel - 24 VDC



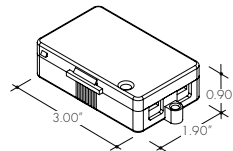
Connectors & Accessories



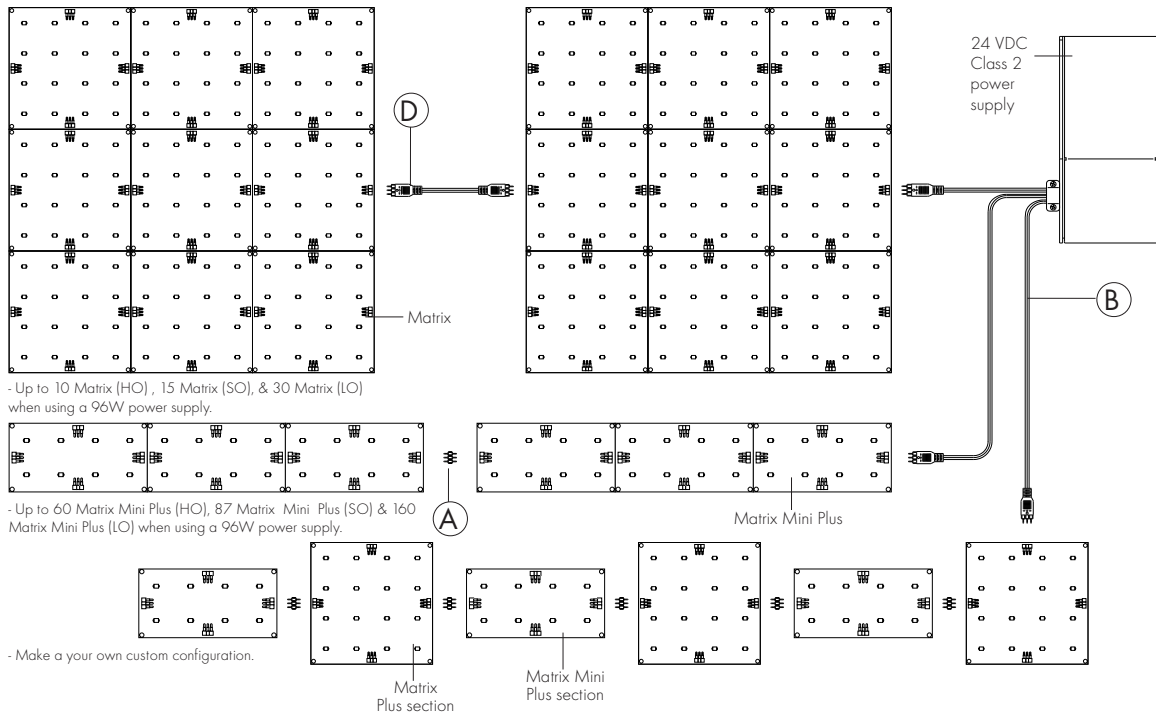
Accessories

Splice Box:
Low voltage, 4 terminal splice box, black.

Part # LVSP-4T-BK



Sample layout with connectors



L22



Matrix Plus & Matrix Mini Plus | High Efficacy Grid LED panel - 24 VDC

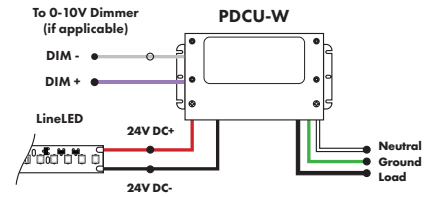
Power Supplies

See Power Supply instructions and spec sheet for wiring information. For a complete list of compatible dimmers, see Compatible Dimming Chart on the Resources page.

Universal Power Supply 1% 120VAC - 277VAC

MODEL	POWER	OUTPUT
PDCU-W - IP66 Wet Series	96 - 96 W 3X96 - 3X96 W	

0-10V dims down to 1%, MLV/ELV/TRIAC dims down to 1%.
For a complete list of compatible dimmers, see [Compatible Dimming Chart](#) on the Resources page.

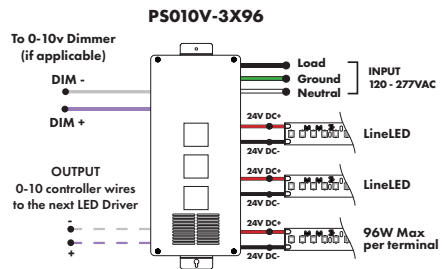
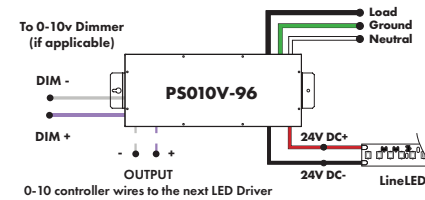


MODELS	PDCU-W 96W	PDCU-W 3X96W
Length	8.66"	11.85"
Width	3.73"	4.32"
Depth	1.61"	1.81"

0-10V Dimming Power Supplies 0.1% 120VAC - 277VAC

MODEL	POWER	OUTPUT	DIMMING
PS010V - 0-10V Power Supply dims down to 0.1%	96 - 96 Watt 3X96 - 3 X 96 Watt	24 - 24 VDC	LIN - Linear LOG - Logarithmic

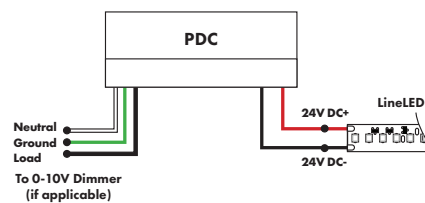
MODELS	96W	3X96
Length	14.40"	15.75"
Width	5.20"	6.62"
Depth	2.60"	4.95"



Triac, MLV, & ELV Compatible Dimmers

MODEL	POWER	OUTPUT
PDC - (IP20) Power Supply	96 - 96 Watts	24 - 24 VDC

MODELS	96W
Length	8.25"
Width	4.10"
Depth	1.56"



Matrix Plus & Matrix Mini Plus | High Efficacy Grid LED panel - 24 VDC

Power Supplies

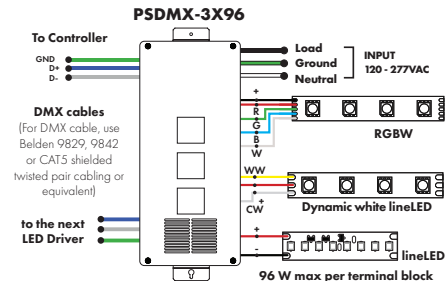
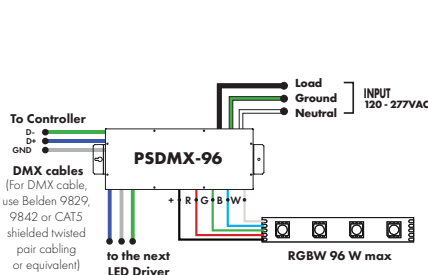
See Power Supply instructions and spec sheet for wiring information. For a complete list of compatible dimmers, see Compatible Dimming Chart on the Resources page.

DMX Dimming Power Supplies 120VAC - 277VAC

MODEL	POWER	OUTPUT
PSDMX - DMX Power Supply dims down to 0%	96 - 96 Watt 3X96 - 3 X 96 Watt	24 - 24 VDC

Features eldoLED's LINEARdrive configurable dimmable drivers

MODELS	96W	3X96
Length	14.40"	15.75"
Width	5.20"	6.62"
Depth	2.60"	4.95"

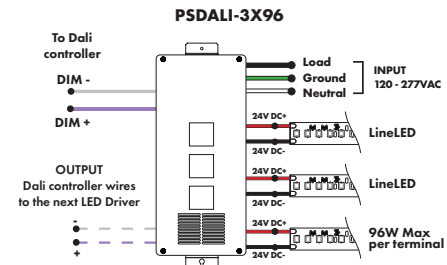
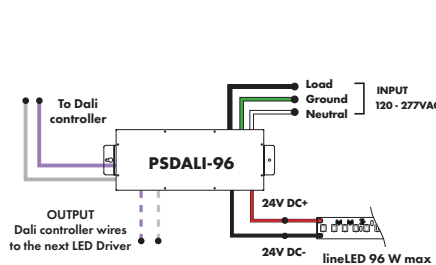


DALI 0% Dimming Power Supplies 120VAC - 277VAC

MODEL	POWER	OUTPUT
PSDALI - DALI Power Supply dims down to 0%	96 - 96 Watt 3X96 - 3 X 96 Watt	24 - 24 VDC

Features eldoLED's LINEARdrive configurable dimmable drivers

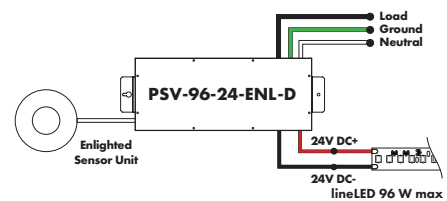
Model	96W	3X96
Length	14.40"	15.75"
Width	5.20"	6.62"
Depth	2.60"	4.95"



Enlighted Enabled Dimming Power Supplies 120VAC - 277VAC

MODEL	POWER	OUTPUT	DIMMING	LOCATION
PSV - PSV Series	96 - 96 Watt	24 - 24 VDC	ENL - Enlighted Dimming dims down to 0%	D - Damp

Model	96W
Length	14.40"
Width	5.20"
Depth	2.60"



Matrix Plus & Matrix Mini Plus

High Efficacy Grid LED panel - 24 VDC



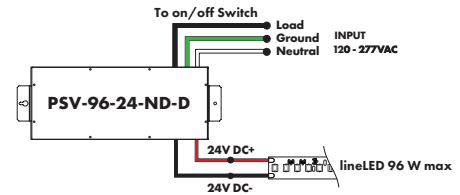
Power Supplies

See Power Supply instructions and spec sheet for wiring information. For a complete list of compatible dimmers, see Compatible Dimming Chart on the Resources page.

Non-Dimming Power Supply 120VAC - 277VAC

MODEL	POWER	OUTPUT	DIMMING	LOCATION
PSV - PSV Series	96 - 96 Watt	24 - 24 VDC	U2ND - Non Dimming	D - Damp

MODELS	96W
Length	14.40"
Width	5.20"
Depth	2.60"

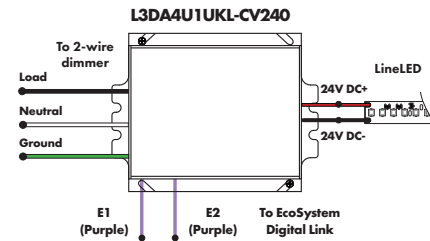
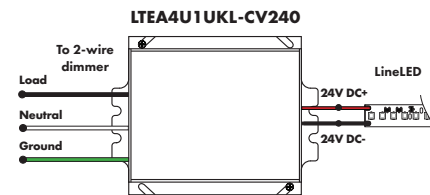


Luminii is a Lutron OEM Advantage Partner

Lutron Power Supplies 1%

MODEL	MODEL
LTEA4U1UKL-CV240	L3DA4U1UKL-CV240
Lutron - HiLume™ 1% 2-wire LED Driver 40W max	HiLume™ 1% EcoSystem Voltage LED driver 40W max
(120V forward phase only)	

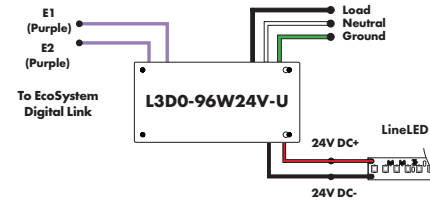
MODELS	LTEA4U1UKL-CV240	L3DA4U1UKL-CV240
Length	4.89"	4.98"
Width	4.00"	4.00"
Depth	2.62"	2.62"



Luminii is a Lutron OEM Advantage Partner

Lutron Power Supplies 0.1%

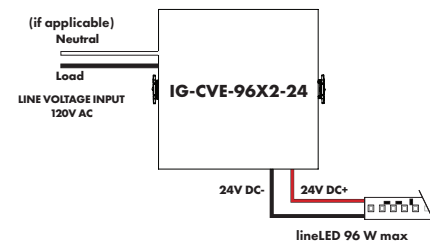
MODEL	MODELS	L3D0
L3D0-96W24V-U	Length	10.50"
HiLume™ 0.1% EcoSystem Voltage LED Driver with Soft-On, Fade-to-Black™ 96W max	Width	5.50"
	Depth	2.00"



In-Ground Power Supplies

MODEL	POWER	OUTPUT	INPUT
IG - In ground CVE Series	CVE - ELV Dimming DALI - eldoLED Dali dimming Both dims down to 0%	96X2 - 2 X 96 Watt	24 - 24 VDC
			Blank - 120 V 277 - 240/277 V

MODELS	Dual Circuit
Length	8.40"
Width	8.30"
Depth	8.10"



Other Manufacturers:
BL "fixFORM SF NS" Series
JESCO "DL-FLEX2-NPXSL" Series
KLUS "PIKO-ZM" Series

FIXTURE TYPE **L23**
PROJECT NAME _____
LOCATION _____



I Description

Our Uniform series provides single bin color consistency across every single output option. Uniform Thin Line provides a solution for projects with exceptionally small dimensional requirements.

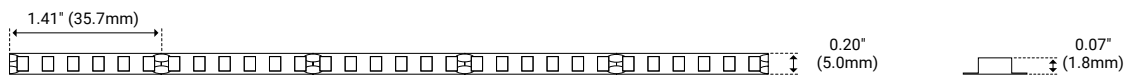
I Features

- Uses U2835 Diode
- Create a Custom Fixture with Kelvix Channels
- 5-Year Warranty
- UL-Listed
- 3M™ Industrial Adhesive Backing
- For Use with 24V Power Supplies
- Dimmable Using Kelvix Power Supplies
- Offering 1-Step, 2-Step, and 3-Step SDCM

I Series Spec

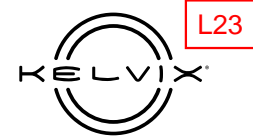
Series	UNI1-TL / UNI2-TL / UNI3-TL
Temp/Colors*	1800K–6500K
Input Voltage	24V DC/Constant Voltage
Beam Spread	120°
CRI	90–97
SDCM	1-Step, 2-Step, and 3-Step
Diode	2835
Diode Pitch	0.23" (5.8mm)
Cut Intervals	1.41" (35.7mm)
Dimensions	0.20" (5.0mm) × 0.07" (1.8mm)
Operating Temp.	-4°F (-20°C) to 140°F (60°C)
Storage Temp.	-4°F (-20°C) to 158°F (70°C)

I Dimensions



* Customizable—Consult Factory
±5% tolerance for all listed data

Conforms to ANSI/UL Standard 2108
Certified to CAN/CSA Standard C22.2 NO. 250.0



I Product Code Builder

Series	Location	Output*	Temp/ Colors*	Voltage	Modification
	I			24V	NA
Series	Location	Output*	Temp/ Colors*	Voltage	Modification
UNI1-TL – Uniform Thin Line 1-Step UNI2-TL – Uniform Thin Line 2-Step UNI3-TL – Uniform Thin Line 3-Step	I – Indoor	100 – 100 lm/ft 200 – 200 lm/ft 300 – 300 lm/ft	18K – 1800K 22K – 2200K 24K – 2400K 27K – 2700K 30K – 3000K 35K – 3500K 40K – 4000K 50K – 5000K 65K – 6500K	24V – 24V DC	NA – None

Example: UNI1-TL-I-100-18K-24V-NA

I Series Data

	1-Step			2-Step			3-Step		
	100 (lm/ft)	200 (lm/ft)	300 (lm/ft)	100 (lm/ft)	200 (lm/ft)	300 (lm/ft)	100 (lm/ft)	200 (lm/ft)	300 (lm/ft)
1800K	97	188	298	99	191	305	99	176	281
2200K	105	204	324	107	207	331	107	190	306
2400K	108	211	335	111	214	342	111	197	316
2700K	113	220	347	116	223	355	115	205	328
3000K	116	227	358	119	229	366	119	211	338
3500K	120	233	369	123	236	377	122	217	348
4000K	122	237	375	125	240	384	125	221	354
5000K	123	240	380	126	243	389	126	224	359
6500K	128	250	395	131	253	404	131	233	373
Wattage ¹ (per ft)	1.1	2.1	3.4	1.1	2.1	3.4	0.9	1.9	2.8
Efficacy (lm/W)	106	108	105	108	109	108	132	111	121
Max Run Length (ft)	37	22	17	37	22	17	37	24	21

* Customizable—Consult Factory

¹Power consumption based on average wattage per foot. Refer to Power Chart on page 5 for details.
±5% tolerance for all listed data



I Power Feed Accessories

Lead



Unit Number	Length*
FML-2C-1	12.00" (305.0mm)
FML-2C-2	24.00" (0.60m)
FML-2C-3	36.00" (0.91m)
FML-2C-6	72.00" (1.82m)
FML-2C-12	144.00" (3.65m)
FML-2C-15	180.00" (4.57m)
FML-2C-20	240.00" (6.09m)



For leads on both input and output,
specify 2x FML-xC-xx per run.

Lead with DC Plug



Unit Number	Length*
FML-2C-DC-1-M	12.00" (305.0mm)
FML-2C-DC-1-F	12.00" (305.0mm)
FML-2C-DC-6-M	72.00" (1.82m)
FML-2C-DC-6-F	72.00" (1.82m)
FML-2C-DC-10-M	120.00" (3.04m)
FML-2C-DC-10-F	120.00" (3.04m)



Connector



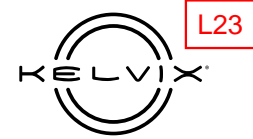
Unit Number	Length*
FMC-2C-1.5I	1.50" (38.0mm)
FMC-2C-3I	3.00" (76.0mm)
FMC-2C-6I	6.00" (152.0mm)
FMC-2C-9I	9.00" (228.0mm)
FMC-2C-1	12.00" (305.0mm)
FMC-2C-2	24.00" (0.60m)



* Customizable—Consult Factory

¹Power consumption based on average wattage per foot. Refer to Power Chart on page 5 for details.

±5% tolerance for all listed data



I Power Chart

1-Step & 2-Step				
		100 (lm/ft)	200 (lm/ft)	300 (lm/ft)
Watts	1 ft	1.1	2.2	3.6
	2 ft	2.3	4.4	6.8
	3 ft	3.5	6.6	10.2
	4 ft	4.6	8.9	13.6
	5 ft	5.8	11.0	17.2
	6 ft	6.9	13.2	20.6
	7 ft	8.0	15.4	24.6
	8 ft	9.2	17.5	27.9
	9 ft	10.3	19.6	31.1
	10 ft	11.4	21.6	34.2
	11 ft	12.5	23.7	37.4
	12 ft	13.6	25.7	40.3
	13 ft	14.7	27.6	43.2
	14 ft	15.8	29.5	46.0
	15 ft	16.8	31.4	48.6
	16 ft	17.9	33.2	51.2
	17 ft	18.9	35.0	53.7
	18 ft	19.9	36.7	-
	19 ft	21.0	38.4	-
	20 ft	21.9	40.0	-
	21 ft	22.9	41.6	-
	22 ft	23.9	43.2	-
	23 ft	24.8	-	-
	24 ft	25.8	-	-
	25 ft	26.7	-	-
	26 ft	27.6	-	-
	27 ft	28.4	-	-
	28 ft	29.3	-	-
	29 ft	30.1	-	-
	30 ft	31.0	-	-
	31 ft	31.8	-	-
	32 ft	32.6	-	-
	33 ft	33.3	-	-
	34 ft	34.1	-	-
	35 ft	34.8	-	-
	36 ft	35.5	-	-
	37 ft	36.2	-	-

3-Step				
		100 (lm/ft)	200 (lm/ft)	300 (lm/ft)
Watts	1 ft	0.9	2	3
	2 ft	1.9	4.1	6.1
	3 ft	2.9	6.1	9.1
	4 ft	3.9	8.1	12.1
	5 ft	4.8	10.1	14.9
	6 ft	5.7	12	17.7
	7 ft	6.7	14	20.5
	8 ft	7.6	15.8	22.9
	9 ft	8.6	17.7	25.5
	10 ft	9.4	19.4	28
	11 ft	10.4	21.2	30.6
	12 ft	11.3	22.9	32.8
	13 ft	12.3	24.6	35.1
	14 ft	12.9	26.1	37.2
	15 ft	14	27.8	39.4
	16 ft	14.5	29.3	41.2
	17 ft	15.7	30.7	43.2
	18 ft	16.3	32.1	45.1
	19 ft	17.1	33.4	46.7
	20 ft	18.1	34.9	48.4
	21 ft	18.7	36.2	49.9
	22 ft	19.6	37.4	-
	23 ft	20.5	38.5	-
	24 ft	21.2	39.7	-
	25 ft	21.7	-	-
	26 ft	22.2	-	-
	27 ft	23.1	-	-
	28 ft	24	-	-
	29 ft	24.4	-	-
	30 ft	25.3	-	-
	31 ft	25.9	-	-
	32 ft	26.6	-	-
	33 ft	26.9	-	-
	34 ft	27.9	-	-
	35 ft	28	-	-
	36 ft	28.9	-	-
	37 ft	29.5	-	-

±5% tolerance for all listed

4/6 | UNIX-TL-I | quotes@kelvix.com | 800.789.3810

Specification & Instruction Subject to Change | 100724JH

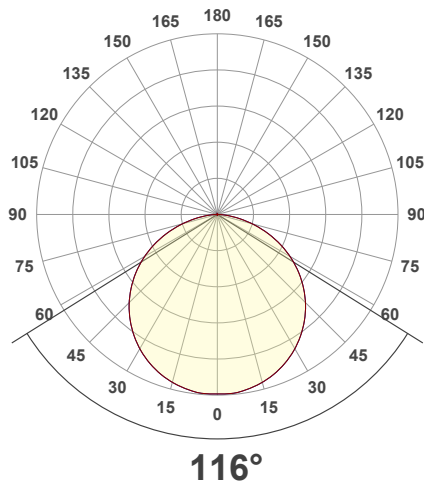


I TM30 Data

	@ 30K	CRI	Rf	Rg	R9
1-Step	100 lm/ft	96	94	102	95
	200 lm/ft	97	94	102	96
	300 lm/ft	97	94	102	97
2-Step	100 lm/ft	96	94	102	96
	200 lm/ft	96	94	102	96
	300 lm/ft	97	94	102	98
3-Step	100 lm/ft	95	91	99	77
	200 lm/ft	93	91	99	89
	300 lm/ft	93	91	100	88

I Polar Plot

UNI1-TL-I-300-30K



±5% tolerance for all listed data

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Specification & Instruction Subject to Change | 100724JH



I Cone of Light

UNI1-TL-I-100-30K / UNI2-TL-I-100-30K

Mtg Height	Light Level	Beam Diameter
1.0 ft	78.9 fc	3.2 ft
2.0 ft	19.7 fc	6.3 ft
3.0 ft	8.8 fc	9.5 ft
4.0 ft	4.9 fc	12.6 ft
5.0 ft	3.2 fc	15.8 ft
6.0 ft	2.2 fc	19.0 ft
7.0 ft	1.6 fc	22.1 ft
8.0 ft	1.2 fc	25.3 ft
9.0 ft	1.0 fc	28.4 ft
10.0 ft	0.8 fc	31.6 ft

UNI1-TL-I-200-30K / UNI2-TL-I-200-30K

Mtg Height	Light Level	Beam Diameter
1.0 ft	151.5 fc	3.2 ft
2.0 ft	37.9 fc	6.4 ft
3.0 ft	16.8 fc	9.6 ft
4.0 ft	9.5 fc	12.9 ft
5.0 ft	6.1 fc	16.1 ft
6.0 ft	4.2 fc	19.3 ft
7.0 ft	3.1 fc	22.5 ft
8.0 ft	2.4 fc	25.7 ft
9.0 ft	1.9 fc	28.9 ft
10.0 ft	1.5 fc	32.1 ft

UNI1-TL-I-300-30K / UNI2-TL-I-300-30K

Mtg Height	Light Level	Beam Diameter
1.0 ft	240.5 fc	3.2 ft
2.0 ft	60.1 fc	6.4 ft
3.0 ft	26.7 fc	9.6 ft
4.0 ft	15.0 fc	12.8 ft
5.0 ft	9.6 fc	16.0 ft
6.0 ft	6.7 fc	19.1 ft
7.0 ft	4.9 fc	22.3 ft
8.0 ft	3.8 fc	25.5 ft
9.0 ft	3.0 fc	28.7 ft
10.0 ft	2.4 fc	31.9 ft

UNI3-TL-I-100-30K

Mtg Height	Light Level	Beam Diameter
1.0 ft	80.0 fc	3.2 ft
2.0 ft	20.0 fc	6.3 ft
3.0 ft	8.9 fc	9.5 ft
4.0 ft	5.0 fc	12.7 ft
5.0 ft	3.2 fc	15.9 ft
6.0 ft	2.2 fc	19.0 ft
7.0 ft	1.6 fc	22.2 ft
8.0 ft	1.2 fc	25.4 ft
9.0 ft	1.0 fc	28.5 ft
10.0 ft	0.8 fc	31.7 ft

UNI3-TL-I-200-30K

Mtg Height	Light Level	Beam Diameter
1.0 ft	143.6 fc	3.1 ft
2.0 ft	35.9 fc	6.2 ft
3.0 ft	16.0 fc	9.3 ft
4.0 ft	9.0 fc	12.5 ft
5.0 ft	5.7 fc	15.6 ft
6.0 ft	4.0 fc	18.7 ft
7.0 ft	2.9 fc	21.8 ft
8.0 ft	2.2 fc	24.9 ft
9.0 ft	1.8 fc	28.0 ft
10.0 ft	1.4 fc	31.2 ft

UNI3-TL-I-300-30K

Mtg Height	Light Level	Beam Diameter
1.0 ft	229.8 fc	3.1 ft
2.0 ft	57.5 fc	6.2 ft
3.0 ft	25.5 fc	9.3 ft
4.0 ft	14.4 fc	12.4 ft
5.0 ft	9.2 fc	15.5 ft
6.0 ft	6.4 fc	18.6 ft
7.0 ft	4.7 fc	21.7 ft
8.0 ft	3.6 fc	24.8 ft
9.0 ft	2.8 fc	27.9 ft
10.0 ft	2.3 fc	31.0 ft

±5% tolerance for all listed data

6/6 | UNIx-TL-I | quotes@kelvix.com | 800.789.3810

Specification & Instruction Subject to Change | 100724JH

L23

FIXTURE TYPE _____

PROJECT NAME _____

LOCATION _____



I Description

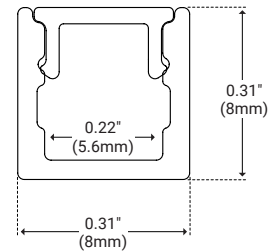
Add Linear Lighting to the Tightest of Spaces With Our Thin Line Tape and Channel Store in Temperature-Controlled Environment.

I Features

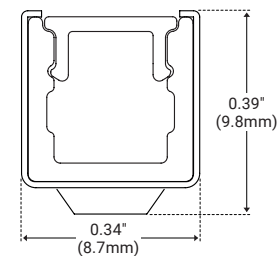
- Available In 78.74" (2m) Sections
- Extruded Aluminum Construction
- Anodized Matte Finish
- Consult Factory for Custom Lengths
- Available in Various Finish Colors

I Dimensions

Length	78.74" (2m)
Width (External)	0.31" (8mm)
Width (Internal)	0.22" (5.6mm)
Height	0.31" (8mm)



CHANNEL + MOUNTING CLIP



I Ordering Code Builder

Series	Length	Lens	Mounts	End Caps
CH0400	2		MMC	EC
CH0400 – CH-0400	2 – 2 Meters	WH – White Lens BK – Black Lens	MMC – Metal Clip	EC – End Cap Pair

Example: CH0400-2-WH-MMC-EC



I Lens



White Lens

Unit Number	CH-LNS-AI-WH-2M	Ordering Code	WH
Dimension	L 78.74" (2m)	W 0.26" (6.6mm)	H 0.12" (3.1mm)
Light transmission	70%		



Black Lens

Unit Number	CH-LNS-AI-BK-2M	Ordering Code	BK
Dimension	L 78.74" (2m)	W 0.26" (6.6mm)	H 0.12" (3.1mm)
Light transmission	30%		

I Mounts



Metal Mounting Clips

Unit Number	CH-CLP-0400-M	Ordering Code	MMC
Dimension	L 0.47" (12.1mm)	W 0.34" (8.7mm)	H 0.39" (9.8mm)

I End Cap



End Cap Pair

Unit Number	CH-EC-0400	Ordering Code	EC
Dimension	L 0.17" (4.4mm)	W 0.31" (7.94mm)	H 0.31" (7.94mm)

I Optional Accessories

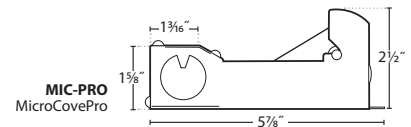
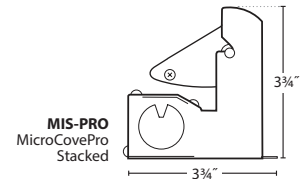
Product	Unit Number	Description
Accessory Pack	CH-PAK-0400	Accessories pack includes 1 pair of end caps and 4 metal clips.

LED MicroCovePro™ | Cove & Perimeter
Intergral

Other Manufacturers:
BIRCHWOOD "ASHLEY" Series
PINNACLE "COVE" Series
LUMENWERX "ALCOVE" Series

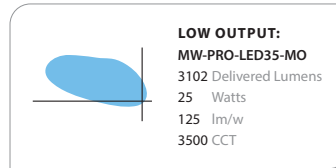


L24



Diminutive in scale, huge in performance.

MicroCovePro is an outstanding concealed cove luminaire designed with patent-pending PruOptics™ creating even light distribution while maintaining high efficiencies. 30° of tilt for vaulted coves. Now "PRO" with higher lumen output and PruHue options: Tunable White, Warm Dim, BIOS and RGBW.



UPTO 125 LPW SMART SPECS

	LO	MO	SO	HO
lm/ft	445	765	1065	1350
w/ft	3.75	6.5	9.4	12.5
NEW PRUHUES: BLU, TU, TU2, AMB + CHR				
lm/ft	300	400	515	650
w/ft	3.6	5	6.4	8.3

Declare.



Lumen output may vary +/- 5%
3500K used for lm/ft estimates above
4000K +2% l.f. 3000K -2%, 2700K -4%
-10% LLF for 90 CRI (4K, 3500K and 3K)
See LED Details PDF for more info

SERIES	LED COLOR	OUTPUT	NOMINAL LENGTH	CIRCUIT-ING	VOLTAGE	DRIVERS	OPTIONS
MIC-PRO MicroCove	LED27 2700K (90CRI) LED3 3000K LED35 3500K LED4 4000K LED3-90 3 000K (90CRI) LED35-90 3500K (90CRI) LED4-90 4000K (90CRI) LED5-90 5000K (90CRI)	LO Low MO Me- dium SO Stan- dard HO High	1' (1' Unit acts as a Sate- lite, 1' not available in individual with LO, no integral driver) 2' 3' 4' 6' 8' R____ (1' increments, see page 4 for row breakout)	SC SC Single Circuit	UNV (120-277) 347 (Emergency battery requires a Step Down transformer)	ND Non-Dimming DM01 0-10v, 1% Dimming (Standard) LDE1 Hi-lume 1% EcoSystem LED (Soft fade on, fade-to-black dimming) ECO 1% 0-10v, EldoLED (Logarithmic dimming std) ECDA 1% DALI, EldoLED (Logarithmic dimming std) SOLO 0.1% 0-10v, EldoLED (Dim-to-dark, Logarithmic dimming std) SODA 0.1% DALI, EldoLED (Dim-to-dark, Logarithmic dimming std) PRUHUES: E10V 2 Channel Color Control EDALI 2 Channel Color Control EDMX ChromaHue or Static White	EMHE CA T20 Emergency Battery (CA Title 20 compli- ant, 1000 delivered lumens, <4" Remote Only) PruTune Wall Device (EDALI driver only, one PruTune device for each zone)
MIS-PRO MicroCove Stacked	LED35-90 3500K (90CRI) LED4-90 4000K (90CRI) LED5-90 5000K (90CRI) PRUHUES: BIOS STATIC: BLU3S BLU35S BLU4S DYNAMIC: BLU3D* BLU35D* BLU4D* * Dynamic BIOS, SkyBlue spike can be dimmed, CCT warms slightly TU Tu-Hue 2700-6500K Tunable White TU2 Tu-Hue 2200-5000K Tunable White AMB AmberHue Warm Dim 2200K-5000K CHR ChromaHue RGBW (DMX at HO only)						

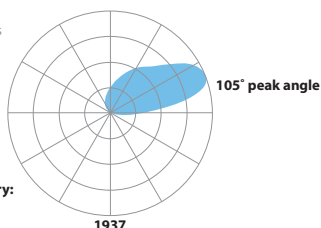
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LED **MicroCovePro™** | Cove & Perimeter
Integral



PHOTOMETRICS

LOW OUTPUT:
MIC-PRO-LED35-MO
3103 Delivered Lumens
25 Watts
125 lm/w
3500 CCT



Zonal Lumen Summary:
0-90 = 2%
90-180 = 98%

Vertical Angle	0°	25°	45°	65°	90°
80°	318	270	222	97	0
85°	487	466	346	147	0
90°	759	663	467	196	0
95°	1140	1055	726	284	32
100°	1599	1444	969	366	64
105°	1889	1606	1218	441	96
110°	1937	1681	1173	505	127
115°	1842	1622	1080	512	158
120°	1622	1459	983	513	189
125°	1484	1286	893	515	219
130°	1298	1130	838	520	250
135°	1148	1018	767	521	280
140°	1043	942	746	517	299
145°	961	868	706	510	319
150°	873	792	665	501	338
155°	782	717	615	491	357
160°	690	641	512	471	370
165°	598	565	490	452	377
170°	455	500	471	433	385
175°	425	446	433	415	392
180°	399	399	399	399	399

LUMEN MAINTENANCE

Designed to last with cool running mid-power LEDs projected to maintain 90% (L90) of their initial output for 100,000 hours (at HO), and L70 exceeding 150,000 hours.

LED SYSTEM

LED modules and drivers are field replaceable.

PROG

(OPTIONAL)

Programmable light output. Specify desired lumens or watts per linear foot. Min: 2.5 w/ft, consult factory for requests above 12 w/ft.

BINNING

Standard binning (all Prudential LED boards) includes testing at the chip level and board integration to provide consistent color temperature within a 3-step MacAdams ellipse, with +/- 5% lumen output range and +/- .004 Duv.

LABELS

CSA and ETL damp labeled and I.B.E.W. manufactured.

ELECTRICAL

Must specify LED dimming controls. LED fixtures have constant current driver(s) with less than 20% THD when loaded to a minimum of 60%. Drivers sink a maximum of 6mA per driver. DM01 LED drivers are 0-10V dimmable and are compatible with most 0-10V wall slide dimmers and direct 0-10V analog signal dimmers. Max driver size 1¼" w x 1" h.

CONSTRUCTION

Power cord is White

Housing

Extruded aluminum >25% PC recycled, 100% recyclable.

End Caps

20-gauge steel, >20% PC recycled, 100% recyclable.

Lens

Extruded acrylic with PruOptics™ prisms, 100% recyclable.

Weight

2.2 lbs / ft.

MOUNTING

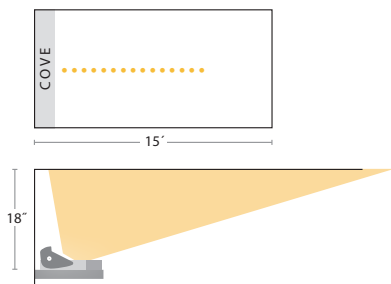
Surface mounted to walls or ceilings in concealed coves.

WARRANTY

Single-source, 5 year limited warranty covers standard components and construction.

MicroCove vs. Leading Competitor

A comparison of footcandle distributions on the ceiling.



	Watts/Ft	Cove Height	Ceiling Height	Ceiling Width	Average Illuminance (Ceiling)	Power Density (W/Sf)	Max	Min
MicroCove at Low Output - 460 lm/ft	5	18"	9'	15'	25fc	.32	82fc	5fc
Leading Competitor - 320 lm/ft	5	18"	9'	15'	17fc	.33	58fc	2fc

MicroCove at Low Output (4000K, 5w/ft) – footcandle values on ceiling (every foot)

COVE	82	76	60	43	31	22	16	12	9	8	6	5	5	5	5
------	----	----	----	----	----	----	----	----	---	---	---	---	---	---	---

Leading Competitor – (5w/ft)

COVE	58	50	38	28	20	14	9	7	5	4	3	3	2	2	2
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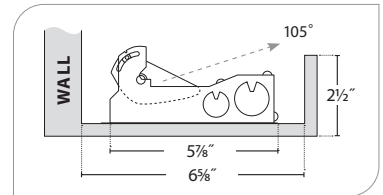
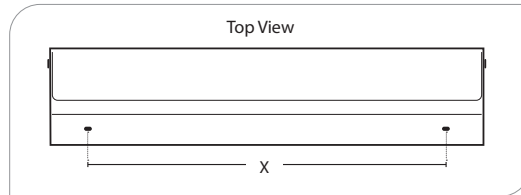
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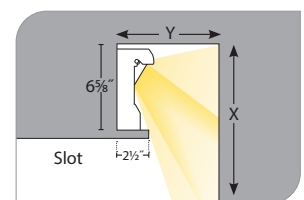
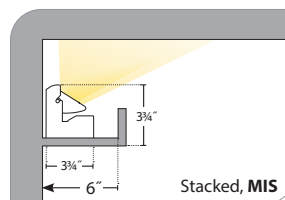
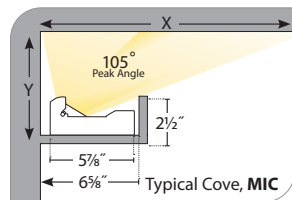
	Actual Fixture Length	'X' Mounting
1' =	12½"	9⅞"
2' =	22½"	20⅞"
3' =	34½"	31⅞"
4' =	46½"	43⅞"
5' =	58½"	55⅞"
6' =	70½"	67⅞"
7' =	82½"	79⅞"
8' =	94½"	91⅞"

Y	X
12"	33"
18"	49"
24"	66"

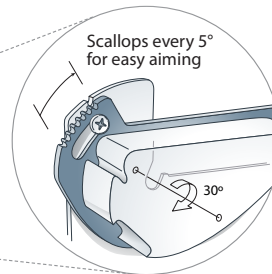
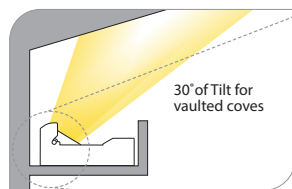
Y = Cove to Ceiling
X = Peak Candela at 105°



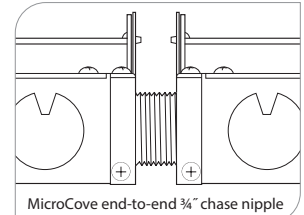
INSTALLATION HEIGHT



ADJUSTABILITY

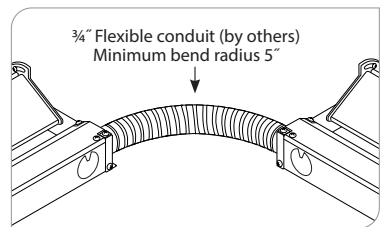
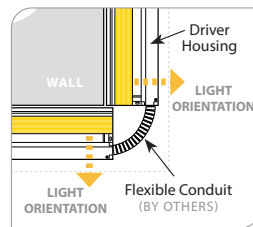
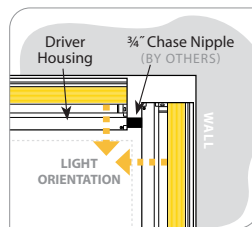


ROW ASSEMBLY



NOTE: ¼" Nipple by others

CORNER ASSEMBLY



INTERNAL PATTERN

EXTERNAL PATTERN

— Consult factory for any pattern layout — Specify internal or external pattern layout

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ROW LAYOUT

RUN (FEET)	FIXTURE LENGTH							
	2	3	4	5	6	7	8	
2'	1							
3'		1						
4'			1					
5'				1				
6'					1			
7'						1		
8'							1	
9'			1	1				
10'			1		1			
11'			1			1		
12'			1				1	
13'				1			1	
14'					1		1	
15'						1	1	
16'							2	
17'			1	1			1	
18'			1		1		1	
19'			1			1	1	
20'			1				2	
21'				1			2	
22'					1		2	
23'						1	2	
24'							3	
25'			1	1			2	
26'			1		1		2	
27'			1			1	2	
28'			1				3	
29'				1			3	
30'					1		3	
31'						1	3	
32'							4	
33'			1	1			3	
34'			1		1		3	
35'			1			1	3	
36'			1				4	
37'				1			4	
38'					1		4	
39'						1	4	
40'							5	
41'			1	1			4	
42'			1		1		4	
43'			1			1	4	
44'			1				5	
45'				1			5	
46'					1		5	
47'						1	5	
48'							6	
49'			1	1			5	
50'			1		1		5	
51'			1			1	5	

RUN (FEET)	FIXTURE LENGTH							
	2	3	4	5	6	7	8	
52'			1				6	
53'				1			6	
54'					1		6	
55'						1	6	
56'							7	
57'				2			6	
58'				1	1		6	
59'				1		1	6	
60'				1			7	
61'					1		7	
62'						1	7	
63'							8	
64'			1	1			7	
65'			1		1		7	
66'			1			1	7	
67'			1				8	
68'				1			8	
69'					1		8	
70'						1	8	
71'							9	
72'			1	1			8	
73'			1		1		8	
74'			1			1	8	
75'			1				9	
76'				1			9	
77'					1		9	
78'						1	9	
79'							10	
80'			1	1			9	
81'			1		1		9	
82'			1			1	9	
83'			1				10	
84'				1			10	
85'					1		10	
86'						1	10	
87'							11	
88'			1	1			10	
89'			1		1		10	
90'			1			1	10	
91'			1				11	
92'				1			11	
93'					1		11	
94'						1	11	
95'							12	
96'			1	1			11	
97'			1		1		11	
98'			1			1	11	
99'			1				12	
100'				1			12	

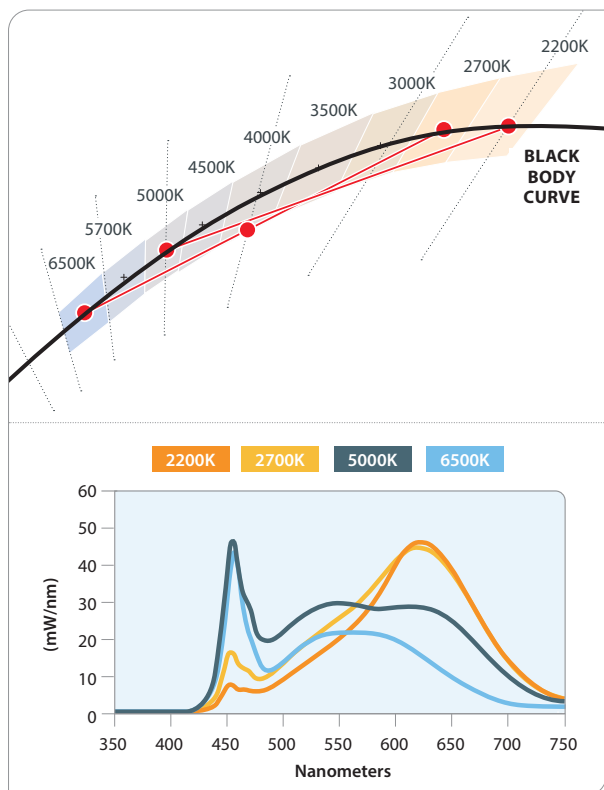
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LED **MicroCovePro™** | Cove & Perimeter
Integral



Prudential Lighting's **TuHue** Tunable White provides warm to cool white light simulating sunlight. Controlling the light source color temperature offers differing design aesthetics with potential benefits via circadian rhythm support. Blue light for alertness while warm light conveys tranquility.

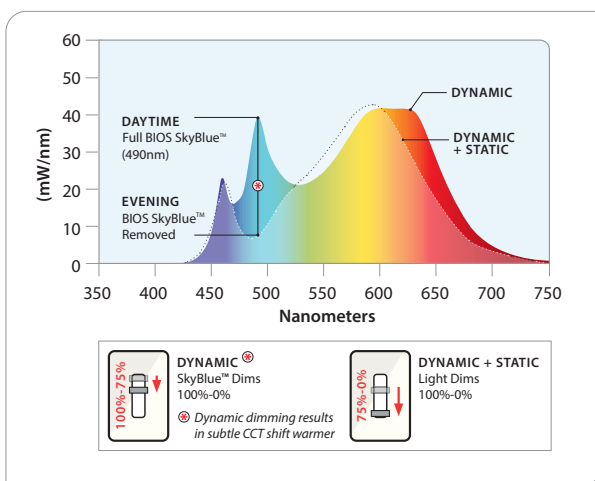
- 2700K-6500K or 2200K-5000K.
- Adjust the color temperate and brightness separately.
- Simulates warm to cool to warm transition of sunlight.



BluHue BIOS SkyBlue™ circadian LED lighting brings the benefits of blue skies inside. Newly discovered blue-sky receptors in our eyes drive improved daytime alertness, mood, brain function, and strengthens circadian rhythms leading to overall better health and well-being.

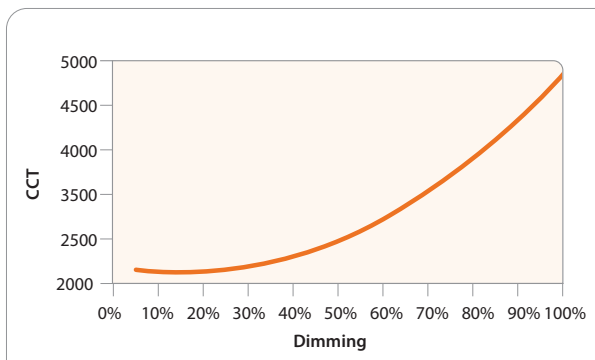


- Circadian rhythms play an integral role in physical and mental health.
- BluHue BIOS SkyBlue pinpoints peak 490nm sensitivity to provide the most benefit from an electric light source.
- At night, simply dim the lights to remove SkyBlue™ wavelengths (specify "Blu_D" to dim Cyan SkyBlue spike separately [night mode]).



AmberHue is Prudential Lighting's Warm Dim offering. It transitions bright white light to warm amber light as brightness is dimmed, reflecting sunlight's transitioning from intense blue midday light to a dimmed golden hue near sunset, also reminiscent of soft glowing candlelight.

- Warm Dim 2200K-5000K.
- Color temperature warms as the luminaire is dimmed.
- Calm, relaxing mood communicated – hospitality, residential feel.



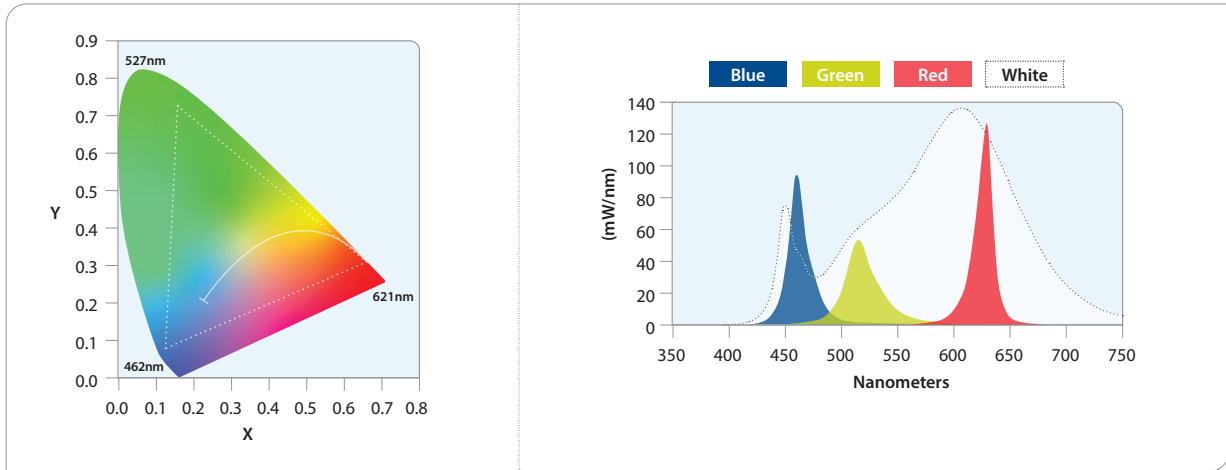
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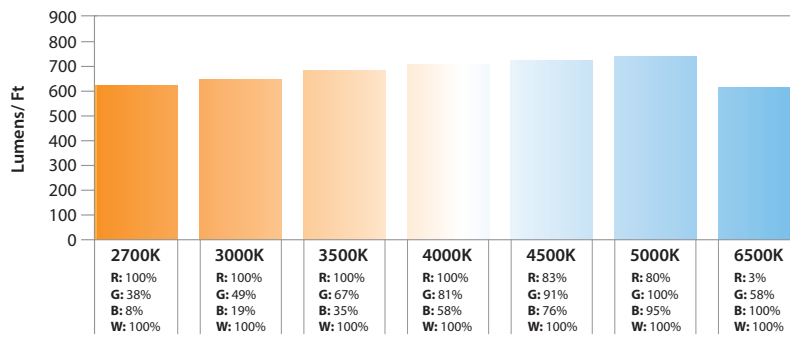


ChromaHue offers a vibrant full gamut of colors for seemingly endless architectural interior applications. Rich color-changing light offers tremendous design flexibility while white light can be achieved with the White chip, or mixing of Red, Green and Blue light. No longer just for the entertainment industry, ChromaHue can be intermixed on MicroCove luminaires for mood-creating indirect illumination combined with static white direct light.

- RGBW LED array (Red, Green, Blue, White) with full spectrum color and white light on the black body curve.
- Four-channel control, DMX drivers.
- Any color point within the triangle can be reached by setting the proper output levels for each individual red, green, blue and white channels.
- Standard DMX is one zone with one XLR drop at start, one XLR return at the end.



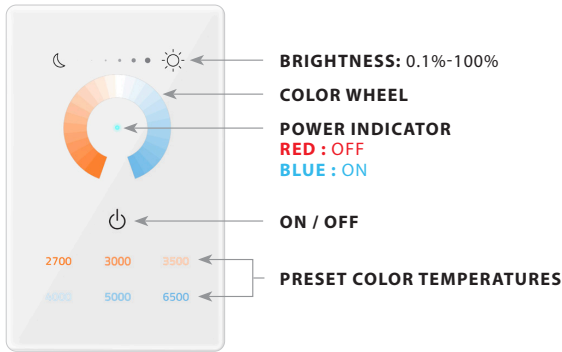
CONSTRUCTED WHITES



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PRUTUNE WALL DEVICE



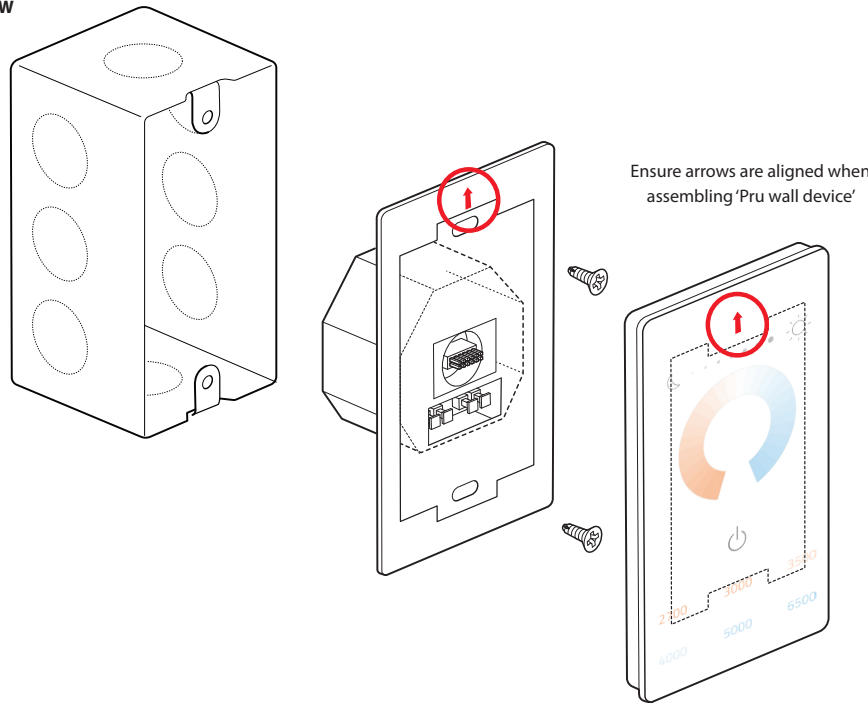
PRUTune DALI device includes:

- Easy-to-understand user control with intuitive design
- Out-of-the-box set-up, no commissioning needed
- Color wheel for color change from 2700K to 6500K
- Dimming to 0.1% (255 Steps)
- Six preset colors (2700K, 3000K, 3500K, 4000K, 5000K, 6500K)
- Must use DALI driver, consult factory to control non-Prudential Ltg Tunable White fixtures
- Control one (1) zone - up to 30 drivers
(Consult factory for fixture quantity dependant upon fixture type, size & output)

PRUTune + EMHE: — Prutune does not have memory

- Once normal power is restored, the controller sends a signal of 100% intensity and 6500K CCT

EXPLODED VIEW



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LM79 & TM30 DATA:

	MEASURED CCT	MEASURED LUMENS	CRI	R9	DuV	SPD	TM30 — COLOR VECTOR	TM30 — COLOR DISTORTION
LED27	2680	80%	93	58	0.001			
LED3	3042	95%	82	6	0.001			
LED3-90	3016	85%	93	61	0.000			
LED35	3482	100%	82	3	0.002			
LED35-90	3417	85%	93	67	0.000			
LED4	3952	102%	82	4	0.003			
LED4-90	3882	85%	92	67	0.003			
LED5-90	4889	85%	94	84	0.002			

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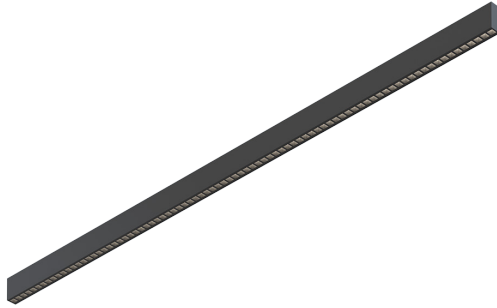


L25

a CarbonNeutral company

Rush Sharp direct

Other Manufacturers:
AXIS "STENCIL" Series
PICASSO "SIENNA 1" Series
XICO "MICROSQUARE" Series



The Sharp Series of architectural luminaires features slim profiles, glare-free, beam shaping optical cells and several mounting options. Custom lengths are tailored to suit any modern space.

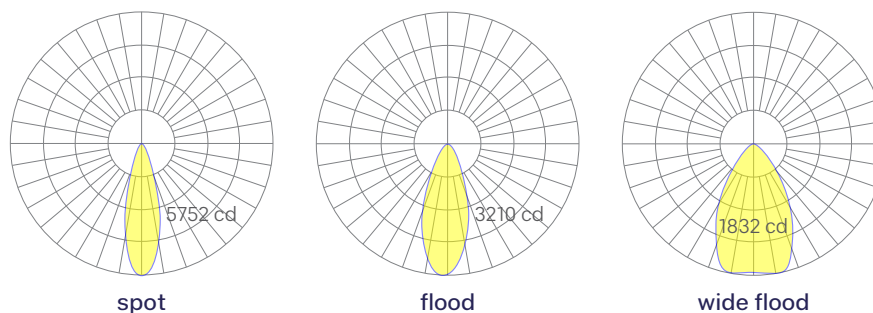
Features

- Power over aircraft cable system
- Extruded recycled aluminum housing
- Aluminum core LED boards, specifiable output
- Specifiable color temperature. CRI > 90, R9 > 50
- Custom lengths, welded patterns, and finishes available
- Specifiable remote dimmable drivers
- 5 Year, 50,000 hour warranty, damp location rated
- WELL Building Standard compatible [learn more](#)

Dimensions



Optics



Representative distribution and peak candela. For other options see order information or IES files [here](#).

Modification date: August 2024

Page 1 of 4

coronetled.com
T 973 345 7660



Coronet reserves the right to make design changes.

L25



a CarbonNeutral company

Rush Sharp direct

Ordering Information

For each option group below specify one option. If you don't see your preferred option listed, contact us for [help](#).

1 Fixture ID	2 Length	3 Color Temperature	4 Output
RUSH SHARP	2 2 ft nominal 4 4 ft nominal 8 8 ft nominal X'X" Specify length Custom lengths in 4.25" increments PAT Pattern (Consult Factory) <div style="border: 1px solid red; padding: 2px; color: red; text-align: center;">LENGTH AS INDICATED ON DRAWINGS</div>	27 2700K/90 CRI 30 3000K/90 CRI <div style="border: 1px solid red; padding: 2px; color: red;">35 3500K/90 CRI</div> 40 4000K/90 CRI	<div style="border: 1px solid red; padding: 2px; color: red;">LOW Low output</div> MED Medium output HIGH High output CUST Custom output Specify watts or lumens
5 Voltage	6 Driver	7 Finish	8 Mounting
<div style="border: 1px solid red; padding: 2px;">UNV Universal (120/277V)</div> 347V 347V Available for DB driver only	<div style="border: 1px solid red; padding: 2px;">DB Standard 0-10V 1%</div> DB.1% 0-10V 0.1% DALI DALI-2 Driver DMX DMX512 All DMX drivers set to default address 001 and provided in remote enclosures. Contact us for other addressing needs.	Housing W White BLK Black CC Custom Color See finish options here. Louver W White BLK Black Decorative Pendant Stem BRS Brass SLV Silver W White BLK Black <div style="border: 1px solid red; padding: 2px; color: red; text-align: center;">FINISH TO BE SELECTED BY ARCHITECT</div>	ACP Power over Aircraft Cable ACP3.5 3.5" canopy + Jbox adaptor adaptor must be mudded in. White canopies and power cord unless option specified in section 12. SM Surface Mount DPS Decorative Pendant Stem 6.5" tall stem, only available with power over aircraft cable
9 Optics	10 Sensors/Controls	11 Circuit	12 Options
<div style="border: 1px solid red; padding: 2px;">SP 24° Beam</div> FL 36° Beam WFL 55° Beam	NA None ACM Acuity nLight Module Only CCS Casambi Module AWRN Lutron Athena Wireless Node Module OTHER Consult Factory All controls remote.	NA None EMPCK Emergency battery pack EMCKT Emergency circuit May require additional power feeds. DAYCKT Daylight circuit May require additional power feeds.	STD White Canopy CAN-X Canopy + color See finish options here

Performance

Output ¹	Watts/ft	Lumens/ft
Low	4	312
Medium	6	469
High	8	625

¹Based on a typically configured 90 CRI, 3500K luminaire using one driver. Custom outputs available. Please consult factory.
For 4000K multiply by 1.05, for 3000K, 0.96, for 2700K, 0.92.

Technical Information



click [here](#) or scan QR code

Wiring diagrams, PoE and sensor details

Modification date: August 2024

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T 973 345 7660



Coronet reserves the right to make design changes.



L25

a CarbonNeutral company

Rush Sharp direct

Drivers & Electrical

Remote, dimmable drivers are supplied in enclosures.

For remote driver box sizes, click [here](#).

Emergency Back-Up

For fixtures three-feet or longer, a 4W remote emergency driver may be wired to 4ft sections. 7W, 10W, and 12W drivers are also available. Emergency circuits for use with building generators are also available.

Finishes

All luminaires are finished in high quality polyester powder coating. Our standard color is white. Any RAL color may be specified.

Weight

1 lb per foot

Optics

Glare-free, beam-controlling TIR optics.

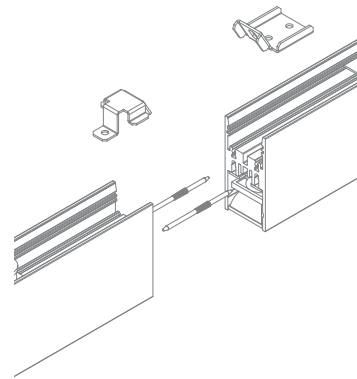
Construction

Extruded, recycled aluminum housing with formed cast ends.

Joined Runs

Runs of any length¹ may be specified and are comprised of multiple, factory-engineered, joined sections. Individually specified luminaires are not field joinable.

¹Custom lengths available in 12" nominal increments.



Representative joinery. For product specific details see installation guides or submittal drawings.

Patterns

Featuring illuminated welded corners and angles. Consult factory for custom designs and elevations.

Square



X



T



Wall/Ceiling



Modification date: August, 2024

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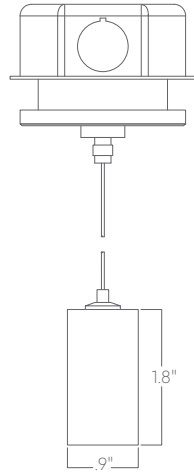
L25

a CarbonNeutral company

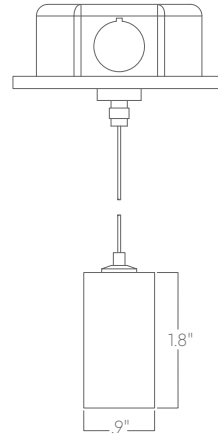
Rush Sharp direct

Mounting Options

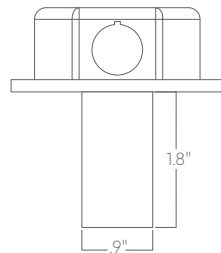
Custom mounting types and ceiling transitions available; consult factory.



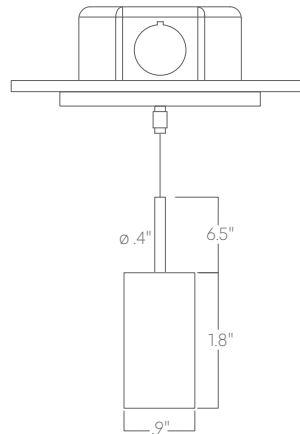
**Power over aircraft cable
3.5" canopy**



**Power over aircraft cable
5" canopy**



Surface mount



Decorative Pendant Stem

Please consult factory shop drawings for suspension points.

To prevent damage to fixtures, factory designated suspension points must not be field altered.

Do not attempt installation if you do not understand the installation instructions.

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L26

a CarbonNeutral company

Rush Sharp recessed

Other Manufacturers:
AXIS "SCULPT MIKROLITE" Series
PICASSO "SIENNA 1" Series
XICO "MICROSQUARE" Series

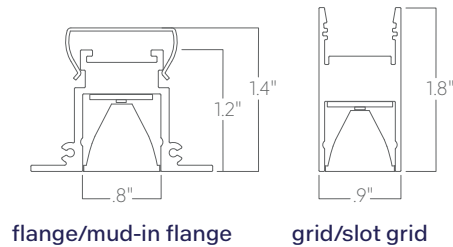


The Sharp Series of architectural luminaires features slim profiles, glare-free, beam shaping optical cells and several mounting options. Custom lengths are tailored to suit any modern space.

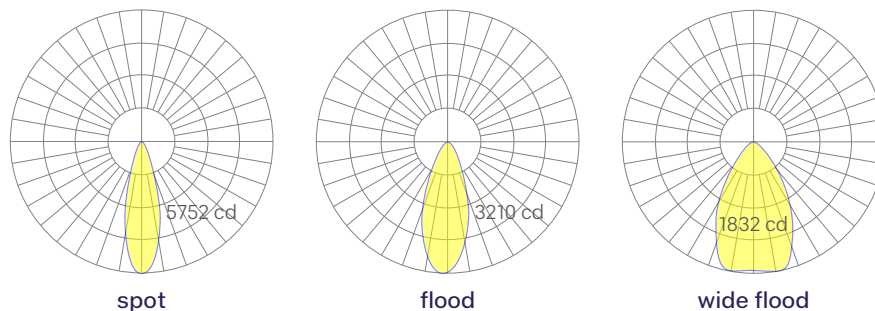
Features

- Extruded recycled aluminum housing
- Aluminum core LED boards, specifiable output
- Specifiable color temperature. CRI > 90, R9 > 50
- Custom lengths, welded patterns, and finishes available
- Specifiable remote dimmable drivers
- 5 Year, 50,000 hour warranty, damp location rated
- WELL Building Standard compatible [learn more](#)

Dimensions



Optics



Representative distribution and peak candela. For other options see order information or IES files [here](#).

Modification date: August 2024

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L26



a CarbonNeutral company

Rush Sharp recessed

Ordering Information

For each option group below specify one option. If you don't see your preferred option listed, contact us for [help](#).

1 Fixture ID	2 Length	3 Color Temperature	4 Output
RUSH SHARP REC	2 2 ft nominal 4 4 ft nominal 8 8 ft nominal X'X" Specify length Custom lengths in 4" increments PAT Pattern (Consult Factory) <div style="border: 1px solid red; padding: 5px; color: red; text-align: center;">LENGTH AS INDICATED ON DRAWINGS</div>	27 2700K/90 CRI 30 3000K/90 CRI <div style="border: 1px solid red; padding: 2px;">35 3500K/90 CRI</div> 40 4000K/90 CRI	<div style="border: 1px solid red; padding: 2px;">LOW Low output</div> MED Medium output HIGH High output CUST Custom output Specify watts or lumens
5 Voltage	6 Driver	7 Finish	8 Mounting
<div style="border: 1px solid red; padding: 2px;">UNV Universal (120/277V)</div> 347V 347V Available for DB driver only	<div style="border: 1px solid red; padding: 2px;">DB Standard 0-10V 1%</div> DB.1% 0-10V 0.1% DALI DALI-2 Driver DMX DMX512 All DMX drivers set to default address 001 and provided in remote enclosures. Contact us for other addressing needs.	Housing W White BLK Black CC Custom Color See finish options here. Louver W White BLK Black <div style="border: 1px solid red; padding: 5px; color: red; text-align: center;">FINISH TO BE SELECTED BY ARCHITECT</div>	T 9/16" Tee Grid T15 15/16" Tee Grid SG Slot Grid/Interlude F Flange NT Mud-in Flange PM-X Perimeter Mount *X denotes mounting type on opposite side of wall (eg PM-NT) WOOD Wood ceiling Provide specifications.
9 Optics	10 Sensors/Controls	11 Circuit	12 Options
<div style="border: 1px solid red; padding: 2px;">SP 24° Beam</div> FL 36° Beam WFL 55° Beam	NA None ACM Acuity nLight Module Only CCS Casambi Module AWNR Lutron Athena Wireless Node Module OTHER Consult Factory All controls remote.	NA None EMPCK Emergency battery pack EMCKT Emergency circuit May require additional power feeds. DAYCKT Daylight circuit May require additional power feeds.	NA None

Performance

Output ¹	Watts/ft	Lumens/ft
Low	4	312
Medium	6	469
High	8	625

¹Based on WFL optic, black louver, 90 CRI, 3500K luminaire using one driver. Custom outputs available. Please consult factory.
For 4000K multiply by 1.05, for 3000K, 0.96, for 2700K, 0.92.

Technical Information



click [here](#) or scan QR code

Wiring diagrams, PoE and sensor details

Modification date: August 2024

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a CarbonNeutral company

Rush Sharp recessed

Drivers & Electrical

Remote, dimmable drivers are supplied in enclosures.

For remote driver box sizes, click [here](#).

Emergency Back-Up

For fixtures three-feet or longer, a 4W remote emergency driver may be wired to 4ft sections. 7W, 10W, and 12W drivers are also available. Emergency circuits for use with building generators are also available.

Finishes

All luminaires are finished in high quality polyester powder coating. Our standard color is white. Any RAL color may be specified.

Weight

1 lb per foot

Optics

Glare-free, beam shaping optical cells.

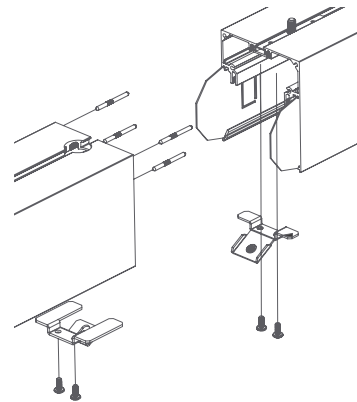
Construction

Extruded, recycled aluminum housing with formed steel ends.

Joined Runs

Runs of any length¹ may be specified and are comprised of multiple, factory-engineered, joined sections. Individually specified luminaires are not field joinable.

¹Custom lengths available in 12" nominal increments.



Representative joinery. For product specific details see installation guides or submittal drawings.

Patterns

Featuring illuminated welded corners and angles. Consult factory for custom designs and elevations.

Square



T



Modification date: August, 2024

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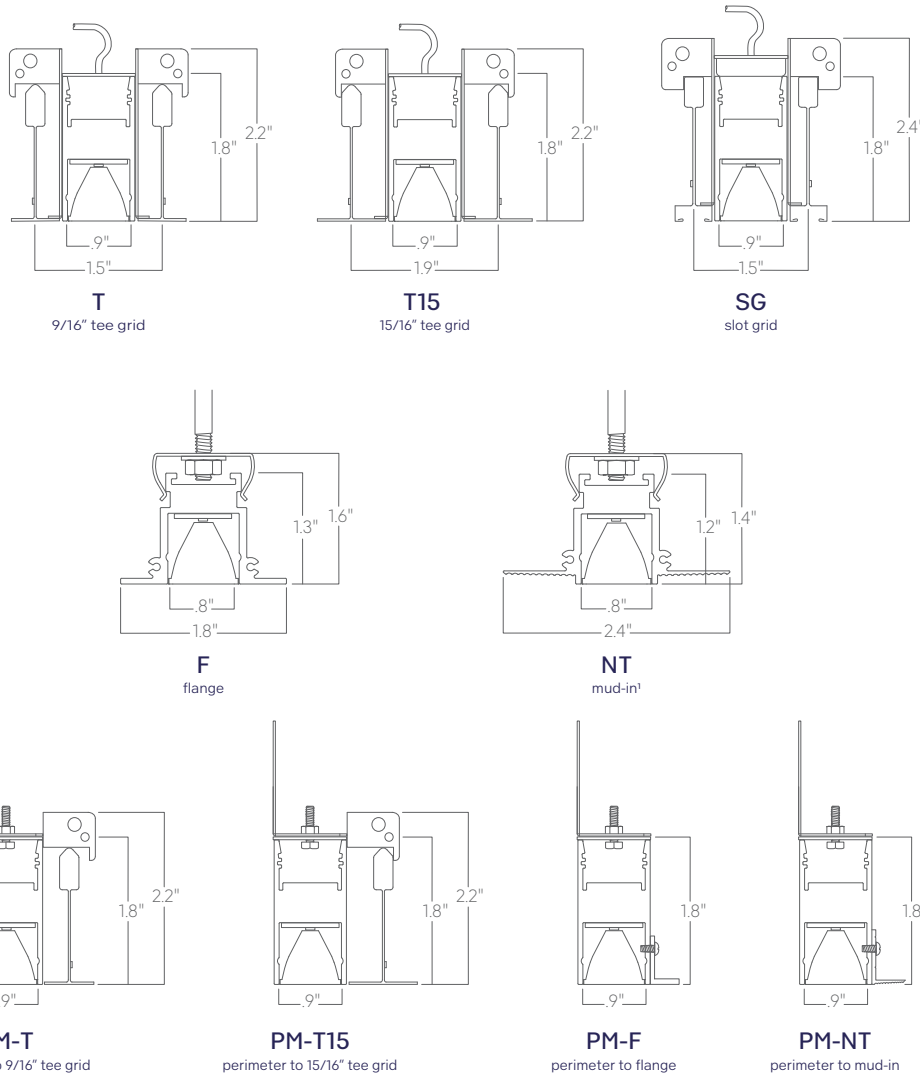


a CarbonNeutral company

Rush Sharp recessed

Mounting Options

Custom mounting types and ceiling transitions available; consult factory.



¹Installation that alters aperture width compromises lens security. Installer must ensure aperture width is maintained.

Please consult factory shop drawings for suspension points.
To prevent damage to fixtures, factory designated suspension points must not be field altered.
Do not attempt installation if you do not understand the installation instructions.

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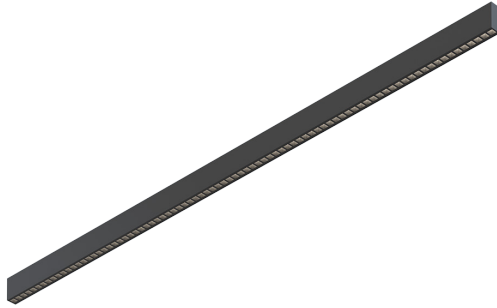


L27

a CarbonNeutral company

Rush Sharp direct

Other Manufacturers:
AXIS "STENCIL" Series
PICASSO "SIENNA 1" Series
XICO "MICROSQUARE" Series



The Sharp Series of architectural luminaires features slim profiles, glare-free, beam shaping optical cells and several mounting options. Custom lengths are tailored to suit any modern space.

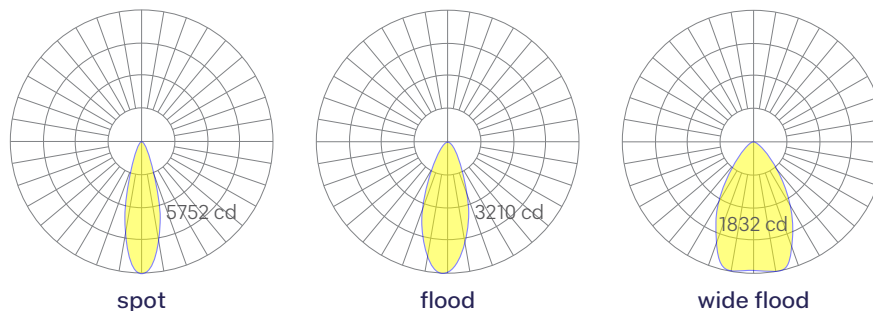
Features

- Power over aircraft cable system
- Extruded recycled aluminum housing
- Aluminum core LED boards, specifiable output
- Specifiable color temperature. CRI > 90, R9 > 50
- Custom lengths, welded patterns, and finishes available
- Specifiable remote dimmable drivers
- 5 Year, 50,000 hour warranty, damp location rated
- WELL Building Standard compatible [learn more](#)

Dimensions



Optics



Representative distribution and peak candela. For other options see order information or IES files [here](#).

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Coronet reserves the right to make design changes.

L27



a CarbonNeutral company

Rush Sharp direct

Ordering Information

For each option group below specify one option. If you don't see your preferred option listed, contact us for [help](#).

1 Fixture ID	2 Length	3 Color Temperature	4 Output
RUSH SHARP	2 2 ft nominal	27 2700K/90 CRI	LOW Low output
	4 4 ft nominal	30 3000K/90 CRI	MED Medium output
	8 8 ft nominal	35 3500K/90 CRI	HIGH High output
	X'X" Specify length Custom lengths in 4.25" increments	40 4000K/90 CRI	CUST Custom output Specify watts or lumens
	PAT Pattern (Consult Factory)		
LENGTH AS INDICATED ON DRAWINGS			
5 Voltage	6 Driver	7 Finish	8 Mounting
UNV Universal (120/277V) 347V 347V Available for DB driver only	DB Standard 0-10V 1% DB.1% 0-10V 0.1% DALI DALI-2 Driver DMX DMX512 All DMX drivers set to default address 001 and provided in remote enclosures. Contact us for other addressing needs.	Housing W White BLK Black CC Custom Color See finish options here. Louver W White BLK Black Decorative Pendant Stem BRS Brass SLV Silver W White BLK Black	ACP Power over Aircraft Cable ACP3.5 3.5" canopy + Jbox adaptor adaptor must be mudded in. White canopies and power cord unless option specified in section 12. SM Surface Mount DPS Decorative Pendant Stem 6.5" tall stem, only available with power over aircraft cable
FINISH TO BE SELECTED BY ARCHITECT			
9 Optics	10 Sensors/Controls	11 Circuit	12 Options
SP 24° Beam FL 36° Beam WFL 55° Beam	NA None ACM Acuity nLight Module Only CCS Casambi Module AWNR Lutron Athena Wireless Node Module OTHER Consult Factory	NA None EMPCK Emergency battery pack EMCKT Emergency circuit May require additional power feeds. DAYCKT Daylight circuit May require additional power feeds.	STD White Canopy CAN-X Canopy + color See finish options here
All controls remote.			

Performance

Output ¹	Watts/ft	Lumens/ft
Low	4	312
Medium	6	469
High	8	625

¹Based on a typically configured 90 CRI, 3500K luminaire using one driver. Custom outputs available. Please consult factory.
For 4000K multiply by 1.05, for 3000K, 0.96, for 2700K, 0.92.

Technical Information



click [here](#) or scan QR code

Wiring diagrams, PoE and sensor details

Modification date: August 2024

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Coronet reserves the right to make design changes.



L27

a CarbonNeutral company

Rush Sharp direct

Drivers & Electrical

Remote, dimmable drivers are supplied in enclosures.

For remote driver box sizes, click [here](#).

Emergency Back-Up

For fixtures three-feet or longer, a 4W remote emergency driver may be wired to 4ft sections. 7W, 10W, and 12W drivers are also available. Emergency circuits for use with building generators are also available.

Finishes

All luminaires are finished in high quality polyester powder coating. Our standard color is white. Any RAL color may be specified.

Weight

1 lb per foot

Optics

Glare-free, beam-controlling TIR optics.

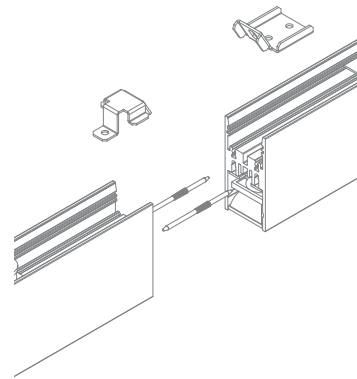
Construction

Extruded, recycled aluminum housing with formed cast ends.

Joined Runs

Runs of any length¹ may be specified and are comprised of multiple, factory-engineered, joined sections. Individually specified luminaires are not field joinable.

¹Custom lengths available in 12" nominal increments.



Representative joinery. For product specific details see installation guides or submittal drawings.

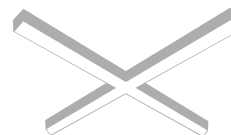
Patterns

Featuring illuminated welded corners and angles. Consult factory for custom designs and elevations.

Square



X



T



Wall/Ceiling





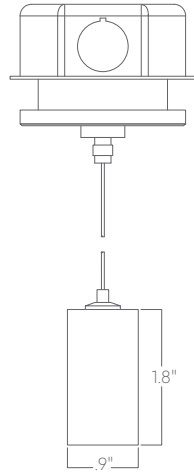
L27

a CarbonNeutral company

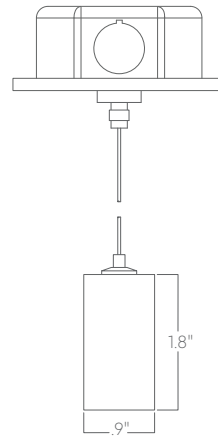
Rush Sharp direct

Mounting Options

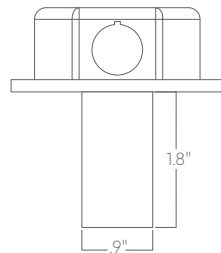
Custom mounting types and ceiling transitions available; consult factory.



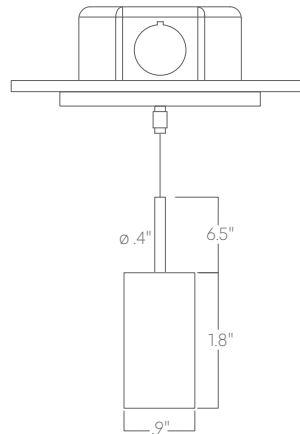
**Power over aircraft cable
3.5" canopy**



**Power over aircraft cable
5" canopy**



Surface mount



Decorative Pendant Stem

Please consult factory shop drawings for suspension points.

To prevent damage to fixtures, factory designated suspension points must not be field altered.

Do not attempt installation if you do not understand the installation instructions.

Modification date: August, 2024

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Coronet reserves the right to make design changes.

Other Manufacturers:
DIODELED "BLAZE" Series
BEULUX "LA01" Series
OMNILIGHT "GENESIS 2.0" Series

L28



LineLED LL Series | Linear LED strip - 24 VDC

Features

Line LED LL series is a small profile, high performance LED strip. It offers excellent color quality with 95+ CRI and 95+ R9 values across the entire range of outputs, while sustaining efficacy above 90 lumens per watt. The simple range consists of just two configurations, 42 and 72 LEDs per foot, with multiple outputs from each, providing a range from 100 to over 500 lumens per foot. Industry-best color consistency is ensured with single-binned LEDs. LL72 provides smooth, dot-free illumination in all Luminii extrusions when paired with a frosted lens.



LL42



LL72

Mounting

LED strip is equipped with 3M™ adhesive transfer tape (9472LE).

Applications

Indoor only - millwork, cove, architectural reveals, undercabinet, display case, handrail, accent lighting.

Approvals

Class 2 damp listed

Operating voltage

24 VDC

Life (L70)

50,000 hours

Warranty

5 years



Technical information

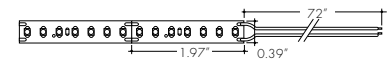
TYPE	LL42			LL72		
	SO	HO	VHO	SO	HO	VHO
OUTPUT OPTIONS	SO	HO	VHO	SO	HO	VHO
Lumens Output (3000K)	132 lm/ft	222 lm/ft	322 lm/ft	272 lm/ft	442 lm/ft	537 lm/ft
Average Power Consumption (for a 4" section)	1.4 W/ft	2.4 W/ft	3.6 W/ft	2.8 W/ft	4.8 W/ft	6.0 W/ft
Efficacy	94 lm/W	93 lm/W	89 lm/W	97 lm/W	92 lm/W	90 lm/W
Cutting Increment (in)	1.97"			1.16"		
Pitch Length	0.28"			0.17"		
Max Run Length (in series)	55 ft	45 ft	35 ft	40 ft	31 ft	22 ft
Dimensions	0.39"W x 0.09" H					

CCT	Multiplier (reference - 3000K)	CRI	TM-30		
			R _f	R _g	R _o
1900K	0.55	96	94	97	90
2200K	0.70	96	95	101	89
2400K	0.72	98	97	101	91
2700K	0.74	97	96	101	91
3000K	1.00	97	95	104	97
3500K	1.02	97	94	105	97
4100K	1.07	97	90	99	97

Section Start/End Options

SL

Soldered lead wires (72")



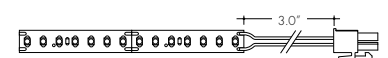
LF

Lead Female 3" cable



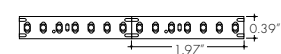
LM

Lead Male 3" cable



NC

No connector



Ordering code

MODEL	OUTPUT	CCT	SECTION START ¹	SECTION END ¹	LENGTH
LL42 - LineLED LL42 LL72 - LineLED LL72	SO - Standard HO - High VHO - Very High	19K - 1900K 22K - 2200K 24K - 2400K 27K - 2700K 30K - 3000K 35K - 3500K 41K - 4100K	SL - Soldered lead wires (72") NC - No connector LM - Lead Male LF - Lead Female	SL - Soldered lead wires (72") NC - No connector LM - Lead Male LF - Lead Female	Ordered in one foot increments. See chart above for max run length.

LENGTH AS INDICATED ON DRAWINGS

¹ - Additional Connectors and Leads available, see below.

L28



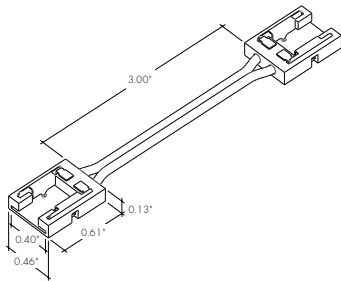
LineLED LL Series | Linear LED strip - 24 VDC

Minii Connectors

Minii connectors are easy, field-installable accessories that make joining LL strip simple! Their minimal width allows them to fit into extrusions, while their transparent frame eliminates dark spots.
Note: verify internal extrusion dimensions to confirm compatibility

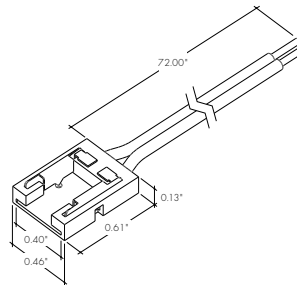
LL-PJC-10-03

Jumper minii connector with 3" wire for LL42/72 LED strip



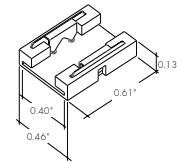
LL-PFC-10-72

Power feed minii connector with 72" wire for LL42/72 LED strip

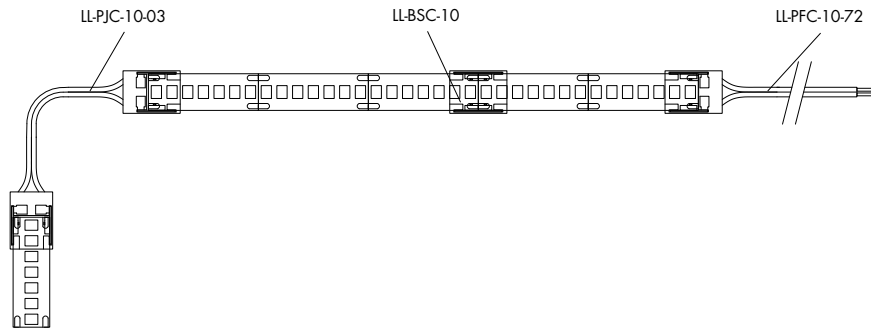


LL-BSC-10

Butt splice minii connector for LL42/72 LED strip



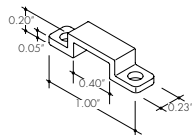
Sample Layout



Accessories

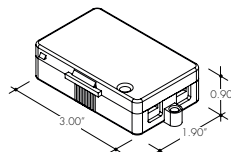
CL1

Mounting clip



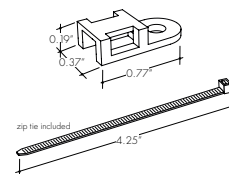
LVSP-4T-BK

Low Voltage, 4 Terminal Splice Box, Black



LL.ZIP

Cable/Wire Strain Relief Clip



Recommended every 12" when LineLED strip is facing down

L28



LineLED LL Series | Linear LED strip - 24 VDC

Lens Options / Light Transmission



*Not compatible with Minii connectors

<p>BOS Channel (BOSC-XX)</p> <p>F SI R G 52% 66% 60% 76%</p>	<p>CLA Channel (CLAC-XX)</p> <p>S Q 62% 65%</p>	<p>MCAL Channel (MCALC-XX)</p> <p>C 94%</p>	<p>K45V Channel (K45V-XX)</p> <p>C HF F 13° 82% 68% 45% 75%</p>
<p>K45R Channel (K45R-XX)</p> <p>RF 61%</p>	<p>KiloR Channel (KILORC-XX)</p> <p>C F 85% 75%</p>	<p>Kilo Channel (KILOC-XX)</p> <p>C F 85% 75%</p>	<p>KL Channel (KLC-XX)</p> <p>C HF F 81% 67% 51%</p>
<p>KRL Channel (KRLC-XX)</p> <p>C HF F 81% 67% 51%</p>	<p>KM Channel (KMC-XX)</p> <p>C HF F FF R GR 82% 68% 45% 52% 58% 56%</p>	<p>KRM Channel (KRMC-XX)</p> <p>C HF F FF GR 82% 68% 45% 52% 56%</p>	<p>KS Channel (KSC-XX)</p> <p>C HF F FF R M 86% 71% 56% 60% 85% 64%</p>

*Not compatible with Minii connectors

Installation

All mounting channels are field cuttable using miter saw with circular blade suitable for cutting aluminum.

Ordering

Extrusions are sold separately. View respective specsheets for details on ordering extrusions and their accessories (endcaps, mounting brackets, etc).

Led Dotting per Extrusion

using the frosted lens option

Extrusion	LED Model LL42	LED Model LL72
BOS	ND	ND
CLA	ND	ND
MCAL	ND	ND
K45V	SD	ND
KM	ND	ND
KRM	ND	ND
KS	CD	ND
K45R	ND	ND
KILOR	ND	ND
KILO	ND	ND
KL	CD	ND
KRL	CD	ND



CD - Clear Dotting
SD - Slight Dotting
ND - No Dotting

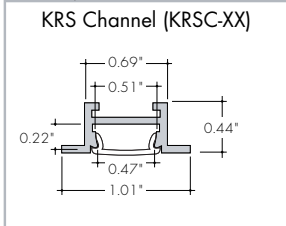


LineLED LL Series | Linear LED strip - 24 VDC

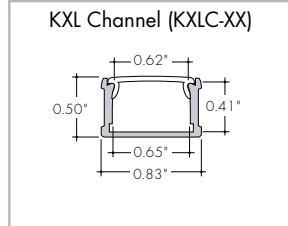
Lens Options / Light Transmission

- C**
Clear
- HF**
Half (50%)
Frosted
- GR**
Graze
- F**
Frosted
- FF**
Flat
Frosted
- R**
Raised
- S**
Square
Frosted
- Q**
Round
Square
Frosted
- 13°**
13°
Semi-Frosted

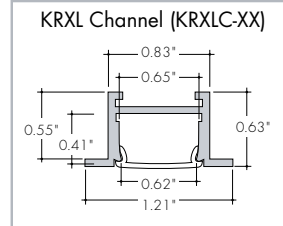
*Not compatible with Minii connectors



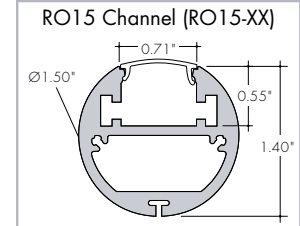
- C**
86%
- HF**
71%
- F**
56%
- FF**
60%
- M**
64%



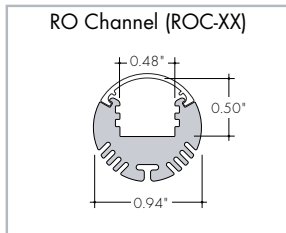
- C**
81%
- HF**
67%
- F**
51%



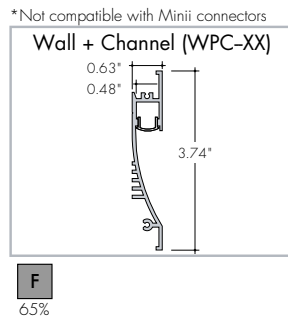
- C**
81%
- HF**
67%
- F**
51%



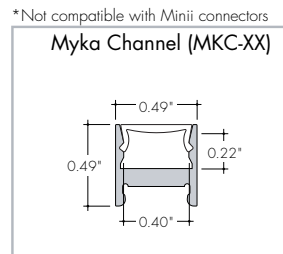
- C**
65%
- F**
41%



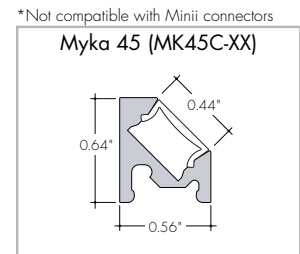
- C**
79%
- F**
50%



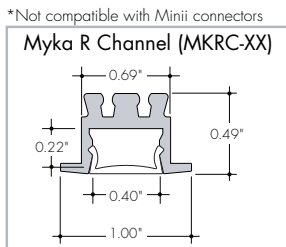
- F**
65%



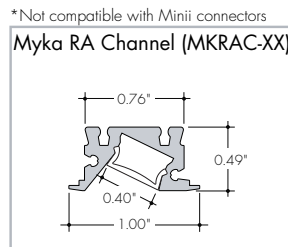
- C**
73%
- F**
61%
- HF**
57%
- MF**
45%
- BLV**
37%
- WLV**
25%



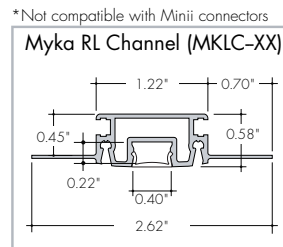
- C**
73%
- F**
61%
- HF**
57%
- MF**
45%
- BLV**
37%
- WLV**
25%



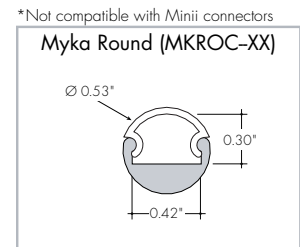
- C**
73%
- F**
61%
- HF**
57%
- MF**
45%
- BLV**
37%
- WLV**
25%



- C**
73%
- F**
61%
- HF**
57%
- MF**
45%
- BLV**
37%
- WLV**
25%



- C**
73%
- F**
61%
- HF**
57%
- MF**
45%
- BLV**
37%
- WLV**
25%



- RF**
57%

Installation

All mounting channels are field cuttable using miter saw with circular blade suitable for cutting aluminum.

Ordering

Extrusions are sold separately. View respective specsheets for details on ordering extrusions and their accessories (endcaps, mounting brackets, etc).

Led Dotting per Extrusion

using the frosted lens option

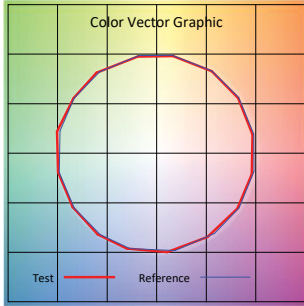
Extrusion	LED Model LL42	LED Model LL72
KRS	CD	ND
KXL	ND	ND
KRXL	ND	ND
RO15	ND	ND
RO	ND	ND
WP	CD	SD
MK	SD	ND
MK45	SD	ND
MKR	SD	ND
MKRA	SD	ND
MKLC	SD	ND
MKRO	ND	ND



- CD** - Clear Dotting
- SD** - Slight Dotting
- ND** - No Dotting

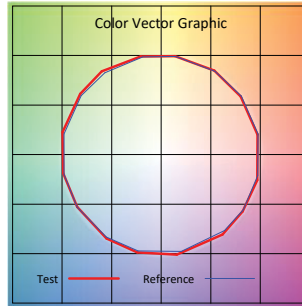
TM-30-15: Data

2200K



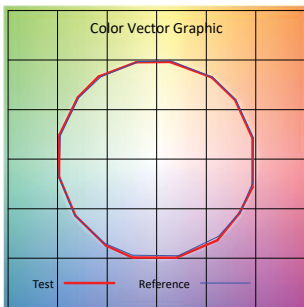
Hue Bin	Rf	Graphic Shifts (%)	
		Chroma	Hue
1	96.8	-1.4%	-0.2%
2	97.4	-0.7%	-0.3%
3	96.2	-0.5%	-0.4%
4	97.5	-0.8%	-1.0%
5	97.3	-0.8%	1.1%
6	95.4	1.0%	2.8%
7	98.1	0.5%	0.6%
8	95.7	2.8%	1.3%
9	97.0	1.1%	-0.8%
10	96.4	0.6%	-1.6%
11	96.0	1.3%	-2.2%
12	94.7	0.8%	-3.0%
13	92.0	0.2%	-7.8%
14	87.2	-1.1%	-7.9%
15	96.6	-0.9%	-1.7%
16	94.1	-1.6%	-3.2%

2400K



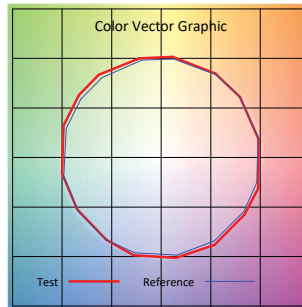
Hue Bin	Rf	Graphic Shifts (%)	
		Chroma	Hue
1	97.3	-0.7%	-0.6%
2	98.0	-0.7%	0.1%
3	96.7	0.1%	1.2%
4	97.4	0.0%	0.5%
5	97.0	1.0%	1.9%
6	95.0	2.9%	1.6%
7	96.4	1.7%	-0.9%
8	96.2	1.9%	-1.3%
9	97.2	0.4%	-1.1%
10	97.9	-0.3%	-0.3%
11	96.9	1.2%	1.2%
12	94.8	1.7%	-0.4%
13	93.6	2.2%	-4.9%
14	92.7	2.2%	-3.9%
15	96.7	0.4%	-2.0%
16	92.9	0.3%	-4.7%

2700K



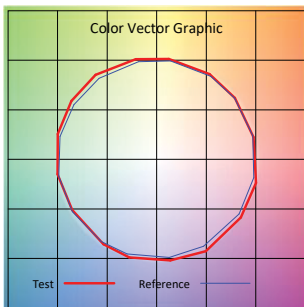
Hue Bin	Rf	Graphic Shifts (%)	
		Chroma	Hue
1	97.1	-1.0%	-0.6%
2	98.2	-0.7%	-0.2%
3	97.0	-0.5%	0.8%
4	97.1	-1.2%	0.2%
5	96.9	-0.1%	1.9%
6	96.2	1.7%	1.8%
7	97.3	0.8%	-0.1%
8	97.9	1.0%	-0.3%
9	98.2	-0.1%	-0.1%
10	96.8	-0.2%	1.5%
11	94.8	0.9%	3.0%
12	94.4	2.4%	0.2%
13	95.7	1.6%	-2.4%
14	94.2	2.7%	-3.1%
15	96.5	-0.0%	-1.4%
16	92.3	0.7%	-5.3%

3000K



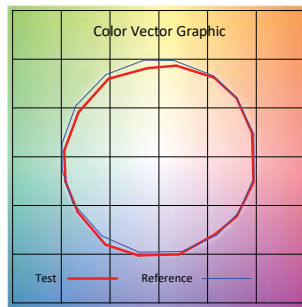
Hue Bin	Rf	Graphic Shifts (%)	
		Chroma	Hue
1	95.9	0.2%	-1.7%
2	97.4	0.2%	-0.2%
3	96.3	0.7%	1.2%
4	95.1	1.9%	1.6%
5	94.9	2.3%	2.1%
6	92.6	4.3%	1.2%
7	92.1	3.9%	-2.2%
8	93.1	3.3%	-2.3%
9	94.8	1.2%	-2.8%
10	94.6	-0.5%	-2.7%
11	96.2	-0.1%	1.0%
12	93.7	2.7%	-0.3%
13	95.7	2.5%	-1.3%
14	94.2	3.6%	-2.1%
15	94.2	2.2%	-2.5%
16	92.0	2.5%	-5.3%

3500K



Hue Bin	Rf	Graphic Shifts (%)	
		Chroma	Hue
1	96.4	0.5%	-1.5%
2	97.7	0.3%	0.2%
3	94.7	1.0%	2.2%
4	94.4	1.7%	2.2%
5	93.4	3.0%	2.3%
6	91.4	5.0%	1.0%
7	92.7	4.1%	-1.6%
8	94.1	2.8%	-2.1%
9	95.0	0.9%	-2.1%
10	95.9	-0.8%	-1.6%
11	93.5	1.1%	3.4%
12	91.7	3.1%	3.0%
13	95.3	3.1%	0.5%
14	93.0	5.3%	-0.8%
15	93.5	3.4%	-2.1%
16	90.9	3.2%	-4.6%

4100K



Hue Bin	Rf	Graphic Shifts (%)	
		Chroma	Hue
1	91.5	-1.3%	1.6%
2	95.3	-0.1%	-0.4%
3	95.4	-1.0%	-1.3%
4	89.1	-4.8%	-3.5%
5	86.6	-8.7%	-2.1%
6	91.9	-5.0%	0.5%
7	87.8	-6.2%	4.0%
8	86.7	-3.5%	6.7%
9	82.7	-1.2%	11.7%
10	81.6	1.0%	10.5%
11	84.5	5.4%	8.0%
12	92.6	3.3%	-0.3%
13	90.9	2.3%	3.9%
14	92.6	-1.5%	-1.5%
15	86.6	0.5%	-4.4%
16	86.7	0.5%	-4.7%

L28

LineLED LL Series | Linear LED strip - 24 VDC



Power Consumption

Tested at full power with PDC Series power supplies.

Nominal Length	LL42						LL72					
	SO		HO		VHO		SO		HO		VHO	
	W/ft	Total Wattage	W/ft	Total Wattage	W/ft	Total Wattage	W/ft	Total Wattage	W/ft	Total Wattage	W/ft	Total Wattage
1	1.2	1.2	2.2	2.2	3.2	3.2	2.7	2.7	4.4	4.4	6.2	6.2
2	1.2	2.4	2.5	4.9	3.2	6.4	2.8	5.6	4.7	9.4	6.3	12.6
3	1.4	4.1	2.4	7.0	3.4	10.1	2.7	8.2	4.6	13.8	6.1	18.4
4	1.4	5.3	2.4	9.2	3.6	14.1	2.7	10.7	4.5	17.8	6.0	23.5
5	1.4	7.1	2.3	11.3	3.6	17.8	2.8	13.8	4.6	22.8	5.8	29.1
6	1.4	8.7	2.3	13.8	3.6	21.6	2.7	16.4	4.4	26.6	5.8	34.7
7	1.4	10.0	2.3	16.1	3.6	25.6	2.7	19.2	4.3	30.8	5.6	40.0
8	1.4	11.1	2.3	18.1	3.6	28.9	2.7	21.8	4.3	34.6	5.5	44.2
9	1.4	12.4	2.3	20.3	3.5	31.6	2.7	24.1	4.3	38.4	5.5	49.2
10	1.4	13.9	2.3	23.0	3.5	34.7	2.7	26.7	4.2	42.0	5.4	54.0
11	1.4	15.4	2.3	25.0	3.4	37.3	2.6	29.1	4.1	45.3	5.3	58.1
12	1.4	16.4	2.3	27.2	3.3	40.0	2.6	31.2	4.0	47.8	5.2	61.9
13	1.4	17.9	2.2	29.1	3.3	42.7	2.6	33.5	4.0	51.7	4.9	64.3
14	1.4	19.0	2.2	31.0	3.3	45.4	2.5	35.5	3.9	54.9	5.1	72.0
15	1.4	20.2	2.2	32.5	3.2	48.0	2.5	37.7	3.9	57.6	5.0	74.4
16	1.3	21.7	2.2	35.1	3.2	51.3	2.5	40.4	3.8	61.5	4.9	78.7
17	1.3	22.7	2.1	36.6	3.1	53.7	2.5	42.4	3.8	63.8	4.7	80.1
18	1.3	23.9	2.1	38.1	3.1	55.8	2.5	44.9	3.7	66.9	4.6	84.0
19	1.3	25.0	2.1	39.8	3.1	58.1	2.4	46.5	3.6	69.0	4.6	87.2
20	1.3	26.5	2.2	43.4	3.0	60.1	2.4	48.5	3.6	71.7	4.5	90.0
21	1.3	27.5	2.1	45.0	3.0	62.3	2.4	49.8	3.5	74.5	4.4	92.5
22	1.3	28.8	2.1	46.6	2.9	64.6	2.3	51.5	3.5	76.2	4.3	95.6
23	1.3	30.0	2.1	48.2	2.9	67.0	2.3	52.6	3.4	78.0		
24	1.3	31.1	2.1	49.7	2.9	69.1	2.3	55.4	3.4	80.6		
25	1.3	32.4	2.1	51.3	2.9	71.4	2.3	56.8	3.3	82.2		
26	1.3	33.4	2.0	52.6	2.8	73.1	2.2	57.3	3.3	84.4		
27	1.3	34.6	2.0	54.2	2.8	75.0	2.2	58.1	3.2	86.5		
28	1.3	35.6	2.0	55.5	2.7	76.6	2.2	60.8	3.2	88.2		
29	1.3	36.6	2.0	56.8	2.7	78.1	2.2	63.3	3.1	89.4		
30	1.3	37.6	1.9	58.1	2.7	79.7	2.2	65.1	3.0	90.9		
31	1.2	38.5	1.9	59.3	2.6	81.1	2.1	64.9	3.0	91.5		
32	1.2	39.4	1.9	60.6	2.6	82.5	2.1	67.8				
33	1.2	40.4	1.9	61.8	2.5	83.8	2.1	69.6				
34	1.2	41.2	1.9	63.0	2.5	85.1	2.1	69.9				
35	1.2	42.1	1.8	64.2	2.5	86.5	2.0	71.4				
36	1.2	43.0	1.8	65.2			2.0	72.8				
37	1.2	44.0	1.8	66.4			2.0	73.7				
38	1.2	44.9	1.8	67.4			2.0	75.5				
39	1.2	45.8	1.8	68.5			1.9	75.9				
40	1.2	46.6	1.7	69.4			1.9	76.7				
41	1.2	47.3	1.7	70.3								
42	1.1	48.0	1.7	71.3								
43	1.1	48.8	1.7	72.2								
44	1.1	49.5	1.7	73.2								
45	1.1	50.1	1.6	74.0								
46	1.1	50.9										
47	1.1	51.7										
48	1.1	52.4										
49	1.1	53.1										
50	1.1	53.8										
51	1.1	54.4										
52	1.1	55.0										
53	1.1	55.7										
54	1.0	56.3										
55	1.0	56.8										

L28

LineLED LL Series | Linear LED strip - 24 VDC



Voltage Drop Calculator

The below chart assumes nominal voltage of 24 Volts and a Voltage Drop Allowance of 3% through the wire

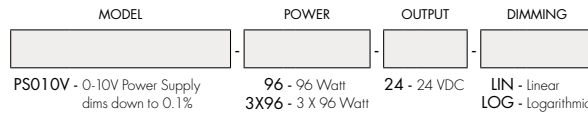
Wattage [W]	Maximum Wire Length From Power Supply to Start of Run [ft]						
	12 AWG	14 AWG	16 AWG	18 AWG	20 AWG	22 AWG	24 AWG
5	1088.2	684.4	430.3	270.6	170.2	107.1	67.3
10	544.1	342.2	215.1	135.3	85.1	53.5	33.7
15	362.7	228.1	143.4	90.2	56.7	35.7	22.4
20	272.0	171.1	107.6	67.7	42.6	26.8	16.8
25	217.6	136.9	86.1	54.1	34.0	21.4	13.5
30	181.4	114.1	71.7	45.1	28.4	17.8	11.2
35	155.5	97.8	61.5	38.7	24.3	15.3	9.6
40	136.0	85.5	53.8	33.8	21.3	13.4	8.4
45	120.9	76.0	47.8	30.1	18.9	11.9	7.5
50	108.8	68.4	43.0	27.1	17.0	10.7	6.7
55	98.9	62.2	39.1	24.6	15.5	9.7	6.1
60	90.7	57.0	35.9	22.6	14.2	8.9	5.6
65	83.7	52.6	33.1	20.8	13.1	8.2	5.2
70	77.7	48.9	30.7	19.3	12.2	7.6	4.8
75	72.5	45.6	28.7	18.0	11.3	7.1	4.5
80	68.0	42.8	26.9	16.9	10.6	6.7	4.2
85	64.0	40.3	25.3	15.9	10.0	6.3	4.0
90	60.5	38.0	23.9	15.0	9.5	5.9	3.7
96	56.7	35.6	22.4	14.1	8.9	5.6	3.5

LineLED LL Series | Linear LED strip - 24 VDC

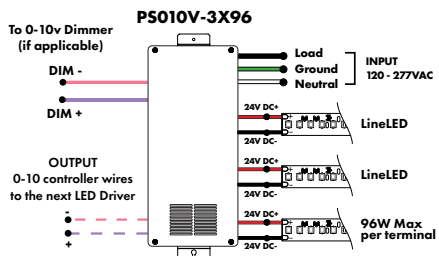
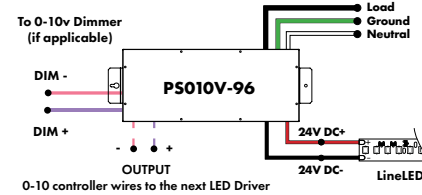
Power Supplies

See Power Supply instructions and spec sheet for wiring information. For a complete list of compatible dimmers, see Compatible Dimming Chart on the Resources page.

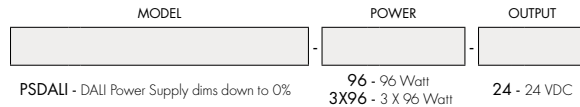
0-10V Dimming Power Supplies 0.1% 120VAC - 277VAC



MODELS	96W	3X96
Length	14.40"	13.00"
Width	5.20"	6.62"
Depth	2.60"	4.20"

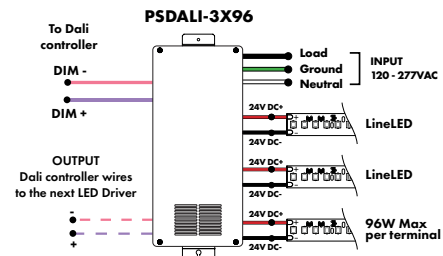
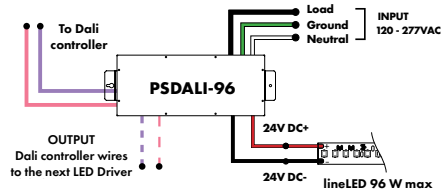


DALI 0% Dimming Power Supplies 120VAC - 277VAC

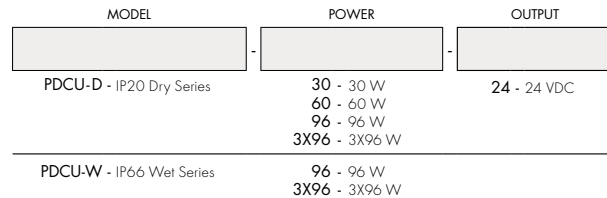


Features eldoLED's LINEARdrive configurable dimmable drivers

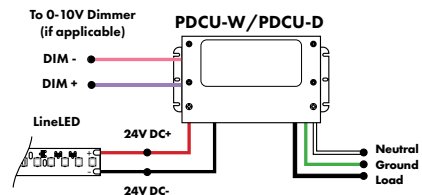
Model	96W	3X96
Length	14.40"	13.00"
Width	5.20"	6.62"
Depth	2.60"	4.20"



Universal Power Supply 1% 120VAC - 277VAC



0-10V dims down to 1%, MLV/ELV/TRIAC dims down to 1%.
For a complete list of compatible dimmers, see [Compatible Dimming Chart](#) on the Resources page.



MODEL	PDCU-W-96W	PDCU-W-3X96W	PDCU-D-30W	PDCU-D-60W	PDCU-D-96W	PDCU-D-3X96W
Length	8.66"	11.85"	6.10"	7.93"	8.25"	9.57"
Width	3.73"	4.32"	3.35"	3.35"	4.10"	5.94"
Depth	1.61"	1.81"	1.33"	1.32"	1.56"	1.13"



LineLED LL Series | Linear LED strip - 24 VDC

Power Supplies

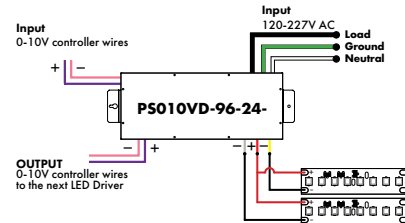
See Power Supply instructions and spec sheet for wiring information. For a complete list of compatible dimmers, see Compatible Dimming Chart on the Resources page.

Customizable Dim to Warm or Variable White via 0 - 10V
(for tunable white or warm dimming control of Dynamic option)

MODEL	POWER	OUTPUT	CONTROL
PS010VD-0-10V Vintage Dim LED Driver	96-96 Watt	24-24 VDC	WZ1- Standard dimming for both tapes

*Zonal control power supplies

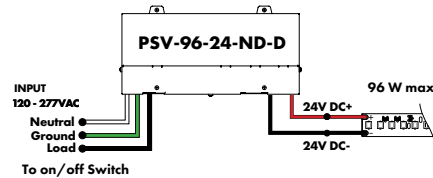
MODELS	96W
Length	14.40"
Width	5.20"
Depth	2.60"



Non-Dimming Power Supply 120VAC - 277VAC

MODEL	POWER	OUTPUT	DIMMING	LOCATION
PSV-PSV Series	96-96 Watt	24-24 VDC	ND- Non Dimming	D- Damp

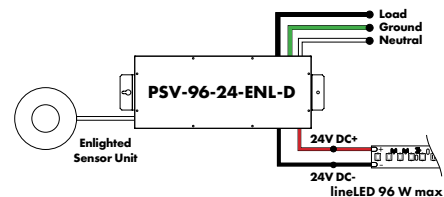
MODELS	96W
Length	8.25"
Width	3.75"
Depth	1.63"



Enlighted Enabled Dimming Power Supplies 120VAC - 277VAC

MODEL	POWER	OUTPUT	DIMMING	LOCATION
PSV-PSV Series	96-96 Watt	24-24 VDC	ENL- Enlighted Dimming dims down to 0%	D- Damp

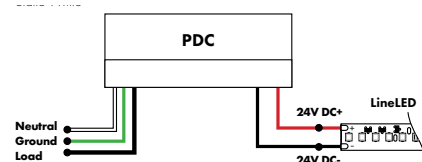
Model	96W
Length	14.40"
Width	5.20"
Depth	2.60"



Triac, MLV, ELV Compatible Dimmers

MODEL	POWER	OUTPUT
PDC - (IP20) Power Supply	96-96 Watts	24-24 VDC

MODELS	96W
Length	8.25"
Width	4.10"
Depth	1.56"

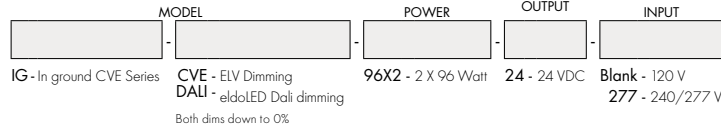


LineLED LL Series | Linear LED strip - 24 VDC

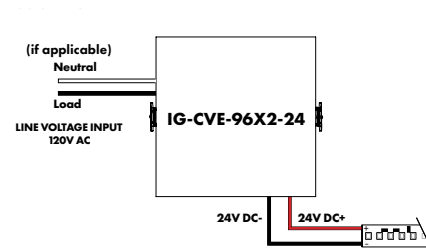
Power Supplies

See Power Supply instructions and spec sheet for wiring information. For a complete list of compatible dimmers, see Compatible Dimming Chart on the Resources page.

In-Ground Power Supplies

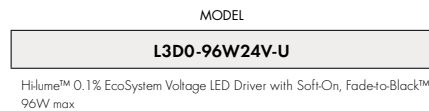


MODEL	Dual Circuit
Length	8.40"
Width	8.30"
Depth	8.10"

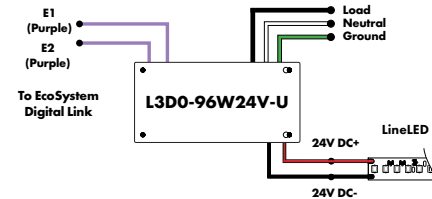


Luminii is a Lutron OEM Advantage Partner

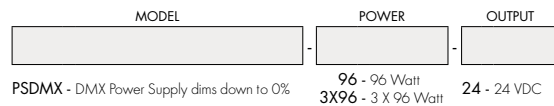
Lutron Power Supplies 0.1%



MODELS	L3D0
Length	10.50"
Width	5.50"
Depth	2.00"

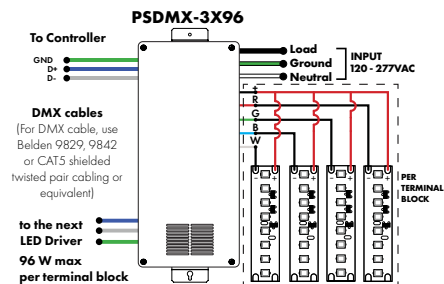
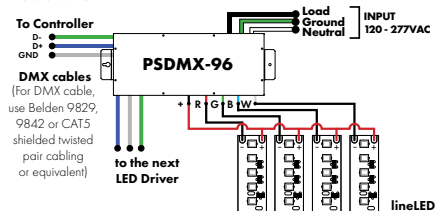


DMX Dimming Power Supplies 120VAC - 277VAC



Features eldoLED's LINEARdrive configurable dimmable drivers
*Zonal control power supplies. Control multiple tapes/zones using DMX channels.

MODEL	96W	3X96
Length	14.40"	13.00"
Width	5.20"	6.60"
Depth	2.60"	4.20"



LineLED LL Series | Linear LED strip - 24 VDC

Decoders



MODEL

DDMX-5CH-RDM-PRO

DDMX-5CH-RDM-PRO-DMX512 Decoder

DMX512 decoder with RDM functionality features 5 PWM output channels with common anode. High PWM output frequency range allows the product to be used in HD video conferencing spaces. All DMX products to be installed per DMX512 Standard.

Power
96 Watt

Inputs
RJ45, XLR-5Pin, Terminal Block

DMX Channels
1 to 5 settable

PWM Output Resolution Ratio
8 or 16 bit

PWM Output Frequency
500Hz - 30KHz

Output Dimming Curve Gamma Value
0.1 ~ 9.9



MODEL

DDMX-RGBW

DDMX-RGBW - DMX512 Decoder

Translates controller DMX512 programs for RGB and white LED strips.

Unique DMX address for the decoder can be set easily and displayed by the numeric display on the case. Changing and resetting the DMX address requires manual input.

Use power repeater to expand output (Luminii part# RGBW-SR).

Operating Voltage
12-36 VDC

Power Capacity
up to 96W at 24V

Operating Temperature Range
from -4°F to +122°F in case

PWM Output Frequency
200Hz or 1500Hz



MODEL

RGBW-RC-R

RGBW-RC-R - RGBW receiver

The RGBW receiver is easily paired with controller by the click of a button. Receiver can be reset to factory settings at any time.

Each receiver can store one static RGB color, one color sequence, and one brightness setting for the white LED strip. Receivers assigned to the same scene within the same zone will have the same LED static color and color sequence.

Operating Voltage
12-36 VDC

Power Capacity
up to 96W at 24V

Operating Temperature Range
from -4°F to +122°F in case

LineLED LL Series | Linear LED strip - 24 VDC

Decoders



MODEL

RGBW-SR

RGBW-SR - RGBW signal repeater

Extends identical signal when connected in series to an RGBW LED control system. The RGBW signal repeater works with Luminii RGB and RGBW controllers, receivers, and decoders.

RGBW signal can be extended indefinitely when adequate power supply (not included) is connected to the system.

Operating Voltage
12-36 VDC

Power Capacity
up to 96W at 24V

Operating Temperature Range
from -4°F to +122°F in case



MODEL

RGBW-Wi-R

RGBW-Wi-R - WiFi generator

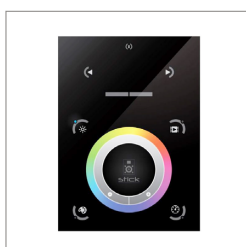
RGBW-Wi-R creates a local network that enables any electronic device (phone, tablet, etc.) to control the RGB/W strip connected to a RGBW-RC-R receiver.

The control functions are achieved through a free application download for Android and iOS devices called REALCOLOR.

Operating Voltage
12-36 VDC

Power Supply
PI-130-24 (included)

Operating Temperature Range
from -4°F to +122°F in case



MODEL

TSDMX-E

TSDMX-E - Touchscreen DMX controller

Programmable advanced DMX512 lighting controller featuring a touch-screen interface. Operates as stand alone controller or integrated with most architectural lighting control systems. Can controller endless DMX512 enabled devices.

Mounts to standard single or dual gang wall box with the included power supply inside the junction box. Terminal block design for power and data connections.

Features

- Sleek glass design which sits 0.43" from the wall
- Graphical color display to show selected environment
- Color/dimmer/speed palette
- Color temperature mixing
- Touch sensitive buttons. No mechanical parts
- Touch sensitive wheel allows for accurate color selection
- Multi-zone microSD memory
- Multi-room control with 500 scenes, 10 zones
- 1024 DMX channels. Control 340 RGB fixtures
- USB & Ethernet connectivity for programming and control

Power Supply

7 VDC (included)

Programmability

PC, Mac, Tablet, Smartphone

Output Signal

DMX512 (1024 channels)

Color Parameters

- Brightness
- Saturation
- Speed of color changing sequence
- Fading / dimming / brightness

L28

LineLED LL Series | Linear LED strip - 24 VDC



Legacy Conversion

	Legacy LL Tapes			NEW LL Tapes			
	lm/ft	W/ft	LPW	lm/ft	W/ft	LPW	
LL18	125	1.6	78	LL42-SO	130	1.4	98
LL30	200	2.7	74	LL42-HO	225	2.4	92
LL36	250	3.2	78	LL42-VHO	320	3.6	96
LL72-LO	310	4.0	78	LL72-SO	270	2.8	96
LL54	390	5.2	67	LL72-HO	440	4.8	98
LLX18	350	4.9	80				
LLX22	450	5.5	82	LL72-VHO	540	6.0	90
LL72	500	6.5	77				

Other Manufacturers:
DIODELED "BLAZE" Series
BEULUX "LA01" Series
OMNILIGHT "GENESIS 2.0" Series

L29



LineLED LL Series | Linear LED strip - 24 VDC

Features

Line LED LL series is a small profile, high performance LED strip. It offers excellent color quality with 95+ CRI and 95+ R9 values across the entire range of outputs, while sustaining efficacy above 90 lumens per watt. The simple range consists of just two configurations, 42 and 72 LEDs per foot, with multiple outputs from each, providing a range from 100 to over 500 lumens per foot. Industry-best color consistency is ensured with single-binned LEDs. LL72 provides smooth, dot-free illumination in all Luminii extrusions when paired with a frosted lens.



LL42



LL72

Mounting

LED strip is equipped with 3M™ adhesive transfer tape (9472LE).

Applications

Indoor only - millwork, cove, architectural reveals, undercabinet, display case, handrail, accent lighting.

Approvals

Class 2 damp listed

Operating voltage

24 VDC

Life (L70)

50,000 hours

Warranty

5 years



Technical information

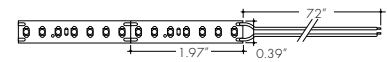
TYPE	LL42			LL72		
	SO	HO	VHO	SO	HO	VHO
OUTPUT OPTIONS						
Lumens Output (3000K)	132 lm/ft	222 lm/ft	322 lm/ft	272 lm/ft	442 lm/ft	537 lm/ft
Average Power Consumption (for a 4" section)	1.4 W/ft	2.4 W/ft	3.6 W/ft	2.8 W/ft	4.8 W/ft	6.0 W/ft
Efficacy	94 lm/W	93 lm/W	89 lm/W	97 lm/W	92 lm/W	90 lm/W
Cutting Increment (in)	1.97"			1.16"		
Pitch Length	0.28"			0.17"		
Max Run Length (in series)	55 ft	45 ft	35 ft	40 ft	31 ft	22 ft
Dimensions	0.39"W x 0.09" H					

CCT	Multiplier (reference - 3000K)	CRI	TM-30		
			R _f	R _g	R _o
1900K	0.55	96	94	97	90
2200K	0.70	96	95	101	89
2400K	0.72	98	97	101	91
2700K	0.74	97	96	101	91
3000K	1.00	97	95	104	97
3500K	1.02	97	94	105	97
4100K	1.07	97	90	99	97

Section Start/End Options

SL

Soldered lead wires (72")



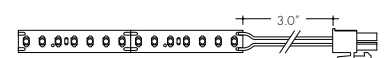
LF

Lead Female 3" cable



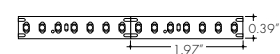
LM

Lead Male 3" cable



NC

No connector



Ordering code

MODEL	OUTPUT	CCT	SECTION START ¹	SECTION END ¹	LENGTH
LL42 - LineLED LL42 LL72 - LineLED LL72	SO - Standard HO - High VHO - Very High	19K - 1900K 22K - 2200K 24K - 2400K 27K - 2700K 30K - 3000K 35K - 3500K 41K - 4100K	SL - Soldered lead wires (72") NC - No connector LM - Lead Male LF - Lead Female	SL - Soldered lead wires (72") NC - No connector LM - Lead Male LF - Lead Female	Ordered in one foot increments. See chart above for max run length.

LENGTH AS INDICATED ON DRAWINGS

¹ - Additional Connectors and Leads available, see below.

L29

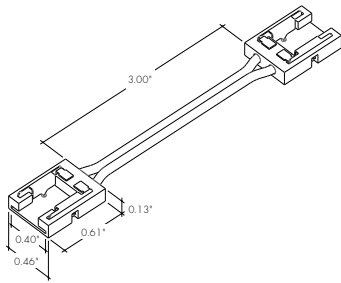


LineLED LL Series | Linear LED strip - 24 VDC

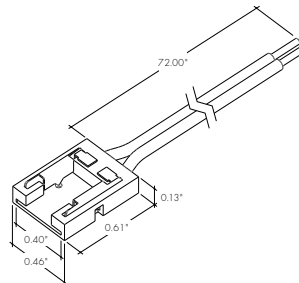
Minii Connectors

Minii connectors are easy, field-installable accessories that make joining LL strip simple! Their minimal width allows them to fit into extrusions, while their transparent frame eliminates dark spots.
Note: verify internal extrusion dimensions to confirm compatibility

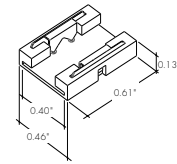
LL-PJC-10-03
Jumper minii connector with 3" wire for LL42/72 LED strip



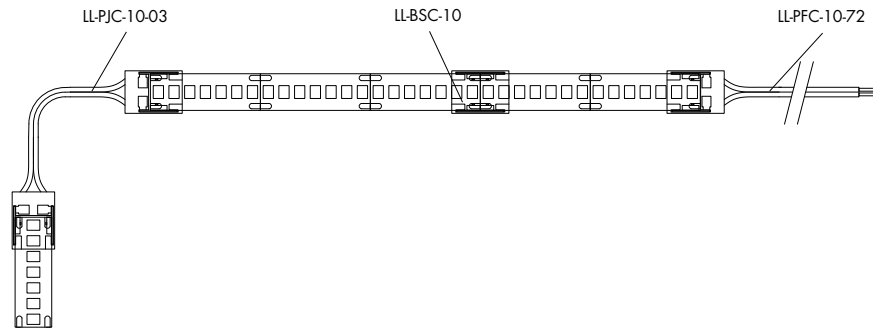
LL-PFC-10-72
Power feed minii connector with 72" wire for LL42/72 LED strip



LL-BSC-10
Butt splice minii connector for LL42/72 LED strip

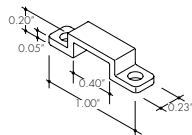


Sample Layout

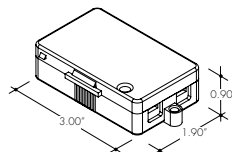


Accessories

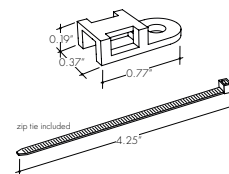
CL1
Mounting clip



LVSP-4T-BK
Low Voltage, 4 Terminal Splice Box, Black



LL.ZIP
Cable/Wire Strain Relief Clip



Recommended every 12" when LineLED strip is facing down

L29



LineLED LL Series | Linear LED strip - 24 VDC

Lens Options / Light Transmission

- C**
Clear
- HF**
Half (50%)
Frosted
- GR**
Graze
- F**
Frosted
- FF**
Flat
Frosted
- R**
Raised
- S**
Square
Frosted
- Q**
Round Square
Frosted
- 13°**
13°
Semi-Frosted

*Not compatible with Minii connectors

<p>BOS Channel (BOSC-XX)</p> <p>F SI R G 52% 66% 60% 76%</p>	<p>CLA Channel (CLAC-XX)</p> <p>S Q 62% 65%</p>	<p>MCAL Channel (MCALC-XX)</p> <p>C 94%</p>	<p>K45V Channel (K45V-XX)</p> <p>C HF F 13° 82% 68% 45% 75%</p>
<p>K45R Channel (K45R-XX)</p> <p>RF 61%</p>	<p>KiloR Channel (KILORC-XX)</p> <p>C F 85% 75%</p>	<p>Kilo Channel (KILOC-XX)</p> <p>C F 85% 75%</p>	<p>KL Channel (KLC-XX)</p> <p>C HF F 81% 67% 51%</p>
<p>KRL Channel (KRLC-XX)</p> <p>C HF F 81% 67% 51%</p>	<p>KM Channel (KMC-XX)</p> <p>C HF F FF R GR 82% 68% 45% 52% 58% 56%</p>	<p>KRM Channel (KRMC-XX)</p> <p>C HF F FF GR 82% 68% 45% 52% 56%</p>	<p>KS Channel (KSC-XX)</p> <p>C HF F FF R M 86% 71% 56% 60% 85% 64%</p>

*Not compatible with Minii connectors

Installation

All mounting channels are field cuttable using miter saw with circular blade suitable for cutting aluminum.

Ordering

Extrusions are sold separately. View respective specsheets for details on ordering extrusions and their accessories (endcaps, mounting brackets, etc).

Led Dotting per Extrusion

using the frosted lens option

Extrusion	LED Model LL42	LED Model LL72
BOS	ND	ND
CLA	ND	ND
MCAL	ND	ND
K45V	SD	ND
KM	ND	ND
KRM	ND	ND
KS	CD	ND
K45R	ND	ND
KILOR	ND	ND
KILO	ND	ND
KL	CD	ND
KRL	CD	ND



CD - Clear Dotting
SD - Slight Dotting
ND - No Dotting

LineLED LL Series | Linear LED strip - 24 VDC

Lens Options / Light Transmission

C Clear	HF Half (50%) Frosted	GR Graze	F Frosted	FF Flat Frosted	R Raised	S Square Frosted	Q Round Square Frosted	13° 13° Semi-Frosted
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*Not compatible with Minii connectors

KRS Channel (KRSC-XX) C 86% HF 71% F 56% FF 60% M 64%	KXL Channel (KXLC-XX) C 81% HF 67% F 51%	KRXL Channel (KRXL-XX) C 81% HF 67% F 51%	RO15 Channel (RO15-XX) C 65% F 41%
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*Not compatible with Minii connectors

RO Channel (ROC-XX) C 79% F 50%	Wall + Channel (WPC-XX) F 65%	Myka Channel (MKC-XX) C 73% F 61% HF 57% MF 45% BLV 37% WLV 25%	Myka 45 (MK45C-XX) C 73% F 61% HF 57% MF 45% BLV 37% WLV 25%
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*Not compatible with Minii connectors

Myka R Channel (MKRC-XX) C 73% F 61% HF 57% MF 45% BLV 37% WLV 25%	Myka RA Channel (MKRAC-XX) C 73% F 61% HF 57% MF 45% BLV 37% WLV 25%	Myka RL Channel (MKLC-XX) C 73% F 61% HF 57% MF 45% BLV 37% WLV 25%	Myka Round (MKROC-XX) RF 57%
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Led Dotting per Extrusion

using the frosted lens option

Extrusion	LED Model LL42	LED Model LL72
KRS	CD	ND
KXL	ND	ND
KRXL	ND	ND
RO15	ND	ND
RO	ND	ND
WP	CD	SD
MK	SD	ND
MK45	SD	ND
MKR	SD	ND
MKRA	SD	ND
MKLC	SD	ND
MKRO	ND	ND



CD - Clear Dotting
SD - Slight Dotting
ND - No Dotting

Installation

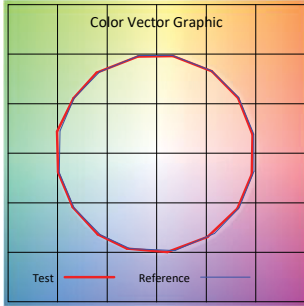
All mounting channels are field cuttable using miter saw with circular blade suitable for cutting aluminum.

Ordering

Extrusions are sold separately. View respective specsheets for details on ordering extrusions and their accessories (endcaps, mounting brackets, etc).

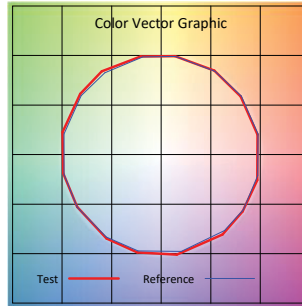
TM-30-15: Data

2200K



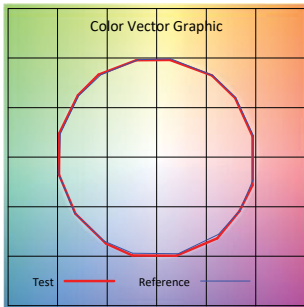
Hue Bin	Rf	Graphic Shifts (%)	
		Chroma	Hue
1	96.8	-1.4%	-0.2%
2	97.4	-0.7%	-0.3%
3	96.2	-0.5%	-0.4%
4	97.5	-0.8%	-1.0%
5	97.3	-0.8%	1.1%
6	95.4	1.0%	2.8%
7	98.1	0.5%	0.6%
8	95.7	2.8%	1.3%
9	97.0	1.1%	-0.8%
10	96.4	0.6%	-1.6%
11	96.0	1.3%	-2.2%
12	94.7	0.8%	-3.0%
13	92.0	0.2%	-7.8%
14	87.2	-1.1%	-7.9%
15	96.6	-0.9%	-1.7%
16	94.1	-1.6%	-3.2%

2400K



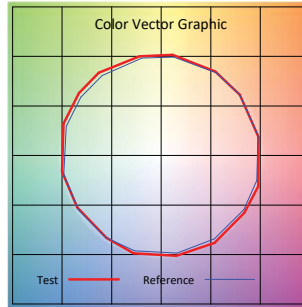
Hue Bin	Rf	Graphic Shifts (%)	
		Chroma	Hue
1	97.3	-0.7%	-0.6%
2	98.0	-0.7%	0.1%
3	96.7	0.1%	1.2%
4	97.4	0.0%	0.5%
5	97.0	1.0%	1.9%
6	95.0	2.9%	1.6%
7	96.4	1.7%	-0.9%
8	96.2	1.9%	-1.3%
9	97.2	0.4%	-1.1%
10	97.9	-0.3%	-0.3%
11	96.9	1.2%	1.2%
12	94.8	1.7%	-0.4%
13	93.6	2.2%	-4.9%
14	92.7	2.2%	-3.9%
15	96.7	0.4%	-2.0%
16	92.9	0.3%	-4.7%

2700K



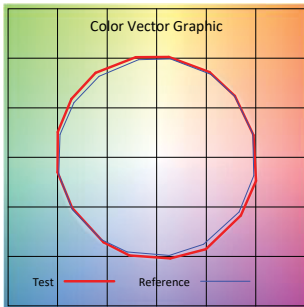
Hue Bin	Rf	Graphic Shifts (%)	
		Chroma	Hue
1	97.1	-1.0%	-0.6%
2	98.2	-0.7%	-0.2%
3	97.0	-0.5%	0.8%
4	97.1	-1.2%	0.2%
5	96.9	-0.1%	1.9%
6	96.2	1.7%	1.8%
7	97.3	0.8%	-0.1%
8	97.9	1.0%	-0.3%
9	98.2	-0.1%	-0.1%
10	96.8	-0.2%	1.5%
11	94.8	0.9%	3.0%
12	94.4	2.4%	0.2%
13	95.7	1.6%	-2.4%
14	94.2	2.7%	-3.1%
15	96.5	-0.0%	-1.4%
16	92.3	0.7%	-5.3%

3000K



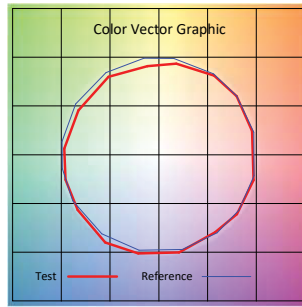
Hue Bin	Rf	Graphic Shifts (%)	
		Chroma	Hue
1	95.9	0.2%	-1.7%
2	97.4	0.2%	-0.2%
3	96.3	0.7%	1.2%
4	95.1	1.9%	1.6%
5	94.9	2.3%	2.1%
6	92.6	4.3%	1.2%
7	92.1	3.9%	-2.2%
8	93.1	3.3%	-2.3%
9	94.8	1.2%	-2.8%
10	94.6	-0.5%	-2.7%
11	96.2	-0.1%	1.0%
12	93.7	2.7%	-0.3%
13	95.7	2.5%	-1.3%
14	94.2	3.6%	-2.1%
15	94.2	2.2%	-2.5%
16	92.0	2.5%	-5.3%

3500K



Hue Bin	Rf	Graphic Shifts (%)	
		Chroma	Hue
1	96.4	0.5%	-1.5%
2	97.7	0.3%	0.2%
3	94.7	1.0%	2.2%
4	94.4	1.7%	2.2%
5	93.4	3.0%	2.3%
6	91.4	5.0%	1.0%
7	92.7	4.1%	-1.6%
8	94.1	2.8%	-2.1%
9	95.0	0.9%	-2.1%
10	95.9	-0.8%	-1.6%
11	93.5	1.1%	3.4%
12	91.7	3.1%	3.0%
13	95.3	3.1%	0.5%
14	93.0	5.3%	-0.8%
15	93.5	3.4%	-2.1%
16	90.9	3.2%	-4.6%

4100K



Hue Bin	Rf	Graphic Shifts (%)	
		Chroma	Hue
1	91.5	-1.3%	1.6%
2	95.3	-0.1%	-0.4%
3	95.4	-1.0%	-1.3%
4	89.1	-4.8%	-3.5%
5	86.6	-8.7%	-2.1%
6	91.9	-5.0%	0.5%
7	87.8	-6.2%	4.0%
8	86.7	-3.5%	6.7%
9	82.7	-1.2%	11.7%
10	81.6	1.0%	10.5%
11	84.5	5.4%	8.0%
12	92.6	3.3%	-0.3%
13	90.9	2.3%	3.9%
14	92.6	-1.5%	-1.5%
15	86.6	0.5%	-4.4%
16	86.7	0.5%	-4.7%



LineLED LL Series | Linear LED strip - 24 VDC

Power Consumption

Tested at full power with PDC Series power supplies.

Nominal Length	LL42						LL72					
	SO		HO		VHO		SO		HO		VHO	
	W/ft	Total Wattage	W/ft	Total Wattage	W/ft	Total Wattage	W/ft	Total Wattage	W/ft	Total Wattage	W/ft	Total Wattage
1	1.2	1.2	2.2	2.2	3.2	3.2	2.7	2.7	4.4	4.4	6.2	6.2
2	1.2	2.4	2.5	4.9	3.2	6.4	2.8	5.6	4.7	9.4	6.3	12.6
3	1.4	4.1	2.4	7.0	3.4	10.1	2.7	8.2	4.6	13.8	6.1	18.4
4	1.4	5.3	2.4	9.2	3.6	14.1	2.7	10.7	4.5	17.8	6.0	23.5
5	1.4	7.1	2.3	11.3	3.6	17.8	2.8	13.8	4.6	22.8	5.8	29.1
6	1.4	8.7	2.3	13.8	3.6	21.6	2.7	16.4	4.4	26.6	5.8	34.7
7	1.4	10.0	2.3	16.1	3.6	25.6	2.7	19.2	4.3	30.8	5.6	40.0
8	1.4	11.1	2.3	18.1	3.6	28.9	2.7	21.8	4.3	34.6	5.5	44.2
9	1.4	12.4	2.3	20.3	3.5	31.6	2.7	24.1	4.3	38.4	5.5	49.2
10	1.4	13.9	2.3	23.0	3.5	34.7	2.7	26.7	4.2	42.0	5.4	54.0
11	1.4	15.4	2.3	25.0	3.4	37.3	2.6	29.1	4.1	45.3	5.3	58.1
12	1.4	16.4	2.3	27.2	3.3	40.0	2.6	31.2	4.0	47.8	5.2	61.9
13	1.4	17.9	2.2	29.1	3.3	42.7	2.6	33.5	4.0	51.7	4.9	64.3
14	1.4	19.0	2.2	31.0	3.3	45.4	2.5	35.5	3.9	54.9	5.1	72.0
15	1.4	20.2	2.2	32.5	3.2	48.0	2.5	37.7	3.9	57.6	5.0	74.4
16	1.3	21.7	2.2	35.1	3.2	51.3	2.5	40.4	3.8	61.5	4.9	78.7
17	1.3	22.7	2.1	36.6	3.1	53.7	2.5	42.4	3.8	63.8	4.7	80.1
18	1.3	23.9	2.1	38.1	3.1	55.8	2.5	44.9	3.7	66.9	4.6	84.0
19	1.3	25.0	2.1	39.8	3.1	58.1	2.4	46.5	3.6	69.0	4.6	87.2
20	1.3	26.5	2.2	43.4	3.0	60.1	2.4	48.5	3.6	71.7	4.5	90.0
21	1.3	27.5	2.1	45.0	3.0	62.3	2.4	49.8	3.5	74.5	4.4	92.5
22	1.3	28.8	2.1	46.6	2.9	64.6	2.3	51.5	3.5	76.2	4.3	95.6
23	1.3	30.0	2.1	48.2	2.9	67.0	2.3	52.6	3.4	78.0		
24	1.3	31.1	2.1	49.7	2.9	69.1	2.3	55.4	3.4	80.6		
25	1.3	32.4	2.1	51.3	2.9	71.4	2.3	56.8	3.3	82.2		
26	1.3	33.4	2.0	52.6	2.8	73.1	2.2	57.3	3.3	84.4		
27	1.3	34.6	2.0	54.2	2.8	75.0	2.2	58.1	3.2	86.5		
28	1.3	35.6	2.0	55.5	2.7	76.6	2.2	60.8	3.2	88.2		
29	1.3	36.6	2.0	56.8	2.7	78.1	2.2	63.3	3.1	89.4		
30	1.3	37.6	1.9	58.1	2.7	79.7	2.2	65.1	3.0	90.9		
31	1.2	38.5	1.9	59.3	2.6	81.1	2.1	64.9	3.0	91.5		
32	1.2	39.4	1.9	60.6	2.6	82.5	2.1	67.8				
33	1.2	40.4	1.9	61.8	2.5	83.8	2.1	69.6				
34	1.2	41.2	1.9	63.0	2.5	85.1	2.1	69.9				
35	1.2	42.1	1.8	64.2	2.5	86.5	2.0	71.4				
36	1.2	43.0	1.8	65.2			2.0	72.8				
37	1.2	44.0	1.8	66.4			2.0	73.7				
38	1.2	44.9	1.8	67.4			2.0	75.5				
39	1.2	45.8	1.8	68.5			1.9	75.9				
40	1.2	46.6	1.7	69.4			1.9	76.7				
41	1.2	47.3	1.7	70.3								
42	1.1	48.0	1.7	71.3								
43	1.1	48.8	1.7	72.2								
44	1.1	49.5	1.7	73.2								
45	1.1	50.1	1.6	74.0								
46	1.1	50.9										
47	1.1	51.7										
48	1.1	52.4										
49	1.1	53.1										
50	1.1	53.8										
51	1.1	54.4										
52	1.1	55.0										
53	1.1	55.7										
54	1.0	56.3										
55	1.0	56.8										

L29

LineLED LL Series | Linear LED strip - 24 VDC



Voltage Drop Calculator

The below chart assumes nominal voltage of 24 Volts and a Voltage Drop Allowance of 3% through the wire

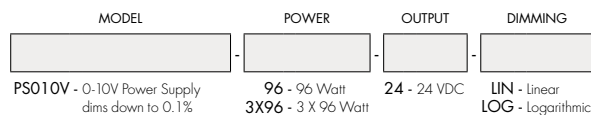
Wattage [W]	Maximum Wire Length From Power Supply to Start of Run [ft]						
	12 AWG	14 AWG	16 AWG	18 AWG	20 AWG	22 AWG	24 AWG
5	1088.2	684.4	430.3	270.6	170.2	107.1	67.3
10	544.1	342.2	215.1	135.3	85.1	53.5	33.7
15	362.7	228.1	143.4	90.2	56.7	35.7	22.4
20	272.0	171.1	107.6	67.7	42.6	26.8	16.8
25	217.6	136.9	86.1	54.1	34.0	21.4	13.5
30	181.4	114.1	71.7	45.1	28.4	17.8	11.2
35	155.5	97.8	61.5	38.7	24.3	15.3	9.6
40	136.0	85.5	53.8	33.8	21.3	13.4	8.4
45	120.9	76.0	47.8	30.1	18.9	11.9	7.5
50	108.8	68.4	43.0	27.1	17.0	10.7	6.7
55	98.9	62.2	39.1	24.6	15.5	9.7	6.1
60	90.7	57.0	35.9	22.6	14.2	8.9	5.6
65	83.7	52.6	33.1	20.8	13.1	8.2	5.2
70	77.7	48.9	30.7	19.3	12.2	7.6	4.8
75	72.5	45.6	28.7	18.0	11.3	7.1	4.5
80	68.0	42.8	26.9	16.9	10.6	6.7	4.2
85	64.0	40.3	25.3	15.9	10.0	6.3	4.0
90	60.5	38.0	23.9	15.0	9.5	5.9	3.7
96	56.7	35.6	22.4	14.1	8.9	5.6	3.5

LineLED LL Series | Linear LED strip - 24 VDC

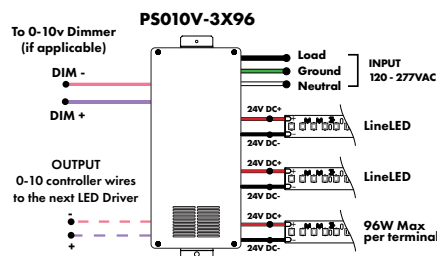
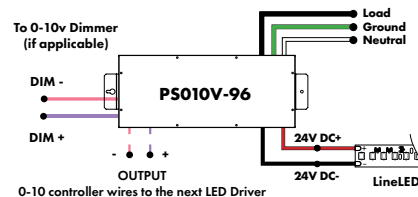
Power Supplies

See Power Supply instructions and spec sheet for wiring information. For a complete list of compatible dimmers, see Compatible Dimming Chart on the Resources page.

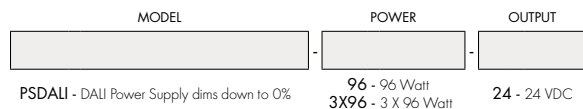
0-10V Dimming Power Supplies 0.1% 120VAC - 277VAC



MODELS	96W	3X96
Length	14.40"	13.00"
Width	5.20"	6.62"
Depth	2.60"	4.20"

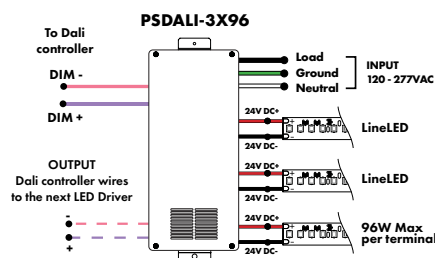
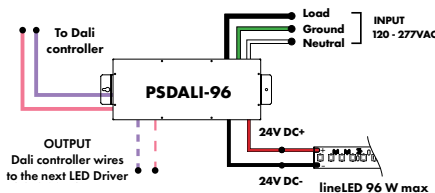


DALI 0% Dimming Power Supplies 120VAC - 277VAC

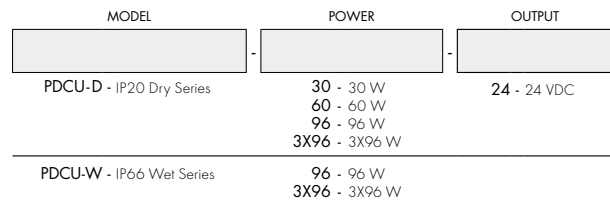


Features eldoLED's LINEARdrive configurable dimmable drivers

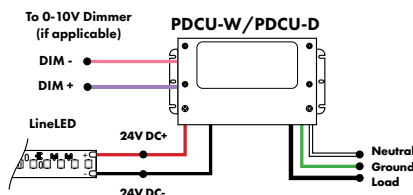
Model	96W	3X96
Length	14.40"	13.00"
Width	5.20"	6.62"
Depth	2.60"	4.20"



Universal Power Supply 1% 120VAC - 277VAC



0-10V dims down to 1%, MLV/ELV/TRIAC dims down to 1%.
For a complete list of compatible dimmers, see [Compatible Dimming Chart](#) on the Resources page.



MODEL	PDCU-W-96W	PDCU-W-3X96W	PDCU-D-30W	PDCU-D-60W	PDCU-D-96W	PDCU-D-3X96W
Length	8.66"	11.85"	6.10"	7.93"	8.25"	9.57"
Width	3.73"	4.32"	3.35"	3.35"	4.10"	5.94"
Depth	1.61"	1.81"	1.33"	1.32"	1.56"	1.13"



LineLED LL Series | Linear LED strip - 24 VDC

Power Supplies

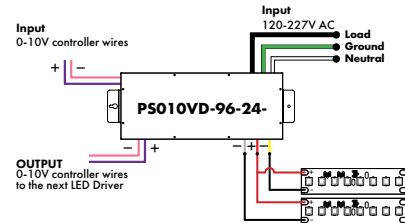
See Power Supply instructions and spec sheet for wiring information. For a complete list of compatible dimmers, see Compatible Dimming Chart on the Resources page.

Customizable Dim to Warm or Variable White via 0 - 10V
(for tunable white or warm dimming control of Dynamic option)

MODEL	POWER	OUTPUT	CONTROL
PS010VD-0-10V Vintage Dim LED Driver	96-96 Watt	24-24 VDC	WZ1-Standard dimming for both tapes

*Zonal control power supplies

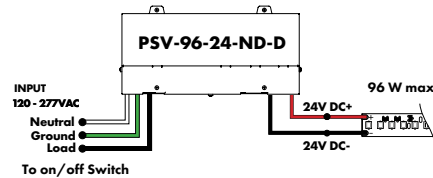
MODELS	96W
Length	14.40"
Width	5.20"
Depth	2.60"



Non-Dimming Power Supply 120VAC - 277VAC

MODEL	POWER	OUTPUT	DIMMING	LOCATION
PSV-PSV Series	96-96 Watt	24-24 VDC	ND-Non Dimming	D-Damp

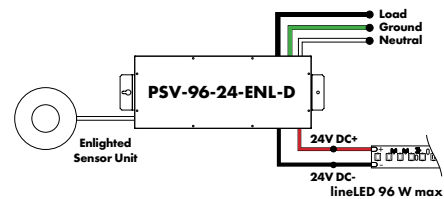
MODELS	96W
Length	8.25"
Width	3.75"
Depth	1.63"



Enlighted Enabled Dimming Power Supplies 120VAC - 277VAC

MODEL	POWER	OUTPUT	DIMMING	LOCATION
PSV-PSV Series	96-96 Watt	24-24 VDC	ENL-Enlighted Dimming dims down to 0%	D-Damp

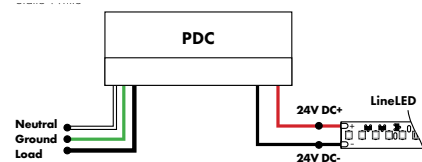
Model	96W
Length	14.40"
Width	5.20"
Depth	2.60"



Triac, MLV, ELV Compatible Dimmers

MODEL	POWER	OUTPUT
PDC - (IP20) Power Supply	96-96 Watts	24-24 VDC

MODELS	96W
Length	8.25"
Width	4.10"
Depth	1.56"

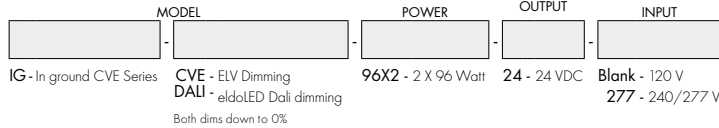


LineLED LL Series | Linear LED strip - 24 VDC

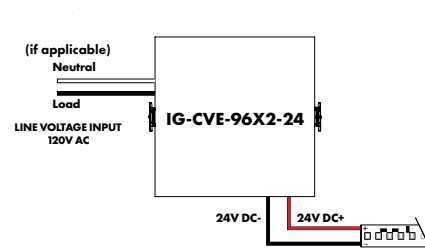
Power Supplies

See Power Supply instructions and spec sheet for wiring information. For a complete list of compatible dimmers, see Compatible Dimming Chart on the Resources page.

In-Ground Power Supplies

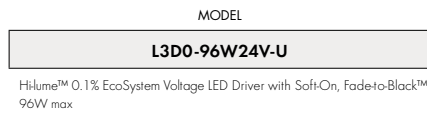


MODEL	Dual Circuit
Length	8.40"
Width	8.30"
Depth	8.10"

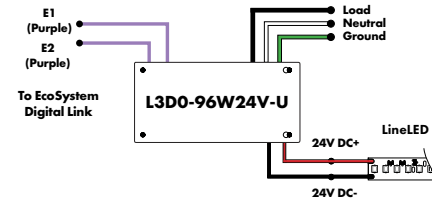


Luminii is a Lutron OEM Advantage Partner

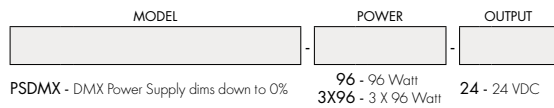
Lutron Power Supplies 0.1%



MODELS	L3D0
Length	10.50"
Width	5.50"
Depth	2.00"



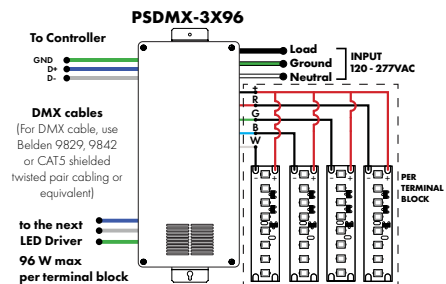
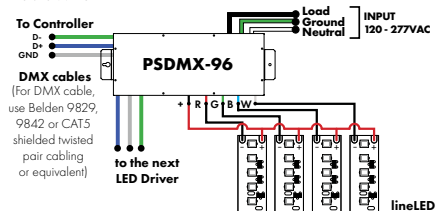
DMX Dimming Power Supplies 120VAC - 277VAC



Features eldoLED's LINEARdrive configurable dimmable drivers

*Zonal control power supplies. Control multiple tapes/zones using DMX channels.

MODEL	96W	3X96
Length	14.40"	13.00"
Width	5.20"	6.60"
Depth	2.60"	4.20"



LineLED LL Series | Linear LED strip - 24 VDC

Decoders



DMX512 decoder with RDM functionality features 5 PWM output channels with common anode. High PWM output frequency range allows the product to be used in HD video conferencing spaces. All DMX products to be installed per DMX512 Standard.

Power
96 Watt

PWM Output Resolution Ratio
8 or 16 bit

Inputs
RJ45, XLR-5Pin, Terminal Block

PWM Output Frequency
500Hz - 30KHz

MODEL

DDMX-5CH-RDM-PRO

DMX Channels
1 to 5 settable

Output Dimming Curve Gamma Value
0.1 ~ 9.9

DDMX-5CH-RDM-PRO-DMX512 Decoder



Translates controller DMX512 programs for RGB and white LED strips.

Unique DMX address for the decoder can be set easily and displayed by the numeric display on the case. Changing and resetting the DMX address requires manual input.

Use power repeater to expand output (Luminii part# RGBW-SR).

Operating Voltage
12-36 VDC

Operating Temperature Range
from -4°F to +122°F in case

Power Capacity
up to 96W at 24V

PWM Output Frequency
200Hz or 1500Hz

MODEL

DDMX-RGBW

DDMX-RGBW - DMX512 Decoder



The RGBW receiver is easily paired with controller by the click of a button. Receiver can be reset to factory settings at any time.

Each receiver can store one static RGB color, one color sequence, and one brightness setting for the white LED strip. Receivers assigned to the same scene within the same zone will have the same LED static color and color sequence.

Operating Voltage
12-36 VDC

Operating Temperature Range
from -4°F to +122°F in case

Power Capacity
up to 96W at 24V

MODEL

RGBW-RC-R

RGBW-RC-R - RGBW receiver

LineLED LL Series | Linear LED strip - 24 VDC

Decoders



MODEL

RGBW-SR

RGBW-SR - RGBW signal repeater

Extends identical signal when connected in series to an RGBW LED control system. The RGBW signal repeater works with Luminii RGB and RGBW controllers, receivers, and decoders.

RGBW signal can be extended indefinitely when adequate power supply (not included) is connected to the system.

Operating Voltage
12-36 VDC

Power Capacity
up to 96W at 24V

Operating Temperature Range
from -4°F to +122°F in case



MODEL

RGBW-WI-R

RGBW-WI-R - WiFi generator

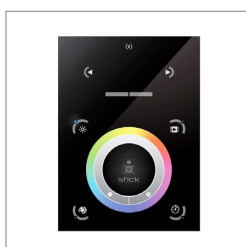
RGBW-WI-R creates a local network that enables any electronic device (phone, tablet, etc.) to control the RGB/W strip connected to a RGBW-RC-R receiver.

The control functions are achieved through a free application download for Android and iOS devices called REALCOLOR.

Operating Voltage
12-36 VDC

Power Supply
PI-130-24 (included)

Operating Temperature Range
from -4°F to +122°F in case



MODEL

TSDMX-E

TSDMX-E - Touchscreen DMX controller

Programmable advanced DMX512 lighting controller featuring a touch-screen interface. Operates as stand alone controller or integrated with most architectural lighting control systems. Can controller endless DMX512 enabled devices.

Mounts to standard single or dual gang wall box with the included power supply inside the junction box. Terminal block design for power and data connections.

Features

- Sleek glass design which sits 0.43" from the wall
- Graphical color display to show selected environment
- Color/dimmer/speed palette
- Color temperature mixing
- Touch sensitive buttons. No mechanical parts
- Touch sensitive wheel allows for accurate color selection
- Multi-zone microSD memory
- Multi-room control with 500 scenes, 10 zones
- 1024 DMX channels. Control 340 RGB fixtures
- USB & Ethernet connectivity for programming and control

Power Supply

7 VDC (included)

Programmability

PC, Mac, Tablet, Smartphone

Output Signal

DMX512 (1024 channels)

Color Parameters

- Brightness
- Saturation
- Speed of color changing sequence
- Fading / dimming / brightness

L29

LineLED LL Series | Linear LED strip - 24 VDC



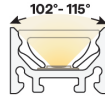
Legacy Conversion

	Legacy LL Tapes			NEW LL Tapes			
	lm/ft	W/ft	LPW	lm/ft	W/ft	LPW	
LL18	125	1.6	78	LL42-SO	130	1.4	98
LL30	200	2.7	74	LL42-HO	225	2.4	92
LL36	250	3.2	78	LL42-VHO	320	3.6	96
LL72-LO	310	4.0	78	LL72-SO	270	2.8	96
LL54	390	5.2	67	LL72-HO	440	4.8	98
LLX18	350	4.9	80				
LLX22	450	5.5	82	LL72-VHO	540	6.0	90
LL72	500	6.5	77				

L30



**VERS-FLUSH (02) STATIC
WHITE**
Linear Fixtures - Surface



- Features a co-extruded lens with an internal reflector, maximizing light delivery for improved brightness.
- The fixture's flat lens sits flush, showcasing the versatile fixture's exceptional light performance in any indoor environment.
- Features integrated metal endcaps
- Mounting options include a concealed or magnetic clip
- With an internal White Optics coating, the fixture achieves greater lumen output
- Durable anodized aluminum housings
- Consult factory for field assembly options

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
PRODUCT	WATTS/FT	CCT	RATED	LENS	EXTERNAL LOUVER	WIRE INPUT/OUTPUT	CONNECTOR/WIRE IN	CONNECTOR/WIRE OUT	WIRE COLOR	WIRE TYPE	MOUNTING	FINISH	LENGTH (IN)	EXACT/OPTIMAL
VERS-02-SW			DRY											

Sample Part Number: **VERS-02-SW-5.0-30-DRY-DF-L1-BK-P1-BW-BW-BK-CL2-CC-BK-48"-E**

<p>1 PRODUCT</p> <p>VERS-02-SW</p> <p>See following pages for compatible power supplies.</p>	<p>2 WATTS/FT</p> <p>1.5 1.5W/ft 3.0 3.0W/ft 4.0 4.0W/ft 5.0 5.0W/ft 1.5HE 1.5W/ft HE 3.0HE 3.0W/ft HE 6.0HE 6.0W/ft HE 9.0HE 9.0W/ft HE</p>	<p>3 CCT</p> <p>20 2000K 22 2200K 24 2400K 27 2700K 30 3000K 35 3500K 40 4000K</p>	<p>4 RATED</p> <p>DRY IP20</p>	<p>5 LENS</p> <p>DF Diffused PR Polar</p> <p>For representation of LED visibility, see Diode Visibility section on following pages. For beam angles, see Photometric Performance section on following pages</p>	<p>6 EXTERNAL LOUVER</p> <p>L1-WH White Plastic L1-BK Black Plastic L2-ST Satin Anodized Aluminum L2-BK Black Anodized Aluminum L2-WH White Powder Coated Aluminum N/A No Louver</p> <p>Plastic Louvers come in 12" lengths, multiple pieces will be used to match fixture length. Aluminum louvers come in maximum 98" lengths and will be cut to match fixture length.</p>
<p>7 WIRE INPUT/OUTPUT</p> <p>S1 Single 1 (Input only) - End Feed S2 Single 2 (Input only) - Bottom Feed</p> <p>When using TBC Mounting, a bare wire S2 wire feed is recommended. See install instructions for details.</p> <p>P1 Pass Through 1 (Input/output) - End Feed P2 Pass Through 2 (Input/output) - Bottom Feed</p> <p>When using TBC Mounting, a bare wire P2 wire feed is recommended. See install instructions for details.</p>	<p>8 CONNECTOR/WIRE IN</p> <p>BW Bare Wire (Standard 36") CON6 Connector 6" CON24 Connector 24"</p> <p>Connector/Wire In not needed to specify product. Typical selection is BW. BW: Standard length is 36"; Max length is 120". Request custom length by writing in part number next to BW (example: BW48)</p> <p>BW Bare Wire (Standard 36") CON6 Connector 6" CON24 Connector 24"</p> <p>Connector/Wire In not needed to specify product. Typical selection is BW. BW: Standard length is 36"; Max length is 120". Request custom length by writing in part number next to BW (example: BW48)</p>	<p>9 CONNECTOR/WIRE OUT</p> <p>CLS Closed End (No feed)</p> <p>BW Bare Wire (Standard 36") CON6 Connector 6" CON24 Connector 24"</p> <p>Connector/Wire Out not needed to specify product. Typical selection is CLS or BW. BW: Standard length is 36"; Max length is 120". Request custom length by writing in part number next to BW (example: BW48)</p>	<p>10 WIRE COLOR</p> <p>WH White BK Black</p>		
<p>11 WIRE TYPE</p> <p>CL2 Class 2 CL2P Plenum Rated</p> <p>CL2P only available with bare wire leads (BW)</p>	<p>12 MOUNTING</p> <p>CC Concealed Clip MG Magnet TBC-03 9/16" Flat TB-Grid TBC-04 15/16" Flat or Tegular TB-Grid TBC-05 9/16" Tegular TB-Grid or 9/16" Flat TB-Grid, with External Louver TBC-06 9/16" Tegular TB-Grid, with External Louver TBC-07 15/16" Flat TB-Grid, with External Louver TBC-08 15/16" Tegular TB-Grid, with External Louver</p>	<p>13 FINISH</p> <p>ST Satin BK Black BZ Bronze WH White CU Custom</p> <p>FINISH TO BE SELECTED BY ARCHITECT</p>	<p>14 LENGTH (IN)</p> <p>Fixture length min 12", max 98" not including end caps. Consult factory for lengths under 12".</p> <p>LENGTH AS INDICATED ON DRAWINGS</p>	<p>15 EXACT/OPTIMAL</p> <p>O Optimal Illumination E Exact Specified Length</p> <p>Exact fixtures are the exact length specified +/- 1/8". Optimal fixtures' length is rounded down with illumination end to end. See Exact/Optimal Fixture Length charts.</p>	

Other Manufacturers:
SCOUT "FLEXDUO LOUVER" Series

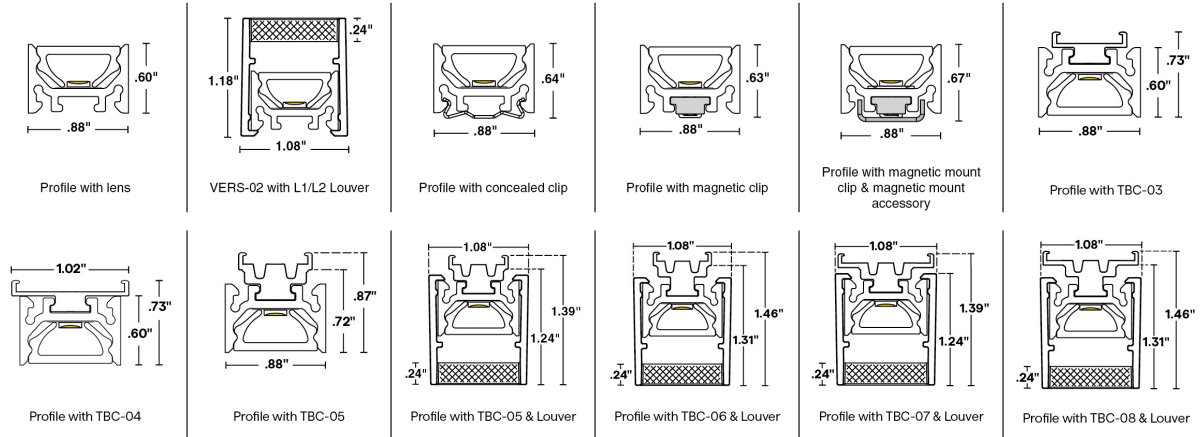
5 year warranty | Warranty only valid with QTL power supplies | Field modifications void warranty | Data subject to change, all data has +/- 5% tolerance | Suitable for installation in the storage area of a clothes closet when using wattage of 4.0W/ft or less

L30



VERS-FLUSH (02) STATIC WHITE
Linear Fixtures - Surface

1 PRODUCT - DIMENSIONS

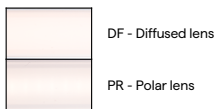


2 DELIVERED LUMENS

[Calculated L70 = 70000 hrs, L70 = 66000 hrs for HE]
Tested with VERS-02-SW-**-30-DRY

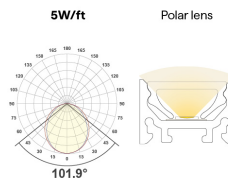
	1.5 W/FT		1.5HE W/FT		3.0 W/FT		3.0HE W/FT		4.0 W/FT		5.0 W/FT		6.0HE W/FT		9.0HE W/FT	
	LM/FT	CRI	LM/FT	CRI	LM/FT	CRI	LM/FT	CRI	LM/FT	CRI	LM/FT	CRI	LM/FT	CRI	LM/FT	CRI
PR	157	98	193	98	274	98	379	98	347	98	420	98	686	98	1022	98
DF	148	98	188	98	256	98	355	98	325	98	392	98	666	98	959	98

5 DIODE VISIBILITY



PHOTOMETRIC PERFORMANCE

Nominal beam spread shown, beam spread varies based on light engine. For more detailed information, see photometric data.



L30



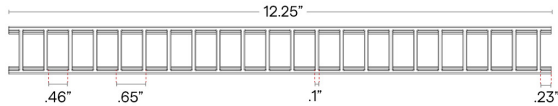
VERS-FLUSH (02) STATIC WHITE
Linear Fixtures - Surface

TEMPERATURE RATINGS

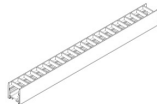
		1.5 W/FT		1.5 HE W/FT		3.0 W/FT		3.0 HE W/FT		4.0 W/FT		5.0 W/FT		6.0 HE W/FT		9.0 HE W/FT	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
DRY	Ambient Operating Temp - Surface	-4°F	140°F	-4°F	145°F	-4°F	130°F	-4°F	135°F	-4°F	125°F	-4°F	120°F	-4°F	120°F	-4°F	100°F

6 EXTERNAL LOUVER

PLASTIC



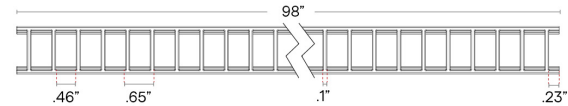
L1-XX



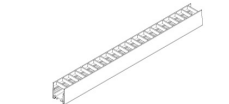
Lumen Multiplier

WH	BK
0.70	0.54

METAL



L2-XX

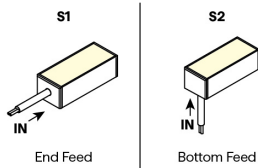


Lumen Multiplier

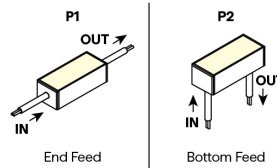
WH	BK	ST
0.64	0.39	0.59

7 WIRE INPUT/OUTPUT

SINGLE (Input only)



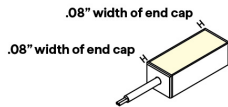
PASS THROUGH (Input/Output)



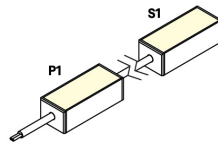


VERS-FLUSH (02) STATIC WHITE
Linear Fixtures - Surface

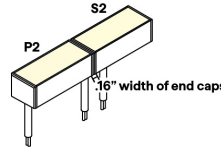
CONFIGURATION OPTIONS



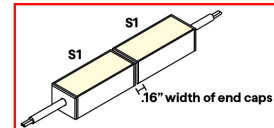
Single End Feed



Non-Continuous End Feed



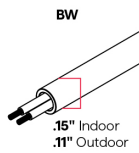
Continuous Bottom Feed



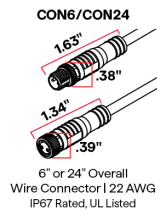
Continuous End to End Feed

8 / 9 CONNECTOR/WIRE - IN/OUT

Connector/Wire In or Out not needed to specify product.

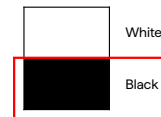


Bare Wire 36"
Stranded 22 AWG

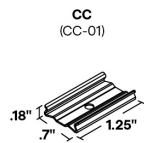


6" or 24" Overall
Wire Connector | 22 AWG
IP67 Rated, UL Listed

10 WIRE COLOR



12 MOUNTING

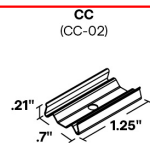


Concealed Clip

2 pieces of hardware provided for 4' or less; 4 pieces of hardware provided for greater than 4'

To order separately use CC-01

Each clips comes with a #4 x 5/8" Flat Head screw.

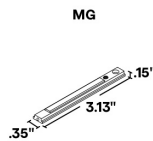


Louver Concealed Clip
Required if L1 or L2 Louver is selected

2 pieces of hardware provided for 4' or less; 4 pieces of hardware provided for greater than 4'

To order separately use CC-02

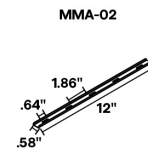
Each clips comes with a #4 x 5/8" Flat Head screw.



Magnet Clip

One MG provided per foot

To order separately use MG-02

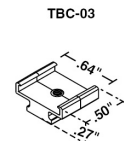


Magnet Mount
Accessory for MG-02

Sold separately, to order use MMA-02

Each clip comes with a #6 Flat Screw

Required when mounting to a non-magnetic surface



Plastic T-Bar Clip

Use on 9/16" Flat Drop Ceiling

2 clips provided for first 12"; 1 clip provided for each additional 12" or less length

To order separately use TBC-03

Each pair of clips comes with M2.5 x 4mm set screw and Allen key



VERS-FLUSH (02) STATIC WHITE
Linear Fixtures - Surface

MOUNTING CONTINUED

TBC-04	TBC-05	TBC-06	TBC-07	TBC-08
Plastic T-Bar Clip	Plastic T-Bar Clip	Plastic T-Bar Clip	Plastic T-Bar Clip	Plastic T-Bar Clip
Use on 15/16" Flat or Tegular Drop Ceiling	Use on 9/16" Tegular Drop Ceiling or with Louver on 9/16" Flat Drop Ceiling	Use with Louver on 9/16" Tegular Drop Ceiling	Use with Louver on 15/16" Flat Drop Ceiling	Use with Louver on 15/16" Tegular Drop Ceiling
2 clips provided for first 12"; 1 clip provided for each additional 12" or less length	2 clips provided for first 12"; 1 clip provided for each additional 12" or less length	2 clips provided for first 12"; 1 clip provided for each additional 12" or less length	2 clips provided for first 12"; 1 clip provided for each additional 12" or less length	2 clips provided for first 12"; 1 clip provided for each additional 12" or less length
To order separately use TBC-04	To order separately use TBC-05	To order separately use TBC-06	To order separately use TBC-07	To order separately use TBC-08
Each pair of clips comes with M2.5 x 4mm set screw and Allen key	Each pair of clips comes with M2.5 x 4mm set screw and Allen key	Each pair of clips comes with M2.5 x 4mm set screw and Allen key	Each pair of clips comes with M2.5 x 4mm set screw and Allen key	Each pair of clips comes with M2.5 x 4mm set screw and Allen key

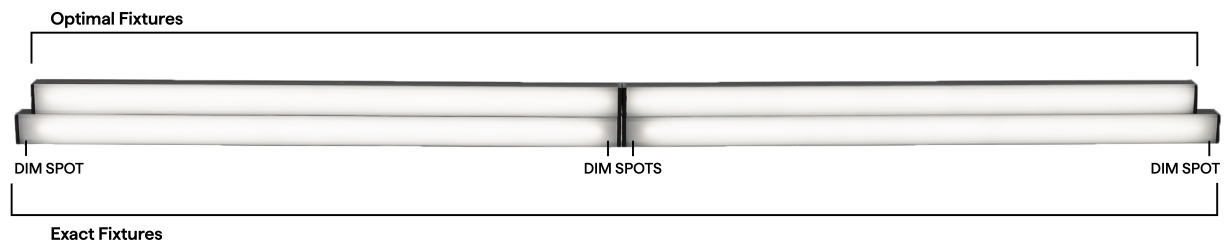
13 FINISH



Custom color available

15 EXACT/OPTIMAL FIXTURE LENGTH

Exact fixtures are the exact length specified. Optimal fixtures' length is rounded down based on LED cut points to allow the fixture to be illuminated end to end. For runs with multiple fixtures that need to fill a specific length, it's recommended to order all optimal fixtures with an exact fixture at the end of the run.





VERS-FLUSH (O2) STATIC WHITE
Linear Fixtures - Surface

SW DRY LENGTHS BY INCH

Available in any length in between 12" and 98" not including end caps, chart below shows example lengths. Exact fixtures are the length specified. Optimal fixtures' length is rounded down with illumination end to end. All fixtures' tolerance is +0 - 1/8". Consult factory for lengths under 12".

EXACT LENGTH

Requested Length	Potential dim spot on either end of fixture
12"	.5"
13"	.5"
14"	.5"
15"	.5"
16"	.5"
17"	.5"
18"	.5"
19"	.5"
20"	.5"
21"	.5"
22"	.5"
23"	.5"
24"	.5"
36"	.5"
48"	.5"
60"	.5"
72"	.5"
84"	.5"
96"	.5"

OPTIMAL LENGTH

Requested Nominal Length	S1 & S2		P1 & P2	
12"		11.5"		11.75"
13"		12.5"		12.75"
14"		13.5"		13.75"
15"		14.5"		14.75"
16"		15.5"		15.75"
17"		16.5"		16.75"
18"		17.5"		17.75"
19"		18.5"		18.75"
20"		19.5"		19.75"
21"		20.5"		20.75"
22"		21.5"		21.75"
23"		22.5"		22.75"
24"		23.5"		23.75"
36"		35.5"		35.75"
48"		47.5"		47.75"
60"		59.5"		59.75"
72"		71.5"		71.75"
84"		83.5"		83.75"
96"		95.5"		95.75"

SW-HE DRY LENGTHS BY INCH

Available in any length in between 12" and 98" not including end caps, chart below shows example lengths. Exact fixtures are the length specified. Optimal fixtures' length is rounded down with illumination end to end. All fixtures' tolerance is +0 - 1/8". Consult factory for lengths under 12".

EXACT LENGTH

Requested Length	Potential dim spot on either end of fixture
12"	1"
13"	0.5"
14"	1"
15"	0.5"
16"	1"
17"	0.5"
18"	1"
19"	0.5"
20"	1"
21"	0.5"
22"	1"
23"	0.5"
24"	1"
36"	1"
48"	1"
60"	1"
72"	1"
84"	1"
96"	1"

OPTIMAL LENGTH: highlighted rows are closest to requested nominal length

Requested Nominal Length	S1 & S2		P1 & P2	
12"		10.5"		10.75"
13"		12.5"		12.75"
14"		12.5"		12.75"
15"		14.5"		14.75"
16"		14.5"		14.75"
17"		16.5"		16.75"
18"		16.5"		16.75"
19"		18.5"		18.75"
20"		18.5"		18.75"
21"		20.5"		20.75"
22"		20.5"		20.75"
23"		22.5"		22.75"
24"		22.5"		22.75"
36"		34.5"		34.75"
48"		46.5"		46.75"
60"		58.5"		58.75"
72"		70.5"		70.75"
84"		82.5"		82.75"
96"		94.5"		94.75"

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VERS-FLUSH (02) STATIC WHITE
Linear Fixtures - Surface

COMPATIBLE POWER SUPPLIES

See power supplies cut sheets for more information. Data subject to change, all data has +/- 5% tolerance.

DIM TO LEVEL	INDOOR	
	SW24/1.5-4.0	SW24/5.0, SW-HE, SW-HE+
Dim to Black	Q6M-DC+CAP QTM-DC+CAP iQ-PH iQ-PH+QD1	Q6M-DC+CAP QTM-DC+CAP iQ-PH iQ-PH+QD1
0.1%	QT-CAB-QZ-PH/0-10V QT-CAB-eLED+0-10V QT-CAB-eLED+0-10V-AWN QT-CAB-eLED-ND QTM-eLED+0-10V QTM-eLED-AWN QZ-DMX QZ-PH/0-10V QZ-STICK-PH/0-10V QZLP	QT-CAB-QZ-PH/0-10V QT-CAB-eLED+0-10V QT-CAB-eLED+0-10V-AWN QT-CAB-eLED-ND QTM-eLED+0-10V QTM-eLED-AWN QZ-DMX QZ-PH/0-10V QZ-STICK-PH/0-10V QZLP
1%	QT-CAB-eLED+DALI-DT6 QT-CAB-eLED+DALI-DT6-AWN QTM-eLED(E) QTM-eLED+DALI-DT6 QTM-eLED+DALI-DT6-AWN QZ-DALI-DT6	QT-CAB-eLED+DALI-DT6 QT-CAB-eLED+DALI-DT6-AWN QTM-eLED(E) QTM-eLED+DALI-DT6 QTM-eLED+DALI-DT6-AWN QZ-DALI-DT6
10%	Non-Dim Power Supply with SW App Dongle	Non-Dim Power Supply with SW App Dongle

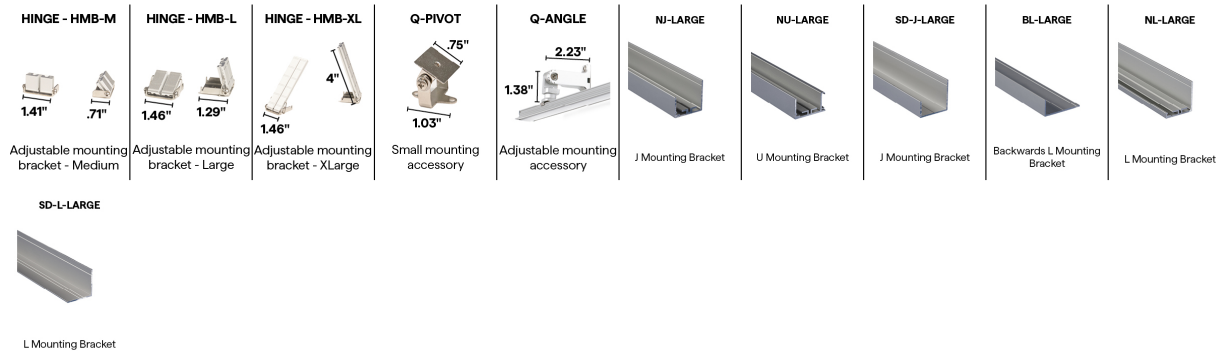
L30



VERS-FLUSH (02) STATIC WHITE
Linear Fixtures - Surface

DIMMING PROTOCOL	INDOOR	
	SW24/1.5-4.0	SW24/5.0, SW-HE, SW-HE+
Non-Dim	QTM-eLED+CAP QTM-eLED-ND QZ-ND	QTM-eLED+CAP QTM-eLED-ND QZ-ND
Phase	Q6M-DC+CAP QT-CAB-QZ-PH/0-10V QTM-DC+CAP QTM-eLED(E) QZ-PH/0-10V QZ-STICK-PH/0-10V QZLP iQ-PH iQ-PH+QD1	Q6M-DC+CAP QT-CAB-QZ-PH/0-10V QTM-DC+CAP QTM-eLED(E) QZ-PH/0-10V QZ-STICK-PH/0-10V QZLP iQ-PH iQ-PH+QD1
0-10V	QT-CAB-QZ-PH/0-10V QT-CAB-eLED+0-10V QT-CAB-eLED+0-10V-AWN QT-CAB-eLED-ND QTM-eLED+0-10V QTM-eLED-AWN QZ-PH/0-10V QZ-STICK-PH/0-10V QZLP	QT-CAB-QZ-PH/0-10V QT-CAB-eLED+0-10V QT-CAB-eLED+0-10V-AWN QT-CAB-eLED-ND QTM-eLED+0-10V QTM-eLED-AWN QZ-PH/0-10V QZ-STICK-PH/0-10V QZLP
Lutron Athena	QT-CAB-eLED+0-10V-AWN QT-CAB-eLED+DALI-DT6-AWN QTM-eLED+DALI-DT6-AWN QTM-eLED-AWN	QT-CAB-eLED+0-10V-AWN QT-CAB-eLED+DALI-DT6-AWN QTM-eLED+DALI-DT6-AWN QTM-eLED-AWN
ECO System	QTM-eLED(E)	QTM-eLED(E)
DMX	QZ-DMX	QZ-DMX
DALI-2: DT6	QT-CAB-eLED+DALI-DT6 QT-CAB-eLED+DALI-DT6-AWN QTM-eLED+DALI-DT6 QTM-eLED+DALI-DT6-AWN QZ-DALI-DT6	QT-CAB-eLED+DALI-DT6 QT-CAB-eLED+DALI-DT6-AWN QTM-eLED+DALI-DT6 QTM-eLED+DALI-DT6-AWN QZ-DALI-DT6
SCENE App Dimmed	Non-Dim Power Supply with SW App Dongle	Non-Dim Power Supply with SW App Dongle

COMPATIBLE MOUNTING ACCESSORIES

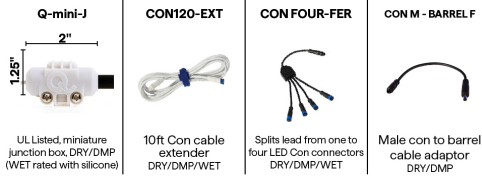




VERS-FLUSH (02) STATIC WHITE

Linear Fixtures - Surface

COMPATIBLE WIRING ACCESSORIES



COMPATIBLE CONTROL ACCESSORIES



COMPATIBLE APPS





L31

a CarbonNeutral company

Rush Sharp recessed

Other Manufacturers:
AXIS "SCULPT MIKROLITE" Series
PICASSO "SIENNA 1" Series
XICO "MICROSQUARE" Series

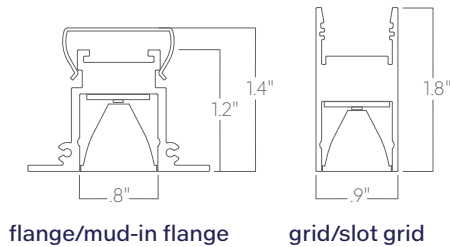


The Sharp Series of architectural luminaires features slim profiles, glare-free, beam shaping optical cells and several mounting options. Custom lengths are tailored to suit any modern space.

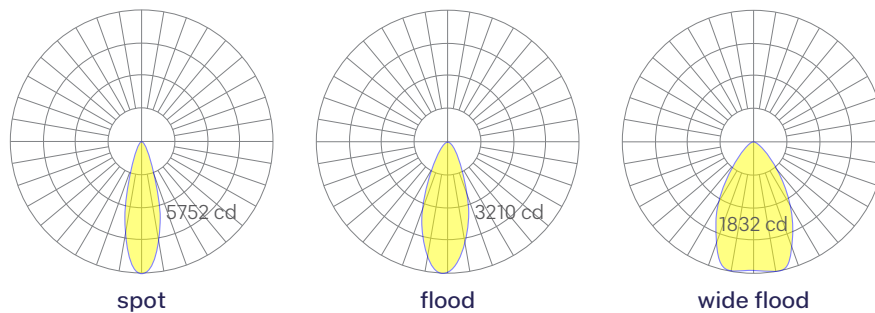
Features

- Extruded recycled aluminum housing
- Aluminum core LED boards, specifiable output
- Specifiable color temperature. CRI > 90, R9 > 50
- Custom lengths, welded patterns, and finishes available
- Specifiable remote dimmable drivers
- 5 Year, 50,000 hour warranty, damp location rated
- WELL Building Standard compatible [learn more](#)

Dimensions



Optics



Representative distribution and peak candela. For other options see order information or IES files [here](#).

Modification date: August 2024

Page 1 of 4

coronetled.com
T 973 345 7660



Coronet reserves the right to make design changes.

L31



a CarbonNeutral company

Rush Sharp recessed

Ordering Information

For each option group below specify one option. If you don't see your preferred option listed, contact us for [help](#).

1 Fixture ID	2 Length	3 Color Temperature	4 Output
RUSH SHARP REC	2 2 ft nominal 4 4 ft nominal 8 8 ft nominal X'X" Specify length Custom lengths in 4" increments PAT Pattern (Consult Factory) <div style="border: 1px solid red; padding: 2px; color: red; text-align: center;">LENGTH AS INDICATED ON DRAWINGS</div>	27 2700K/90 CRI 30 3000K/90 CRI <div style="border: 1px solid red; padding: 2px; color: red;">35 3500K/90 CRI</div> 40 4000K/90 CRI	LOW Low output MED Medium output HIGH High output <div style="border: 1px solid red; padding: 2px; color: red;">CUST Custom output Specify watts or lumens</div> <div style="border: 1px solid red; padding: 2px; color: red; text-align: center;">2 Watts/ft</div>
5 Voltage	6 Driver	7 Finish	8 Mounting
<div style="border: 1px solid red; padding: 2px; color: red;">UNV Universal (120/277V)</div> 347V 347V Available for DB driver only	<div style="border: 1px solid red; padding: 2px; color: red;">DB Standard 0-10V 1%</div> DB.1% 0-10V 0.1% DALI DALI-2 Driver DMX DMX512 All DMX drivers set to default address 001 and provided in remote enclosures. Contact us for other addressing needs.	Housing W White BLK Black CC Custom Color See finish options here. Louver W White BLK Black <div style="border: 1px solid red; padding: 2px; color: red; text-align: center;">FINISH TO BE SELECTED BY ARCHITECT</div>	T 9/16" Tee Grid T15 15/16" Tee Grid SG Slot Grid/Interlude F Flange NT Mud-in Flange <div style="border: 1px solid red; padding: 2px; color: red;">PM-X Perimeter Mount *X denotes mounting type on opposite side of wall (eg PM-NT)</div> <div style="border: 1px solid red; padding: 2px; color: red;">PM-F</div> WOOD Wood ceiling Provide specifications.
9 Optics	10 Sensors/Controls	11 Circuit	12 Options
SP 24° Beam FL 36° Beam <div style="border: 1px solid red; padding: 2px; color: red;">WFL 55° Beam</div>	NA None ACM Acuity nLight Module Only CCS Casambi Module AWRN Lutron Athena Wireless Node Module OTHER Consult Factory All controls remote.	NA None EMPCK Emergency battery pack EMCKT Emergency circuit May require additional power feeds. DAYCKT Daylight circuit May require additional power feeds.	NA None

Performance

Output ¹	Watts/ft	Lumens/ft
Low	4	312
Medium	6	469
High	8	625

¹Based on WFL optic, black louver, 90 CRI, 3500K luminaire using one driver. Custom outputs available. Please consult factory.
For 4000K multiply by 1.05, for 3000K, 0.96, for 2700K, 0.92.

Technical Information



click [here](#) or scan QR code

Wiring diagrams, PoE and sensor details

Modification date: August 2024

Page 2 of 4

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T 973 345 7660



Coronet reserves the right to make design changes.

L31

a CarbonNeutral company



Rush Sharp recessed

Drivers & Electrical

Remote, dimmable drivers are supplied in enclosures.

For remote driver box sizes, click [here](#).

Emergency Back-Up

For fixtures three-feet or longer, a 4W remote emergency driver may be wired to 4ft sections. 7W, 10W, and 12W drivers are also available. Emergency circuits for use with building generators are also available.

Finishes

All luminaires are finished in high quality polyester powder coating. Our standard color is white. Any RAL color may be specified.

Weight

1 lb per foot

Optics

Glare-free, beam shaping optical cells.

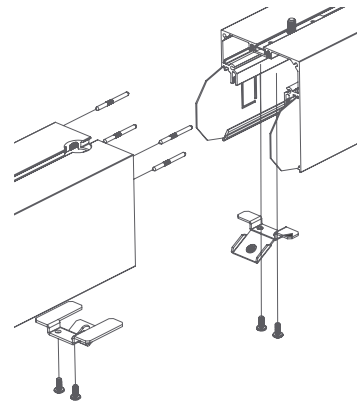
Construction

Extruded, recycled aluminum housing with formed steel ends.

Joined Runs

Runs of any length¹ may be specified and are comprised of multiple, factory-engineered, joined sections. Individually specified luminaires are not field joinable.

¹Custom lengths available in 12" nominal increments.



Representative joinery. For product specific details see installation guides or submittal drawings.

Patterns

Featuring illuminated welded corners and angles. Consult factory for custom designs and elevations.

Square



T



Modification date: August, 2024

Page 3 of 4

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L31

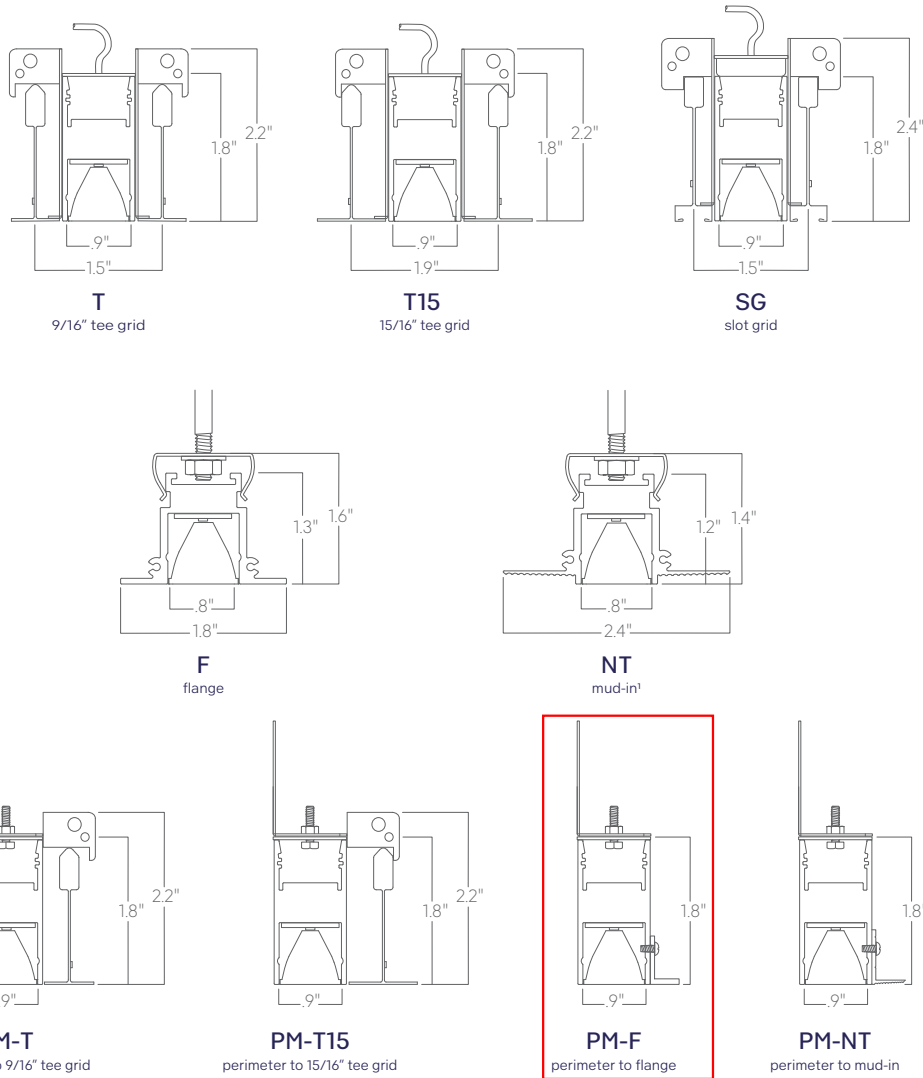
a CarbonNeutral company



Rush Sharp recessed

Mounting Options

Custom mounting types and ceiling transitions available; consult factory.



¹Installation that alters aperture width compromises lens security. Installer must ensure aperture width is maintained.

Please consult factory shop drawings for suspension points.

To prevent damage to fixtures, factory designated suspension points must not be field altered.

Do not attempt installation if you do not understand the installation instructions.

Modification date: August, 2024

Page 4 of 4

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Coronet reserves the right to make design changes.

Other Manufacturers:
CONTECH "TLTAC" Series
JESCO "DL-AC-FLEX-FS" Series
OMNILIGHT "HVR" Series

L32

FIXTURE TYPE _____
PROJECT NAME _____
LOCATION _____



I Description

Offering up to 500 lumens per foot, Orex is a simple indoor/outdoor line voltage solution to long run lengths requiring high output levels.

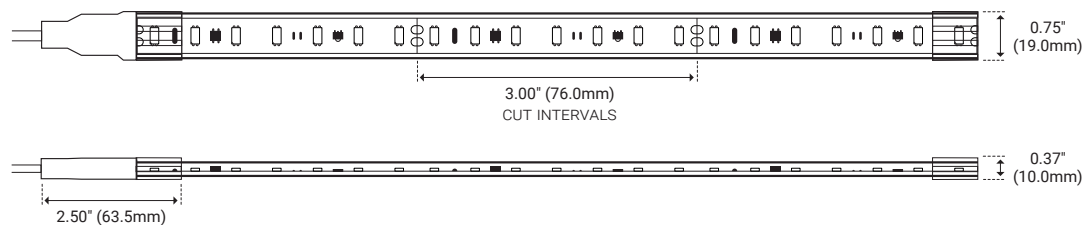
I Features

- 120V Line Voltage
- Integral AC/DC Rectifier
- ETL, Triac, 0–10V (with LCX-1041)
- Hardwire or Plug-in Installation
- IP65

I Series Spec

Series	RX
Temp/Colors	2400K–6500K
Input Voltage	120V AC
Watts per Foot	250 lm/ft = 3W/ft 500 lm/ft = 6W/ft
Beam Spread	120°
CRI	90+
Diode	3056
Orex Width	0.56" (14.3mm)
Orex Height	0.25" (6.5mm)
End Cap Length	2.50" (63.5mm)
End Cap Width	0.75" (19.0mm)
End Cap Height	0.37" (10.0mm)
Cut Intervals	3.00" (76.0mm)
Max Run Length	250 lm/ft = 120ft per Power Feed 500 lm/ft = 100ft per Power Feed
Dimming Protocol	0–10V (with LCX-1041) ¹ , Triac, and ELV
Operating Temp.	-4°F (-20°C) to 107°F (42°C)
Installation Temp.	32°F (0°C) to 107°F (42°C)
Storage Temp.	-4°F (-20°C) to 140°F (60°C)

I Dimensions

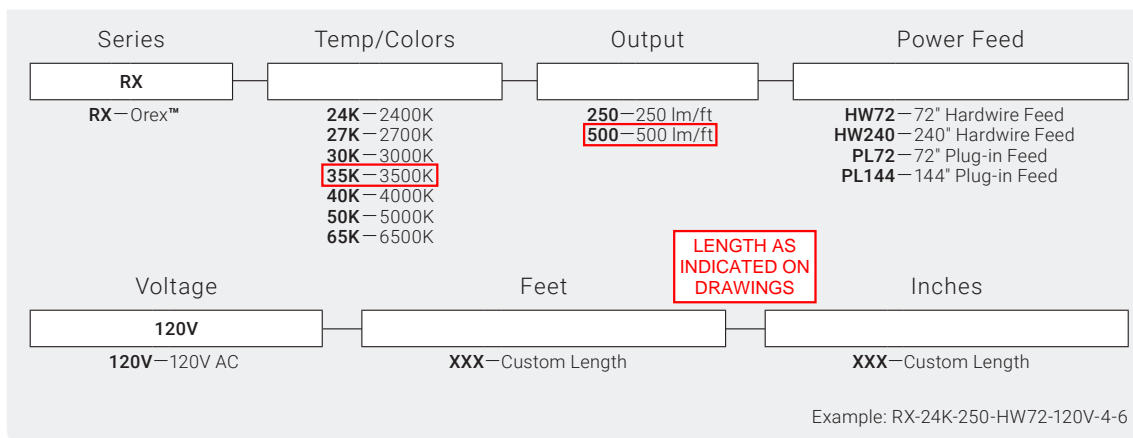


¹ See separate LCX-1041 spec sheet for more information.

Conforms to ANSI/UL Standard 1598
Certified to CAN/CSA Standard C22.2 NO. 250.0



I Product Code Builder



I Series Data

	Configuration	2400K	2700K	3000K	3500K	4000K	5000K	6500K
Orex 250	Tape Only	222	251	256	263	268	276	279
	Tape, Channel, & Flat Lens	124	140	142	147	150	154	155
	Tape, Channel, & Square Lens	120	135	138	142	145	149	150
Orex 500	Tape Only	412	464	473	487	497	511	516
	Tape, Channel, & Flat Lens	237	267	272	281	286	294	297
	Tape, Channel, & Square Lens	245	275	281	290	295	304	306
% Difference from 30K	--	87%	98%	100%	103%	105%	108%	109%



I Mounting Options

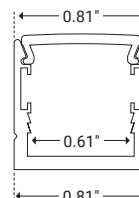
Flat Aluminum Channel



Channel & Lens Specifications

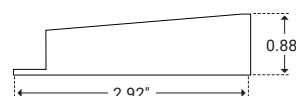
Model	RX-CH-TL-2-FL
Channel Material	Aluminum
Lens Material	Acrylic
Length	78.74" (2m)
Width	0.81" (20.0mm)
Internal Width	0.61" (15.6mm)
Light Transmission	57%

Includes 1 set of end caps, 5 mounting clips, and flat pixel free lens.



End Caps Specifications

Model	RX-EC-FL-SD
Start Cap Dimensions	
Length	2.92" (74.23mm)
Width	1.52" (38.82mm)
Height	0.88" (22.5mm)
Finish Cap Dimensions	
Length	1.27" (32.25mm)
Width	1.52" (38.82mm)
Height	0.88" (22.5mm)



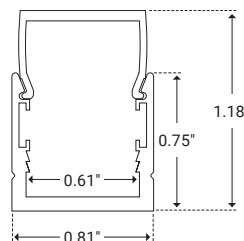
Square Aluminum Channel



Channel & Lens Specifications

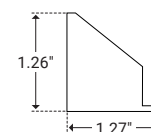
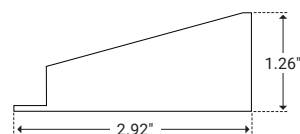
Model	RX-CH-TL-2-SQ
Channel Material	Aluminum
Lens Material	Acrylic
Length	78.74" (2m)
Width	0.81" (20.0mm)
Internal Width	0.61" (15.6mm)
Light Transmission	57%

Includes 1 set of end caps, 5 mounting clips, and square pixel free lens.



End Caps Specifications

Model	RX-EC-SQ-SD
Start Cap Dimensions	
Length	2.92" (74.2mm)
Width	1.52" (38.8mm)
Height	1.26" (32.0mm)
Finish Cap Dimensions	
Length	1.27" (32.0mm)
Width	1.52" (38.8mm)
Height	1.26" (32.0mm)





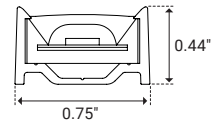
I Mounting Options

Plastic Mounting Base



Specifications

Model	RX-CH-PL-2M
Material	Polycarbonate
Length	78.74" (2m)
Width	0.75" (18.9mm)
Height	0.44" (14.3mm)



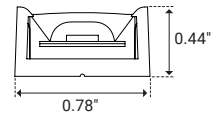
Mounting Clips



Specifications

Model	RX-CLP-F1-PAK-P
Material	Polycarbonate
Length	0.56" (15.0mm)
Width	0.78" (19.8mm)
Height	0.44" (11.3mm)

Includes 10 Clips



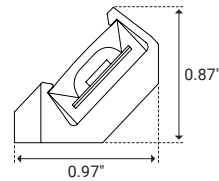
45° Mounting Clips



Specifications

Model	RX-CLP-A1-PAK-P
Material	ABS Plastic
Length	0.78" (19.7mm)
Width	0.97" (24.7mm)
Height	0.87" (22.0mm)

Includes 10 Clips



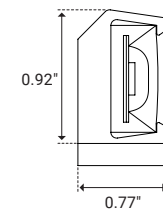
90° Mounting Clips



Specifications

Model	RX-CLP-V1-PAK-P
Material	ABS Plastic
Length	0.77" (19.6mm)
Width	0.52" (13.3mm)
Height	0.92" (23.3mm)

Includes 10 Dual Mounting Clips



Base Mount



Back Mount

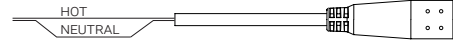
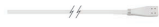




I Hardwire Power & Connectors

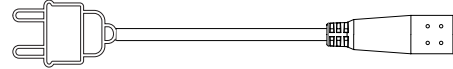
Hardwire Power Feed

Description	Ordering Codes
72" Length	HW72
240" Length	HW240



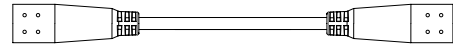
Plug-in Power Feed

Description	Ordering Codes
72" Length	PL72
144" Length	PL144

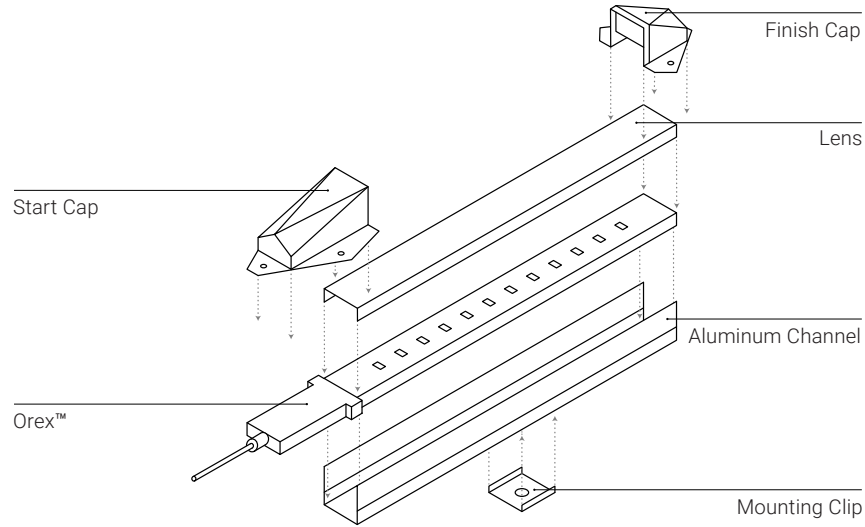


Jump Cables

Description	Ordering Codes
6" Length	RX-JP-6
24" Length	RX-JP-24
48" Length	RX-JP-48



Aluminum Channels Diagram

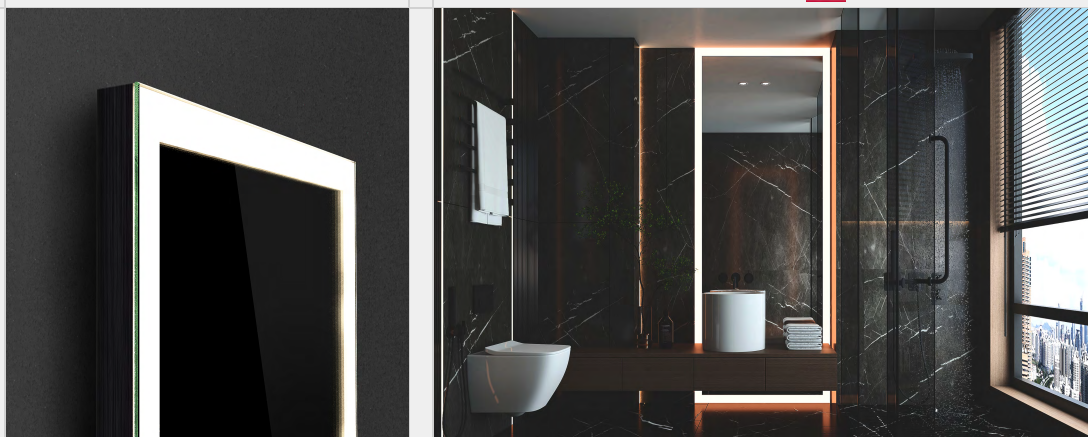


M1

CLASSIC LINE L02D



Made in the USA



ITEM CODE

L 0 2 D

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

Other Manufacturers:
TGS "MIRAGE" Series
SAL "SM010" Series
ELECTRIC MIRROR "SILHOUETTE" Series



Additional Custom Specification Notes ⑩

(specify the accurate size in additional custom specification notes)

① Types

- L - Classic Line

② Styles

- 02 - Full Frame Edge Frost

③ Lighting Styles

- D - Direct Light

④ Glass Sizes

- 1836 - 18" x 36"
- 2436 - 24" x 36"
- 2448 - 24" x 48"
- 2460 - 24" x 60"
- 3042 - 30" x 42"
- 3048 - 30" x 48"
- 3060 - 30" x 60"
- 3072 - 30" x 72"
- 3232 - 32" x 32"
- 3636 - 36" x 36"
- 3642 - 36" x 42"
- 3648 - 36" x 48"
- 3660 - 36" x 60"
- 3672 - 36" x 72"
- 4242 - 42" x 42"
- 4254 - 42" x 54"
- 4260 - 42" x 60"
- 4284 - 42" x 84"
- Custom 3173 - 31.4" x 72.5"

SEE ARCHITECTURAL SECTIONS/DETAILS FOR MIRROR SIZES

(specify the accurate size in additional custom specification notes)

⑤ Outputs

- S - Standard Output (550 lumens/ft; 4.5 watts/ft)
- H - High Output (750 lumens/ft; 6 watts/ft)

Account for approximately 50% -60% light loss factor

- 60% for direct lighting
- 50% for indirect lighting

Use frost size on page 2 to calculate linear footage

⑥ Color Temperatures

- 00 - Color Switchable 2700k-6500k (90+ CRI) (Only available with high output with touch sensor accessory or MTS)
- 27 - 2700k (90+ CRI)
- 30 - 3000k (90+ CRI)
- 35 - 3500k (90+ CRI)
- 40 - 4000k (90+ CRI)
- 50 - 5000k (90+ CRI)

⑦ Drivers

- V - 120-277VAC 0-10 Dimmable
- E - 120-277VAC ELV Dimmable
- N - 120-277VAC Non-Dimming (Mirrors with touch sensor has to use a non-dimming driver)

⑧ Mounting

- 1 - Vertical
- 2 - Horizontal

⑨ Accessories

- NA - None
- TS - Touch Sensor
- AF - Anti-Fog Demister
- NL - Night Light (Selected styles only)
- AT - Anti-Fog & Touch Sensor
- NT - Night Light & Touch Sensor
- AN - Anti Fog & Night Light
- AL - Anti-Fog, Night Light & Touch Sensor
- TR - Matrix Touch System

⑩ Additional Custom Specification Notes

- Low-Iron Glasses
- Bluetooth Speakers
- Antimicrobial Powder Coat
- DIY Touch Sensor Icons
- Powder Coated Chassis
- Custom Inset & Frosting Sizes (Up to 2")

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MATRIX MIRRORS

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S

CLASSIC LINE L02D



M1

Made in the USA

ACCESSORY DESCRIPTIONS

Anti-Fog Demister (120v power supply)

Available Sizes

- 12" x 12" • 16" x 28"
- 12" x 18" • 18" x 22"
- 16" x 16" • 18" x 34"

Connection Options

- On touch sensor
- On hard wire

Touch Sensor

1 Key Touch Sensor

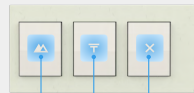
- On/Off Dim
- Color Temperature Switchable between 2700k to 6500k



Direct Light

Matrix Touch System

- On/Off Dim
- Color Temperature Tunable between 2700k to 6500k
- Demister

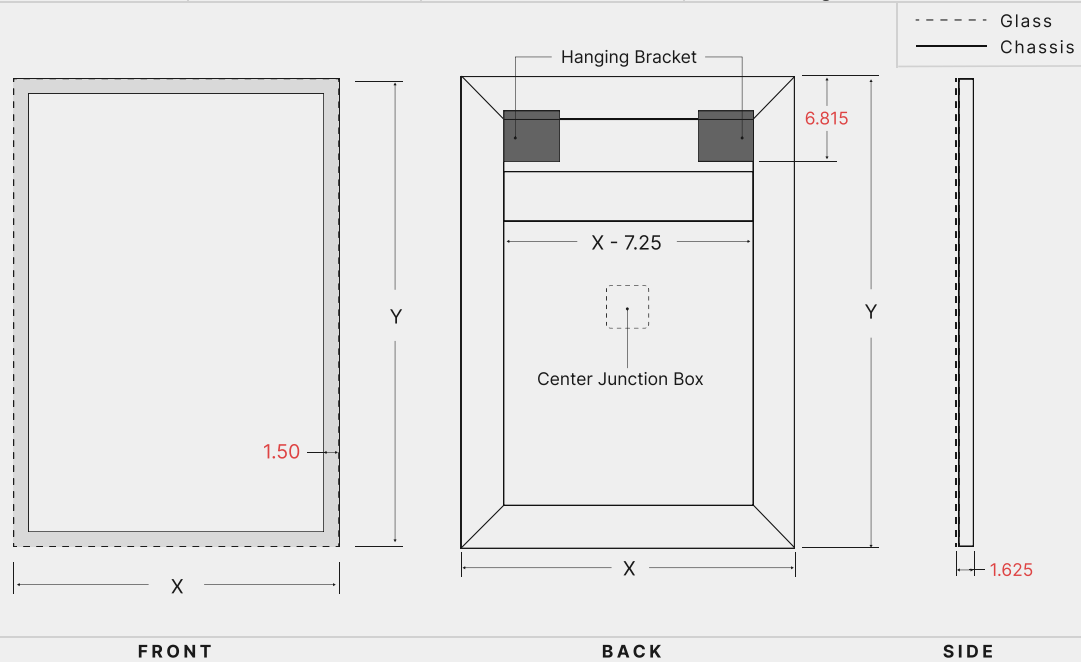


On/Off Hold to Dim
Tap to Switch Hold to Tune
Demister

STANDARD SIZE (Dimensions in red are set)

UNIT: inch

Frost: 1.50	Depth: 1.625	Glass Width: X	Full Width: X
Inset: N/A		Glass Height: Y	Full Height: Y



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M2

CLASSIC LINE L021



Made in the USA



ITEM CODE

L 0 2 1

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

Other Manufacturers:
TGS "MIRAGE" Series
SAL "SM010" Series
ELECTRIC MIRROR "SILHOUETTE" Series



Additional Custom Specification Notes ⑩

(specify the accurate size in additional custom specification notes)

① Types

- L - Classic Line

② Styles

- 02 - Full Frame Edge Frost

③ Lighting Styles

- 1 - Indirect Light

④ Glass Sizes

- 1836 - 18" x 36"
- 2436 - 24" x 36"
- 2448 - 24" x 48"
- 2460 - 24" x 60"
- 3042 - 30" x 42"
- 3048 - 30" x 48"
- 3060 - 30" x 60"
- 3072 - 30" x 72"
- 3232 - 32" x 32"
- 3636 - 36" x 36"
- 3642 - 36" x 42"
- 3648 - 36" x 48"
- 3660 - 36" x 60"
- 3672 - 36" x 72"
- 4242 - 42" x 42"
- 4254 - 42" x 54"
- 4260 - 42" x 60"
- 4284 - 42" x 84"
- Custom 3173 - 31.4" x 72.5"

SEE ARCHITECTURAL SECTIONS/DETAILS FOR MIRROR SIZES

(specify the accurate size in additional custom specification notes)

⑤ Outputs

- S - Standard Output (550 lumens/ft; 4.5 watts/ft)
- H - High Output (750 lumens/ft; 6 watts/ft)

Account for approximately 50% - 60% light loss factor

- 60% for direct lighting
- 50% for indirect lighting

Use frost size on page 2 to calculate linear footage

⑥ Color Temperatures

- 00 - Color Switchable 2700k-6500k (90+ CRI) (Only available with high output with touch sensor accessory or MTS)
- 27 - 2700k (90+ CRI)
- 30 - 3000k (90+ CRI)
- 35 - 3500k (90+ CRI)
- 40 - 4000k (90+ CRI)
- 50 - 5000k (90+ CRI)

⑦ Drivers

- V - 120-277VAC 0-10 Dimmable
- E - 120-277VAC ELV Dimmable
- N - 120-277VAC Non-Dimming (Mirrors with touch sensor has to use a non-dimming driver)

⑧ Mounting

- 1 - Vertical
- 2 - Horizontal

⑨ Accessories

- NA - None
- TS - Touch Sensor
- AF - Anti-Fog Demister
- NL - Night Light (Selected styles only)
- AT - Anti-Fog & Touch Sensor
- NT - Night Light & Touch Sensor
- AN - Anti Fog & Night Light
- AL - Anti-Fog, Night Light & Touch Sensor
- TR - Matrix Touch System

⑩ Additional Custom Specification Notes

- Low-Iron Glasses
- Bluetooth Speakers
- Antimicrobial Powder Coat
- DIY Touch Sensor Icons
- Powder Coated Chassis
- Custom Inset & Frosting Sizes (Up to 2")

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Please punch holes before the dashed line

MATRIX MIRRORS

M
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S

CLASSIC LINE L021



M2

Made in the USA

ACCESSORY DESCRIPTIONS

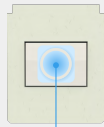
Anti-Fog Demister (120v power supply)

- | | |
|---|---|
| Available Sizes | Connection Options |
| <ul style="list-style-type: none"> • 12" x 12" • 16" x 28" • 12" x 18" • 18" x 22" • 16" x 16" • 18" x 34" | <ul style="list-style-type: none"> • On touch sensor • On hard wire |

Touch Sensor

1 Key Touch Sensor

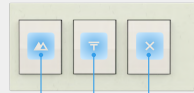
- On/Off Dim
- Color Temperature Switchable between 2700k to 6500k



Direct Light

Matrix Touch System

- On/Off Dim
- Color Temperature Tunable between 2700k to 6500k
- Demister

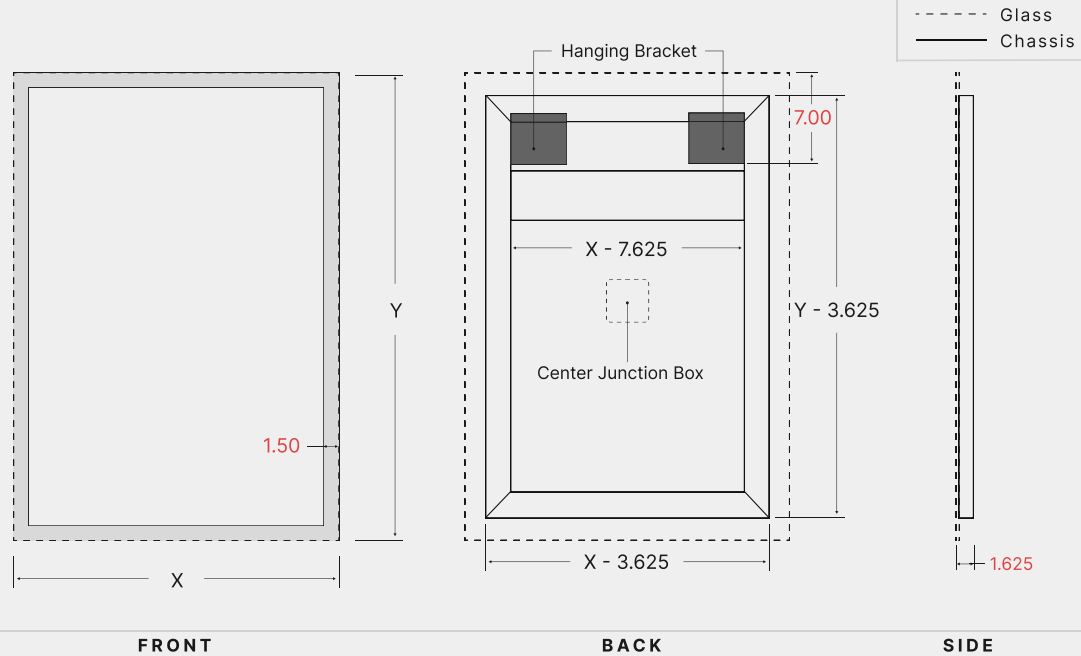


On/Off Hold to Dim
Tap to Switch Hold to Tune
Demister

STANDARD SIZE (Dimensions in red are set)

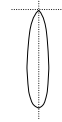
UNIT: inch

Frost: 1.50	Depth: 1.625	Glass Width: X	Full Width: X
Inset: N/A		Glass Height: Y	Full Height: Y



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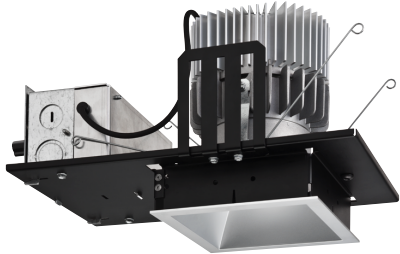
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Luminaire Type: **OL1**
Catalog Number:



High Center Beam Square Downlight 4"



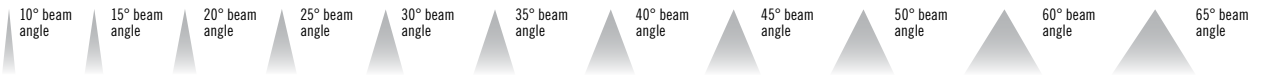
Other Manufacturers:
PORTFOLIO "LDSQ4D" Series
INTENSE "SD4DS" Series
PRESCOLITE "LFR-4SQD" Series

OVERVIEW

Feature Set

- Eleven optimized distribution patterns allow designers to achieve tailored objectives
- Bounding Ray™ optical design
- 45° Cutoff to source and source image
- Field interchangeable optic
- Driver and LED light engine fully serviceable from below ceiling
- 70% lumen maintenance at 60,000 hours
- 2.5 SDCM; 85 CRI typical, 90+ CRI optional
- Fixtures are wet location, covered ceiling
- ENERGY STAR® Certified product

Distribution



Superior Performance

Nominal Lumens	500	750	1000	1500	2000	2500	3000	3500	4000	4500	5000
Delivered	669	768	1011	1470	1881	2302	2779	3377	3790	4205	4614
Wattage	6.7	7.5	9.8	15.1	21.5	26.5	34.1	33.8	39.5	46.2	53.2
Efficacy	99	103	103	97	88	87	81	100	96	91	87

*Based on 3500K 80CRI 35D AR T00 LSS @ 0 Degrees

COMPLEMENTARY PRODUCTS

Coordinated Apertures | Multiple Layers of Light



General Illumination Layer | EVO



High Center Beam Layer | Incito



EVO + Incito — Multiple Layers of Light

Downlight	Open Wallwash	Lensed Wallwash	Cylinder	Downlight	Adjustable	Lensed Wallwash	Cylinder	Core		
MRI	Surgical Suite	Patient Room							Healthcare	
Dynamic	Food Service	Vandal	Clean Room	Shower						Special Applications



4" High Center Beam Square Downlight

ORDERING INFORMATION

A+ Capable options indicated by this color background.

Luminaire Type: **OL1**
Catalog Number:

EXAMPLE: IC04SQ 35/15 AR LSS 35D 277 EZ1

Series	Color Temperature	Lumens	Reflector Color	Flange Type	Reflector Finish	Beam
IC04SQ Incito 4in Square Downlight	27/ 2700 K	05 500 lumens	AR Clear	(blank) Self-flanged	LSS Semi-specular	100² 10° beam angle
	30/ 3000 K	07 750 lumens	PR Pewter	FL Flangeless	LD Matte diffuse	15D 15° beam angle
	35/ 3500 K	10 1000 lumens	WTR Wheat			20D 20° beam angle
	40/ 4000 K	15 1500 lumens	GR Gold			25D 25° beam angle
	50/ 5000 K	20 2000 lumens	WR ¹ White painted			30D 30° beam angle
		25 2500 lumens	BR ¹ Black			35D 35° beam angle
		30 3000 lumens	BZR ¹ Dark Bronze painted			40D 40° beam angle
		35 3500 lumens	WRAMP ¹ White Anti-microbial			45D 45° beam angle
		40 4000 lumens				50D 50° beam angle
		45 4500 lumens				60D 60° beam angle
	50 5000 lumens				65D 65° beam angle	

Voltage	Driver	Control Interface	Options
120 120V	GZ10 0-10V driver dims to 10%	(blank)	SF Single fuse.
277 277V	GZ1 0-10V driver dims to 1%	NLT ⁷ nLight® dimming pack.	90CRI High CRI (90+)
347 ^{3,4} 347V	EZ10 eldoLED 0-10V ECOdrive. Linear dimming to 10% min.	NLTER ^{7,8} nLight® dimming pack for fixtures on emergency circuit	TRW⁹ White Painted Flange
	EZ1 eldoLED 0-10V ECOdrive. Linear dimming to 1% min.	NLTAIR2 nLight® AIR dimming pack.	TRBL¹⁰ Black Painted Flange
	EZB eldoLED 0-10V SOLOdrive. Logarithmic dimming to <1%.	NLTAIRER2 ⁹ nLight® AIR dimming pack for fixtures on emergency circuit	ELR¹¹ Batterypack with remote test switch
	EDAB⁶ eldoLED SOLOdrive DALI. Logarithmic dimming to <1%.	NLTAIREM2 nLight® AIR dimming pack for fixtures on emergency circuit	CP¹² Chicago Plenum
	EDXB^{5,6} eldoLED POWERdrive DMX with RDM (remote device management). Square Law dimming to <1%. MIN:1000 MAX:4000		N80 nLight Lumen Compensation
	ECOD⁶ Lutron® EcoSystem® digital Hi-Lume 1% soft-on, fade to black. Min: 500LM; Max: 4000LM.		RRL RELOC® Ready Luminaire connectors enable a simple and consistent factory installed option across all ABL luminaire brands. Available only with RRLA, RRLB, RRLAE, and RRLC12S. Refer to RRL spec sheet on www.acuitybrands.com for RELOC® product specifications. Above ceiling access required.

ACCESSORIES — order as separate catalog numbers (shipped separately)	
OPTC4 XXD	Additional optics for field installation. Replace "XX" with beam angle.

ORDERING NOTES	
1. Not Available with Finishes.	9. For use with different reflector finish only (i.e. AR, PR, WTR, GR options). Not available with WR (White Reflector). Not available with FL.
2. Only available 1500lm and below.	10. For use with different reflector finish only (i.e. AR, PR, WTR, GR options). Not available with BR (Black Reflector). Not available with FL.
3. Not available with ELR emergency option.	11. Must specify 120 or 277. Not available with 347. Require 13 1/2" above ceiling access for use with ELR option.
4. Supplied with factory installed step down transformer.	12. Only available up to 4500 lumens. Specify 120 or 277.
5. Includes terminator resistor.	
6. Not Available with Control Interfaces.	
7. Must specify 120 or 277.	
8. For use with generator supply EM power. Will require an emergency hot feed and normal hot feed.	





4"

High Center Beam Square Downlight

SPECIFICATIONS

Optical and Trim Assembly

Fully serviceable and upgradeable lensed LED light engine suitable for field maintenance or service from above or below the ceiling. Optical design is a Bounding Ray™ design with 45° cutoff to source and source image. Top down flash characteristic for superior glare control. Flangeless trim option includes proprietary Gotham mud ring enabling seamless integration into drywall applications. Mud ring ships separately.

OL1

Electrical

The luminaire shall operate from a 50 or 60 Hz ± 3 Hz AC line over a voltage ranging from 120 VAC to 277 VAC. Support 347V via fixture-mounted stepdown transformer. The fluctuations of line voltage shall have no visible effect on the luminous output.

The luminaire shall have a power factor of 90% or greater at all standard operating voltages and full luminaire output.

Sound Rated A+. Driver shall be >80% efficient at full load across all input voltages.

Input wires shall be 18AWG, 300V minimum solid copper.

All drivers are ROHS compliant.

Controls

Luminaire shall be equipped with interface for nLight wired or nLight AIR networks with integral power supply as per specification.

Emergency

Luminaires supplied with a battery pack comply with NFPA 101 (Life Safety code) and deliver constant light output throughout the 90 minutes of code required emergency operation period when there is a normal AC power loss with remote test switch available.

Dimming

The luminaire shall be capable of continuous dimming without perceivable stroboscopic flicker as measured by flicker index (ANSI/IES RP-16-10) over a range of 100 – 10%, 100 – 1.0% or 100 – 0.1% of rated lumen output with a smooth shut off function to step to 0%.

elidoLED LED drivers shall conform to IEEE P1789 standards. Alternatively, manufacturers must demonstrate conformance with product literature and testing which demonstrates this performance. Systems that do not meet IEEE P1789 will not be considered.

Driver is inaudible in 24dB environment, and stable when input voltage conditions fluctuate over what is typically experienced in a commercial environment.

Construction

Light engine and driver are accessible from above or below ceiling.

16-gauge black painted steel mounting frame with mounting bars included.

Post-installation adjustment possible from above or below ceiling.

Galvanized steel junction box with hinged access covers and spring latch. Three combination 1/2"-3/4" and one 1/2" knockout for straight-through conduit runs.

Capacity: 8 (4 in, 4 out) No. 12 AWG conductors rated for 90°C.

Accommodates up to 1 1/2"-thick ceilings.

Listings

Fixtures are CSA Certified to meet US and Canadian Standards: All fixtures manufactured in strict accordance with the appropriate and current requirements of the "Standards for Safety" to UL, wet location covered ceiling.

Luminaire configurations are Energy Star certified through testing in EPA-recognized laboratories, with the results reviewed by an independent, accredited certification organization. Visit www.energystar.gov for specific configurations listed.

IC-rated up to 1000 lumens.

Photometrics

LEDs tested to LM-80 standards. Measured by IESNA Standard LM-79-08 in an accredited lab. Lumen output shall not decrease by more than 30% over the minimum operational life of 60,000 hours.

Color appearance from luminaire to luminaire of the same type and in all configurations, shall be consistent both initially and at 6,000 hours and operate within a tolerance of <2.5 MacAdam ellipse as defined by the center of the quadrangles defined in ANSI C78.377-2015.

Buy American Act

This product is assembled in the USA and meets the Buy America(n) government procurement requirements under FAR, DFARS and DOT regulations. Please refer to www.acuitybrands.com/buy-american for additional information.

Warranty

5-year limited warranty. This is the only warranty provided and no other statements in this specification sheet create any warranty of any kind. All other express and implied warranties are disclaimed. Complete warranty terms located at: www.acuitybrands.com/support/warranty/terms-and-conditions

Note:

Actual performance may differ as a result of end user environment and application. All values are design or typical values, measured under laboratory conditions at 25 °C.

A+ Capable Luminaire

This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight™ control networks when ordered with drivers marked by a shaded background*
- This luminaire is part of an A+ Certified solution for nLight™ control networks, providing advanced control functionality at the luminaire level, when selection includes driver and control options marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.

*See ordering tree for details



OL1

4"

High Center Beam Square Downlight

Tables of Use

ICO - eldoLED Driver Default Dimming Curve			
Nomenclature	Min Dimming	Driver Dim Curve	Control Dim Curve
EZ10	10%	Linear	Linear/Logarithmic
EZ1	1%	Linear	Linear/Logarithmic
EZB	<1%	Logarithmic	Linear
EDAB	<1%	Logarithmic*	Linear
EDXB	<1%	Square	Linear

*Changeable through DALI controller

Lumen Output Multiplier		
CRI	CCT	Multiplier
80	2700K	0.916
	3000K	0.948
	3500K	1
	4000K	1.032
	5000K	1.1
90	2700K	0.748
	3000K	0.8
	3500K	0.838
	4000K	0.845
	5000K	0.945

Reflector Finish Multiplier	
Reflector Finish	Multiplier
LS - Specular	1
LSS - Semi Specular	0.956
WR - White	0.87
LD - Matte Diffuse	0.85
BR - Black	0.73
BZR - Bronze	0.73

Driver		Control Provided				
Nomenclature	Description	NLT	NLTER	NLTAIR2	NLTAIREM2	NLTAIRER2
GZ10	0-10V driver dims to 10%	nPP16 D EFP	nPP16 D ER EFP	RPP20 D 24V G2	RPP20 D 24V EM G2	RPP20 D 24V ER G2
GZ1	0-10V driver dims to 1%	nPP16 D EFP	nPP16 D ER EFP	RPP20 D 24V G2	RPP20 D 24V EM G2	RPP20 D 24V ER G2
EZ10	eldoLED 0-10V ECOdrive	nPS 80 EZ	nPS 80 EZ ER	RPP20 D 24V G2	RPP20 D 24V EM G2	RPP20 D 24V ER G2
EZ1	eldoLED 0-10V ECOdrive	nPS 80 EZ	nPS 80 EZ ER	RPP20 D 24V G2	RPP20 D 24V EM G2	RPP20 D 24V ER G2
EZB	eldoLED 0-10V SOLOdrive	nPS 80 EZ	nPS 80 EZ ER	RPP20 D 24V G2	RPP20 D 24V EM G2	RPP20 D 24V ER G2

Marked Spacing in Inches 25°C Ambient			
Lumen Package	Fixed Center to Center MIN	Fixture Center to Building Member MIN	Space Above Fixture
5000	24	12	0.5
3500-4500 (GZ1/GZ10 Only)	24	12	0.5
4000-4500 w/CP (EZ1/EZ10 Only)	24	12	0.5
3500-4500 w/CP (GZ1/GZ10 Only)	24	12	0.5

ELR Availability/Compatibility - Initial Lumens			
Product	LED		Initial Lumens
	Lumens	Watts	ELR
ICO4	500-5000	6-53	600



OL1

4"

High Center Beam Square Downlight

DIMENSIONAL DATA

*Dimensions in inches [centimeters]

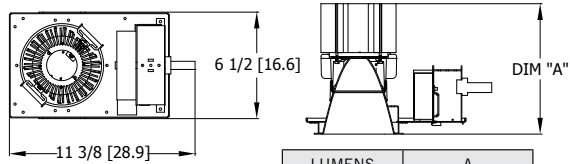
Aperture: 4-5/16 [11]

Ceiling Opening: 5-1/8 [13] self-flanged

Overlap Trim: 5-7/16 [13.8]

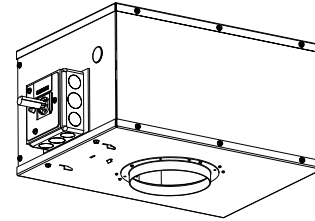
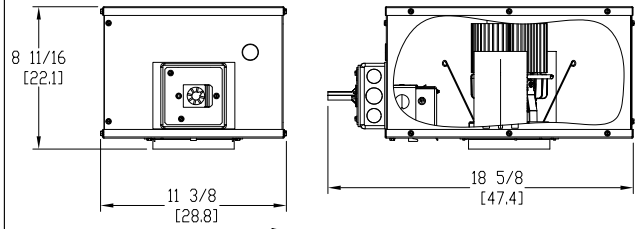
4-15/16 [12.5] flangeless

Standard



LUMENS	A
Up to 1000	6 [15.2]
Up to 2000	7 [17.8]
Above 2000	8 [20.3]

Chicago Plenum





OL1

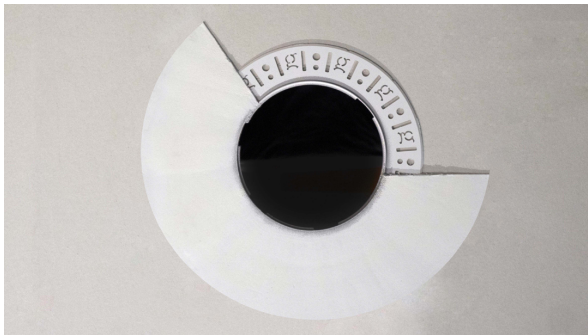
4"

High Center Beam Square Downlight

Flangeless



Partially finished mud ring, showing cross-section detail.



An ICO downlight requires only approximately 3" of plaster to finish.



ICO with flangeless trim

Flangeless Installation

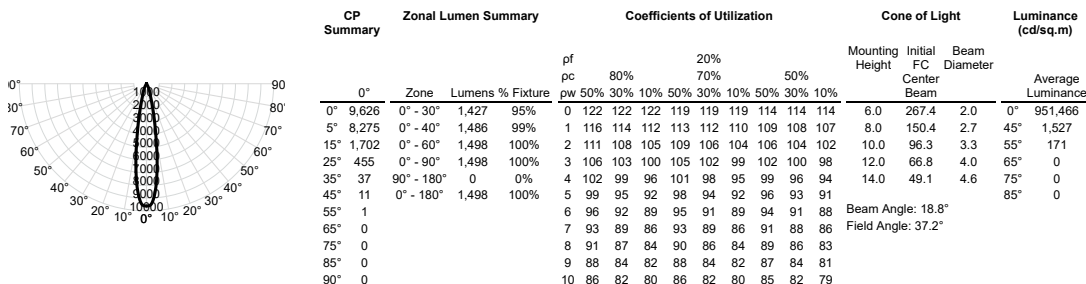
Gotham's flangeless option utilizes a micro-thin polymer mud ring that minimizes the amount of drywall compound required to finish the ceiling. The end result is a virtually undetectable flangeless downlight installation.

The polymer mud ring is installed independent of the recessed frame, therefore floating with the ceiling. This innovation minimizes any surface cracks during reflector installation, ceiling movement and any future service to the recessed frame, wiring, electronics, etc.

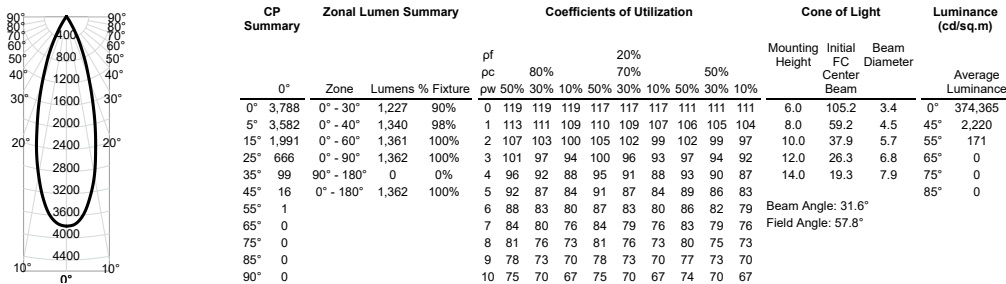
Photometry

CONSULT WWW.GOTHAMLIGHTING.COM FOR ADDITIONAL PHOTOMETRY

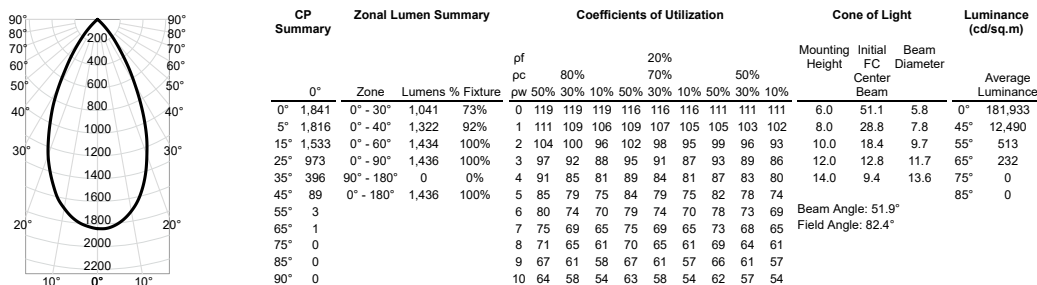
IC04SQ 35/15 AR LSS 15D Input Watts: 15.1, Delivered Lumens: 1498, LPW: 99.2, S/MH: 0.32, Test No: ISF 192901P563



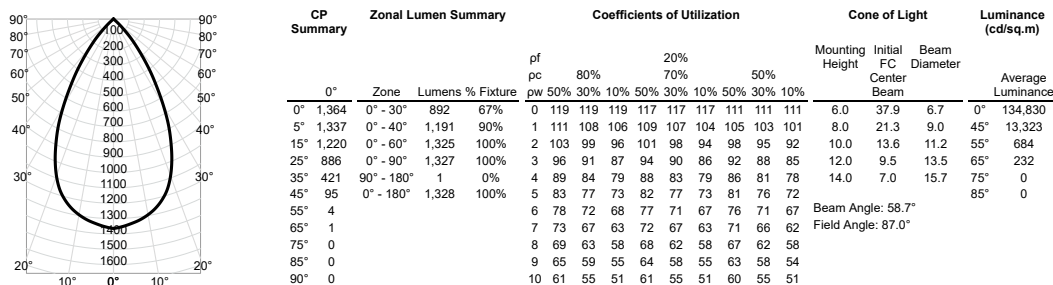
IC04SQ 35/15 AR LSS 30D Input Watts: 15.1, Delivered Lumens: 1362, LPW: 90.2, S/MH: 0.51, Test No: ISF 192904P563



IC04SQ 35/15 AR LSS 45D Input Watts: 15.1, Delivered Lumens: 1436, LPW: 95.1, S/MH: 0.81, Test No: ISF 192907P563



IC04SQ 35/15 AR LSS 65D Input Watts: 15.1, Delivered Lumens: 1328, LPW: 87.9, S/MH: 0.91, Test No: ISF 192910P563





4"

High Center Beam Square Downlight

nLIGHT AIR

nLight® AIR is the ideal solution for retrofit or new construction spaces where adding communication wiring is cost prohibitive. The integrated nLight AIR rPP20 Power Pack is part of each EVO Luminaire ordered with the NLTAIR option. These individually addressable controls offer the ultimate in flexibility during initial setup and for space repurposing.

nLight® AIR Control Accessories

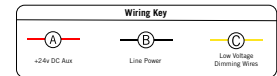
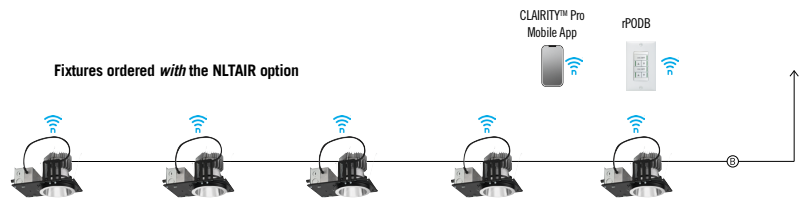
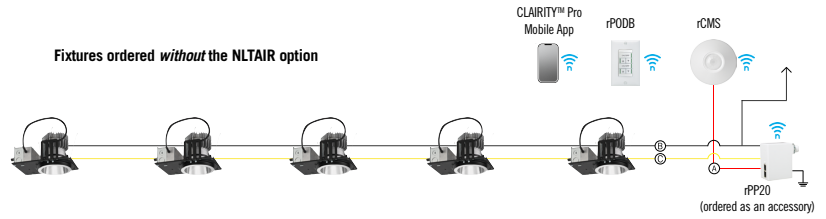
Order as separate catalog number. Visit [nLight AIR](#).

Wall Switches	Model Number
On/Off single pole	rPODB (color) G2
On/Off two pole	rPODB 2P (color) G2
On/Off & raise/lower single pole	rPODB DX (color) G2
On/Off & raise/lower two pole	rPODB 2P DX (color) G2

nLight® AIR Control Accessories (cont.)

Occupancy Sensors (PIR/dual tech)	Model Number
Small motion 360°, ceiling	rCMS 9 / rCMS PDT 9
Large motion 360°, ceiling	rCMS 10 / rCMS PDT 10

Possibilities for nLight® AIR



nLIGHT

nLight® Wired The nLight® solution is a digital networked lighting control system that provides both energy savings and increased user configurability by cost effectively integrating time-based, daylight-based, sensor-based and manual lighting control schemes.

nLight® Wired Control Accessories

Order as separate catalog number. Visit [nLight](#).

Wall Switches	Model Number
On/Off single pole	nPODM (XX)
On/Off two pole	nPODM 2P (XX)
On/Off & raise/lower single pole	nPOD DX (XX)
On/Off & raise/lower two pole	nPODM 2P DX (XX)
Graphic touchscreen	nPOD GFX (XX)

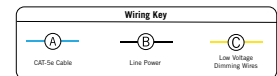
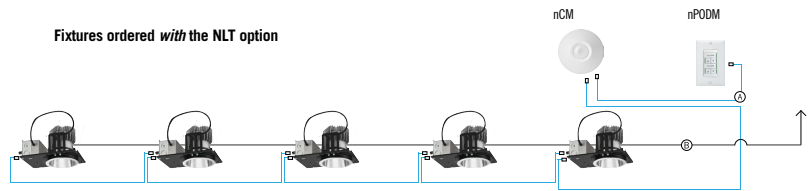
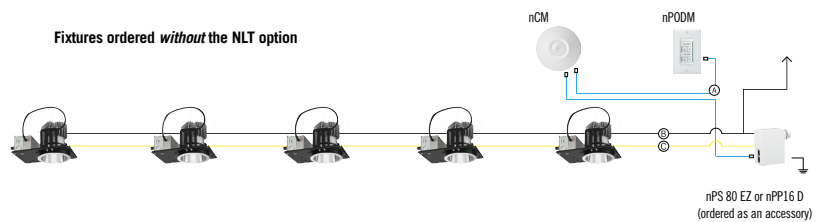
Photocell Controls	Model Number
Dimming	nCM ADCX

nLight® Wired Control Accessories (cont.)

Occupancy Sensors (PIR/dual tech)	Model Number
Small motion 360°, ceiling	nCM 9 / nCM PDT 9
Large motion 360°, ceiling	nCM 10 / nCM PDT 10
Wide View	nWV 16 / nWV PDT 16
Wall switch with raise/lower	nWSX LV DX / nWSX PDT LV DX

Cat-5 Cables (plenum rated)	Model Number
10', CAT5	CAT5 10FT J1
15', CAT5	CAT5 15FT J1

Possibilities for nLight® wired





Luminaire Type: **OL2**
Catalog Number:



Other Manufacturers:
PORTFOLIO "LDSQ4C" Series
INTENSE "SD4WS" Series
PRESCOLITE "LFR-4SQW" Series

General Illumination Square Lensed Wallwash 4"

OVERVIEW

Feature Set

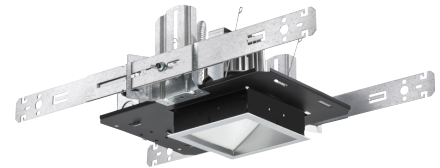
- Bounding Ray™ optical design
- Unitized optics mechanically attach the light engine to the lower reflector for complete optical alignment
- Fully serviceable and upgradeable lensed LED light engine
- 70% lumen maintenance at 60,000 hours
- 2.5 SDCM; 85 CRI typical, 90+ CRI optional
- Fixtures are wet location, covered ceiling
- Available with 10% dimming, 1% dimming, or dim to dark
- Wallwash enables uniformity from floor to ceiling

Distribution



Superior Performance

Nominal Lumens	250	500	750	1000	1500	2000	2500	3000
Delivered Lumens*	201	403	649	805	1227	1602	2073	
Wattage	3.1	7.2	7.9	8.8	13.7	19.5	25.7	31.2
Lumens per Watt	64.8	55.9	82.2	91.5	89.6	82.2	80.7	0.0



COMPLEMENTARY PRODUCTS

Coordinated Apertures | Multiple Layers of Light



General Illumination Layer | EVO



High Center Beam Layer | Incito



EVO + Incito — Multiple Layers of Light

Core	Downlight	Adjustable	Open Wallwash	Lensed Wallwash	Cylinder	Pinhole	Bevel	Hyperbolic
Healthcare	MRI	Surgical Suite	Patient Room					
Special Applications	Dynamic	Food Service	Vandal/Tamper	Clean Room	Shower	Steam Room		



4" General Illumination Square Lensed Wallwash

ORDERING INFORMATION

A+ Capable options indicated by this color background.

Luminaire Type: **OL2**
Catalog Number:

EXAMPLE: EVO4SQLW 35/10 AR LSS MVOLT EZ1

Series	Color Temperature	Nominal Lumen Values	Reflector & Flange Color	Trim Style	Finish
EVO4SQLW	27/ 2700 K 30/ 3000 K 35/ 3500 K 40/ 4000 K 50/ 5000 K	02 250 lumens 05 500 lumens 07 750 lumens 10 1000 lumens 15 1500 lumens 20 2000 lumens 25 2500 lumens 30 3000 lumens	AR Clear PR Pewter WTR Wheat GR Gold WR ¹ White BR ¹ Black WRAMF ¹ White anti-microbial	(blank) Self-flanged FL Flangeless	LSS Semi-specular LD Matte-diffuse

Voltage	Driver ⁴	
MVOLT	GZ10 0-10V driver dims to 10%	EDAB⁵ eldoLED SOLOdrive DALI. Logarithmic dimming to <1%.
120	GZ1 0-10V driver dims to 1%	EDXB⁵ eldoLED POWERdrive DMX with RDM (remote device management). Square Law dimming to <1%. Includes termination resistor. Minimum 1000 lumens. Refer to DMXR Manual
277	EZ10 eldoLED 0-10V ECOdrive. Linear dimming to 10% min.	ECOD⁵ Lutron Ecosystem digital Hi-Lume 1% soft-on, fade to black
347 ^{2,3}	EZ1 eldoLED 0-10V ECOdrive. Linear dimming to 1% min.	
	EZB eldoLED 0-10V SOLOdrive. Logarithmic dimming to <1%.	

Control Interface	Options
NLT² nLight [®] dimming pack controls	SF Single fuse. Specify 120V or 277V.
NLTER^{2,5,10} nLight [®] dimming pack controls emergency circuit	TRW⁷ White painted flange
NLTAIR^{2,14} nLight [®] AIR enabled	TRBL⁸ Black painted flange
NLTAIRER^{2,10,13} nLight [®] AIR enabled emergency	ELR⁹ Emergency battery pack, 10W, with remote test switch
NLTAIREM^{2,13} nLight [®] AIR Dimming Pack Wireless Controls. Controls fixtures on emergency circuit with battery pack options.	ELRSD⁹ Emergency battery pack, 10W, with self-diagnostics, remote test switch
	E10WCPR⁹ Emergency battery pack, 10W Constant Power, CA Title 20 compliant with remote test switch
	N80¹¹ nLight [®] Lumen Compensation
	BGTD Bodine generator transfer device. Specify 120V or 277V.
	90CRI High CRI (90+)
	CP¹² Chicago Plenum. Specify 120V or 277V for 5000lm and above.
	RRL₋ RELOC [®] -ready luminaire connectors enable a simple and consistent factory installed option across all ABL luminaire brands. Refer to RRL for complete nomenclature

ACCESSORIES — order as separate catalog numbers (shipped separately)

ISD BC 0-10V wallbox dimmer. Refer to [ISD-BC](#).

ORDERING NOTES

- Not available with finishes.
- Not available with emergency battery pack options.
- Supplied with factory installed step down transformer.
- Refer to [TECH-240](#) for compatible dimmers.
- Not available with nLight[®] and X Point options.
- Must specify voltage.
- For use with different reflector finish only (i.e. AR, PR, WTR, GR options). Not applicable with WR (white reflector). Not applicable with FL option.
- For use with different reflector finish only (i.e. AR, PR, WTR, GR options). Not applicable with BR (black reflector). Not applicable with FL option.
- 11" of plenum depth or top access required for battery pack maintenance.
- For use with generator supply EM power. Will require an emergency hot feed and normal hot feed.
- Fixture begins at 80% light level. Must be specified with NLT or NLTER.
- Not available with battery pack, EXA1, or EXAB options. 2500 lumen max.
- Not available DALI or DMX drivers. Not available with CP, or N80 options. Not recommended for metal ceiling installations.
- When combined with the EZ1, EZ10, or EZB option, normal luminaires (non-emergency) can be used as a normal power sensing device for nearby nLight AIR devices and luminaires with EM emergency options.





4"

General Illumination Square Lensed Wallwash

OL2

SPECIFICATIONS

Optical Assembly

Fully serviceable and upgradeable lensed LED light engine suitable for field maintenance or service from below the ceiling. Unitized optics shall have mechanical attachment of the light engine to the lower reflector for complete optical alignment. Wallwash enables uniformity from floor to ceiling. Smooth, balanced illumination optimized for ceilings of 8' to 12' with recommended spacing of 3' from wall and 3' centers.

Electrical

The luminaire shall operate from a 50 or 60 Hz ± 3 Hz AC line over a voltage ranging from 120 VAC to 277 VAC. The fluctuations of line voltage shall have no visible effect on the luminous output.

The luminaire shall have a power factor of 90% or greater at all standard operating voltages and full luminaire output.

Sound Rated A+. Driver shall be >80% efficient at full load across all input voltages.

Input wires shall be 18AWG, 300V, minimum, solid copper.

Controls

Luminaire shall be equipped with interface for nLight wired or wireless network with integral power supply as per specification.

Dimming

The luminaire shall be capable of continuous dimming without perceivable stroboscopic flicker as measured by flicker index (ANSI/IES RP-16-10) over a range of 100 – 10%, 100 – 1.0% or 100 – 0.1% of rated lumen output with a smooth shut off function to step to 0%.

LED drivers shall conform to IEEE P1789 standards. Alternatively, manufacturers must demonstrate conformance with product literature and testing which demonstrates this performance. Systems that do not meet IEEE P1789 will not be considered.

Driver is inaudible in 24dB environment, and stable when input voltage conditions fluctuate over what is typically experienced in a commercial environment.

Construction

Luminaire housing shall be constructed of 16-gauge galvanized steel and have preinstalled telescopic mounting bars with maximum 32" and minimum 15" extension and 4" vertical adjustment.

High-impact polymer trim shall be constructed with a durable, vapor deposition finish.

Patented adjustable aperture allows ¼" adjustments in all directions and up to 5° of rotation for post-installation adjustment to ensure trim-to-trim alignment.

Injection molded mud ring included with flangeless trims. Ships separately. Installs independently of the mounting frame to reduce cracks in plaster due to vibration.

Luminaires shall be suitable for installation in ceilings up to 1½" thick.

Tool-less adjustments shall be possible after installation.

The assembly and manufacturing process for the luminaire shall be designed to assure all internal components are adequately supported to withstand mechanical shock and vibration.

25°C ambient temperature standard (1/2" clearance on all sides from non-combustible materials in non-IC applications, unless marked spacing noted otherwise). For use in insulated ceilings, a 3" clearance on all sides from insulation is required (unless marked spacing noted otherwise).

Listings

Fixtures are CSA certified to meet US and Canadian standards: All fixtures manufactured in strict accordance with the appropriate and current requirements of the "Standards for Safety" to UL, wet location covered ceiling.

Photometrics

LEDs tested to LM-80 standards. Measured by IESNA Standard LM-79-08 in an accredited lab. Lumen output shall not decrease by more than 30% over the minimum operational life of 60,000 hours.

Color appearance from luminaire to luminaire of the same type and in all configurations, shall be consistent both initially and at 6,000 hours and operate within a tolerance of <2.5 MacAdam ellipse as defined by a point at the intersection of the CCT line and the black body locus line in CIE chromaticity space.

Buy American Act

This product is assembled in the USA and meets the Buy America(n) government procurement requirements under FAR, DFARS and DOT regulations. Please refer to <https://www.acuitybrands.com/resources/buy-american> for additional information.

Warranty

5-year limited warranty. This is the only warranty provided and no other statements in this specification sheet create any warranty of any kind. All other express and implied warranties are disclaimed. 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.



OL2

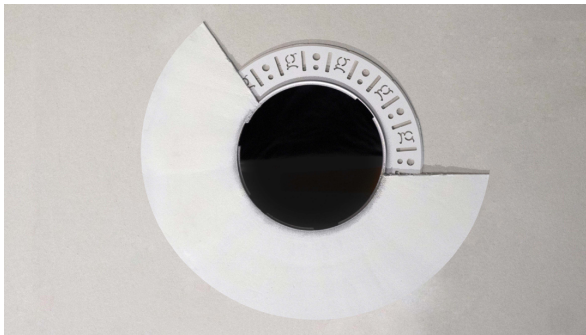
4"

General Illumination Square Lensed Wallwash

Flangeless



Partially finished mud ring, showing cross-section detail.



An EVO downlight requires only approximately 3" of plaster to finish.



EVO with flangeless trim

Flangeless Installation

Gotham's flangeless option utilizes a micro-thin polymer mud ring that minimizes the amount of drywall compound required to finish the ceiling. The end result is a virtually undetectable flangeless downlight installation.

The polymer mud ring is installed independent of the recessed frame, therefore floating with the ceiling. This innovation minimizes any surface cracks during reflector installation, ceiling movement and any future service to the recessed frame, wiring, electronics, etc.

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



Tables of Use

EVO - eldoLED Driver Default Dimming Curve			
Nomenclature	Min Dimming	Driver Dim Curve	Control Dim Curve
EZ10	10%	Linear	Linear/Logarithmic
EZ1	1%	Linear	Linear/Logarithmic
EXA1	1%	Linear	Linear/Logarithmic
EZB	<1%	Logarithmic	Linear
EDAB	<1%	Logarithmic	Linear
EXAB	<1%	Logarithmic	Linear
EDXB	<1%	Square	Linear

Lumen Output Multiplier		
CRI	CCT	Multiplier
80	2700K	0.96
	3000K	1.00
	3500K	1.00
	4000K	1.01
	5000K	1.07
90	2700K	0.80
	3000K	0.83
	3500K	0.85
	4000K	0.87
	5000K	0.91

Reflector Finish Multiplier	
Reflector Finish	Multiplier
LSS - Semi Specular	0.956
WR - White	0.87
LD - Matte Diffuse	0.85
BR - Black	0.73

Driver		Control Provided (note: 347V/UVOLT versions provided with 347 option selected)			
Nomenclature	Description	NLT	NLTER	NLTAIR2	NLTAIRER2
GZ10	0-10V driver dims to 10%	nPP16 D EFP	nPP16 D ER EFP	RPP20 D 24V G2	RPP20 D 24V ER G2
GZ1	0-10V driver dims to 1%	nPP16 D EFP	nPP16 D ER EFP	RPP20 D 24V G2	RPP20 D 24V ER G2
EZ10	eldoLED 0-10V ECOdrive	nPS 80 EZ	nPS 80 EZ ER	RPP20 D 24V G2	RPP20 D 24V ER G2
EZ1	eldoLED 0-10V ECOdrive	nPS 80 EZ	nPS 80 EZ ER	RPP20 D 24V G2	RPP20 D 24V ER G2
EZB	eldoLED 0-10V SOLOdrive	nPS 80 EZ	nPS 80 EZ ER	RPP20 D 24V G2	RPP20 D 24V ER G2

How to Estimate Delivered Lumens in Emergency Mode

Delivered Lumens = 1.25 x P x LPW

P = Output power of emergency driver. P = 10W for PS1055CP

LPW = Lumen per watt rating of the luminaire. This information is available on the ABL luminaire spec sheet.



OL2

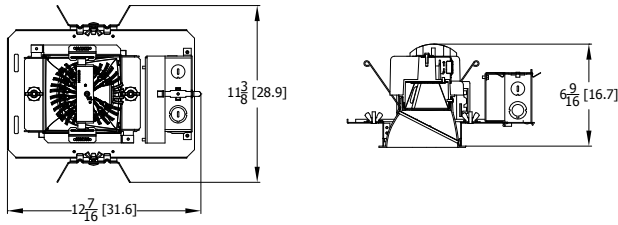
4" General Illumination Square Lensed Wallwash

DIMENSIONAL DATA

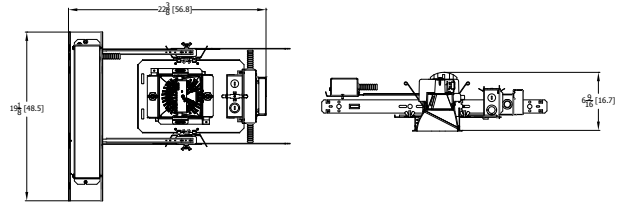
*Dimensions in inches [centimeters]

Aperture: 4-5/16" (11)	Ceiling Opening: 5-1/8" (13) self-flanged
Overlap trim: 5-7/16" (13.8)	5-1/4" (13.3) flangeless

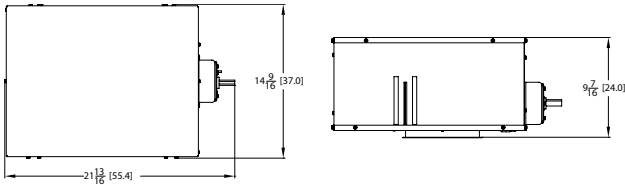
Standard Dimensions



Battery Pack



Dimensions For CP

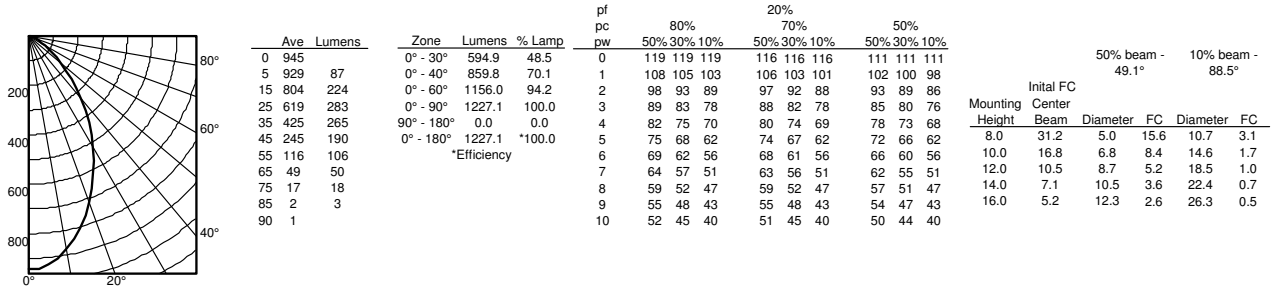




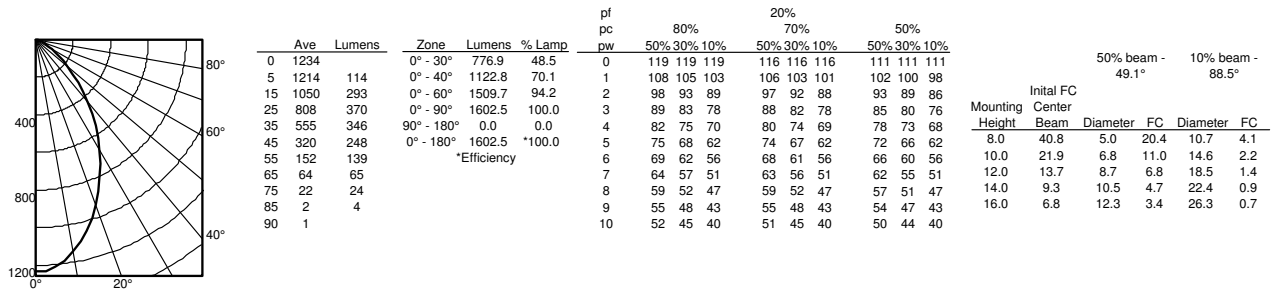
OL2

Photometry

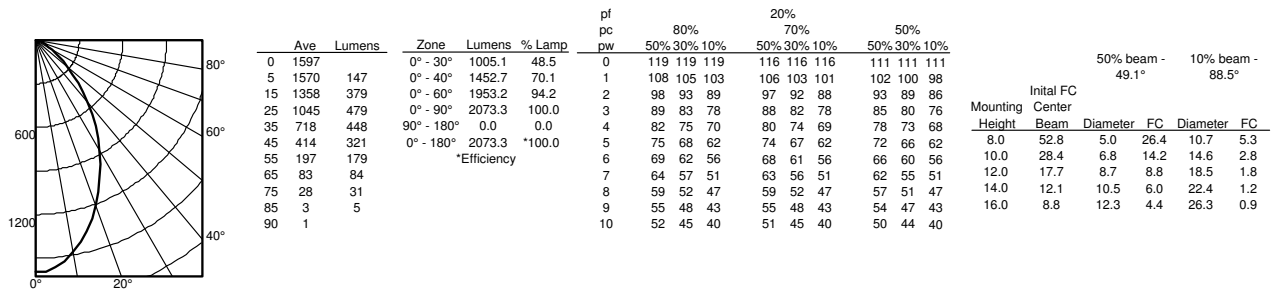
EVO4SQLW 35/15 LSS INPUT WATTS:14.7W, DELIVERED LUMENS: 1227LM, LPW = 83.5, 1.26 S/MH, TEST NO. LTL27800P49



EVO4SQLW 35/20 LSS INPUT WATTS: 19.7W, DELIVERED LUMENS: 1603LM, LPW = 81.4, 1.26 S/MH, TEST NO. LTL27800P53



EVO4SQLW 35/25 LSS INPUT WATTS: 24.7W, DELIVERED LUMENS: 2073LM, LPW = 83.9, 1.26 S/MH, TEST NO. LTL27800P57





4" General Illumination Square Lensed Wallwash **OL2**

nLight AIR

nLight® AIR is the ideal solution for retrofit or new construction spaces where adding communication wiring is cost prohibitive. The integrated nLight AIR rPP20 Power Pack is part of each EVO Luminaire ordered with the NLTAIR option. These individually addressable controls offer the ultimate in flexibility during initial setup and for space repurposing.

nLight® AIR Control Accessories	
<i>Order as separate catalog number. Visit nLight AIR.</i>	
Wall Switches	Model Number
On/Off single pole	rPODB (color) G2
On/Off two pole	rPODB 2P (color) G2
On/Off & raise/lower single pole	rPODB DX (color) G2
On/Off & raise/lower two pole	rPODB 2P DX (color) G2

nLight® AIR Control Accessories (cont.)	
Occupancy Sensors (PIR/dual tech)	Model Number
Small motion 360°, ceiling	rCMS 9 / rCMS PDT 9
Large motion 360°, ceiling	rCMS 10 / rCMS PDT 10

UL924 Sequence of Operation

The below information applies to all nLight AIR devices with an EM option.

- EM devices will remain at their high-end trim and ignore wireless lighting control commands, unless a normal-power-sensed (NPS) broadcast is received at least every 8 seconds.
- Using the CLAIRITY+ mobile app, EM devices must be associated with a group that includes a normal power sensing device to receive NPS broadcasts.
- Only non-emergency rPP20, rLSXR, rSBOR, rSDGR, and nLight AIR luminaires with version 3.4 or later firmware can provide normal power sensing for EM devices. See specification sheets for control devices and luminaires for more information on options that support normal power sensing.

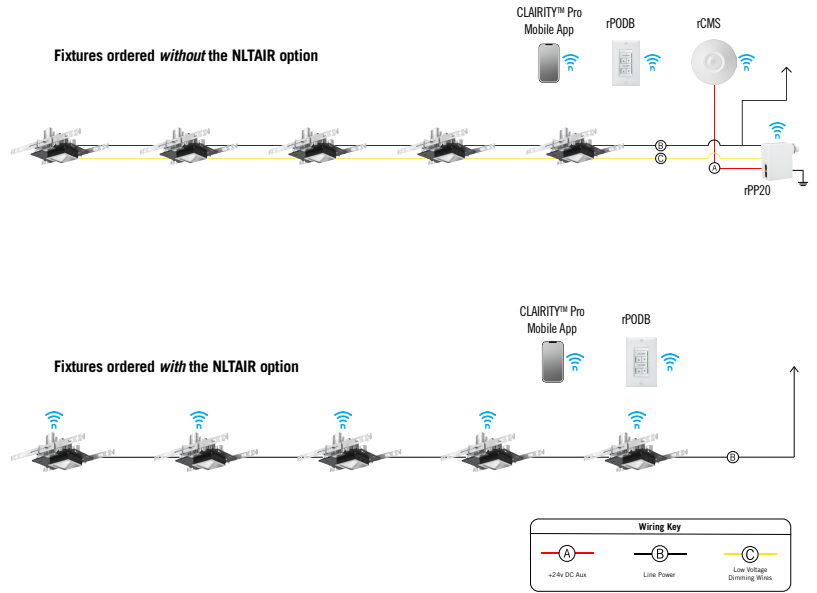
nLight

nLight® The nLight® solution is a digital networked lighting control system that provides both energy savings and increased user configurability by cost effectively integrating time-based, daylight-based, sensor-based and manual lighting control schemes.

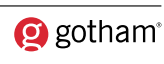
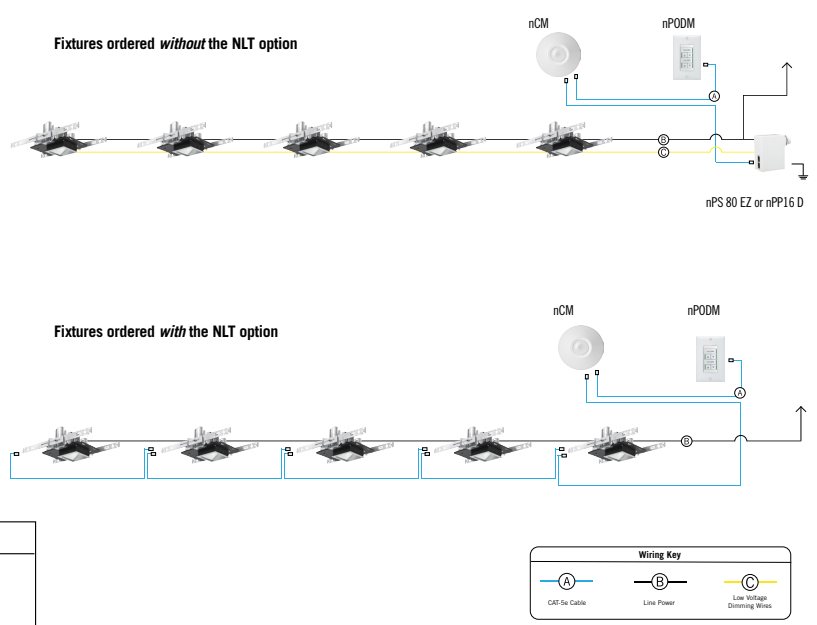
nLight® Wired Control Accessories	
<i>Order as separate catalog number. Visit nLight.</i>	
Wall Switches	Model Number
On/Off single pole	nPODM XX
On/Off two pole	nPODM 2P XX
On/Off & raise/lower single pole	nPOD DX XX
On/Off & raise/lower two pole	nPODM 2P DX XX
Graphic touchscreen	nPOD GFX XX
Photocell Controls	
Dimming	nCM ADCX

nLight® Wired Control Accessories (cont.)	
Occupancy Sensors (PIR/dual tech)	Model Number
Small motion 360°, ceiling	nCM 9 / nCM PDT 9
Large motion 360°, ceiling	nCM 10 / nCM PDT 10
Wide View	nWV 16 / nWV PDT 16
Wall switch with raise/lower	nWSX LV DX / nWSX PDT LV DX
Cat-5 Cables (plenum rated)	
10', CAT5	CAT5 10FT J1
15', CAT5	CAT5 15FT J1

Possibilities for nLight® AIR



Possibilities for nLight® wired



insight lighting

OL3 E5X

ASYMMETRIC WALL WASH | WHITE LIGHT

PROJECT: _____ TYPE: _____ CAT. #: E5X - - - - - ILV - _____

PROFILE

LIGHT SOURCE	HIGH PERFORMANCE LEDs
OUTPUT	4.0 W/FT, 8.0 W/FT, 12.0 W/FT
DISTRIBUTION	ASYMMETRIC
WHITE CCT	2700K, 3000K, 3500K, 4000K
CRI	82 CRI (OPTIONAL 90 CRI)
PERFORMANCE	Up to 97.6 LM/W
VOLTAGE	UNIVERSAL 120-277V
POWER	REMOTE
DIMMING	0-10V, LUTRON - HI-LUME PREMIER 0.1% ECOSYSTEM WITH SOFT-ON, WITH FADE TO BLACK DIMMING
LENGTHS	12", 24", 36", 48"
HOUSING	PRECISION EXTRUDED ALUMINUM
LENS	HIGH-DENSITY TEMPERED GLASS
FINISH	HIGH DURABILITY POWDER COATING
WARRANTY	5-YEAR LIMITED
OPERATING TEMP.	-20° C TO 50° C
LUMEN MAINTENANCE	60,000 HRS L70
CERTIFICATION	ETL AND cETL FOR IP67

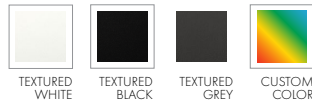


Other Manufacturers:
ELLIPTIPAR "S151" Series
ECOSENSE "TROV" Series

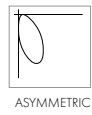


FIXTURE SHOWN: E5X-MO-27K-UL-EX-12-48-DIM-TBL-ILV

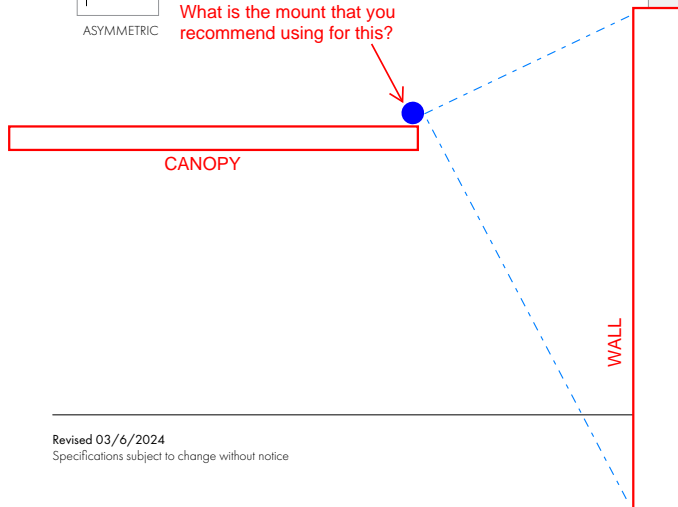
FINISHES



DISTRIBUTION

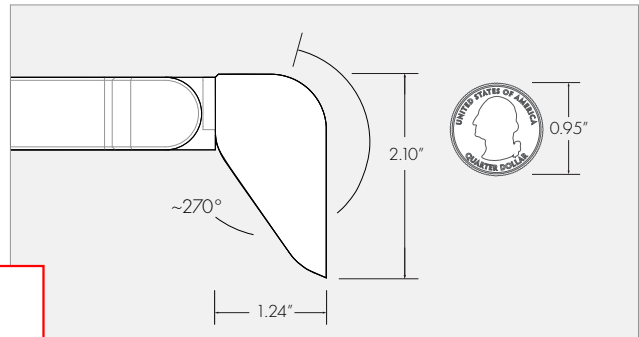


We would like to mount the fixture on top of the canopy and aim it at the wall across. What is the mount that you recommend using for this?



PROFILE

[Go to Fixture Dimensions >](#)



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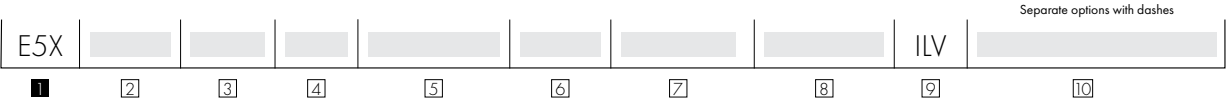
insight lighting

OL3 E5X

ASYMMETRIC WALL WASH | WHITE LIGHT

PROJECT: TYPE: CAT. #: E5X - - - - - ILV -

PROFILE



1 FIXTURE

E5X E5X

2 WATTAGE

LOW OUTPUT LO
4.0 W/FT

MEDIUM OUTPUT MO
8.0 W/FT

HIGH OUTPUT HO
12.0 W/FT

3 CCT

2700K 27K

3000K 30K

3500K 35K

4000K 40K

4 LIGHT DIRECTION

UPLIGHT UL
Uplight is provided with a right power-feed location

DOWNLIGHT DL
Downlight is provided with a left power-feed location
Contact factory for alternate power-feed locations

5 MOUNTING

PENDANT, JBOX PNA-X
X = pendant length specify min. 6" up to max 96"
Available as a downlight, left power-feed only

EXTENDED ARM, JBOX EXA-X
X = arm length, specify between 6" minimum and 18" maximum

EXTENDED ARM, ARCH. EA-X
X = arm length, specify between 6" minimum and 24" maximum

GROUND MOUNT 12" OX GM
6" arm
Available as an uplight, right power-feed only

6 LENGTH

12.00" 12

24.00" 24

36.00" 36

48.00" 48

7 CONTROL OPTIONS

NO DIMMING NO

0-10V DIMMING DIM

LUTRON HI-LUME LU1
EcoSystem 24V constant voltage with Soft-on, Fade to Black dimming. Dimming control system to be supplied by others.
40W max. Not available with a 48.0" fixture in high output

DMX DIMMING DMXDM
Default factory setting is DMX System Resolution
Fixtures are not pre-addressed or labeled at the factory. A **DMXCAT** tool is required for on-site fixture resolution and addressing. Must be ordered separately. See control options below.

Fixtures are shipped from the factory with default addressed channel 1
A **CDS/RDM** Distribution Kit is required. Must be ordered separately. See control options below.
DMX controls are required. Must be ordered separately.

9 LOUVER

INTERNAL LOUVER ILV
Standard

10 OPTIONS

HIGH CRI +90 HCRI

CORROSION RES. FINISH CRF
Corrosion Resistance Finish Complies with ASTM B117 standard
CRF is recommended for coastal or extreme exterior environments

DMX DISTRIBUTION KIT & ADDRESSING TOOL - REQUIRED FOR DMX DIMMING

DMX/RDM DISTRIBUTION KIT - IP67 CDS-RDM

Consists of 4 outputs. Each output is limited to (1) run, up to 32 fixtures max. 4 terminators are included for end of line termination.

REMOTE DMX/RDM ADDRESSING AND MONITORING TOOL DMXCAT

Uses Bluetooth LE technology for communication with a smartphone/applications (up to 50' range). Allows for on-site fixture resolution and addressing.



OL3 E5X

ASYMMETRIC WALL WASH | WHITE LIGHT

PROJECT: [] TYPE: [] CAT. #: E5X - [] - [] - [] - [] - [] - [] - [] - [] - [] - ILV - []

PERFORMANCE

OUTPUT	LENGTH	CCT	TOTAL WATTAGE	DELIVERED LUMENS	LUMINAIRE EFFICACY	PEAK CANDELA
LOW	48.00"	4000K	16.5 W	1610.0 LM	97.6 LM/W	876.0
MEDIUM	48.00"	4000K	32.1 W	3056.0 LM	95.2 LM/W	1664.0
HIGH	48.00"	4000K	48.7 W	4490 LM	92.2 LM/W	2446.0

REMOTE DISTANCE LIMITS Non-compliance with recommended remote wiring distances may void warranty

DRIVERS CAN BE LOCATED UP TO 40' AWAY FROM FIXTURE.

insight lighting

OL3 E5X

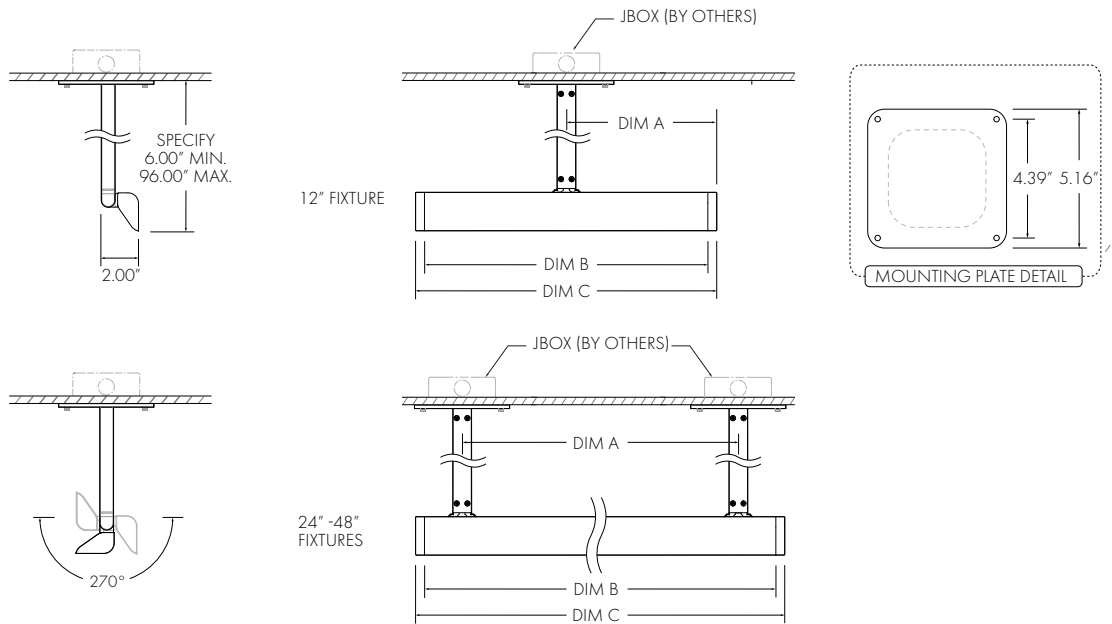
ASYMMETRIC WALL WASH | WHITE LIGHT

PROJECT: TYPE: CAT. #: E5X - - - - - ILV -

FIXTURE DIMENSIONS

DIMENSION	12"	24"	36"	48"
DIM A	6.38"	19.49"	31.24"	43.00"
DIM B	11.8"	23.55"	35.30"	47.05"
DIM C	12.76"	24.50"	36.25"	48.00"

PENDANT, JBOX (PN-X)



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insight lighting

OL3 E5X

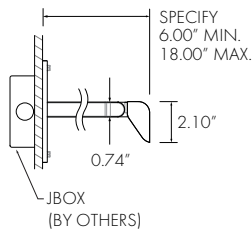
ASYMMETRIC WALL WASH | WHITE LIGHT

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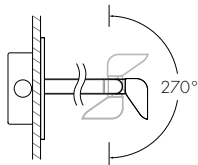
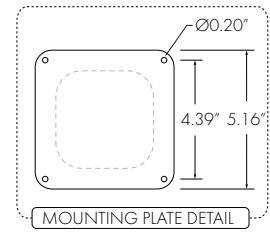
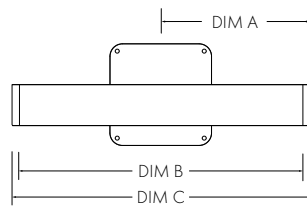
FIXTURE DIMENSIONS

DIMENSION	12"	24"	36"	48"
DIM A	6.38"	19.49"	31.24"	43.00"
DIM B	12.43"	23.54"	35.29"	47.04"
DIM C	12.76"	24.50"	36.25"	48.00"

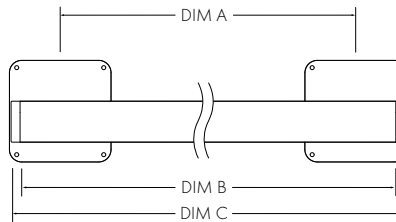
EXTENDED ARM, JBOX (EXA-X)



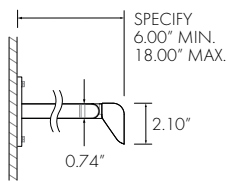
12" FIXTURE



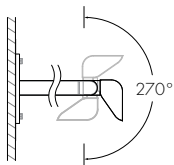
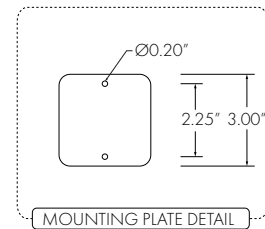
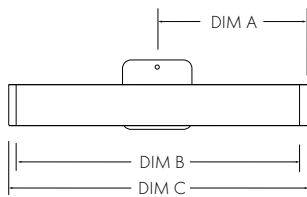
24" -48" FIXTURES



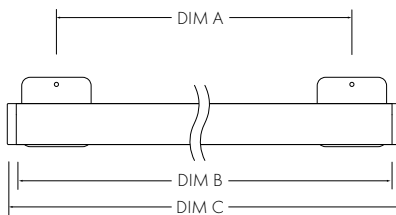
EXTENDED ARM, ARCHITECTURAL (EA-X)



12" FIXTURE



24" -48" FIXTURES



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insight lighting

OL3 E5X

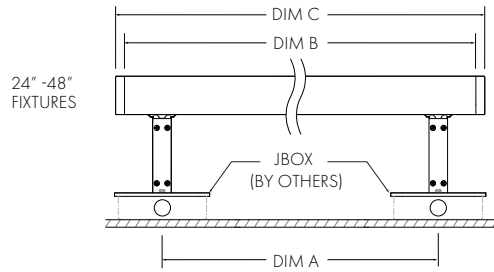
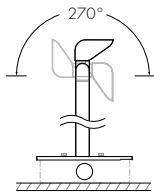
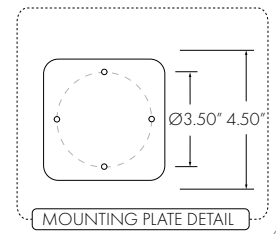
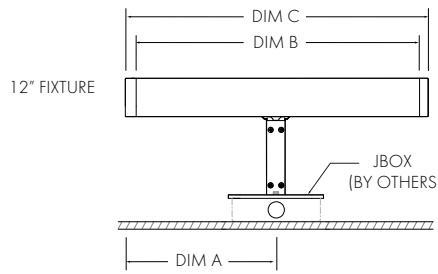
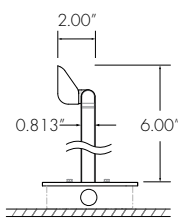
ASYMMETRIC WALL WASH | WHITE LIGHT

PROJECT: TYPE: CAT. #: E5X - - - - - ILV -

FIXTURE DIMENSIONS

DIMENSION	12"	24"	36"	48"
DIM A	6.38"	19.49"	31.24"	43.00"
DIM B	12.43"	23.54"	35.29"	47.04"
DIM C	12.76"	24.50"	36.25"	48.00"

GROUND MOUNT, JBOX (GM)



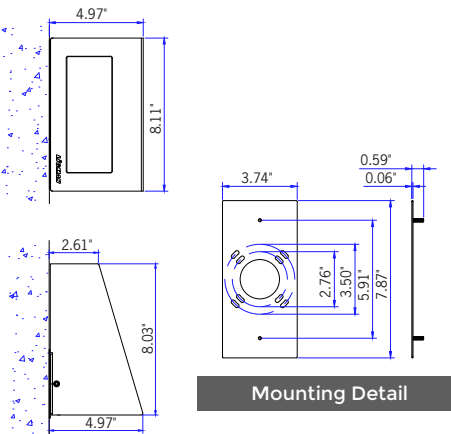
Revised 03/6/2024
Specifications subject to change without notice

ULEW-30011

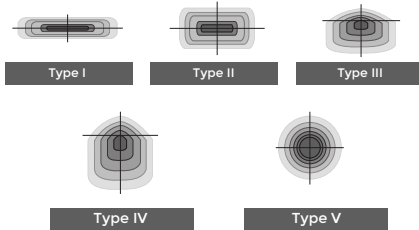
Leeds 2 Medium Surface Wedge Downlight



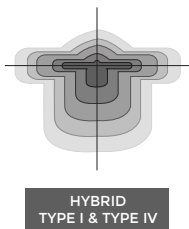
14w LED 1660 Lumens
IP65 • Suitable For Wet Locations
IK07 • Impact Resistant
Weight 12 lbs



Ligman's micro Variable Optical System provides the ability to interchange, mix & rotate optics to provide specific light distributions for optimized spacing and uniformity.



The variable optic system allows for the designer to create hybrid distributions for precise lighting requirements.



Construction

Aluminum
Less than 0.1% copper content – Marine Grade 6060 extruded & LM6 Aluminum High Pressure die casting provides excellent mechanical strength, clean detailed product lines and excellent heat dissipation.

Pre paint
8 step degrease and phosphate process that includes oxidizing and etching as well as a zinc and nickel phosphate process before product painting.

Memory Retentive -Silicon Gasket
Provided with special injection molded "fit for purpose" long life high temperature memory retentive silicon gaskets. Maintains the gaskets exact profile and seal over years of use and compression.

Thermal management
LM6 Aluminum is used for its excellent mechanical strength and thermal dissipation properties in low and high ambient temperatures. The superior thermal heat sink design by Ligman used in conjunction with the driver, controls thermals below critical temperature range to ensure maximum luminous flux output, as well as providing long LED service life and ensuring less than 10% lumen depreciation at 50,000 hours.

Surge Suppression
Standard 10kv surge suppressor provided with all fixtures.

BUG Rating
B0 - U0 - G0 [T2, T3/W30, T4, ME/W40]
B1 - U0 - G0 [T3/W40, W/W30, ME/W30, EW]
B2 - U0 - G0 [W/W40]
B1 - U0 - G1 [T1]

Finishing
All Ligman products go through an extensive finishing process that includes fettling to improve paint adherence.

Paint
UV Stabilized 4.9Mil thick powder coat paint and baked at 200 Deg C. This process ensures that Ligman products can withstand harsh environments. Rated for use in natatoriums.

Inspired by Nature Finishes
The Inspired by nature Finishing is a unique system of decorative powder coating. Our metal decoration process can easily transform the appearance of metal or aluminum product into a wood grain finish.

This patented technology enables the simulation of wood grain, and even marble or granite finish through the use of decorative powder coating.

The wood grain finish is so realistic that it's almost undistinguishable from real wood, even from a close visual inspection. The system of coating permeates the entire thickness of the coat and as a result, the coating cannot be removed by normal rubbing, chipping, or scratching.

The Coating Process
After pre-treatment the prepared parts are powder coated with a specially formulated polyurethane powder. This powder provides protection against wear, abrasion, impact and corrosion and acts as the relief base color for the finalized metal decoration.

The component is then wrapped with a sheet of non-porous film with the selected decorative pattern printed on it using special high temperature inks.

This printed film transfer is vacuum-sealed to the surface for a complete thermo print and then transferred into a customized oven. The oven transforms the ink into different forms within the paint layer before it becomes solid. Finally, the film is removed, and a vivid timber look on aluminum remains.

Wood grain coating can create beautiful wood-looking products of any sort. There are over 300 combinations of designs currently in use. Wood grains can be made with different colors, designs, etc.

Our powder coatings are certified for indoor and outdoor applications and are backed by a comprehensive warranty. These coatings rise to the highest conceivable standard of performance excellence and design innovation.

- Added Benefits**
- Resistance to salt-acid room, accelerated aging
 - Boiling water, lime and condensed water resistant
 - Anti-Graffiti, Anti-Slip, Anti-Microbial, Anti-Scratch
 - Super durable (UV resistant)
 - TGIC free (non-toxic)

Hardware
Provided Hardware is Marine grade 316 Stainless steel.

Anti Seize Screw Holes
Tapped holes are infused with a special anti seize compound designed to prevent seizure of threaded connections, due to electrolysis from heat, corrosive atmospheres and moisture.

Crystal Clear Low Iron Glass Lens
Provided with tempered, impact resistant crystal clear low iron glass ensuring no green glass tinge.

Optics & LED
Precise optic design provides exceptional light control and precise distribution of light. LED CRI > 80

Lumen - Maintenance Life
L80 /B10 at 50,000 hours (This means that at least 90% of the LED still achieve 80% of their original flux)

Clean, beautiful, surface wall fixtures with class leading performance. Minimalist form, yet the most powerful and flexible lighting tool of its type, offering packages up to 2,400 lumens and microVos technology.

A range of small, square and rectangular, ADA compliant wall mounted luminaires with options of upward or downward light distributions. Ideally suited to illuminate the wall and surfaces in front of wall and for light accents on vertical surfaces using high efficiency LED's. The Leeds is suitable for indoor and outdoor applications and provides a clean, visually appealing solution for small, unobtrusive wall mounted luminaires.

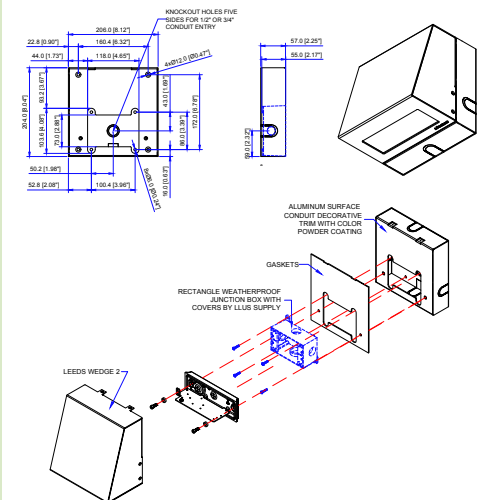
This luminaire is available in 3 different sizes and in combinations of down, up or up/down light distributions.

This fixture utilizes microVos technology, meaning the ability to do Type I,II,III,IV & V distributions as well as hybrid distributions to suit the designer's requirements.

Using the microVos optics allows for very wide spacing to mounting height ratios, while still providing perfect uniformity and code compliant light levels.

To meet International Dark Sky criteria, 3000k or warmer LEDs must be selected and luminaire fix mounted (+/- 15° allowable to permit leveling).

Additional Options (Consult Factory For Pricing)



Other Manufacturers:
GARDCO "GWS" Series
BEACON "VIPER WALL" Series
BEGA "B24219" Series

Ligman Lighting USA reserves the right to change specifications without prior notice, please contact factory for latest information. Due to the continual improvements in LED technology data and components may change without notice.

ULEW-30011

Leeds 2 Medium Surface Wedge Downlight



PROJECT	<input type="text"/>	DATE	<input type="text"/>
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QUANTITY	<input type="text"/>	TYPE	<input type="text" value="OL4"/>	NOTE	<input type="text"/>
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ORDERING EXAMPLE || ULEW - 30011 - 14w - T2 - W30 - 02 - 120/277v - Options

ULEW-30011	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
	LAMP	BEAM	LED COLOR	FINISH COLOR	VOLTAGE
	14w LED 1660 Lumens	T1 - Type I Distribution T2 - Type II Distribution T3 - Type III Distribution T4 - Type IV Distribution M - Medium 30° W - Wide 56° EW - Extra Wide 99°x102°	W27 - 2700K W30 - 3000K W35 - 3500K W40 - 4000K	01 - BLACK RAL 9011 02 - DARK GREY RAL 7043 03 - WHITE RAL 9003 04 - METALLIC SILVER RAL 9006 05 - MATTE SILVER RAL 9006 06 - LIGMAN BRONZE 07 - CUSTOM RAL	120/277v Other - Specify

<input type="text"/>	<input type="text"/>	<input type="text"/>
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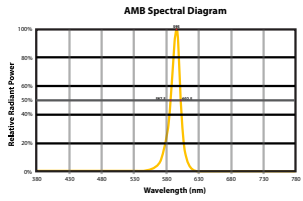
ADDITIONAL OPTIONS

- BPC - Button Photocell
- SCBT - Surface Conduit Box Trim
- F - Frosted Lens
- AMB - Turtle Friendly Amber LED
- DIM - 0-10v Dimming
- NAT - Natatorium Rated



BPC Button Photocell

CITY OF FLAGSTAFF & TURTLE FRIENDLY COMPLIANT



Narrow-Spectrum Amber LEDs
Peak wavelength between 585 & 595 nanometers and a full width of 50% power no greater than 15 nanometers.

More Custom Finishes Available Upon Request

Consult factory for pricing and lead times



- #### INSPIRED BY NATURE FINISHES
- SW01 - OAK FINISH
 - SW02 - WALNUT FINISH
 - SW03 - PINE FINISH
 - DF - DOUGLAS FIR FINISH
 - CW - CHERRY WOOD FINISH
 - NW - NATIONAL WALNUT FINISH
 - SU01 - CONCRETE FINISH
 - SU02 - SOFTSCAPE FINISH
 - SU03 - STONE FINISH
 - SU04 - CORTEN FINISH

THERE IS AN ADDITIONAL COST FOR THESE FINISHES

FINISH TO BE SELECTED BY ARCHITECT



Example: Inspired by Nature Finish

Ligman Lighting USA reserves the right to change specifications without prior notice, please contact factory for latest information. Due to the continual improvements in LED technology data and components may change without notice.



Leeds Product Family

OL4



Leeds 1 - Up/Down

• ULEE-30031-2x5.5w-2x570lm



Leeds 2 - Down

• ULEE-30001-5.5w-570lm



Leeds 3 - Up/Down

• ULEE-30041-2x14w-2x1660lm



Leeds 4 - Down

• ULEE-30011-14w-1660lm



Leeds 5 - Up/Down

• ULD-30051-2x20w-2x2422lm



Leeds 6 - Down

• ULEE-30021-20w-2422lm

Leeds Wedge Product Family



Leeds Wedge 1

• ULEW-30001-5.5w-570lm



Leeds Wedge 2

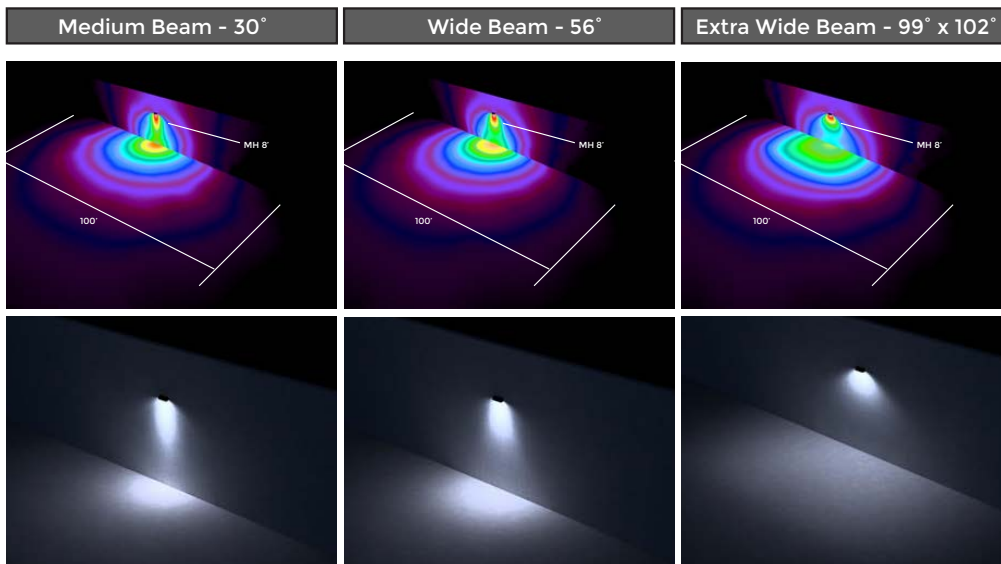
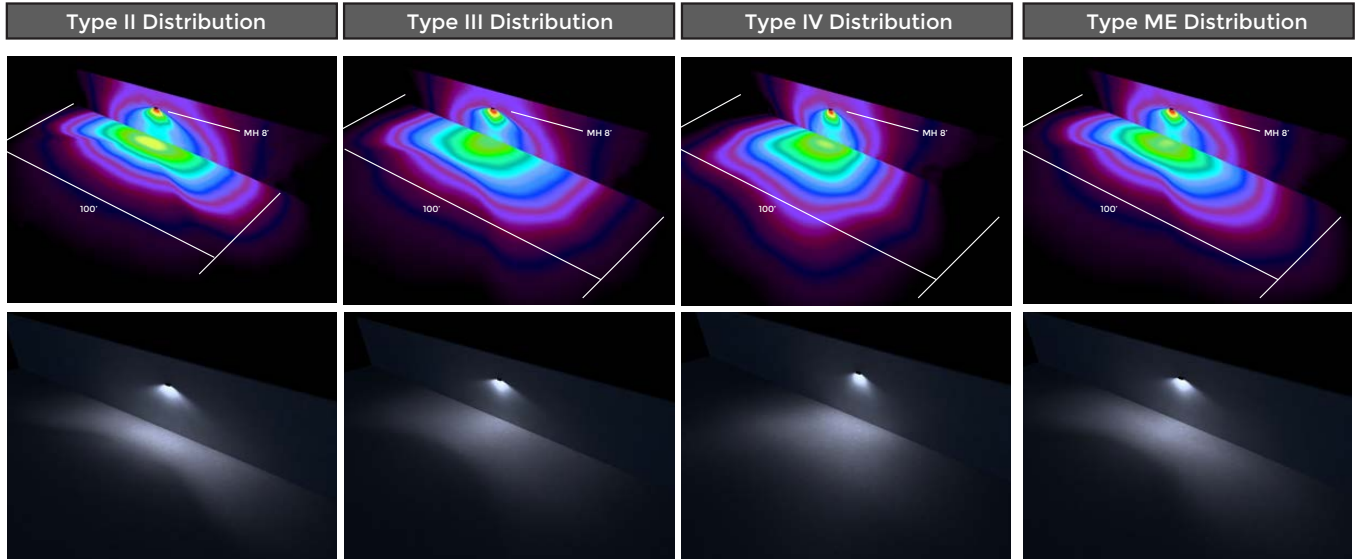
• ULEW-30011-14w-1660lm



Leeds Wedge 3

• ULEW-30021-20w-2422lm

OL4



OL5



Walkway Bollard
BX-CAV-20W-CORT-CFA-DN-32X6-30K-GFCI

SPECIFICATION FEATURES	Date 08-26-24
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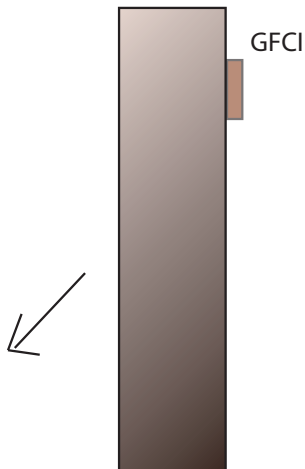
PROJECT: [REDACTED]

Dimensions	32"H X 6"W X 6"D
Lamps	20 watts of LED - 3000K
Material	Corten Steel 3500K
Finish	Corten Steel
Lens	Clear Frosted Acrylic
Label	WET Location
Voltage	120 / 277
Description	Walkway Anchor base bollard

SPECIFIER: [REDACTED]

1,700 lumens

LED in the top hood area facing downward



Inside anchor base
Bolts included

EVERGREEN LIGHTING WWW.EVERGREENLIGHTING.COM
1379 Ridgeway St. Pomona, CA 91768 PHONE: (909) 865-5599 FAX: (909) 865-5539



MADE IN USA • Information appearing hereon is proprietary and confidential and may not be used without the permission of Evergreen Lighting.

MADE IN USA

Invue

DESCRIPTION

The LuxeScope Collection presents a contemporary, architectural dayform providing superior uniformity and efficient illumination. Designed to enhance urban spaces with beautiful visual appearances and integral control solutions, LuxeScope integrates into any environment while providing high visibility by utilizing industry-leading WaveStream™ LED optics.

Other Manufacturers:
KIM "UR20 EDGE-LIT" Series
LITHONIA "RADEAN ARM MOUNT" Series

Catalog #		Type	
Project		OL6	
Comments		Date	
Prepared by			

SPECIFICATION FEATURES

Construction

Housing assembly is IP66 rated and cast from low copper content corrosion resistant aluminum, maintaining strength and precision to sustain long term dayform appearance. 3G rated construction avoids damages from installation generated vibration. Corrosion-resistant color matching hardware are minimized to enhance appearance.

Optics

Designed for complex site or pedestrian applications, WaveStream™ LED optical waveguide technology produces both symmetric NEMA Type V and asymmetric NEMA II, III, IV distributions. The waveguide is manufactured from precision injection molded acrylic delivering visual comfort and optically controlled illumination for improved glare control. Luminaire efficacy measures in excess of 100 lm/W for 4000K (+/- 275K) CCT at 70 CRI (min). Optional 3000K CCT at 70 CRI or 3000K CCT at 80 CRI also available.

Electrical

LED drivers are uniquely positioned and mounted for

maximum thermal performance and extended life. Standard 0-10V dimming drivers and surge protection module are designed to withstand 10kV of transient line surge. Drivers operate at 120-277V 50/60Hz with 347V 60Hz or 480V 60Hz operation optional. Suitable for ambient temperature applications as low as -40°C (40°F) to 40°C (104°F). High ambient options available allow for 50°C operation.

Controls

Control options are designed to be simple, cost-effective, energy code, and regulation compliant solutions featuring WaveLinX. See control options page for more details.

Mounting

Invue's aluminum round decorative pole (ARP) offering provides a seamless transition and complements the contemporary design architecture with its unique sleek taper and base design. The tenon mount pole comes standard with an access door feature integrated into the base.

Arm Mount

The integrated aluminum contemporary upsweep arm is bolted directly to the pole using

an "N" drill pattern. Provides a seamless transition to a 4" or 5" round pole.

Spider & Cantilever Mount

Fitter assembly mounts over 3" O.D. tenon and can be adapted to a 2-3/8" tenon. It is secured via concealed, corrosion resistant set screw and jam screw pairs in six inconspicuous locations. Fitter design provides seamless transition to 4" O.D. round pole top. Optional mounting accessories include a twin arm mount and wall mount arm.

Finish

Cooper Lighting Solutions utilizes premium ultra-weatherable TGIC based polyester powder coatings specifically formulated to withstand extended outdoor exposure while providing decorative appeal. Finish is compliant to 3,000 hour salt spray standard (per ASTM B117). RAL and custom color matches available. Options to meet Buy American Act requirements.

Warranty

Five year limited warranty, consult website for details.
www.cooperlighting.com/legal



LXS LUXESCAPE COLLECTION

DECORATIVE LUMINAIRE

CERTIFICATION DATA

UL/cUL Listed
FCC Class A
IEC 60529 IP66 Housing
ANSI C136.31 3G Vibration
ASTM A356.0 Low Copper Alloy
ASTM B117 Salt Spray Tested
RoHS
ISO 9001
DesignLights Consortium* Qualified*
Dark Sky Approved (3000K CCT and warmer only)

ENERGY DATA

Electronic LED Driver
>0.9 Power Factor
<20% Total Harmonic Distortion
120-277V 50/60Hz, 347V 60Hz, 480V 60Hz
40°C Ambient Temperature Rating
As low as -40°C (-40°F) minimum temperature
*See MINIMUMTEMPERATURE table

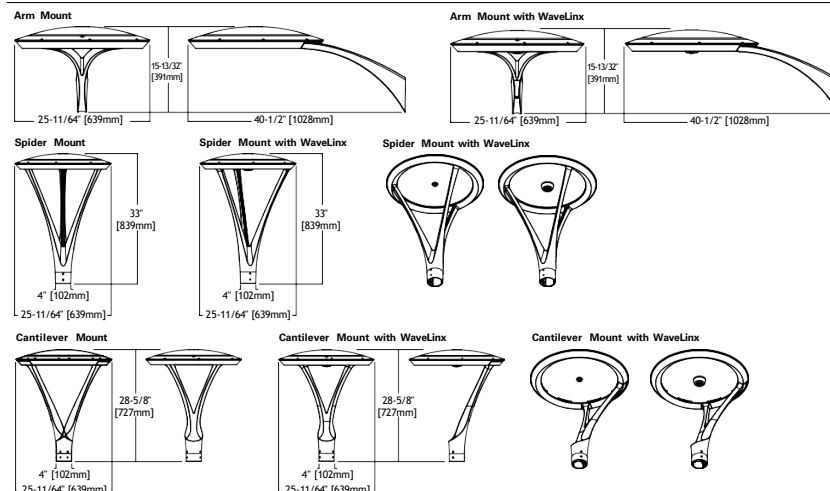
EPA

Effective Projected Area: (Sq. Ft.)
Arm Mount: 1.0
Cantilever Mount: 1.3
Spider Mount: 1.6

SHIPPING DATA

Approximate Net Weight:
Arm Mount Weight: 41 lbs. [18.6 kgs.]
Cantilever Mount Weight: 46 lbs. [20.8 kgs.]
Spider Mount Weight: 53 lbs. [24 kgs.]

DIMENSIONS



www.designlights.org

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ORDERING INFORMATION

Sample Number: LXS-VA3-LED-D1-T2-GM-5

Product Family ^{1,2}	Optic Type	Lumen Package ³	CRI/CCT	Voltage	Distribution	Mounting	Finish			
LXS=LuxeScape Collection BAA=LXS=LuxeScape Collection Buy American Act Compliant ²⁴	VA=Visual Comfort / WaveStream	1=Nominal 2,300 Lumens 2=Nominal 4,500 Lumens 3=Nominal 8,500 Lumens 4=Nominal 9,500 Lumens ⁴	730=70 CRI / 3000K 735=70 CRI / 3500K 740=70 CRI / 4000K 830=80 CRI / 3000K 835=80 CRI / 3500K 840=80 CRI / 4000K AMB=Amber 590nm ^{21, 22}	U=120-277 1=120 2=208 3=240 4=277 8=480 ^{5,6} 9=347 ⁵	ASC=Asymmetric Curbline ⁷ ASW=Asymmetric Wide ⁸ AST=Asymmetric Transverse ⁹ SYM=Symmetric Round ¹⁰	A=Arm Mount S=Spider Mount C=Cantilever Mount	AP=Grey BK=Black BZ=Bronze DP=Dark Platinum GM=Graphite Metallic WH=White RALXX=Custom Color ¹¹			
Options (Add as Suffix)					Accessories (Order Separately) ^{19, 20}					
F=Single Fuse ¹² FF=Double Fuse ¹³ X=Driver Surge only 10MSP=10K MOV Surge Protective Device 20MSP=20kV MOV Surge Protective Device 20K=20kV UL 1449 Fused Surge Protective Device DIM=External 0-10V Dimming Leads ¹⁴ HA=50°C High Ambient Temperature ¹⁵ VS=Vandal Shield ¹⁶ CC=Coastal Construction ¹⁷ DALI=DALI Driver ¹⁸ BPC=Button Type Photocontrol ¹⁹ PR=NEMA 3-PIN Twistlock Photocontrol Receptacle ²⁰ PR7=NEMA 7-PIN Twistlock Photocontrol Receptacle ²⁰ PC=Twistlock NEMA Photocontrol LLPC=Long Life Twistlock NEMA Photocontrol ²² SC=Shorting Cap MS-L08=Motion Sensor for ON/OFF Operation, Up to 8' Mounting Height ^{21, 22, 23}					MS-L20=Motion Sensor for ON/OFF Operation, 9' - 20' Mounting Height ^{21, 22, 23} MS-L40W=Motion Sensor for ON/OFF Operation, 21' - 40' Mounting Height ^{21, 22, 23} MS/DIM-L08=Motion Sensor for Dimming Operation, Up to 8' Mounting Height ^{21, 22, 23} MS/DIM-L20=Motion Sensor for Dimming Operation, 9' - 20' Mounting Height ^{21, 22, 23} MS/DIM-L40W=Motion Sensor for Dimming Operation, 21' - 40' Mounting Height ^{21, 22, 23} DIM10=AirMesh Integrated Control Module WLS2WH=WaveLinx LITE, SR Driver, Dimming Motion and Daylight, Bluetooth Programmable, 7' - 15' Mounting WLS4WH=WaveLinx LITE, SR Driver, Dimming Motion and Daylight, Bluetooth Programmable, 15' - 40' Mounting WFS2WH=WaveLinx PRO, SR Driver, Dimming Motion and Daylight, WAC Programmable, 7' - 15' Mounting ^{26,27,28} WFS4WH=WaveLinx PRO, SR Driver, Dimming Motion and Daylight, WAC Programmable, 15' - 40' Mounting ^{26,27,28}			FSIR-100=Wireless Configuration Tool for Occupancy Sensor ²⁹ ARPA2=2-3/8" O.D. Tenon Sleeve Adapter ³⁰ VA6028-XX=Twin Mount Arm (EPA 1.36 sq./ft.) ^{30,31} VA6029-XX=Wall Mount Arm ^{30,31} MA1036-XX=Single Tenon Adapter for 2-3/8" O.D. Tenon ³¹ MA1037-XX=2@180° Tenon Adapter for 2-3/8" O.D. Tenon ³¹ MA1197-XX=3@120° Tenon Adapter for 2-3/8" O.D. Tenon ³¹ MA1188-XX=4@90° Tenon Adapter for 2-3/8" O.D. Tenon ³¹ MA1189-XX=2@90° Tenon Adapter for 2-3/8" O.D. Tenon ³¹ MA1190-XX=3@90° Tenon Adapter for 2-3/8" O.D. Tenon ³¹ MA1191-XX=2@120° Tenon Adapter for 2-3/8" O.D. Tenon ³¹ MA1038-XX=Single Tenon Adapter for 3-1/2" O.D. Tenon ³¹ MA1039-XX=2@180° Tenon Adapter for 3-1/2" O.D. Tenon ³¹ MA1192-XX=3@120° Tenon Adapter for 3-1/2" O.D. Tenon ³¹ MA1188-XX=4@90° Tenon Adapter for 3-1/2" O.D. Tenon ³¹ MA1194-XX=2@90° Tenon Adapter for 3-1/2" O.D. Tenon ³¹ MA1195-XX=3@90° Tenon Adapter for 3-1/2" O.D. Tenon ³¹ WOLC-7P-10A=WaveLinx Outdoor Control Module (7-PIN) ²⁹ TL7-HVG=AirMesh 7-PIN node, 110-480V ²⁹		

ARCHITECT TO SELECT FINISH

NOTES:

1. Customer is responsible for engineering analysis to confirm pole and fixture compatibility for all applications. Refer to our white paper WP513001EN for additional support information. 2. DesignLights Consortium[®] Qualified. Refer to www.designlights.org Qualified Products List under Family Models for details. 3. Lumens are nominal. See lumen table for more information. 4. 9,500 Lumen package available only on SYM distribution. 5. Requires the use of a step-down transformer. 6. Only for use with 480V Wye systems. Per NEC, not for use with ungrounded systems, impedance grounded systems or corner grounded systems (commonly known as Three Phase Three Wire Delta, Three Phase High Leg Delta and Three Phase Corner Grounded Delta systems). 7. IESNA Type III typical. 8. IESNA Type IV typical. 9. IESNA Type IV typical. 10. IESNA Type V typical. 11. Specify RAL number for Custom Color. Custom color matching available upon request. Consult your lighting representative at Cooper Lighting Solutions for more information. 12. Must specify voltage (120V, 277V, or 347V) to fuse the single hot leg. 13. Must specify voltage (208V, 240V, or 480V) to fuse the both hot legs. 14. Low voltage control leads brought out 18" outside fixture. Not available with control options. 15. Not available in VA3 with Type ASC, ASW and AST distributions. 16. Reduce total lumens by a 0.95 multiplier to accommodate losses. 17. Post-coating over the primary finish providing 7,000+ salt spray hours. Extended lead-times can be 4 -10 additional weeks. 18. Only available with VA3 and VA4 lumen packages. 19. Not available with MS-LXX, MS/DIM-LXX, LWR-LW, LWR-LN or 347V or 480V options. 20. Not available with MS-LXX, MS/DIM-LXX, LWR-LW, LWR-LN or 347V or 480V options. 21. Not available with HA option. 22. The FSIR-100 configuration tool is required to adjust parameters including high and low modes, sensitivity, time delay, cutoff and more. Consult your lighting representative at Cooper Lighting Solutions for more information. 23. Approximately 22' detection diameter at 8' mounting height. 24. Approximately 40' detection diameter at 20' mounting height. 25. Approximately 100' detection diameter at 40' mounting height. 26. Cannot be used in conjunction with photocontrol or other controls systems (BPC, PR, PR7, MS). 27. WAC Gateway required to enable field-configurability. Order WAC-POE and WPOE-120 (10V to POE injector) power supply if needed. Only compatible with WaveLinx system and software and requires system components to be installed for operation. See website for more WaveLinx application information. 28. This tool enables adjustment of parameters including high and low modes, sensitivity, time delay, cutoff and more. Consult your lighting representative at Cooper Lighting Solutions for more information. 29. Requires 7-PIN NEMA twistlock photocontrol receptacle. WOLC-7P-10A cannot be used in conjunction with additional sensors or controls. 30. Not vibration rated at this time. Consult your lighting representative at Cooper Lighting Solutions for more information. 31. Replace XX with color designation. 32. Requires photocontrol receptacle PR or PR7. 33. Narrow-band 590nm +/- 5nm for wildlife and observatory use. Choose Lumen Package 1. See IES files for photometric performance. 34. Only product configurations with this designated prefix are built to be compliant with the Buy American Act of 1933 (BAA). Please refer to [DEMESTIC-PREFERENCES](http://www.demestic-preferences.com) website for more information. Components shipped separately may be separately analyzed under domestic preference requirements. 35. Accessories sold separately will be separately analyzed under domestic preference requirements. Consult factory for further information. 36. Not available with 5LTD option. 37. Not available with 2300 or 9500 lumen package.

ARP ORDERING INFORMATION (ALUMINUM DECORATIVE POLE)

SAMPLE NUMBER: ARP5L370A822

Product Family	Shaft Size (Inches) ¹	Wall Thickness (Inches)	Pole Top Diameter (Inches)	Mounting Height	Base Type	Finish	Mounting Type	Number and Location of Arms	Options (Add as Suffix)
ARP=Aluminum Round Tapered Decorative BAA-ARP=Aluminum Round Tapered Decorative Buy American Act Compliant ²⁶	5=5"	L=0.156" M=0.188"	3=3" O.D. ² 6=4" O.D. ³				tenon n	X=None	C=Convenience Outlet ⁵ E=CFCI Convenience Outlet ⁵ G=Ground Lug V=Vibration Dampener ⁴
						GN=Hartford Green WH=White			

PROVIDE ROUND TAPERED STEEL POLE FOR TWO FIXTURES IN BACK-TO-BACK MOUNTING. POLE SHALL BE MOUNTED ON 36" HIGH CONCRETE SONOTUBE WHEN IN PARKING LOT. PROVIDE POLE HEIGHT SUCH THAT FIXTURE HEIGHT IS 30'A.F.G.

NOTES: 1 All shaft sizes nominal. 2 Provides 3" O.D. pole top suited for Arbor Post Top. 3 Provides 4" O.D. pole top suited for LuxeScape post tops. 4 Vibration damper recommended over 18 feet add suffix "V" to catalog number. 5 Specify outlet location. Receptacle not included, provision only.



Cooper Lighting Solutions
1121 Highway 74 South
Peachtree City, GA 30269
P: 770-486-4800
www.cooperlighting.com

Specifications and dimensions subject to change without notice.

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POWER AND LUMENS

Lumen Package			VA1	VA2	VA3	VA4	
Drive Current							
Power Wattage (Watts)*			24W	48W	96W	99W	
Input Current (mA) @ 120V			200	400	800	830	
Input Current (mA) @ 277V			90	180	350	360	
Power Wattage (Watts)*			28W	55W	114W	108W	
Input Current (mA) @ 347V			79	161	325	328	
Input Current (mA) @ 480V			58	117	235	237	
CRI/CCT (Nominal)	Mounting	Distribution					
730: 70CRI/3000K	A: Arm	ASC: Asymmetric Curbline	Lumens	1,949	3,740	6,730	--
			Lumens per Watt	81.2	77.9	68.0	--
			BUG Rating	B1-U0-G1	B2-U0-G2	B3-U0-G3	--
			IESNA Type	III	III	III	--
		ASW: Asymmetric Wide	Lumens	2,323	4,458	8,022	--
			Lumens per Watt	96.8	92.9	81.0	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--
			IESNA Type	IV	IV	IV	--
		AST: Asymmetric Transverse	Lumens	2,400	4,607	8,291	--
			Lumens per Watt	100.0	96.0	83.7	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--
			IESNA Type	IV	IV	IV	--
	SYM: Symmetric Round	Lumens	2,485	4,958	9,111	10,571	
		Lumens per Watt	118.3	120.9	105.9	110.1	
		BUG Rating	B2-U0-G1	B3-U0-G2	B3-U0-G2	B4-U0-G3	
		IESNA Type	V	V	V	V	
	S: Spider Mount	ASC: Asymmetric Curbline	Lumens	1,780	3,417	6,148	--
			Lumens per Watt	74.2	71.2	62.1	--
			BUG Rating	B1-U0-G1	B2-U0-G2	B3-U0-G3	--
			IESNA Type	III	III	III	--
		ASW: Asymmetric Wide	Lumens	2,097	4,024	7,242	--
			Lumens per Watt	87.4	83.8	73.2	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G2	--
			IESNA Type	IV	IV	IV	--
AST: Asymmetric Transverse		Lumens	2,198	4,218	7,590	--	
		Lumens per Watt	91.6	87.9	76.7	--	
		BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--	
		IESNA Type	IV	IV	IV	--	
SYM: Symmetric Round	Lumens	2,305	4,600	8,452	9,807		
	Lumens per Watt	109.8	112.2	98.3	102.2		
	BUG Rating	B2-U0-G1	B3-U0-G2	B3-U0-G2	B4-U0-G3		
	IESNA Type	V	V	V	V		



Cooper Lighting Solutions
1121 Highway 74 South
Peachtree City, GA 30269
P: 770-486-4800
www.cooperlighting.com

Specifications and
dimensions subject to
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POWER AND LUMENS

Lumen Package			VA1	VA2	VA3	VA4	
CRI/CCT (Nominal)	Mounting	Distribution					
730: 70CRI/3000K	C: Cantilever Mount	ASC: Asymmetric Curbline	Lumens	1,857	3,564	6,414	--
			Lumens per Watt	77.4	74.3	64.8	--
			BUG Rating	B1-U0-G1	B2-U0-G2	B3-U0-G3	--
			IESNA Type	III	III	III	--
		ASW: Asymmetric Wide	Lumens	2,213	4,248	7,645	--
			Lumens per Watt	92.2	88.5	77.2	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--
			IESNA Type	IV	IV	IV	--
		AST: Asymmetric Transverse	Lumens	2,324	4,460	8,025	--
			Lumens per Watt	96.8	92.9	81.1	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--
			IESNA Type	IV	IV	IV	--
		SYM: Symmetric Round	Lumens	2,342	4,674	8,588	9,965
			Lumens per Watt	111.5	114.0	99.9	103.8
			BUG Rating	B2-U0-G1	B3-U0-G2	B3-U0-G2	B4-U0-G3
			IESNA Type	V	V	V	V
740: 70CRI/4000K	A: Arm	ASC: Asymmetric Curbline	Lumens	2,105	4,040	7,270	--
			Lumens per Watt	87.7	84.2	73.4	--
			BUG Rating	B1-U0-G1	B2-U0-G2	B3-U0-G3	--
			IESNA Type	III	III	III	--
		ASW: Asymmetric Wide	Lumens	2,509	4,816	8,666	--
			Lumens per Watt	104.5	100.3	87.5	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--
			IESNA Type	IV	IV	IV	--
		AST: Asymmetric Transverse	Lumens	2,593	4,977	8,956	--
			Lumens per Watt	108.0	103.7	90.5	--
			BUG Rating	B1-U0-G1	B2-U0-G2	B2-U0-G3	--
			IESNA Type	IV	IV	IV	--
		SYM: Symmetric Round	Lumens	2,684	5,356	9,842	11,420
			Lumens per Watt	127.8	130.6	114.4	119.0
			BUG Rating	B2-U0-G1	B3-U0-G2	B3-U0-G3	B4-U0-G3
			IESNA Type	V	V	V	V



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OL6

POWER AND LUMENS

Lumen Package			VA1	VA2	VA3	VA4	
CRI/CCT (Nominal)	Mounting	Distribution					
740: 70CRI/4000K	S: Spider Mount	ASC: Asymmetric Curbline	Lumens	1,923	3,691	6,642	--
			Lumens per Watt	80.1	76.9	67.1	--
			BUG Rating	B1-U0-G1	B2-U0-G2	B3-U0-G3	--
			IESNA Type	III	III	III	--
		ASW: Asymmetric Wide	Lumens	2,265	4,347	7,823	--
			Lumens per Watt	94.4	90.6	79.0	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G2	--
			IESNA Type	IV	IV	IV	--
		AST: Asymmetric Transverse	Lumens	2,374	4,557	8,200	--
			Lumens per Watt	98.9	94.9	82.8	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--
			IESNA Type	IV	IV	IV	--
	SYM: Symmetric Round	Lumens	2,490	4,969	9,131	10,595	
		Lumens per Watt	118.6	121.2	106.2	110.4	
		BUG Rating	B2-U0-G1	B3-U0-G2	B3-U0-G3	B4-U0-G3	
		IESNA Type	V	V	V	V	
	C: Cantilever Mount	ASC: Asymmetric Curbline	Lumens	2,006	3,850	6,929	--
			Lumens per Watt	83.6	80.2	70.0	--
			BUG Rating	B1-U0-G1	B2-U0-G2	B3-U0-G3	--
			IESNA Type	III	III	III	--
		ASW: Asymmetric Wide	Lumens	2,391	4,589	8,258	--
			Lumens per Watt	99.6	95.6	83.4	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--
			IESNA Type	IV	IV	IV	--
AST: Asymmetric Transverse		Lumens	2,510	4,818	8,669	--	
		Lumens per Watt	104.6	100.4	87.6	--	
		BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--	
		IESNA Type	IV	IV	IV	--	
SYM: Symmetric Round	Lumens	2,530	5,049	9,277	10,765		
	Lumens per Watt	120.5	123.1	107.9	112.1		
	BUG Rating	B2-U0-G1	B3-U0-G2	B3-U0-G3	B4-U0-G3		
	IESNA Type	V	V	V	V		



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POWER AND LUMENS

Lumen Package			VA1	VA2	VA3	VA4	
CRI/CCT (Nominal)	Mounting	Distribution					
830: 80CRI/3000K	A: Arm	ASC: Asymmetric Curbline	Lumens	1,758	3,374	6,072	--
			Lumens per Watt	73.2	70.3	61.3	--
			BUG Rating	B1-U0-G1	B2-U0-G2	B3-U0-G3	--
			IESNAType	III	III	III	--
		ASW: Asymmetric Wide	Lumens	2,096	4,022	7,238	--
			Lumens per Watt	87.3	83.8	73.1	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G2	--
			IESNAType	IV	IV	IV	--
		AST: Asymmetric Transverse	Lumens	2,166	4,157	7,480	--
			Lumens per Watt	90.2	86.6	75.6	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--
			IESNAType	IV	IV	IV	--
	SYM: Symmetric Round	Lumens	2,242	4,473	8,220	9,538	
		Lumens per Watt	106.8	109.1	95.6	99.4	
		BUG Rating	B2-U0-G1	B3-U0-G2	B3-U0-G2	B3-U0-G2	
		IESNAType	V	V	V	V	
	S: Spider Mount	ASC: Asymmetric Curbline	Lumens	1,606	3,083	5,547	--
			Lumens per Watt	66.9	64.2	56.0	--
			BUG Rating	B1-U0-G1	B2-U0-G2	B3-U0-G3	--
			IESNAType	III	III	III	--
		ASW: Asymmetric Wide	Lumens	1,892	3,631	6,534	--
			Lumens per Watt	78.8	75.6	66.0	--
			BUG Rating	B1-U0-G1	B1-U0-G1	B2-U0-G2	--
			IESNAType	IV	IV	IV	--
AST: Asymmetric Transverse		Lumens	1,983	3,806	6,848	--	
		Lumens per Watt	82.6	79.3	69.2	--	
		BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--	
		IESNAType	IV	IV	IV	--	
SYM: Symmetric Round	Lumens	2,080	4,150	7,626	8,849		
	Lumens per Watt	99.0	101.2	88.7	92.2		
	BUG Rating	B2-U0-G1	B3-U0-G2	B3-U0-G2	B3-U0-G3		
	IESNAType	V	V	V	V		



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POWER AND LUMENS

Lumen Package			VA1	VA2	VA3	VA4	
CRI/CCT (Nominal)	Mounting	Distribution					
830: 80CRI/3000K	C: Cantilever Mount	ASC: Asymmetric Curbline	Lumens	1,675	3,216	5,787	--
			Lumens per Watt	69.8	67.0	58.5	--
			BUG Rating	B1-U0-G1	B2-U0-G2	B3-U0-G3	--
			IESNAType	III	III	III	--
		ASW: Asymmetric Wide	Lumens	1,997	3,833	6,897	--
			Lumens per Watt	83.2	79.9	69.7	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G2	--
			IESNAType	IV	IV	IV	--
		AST: Asymmetric Transverse	Lumens	2,096	4,024	7,241	--
			Lumens per Watt	87.3	83.8	73.1	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--
			IESNAType	IV	IV	IV	--
	SYM: Symmetric Round	Lumens	2,113	4,217	7,748	8,991	
		Lumens per Watt	100.6	102.9	90.1	93.7	
		BUG Rating	B2-U0-G1	B3-U0-G2	B3-U0-G2	B3-U0-G3	
		IESNAType	V	V	V	V	

LUMEN MULTIPLIER

Ambient Temperature	Lumen Multiplier
0°C	1.02
10°C	1.01
25°C	1.00
40°C	0.99
50°C	0.97

MINIMUM AMBIENT TEMPERATURE

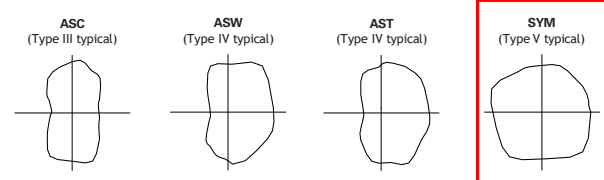
Lumen Package	Temperature
VA1	-40°C
VA2	-35°C
VA3	-35°C
VA4	-40°C
All DALI powered lumen packages	-20°C

LUMEN MAINTENANCE (TM-21)

Ambient Temperature	25,000 hours*	50,000 hours*	60,000 hours*	100,000 hours**	Theoretical L70 (Hours)**
25°C	94.4%	90.4%	89.0%	83.0%	>199,000
40°C	94.6%	90.9%	89.4%	83.9%	>212,000
50°C	91.8%	87.0%	85.2%	78.2%	>151,000

NOTES:
 * Supported by IESTM-21 standards
 ** Theoretical values represent estimations commonly used; however, refer to the IES position on LED Product Lifetime Prediction, IES PS-10-18, that explains proper use of IESTM-21 and LM-80.

OPTICAL DISTRIBUTIONS (Arm mount shown, distribution dependent on mounting)



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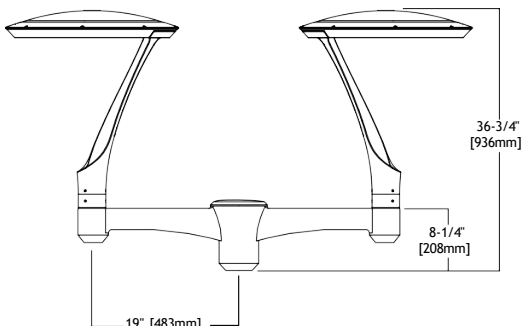
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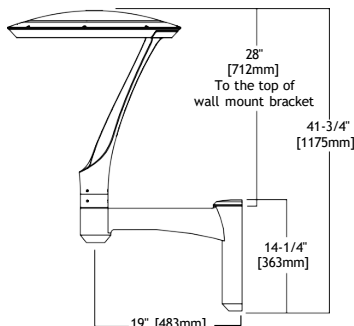
MOUNTING CONFIGURATIONS (EPAS INCLUDES FIXTURE)

MOUNTING REQUIREMENTS OL6

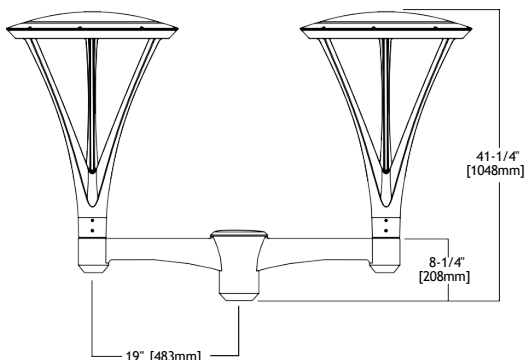
Twin mount arm (shown with Cantilever mount)



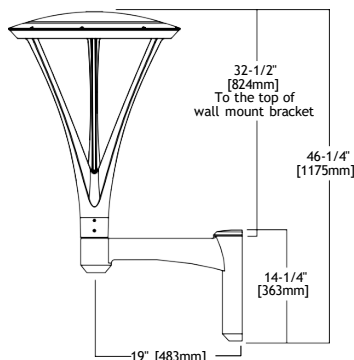
Wall mount arm (shown with Cantilever mount)



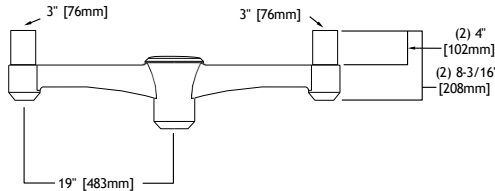
Twin mount arm (shown with Spider mount)



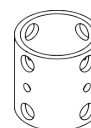
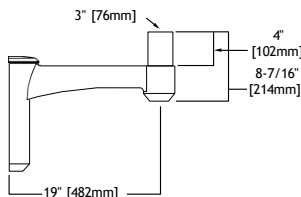
Wall mount arm (shown with Spider mount)



Twin mount arm (EPA 1.36)



Wall Mount Arm

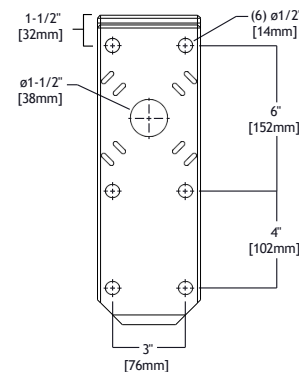


ARP2*

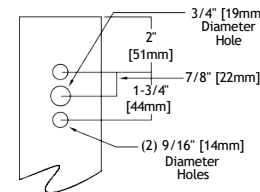
Pole Top O.D. (Inches)	4"	
Tenon O.D. (Inches)	2-3/8" Tenon	3" Tenon
Post Top	ARPA2*	Standard
Twin Mount Arm	ARPA2*	Standard

* Required for stability. Order separately.

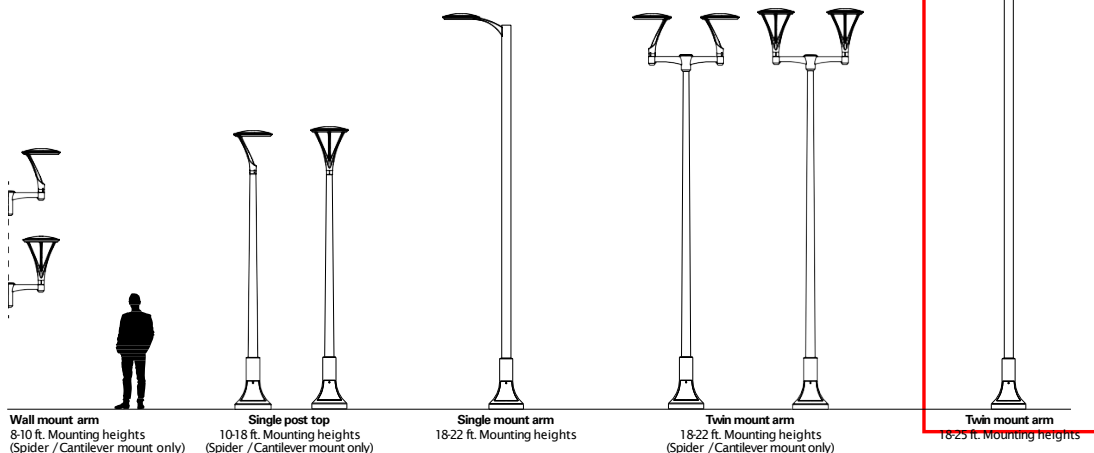
WALL MOUNT ARM DRILL PATTERN



TYPE "N"



POLE CONFIGURATIONS - (ARP DECORATIVE POLE SHOWN)



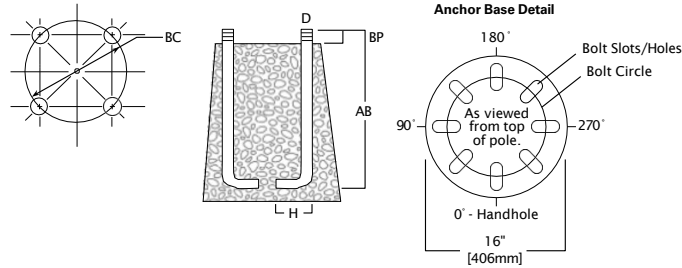
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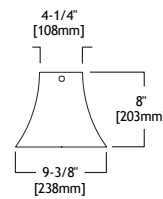
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OL6

ANCHORAGE DATA



ACCESS DOOR



Pole	Anchor Bolt and Template Package	Shaft Diameter (inches)	Bolt Circle (inches)	Number of Bolts	Bolt Size (inches)	Template Only
Aluminum Round Decorative Pole (ARP)	317AVE30	4 x 5	9	4	3/4 x 17	407040D

Effective Projected Area (At Pole Top)

Mounting Height (Feet)	Catalog Number	Wall Thickness (Inches)	Bolt Circle Diameter (Inches)	Anchor Bolt Projection (Inches)	Shaft Taper (Inches)	Anchor Bolt Diameter x Length x Hook (Inches)	Net Weight (Pounds)	Maximum Effective Projected Area (Square Feet) (1.3 gust factor)			Max. Load (Pounds)
								80 mph	90 mph	100 mph	
MH			BC	BP	B	AB ¹		80 mph	90 mph	100 mph	
10	ARPSL310A	0.156	9.0	3.5	5 x 3	3/4 x 17 x 3	57	20.0	17.5	14.1	120
10	ARPSL610A	0.156	9.0	3.5	5 X4	3/4 x 17 x 3	57	17.0	13.3	10.7	120
12	ARPSL312A	0.156	9.0	3.5	5 x 3	3/4 x 17 x 3	62	18.2	14.1	11.2	120
12	ARPSL612A	0.156	9.0	3.5	5 X4	3/4 x 17 x 3	62	14.1	10.9	8.7	120
14	ARPSL314A	0.156	9.0	3.5	5 x 3	3/4 x 17 x 3	67	14.8	11.4	9.0	120
14	ARPSL614A	0.156	9.0	3.5	5 X4	3/4 x 17 x 3	67	11.7	9.0	7.1	120
16	ARPSL316A	0.156	9.0	3.5	5 x 3	3/4 x 17 x 3	72	12.0	9.1	7.0	120
16	ARPSL616A	0.156	9.0	3.5	5 X4	3/4 x 17 x 3	72	9.4	7.1	5.6	120
18	ARPSL318A	0.156	9.0	3.5	5 x 3	3/4 x 17 x 3	77	9.5	7.1	5.4	120
18	ARPSL618A	0.156	9.0	3.5	5 X4	3/4 x 17 x 3	77	7.6	5.6	4.3	120
18	ARPSM618A	0.188	9.0	3.5	5 X4	3/4 x 17 x 3	83	9.5	7.1	5.6	120

Effective Projected Area (18" Above Pole Top)

Mounting Height (Feet)	Catalog Number	Wall Thickness (Inches)	Bolt Circle Diameter (Inches)	Anchor Bolt Projection (Inches)	Shaft Taper (Inches)	Anchor Bolt Diameter x Length x Hook (Inches)	Net Weight (Pounds)	Maximum Effective Projected Area (Square Feet) (1.3 gust factor)			Max. Load (Pounds)
								80 mph	90 mph	100 mph	
MH			BC	BP	B	AB ¹		80 mph	90 mph	100 mph	
10	ARPSL310A	0.156	9.0	3.5	5 x 3	3/4 x 17 x 3	57	19.6	15.3	12.3	120
10	ARPSL610A	0.156	9.0	3.5	5 X4	3/4 x 17 x 3	57	17.0	13.3	10.7	120
12	ARPSL312A	0.156	9.0	3.5	5 x 3	3/4 x 17 x 3	62	16.1	12.5	9.9	120
12	ARPSL612A	0.156	9.0	3.5	5 X4	3/4 x 17 x 3	62	14.1	10.9	8.7	120
14	ARPSL314A	0.156	9.0	3.5	5 x 3	3/4 x 17 x 3	67	13.2	10.1	8.0	120
14	ARPSL614A	0.156	9.0	3.5	5 X4	3/4 x 17 x 3	67	11.7	9.0	7.1	120
16	ARPSL316A	0.156	9.0	3.5	5 x 3	3/4 x 17 x 3	72	10.6	8.0	6.2	120
16	ARPSL616A	0.156	9.0	3.5	5 X4	3/4 x 17 x 3	72	9.4	7.1	5.6	120
18	ARPSL318A	0.156	9.0	3.5	5 x 3	3/4 x 17 x 3	77	8.5	6.4	4.8	120
18	ARPSL618A	0.156	9.0	3.5	5 X4	3/4 x 17 x 3	77	7.6	5.6	4.3	120
18	ARPSM618A	0.188	9.0	3.5	5 X4	3/4 x 17 x 3	83	9.5	7.1	5.6	120



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CONTROL OPTIONS

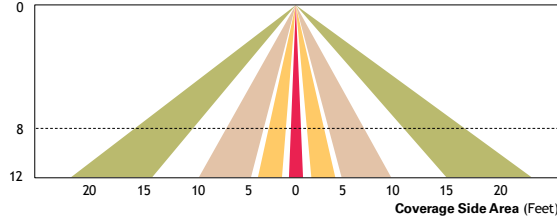
0-10V (D) The dimming option provides 0-10V dimming wire leads for use with a lighting control panel or other control method.

Photocontrol (PER and PER7) Photocontrol receptacles provide a flexible solution to enable "dusk-to-dawn" lighting by sensing light levels. Advanced control systems compatible with NEMA 7-pin standards can be utilized with the PER7 receptacle.

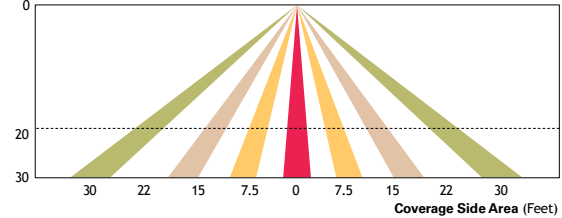
Dimming Occupancy Sensor (MS) These sensors are factory installed in the luminaire housing. When a sensor for dimming operation (/DIM) option is selected, the luminaire will dim down to approximately 50 percent power after five minutes of no activity detected. When activity is detected, the luminaire returns to full light output. When a sensor for ON/OFF operation is selected, the luminaire will turn off after five minutes of no activity.

These occupancy sensors include an integral photocell that can be activated or inactivated with the programming remote /configuration tool for "dusk-to-dawn" control or "daylight harvesting". Note: For MS sensors, the factory preset is OFF (Disabled). The programming remote /tool is a wireless tool that can be utilized to change the dimming level, time delay, sensitivity and other parameters. A variety of sensor lenses are available to optimize the coverage pattern for mounting heights from 8'-40'.

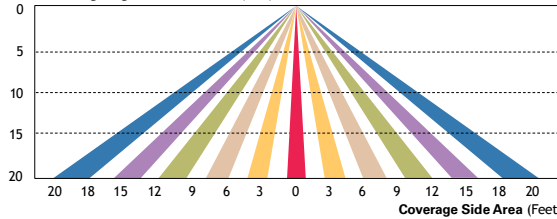
For mounting heights from 8' to 12' (-L12)



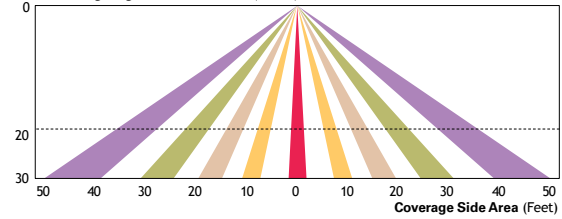
For mounting heights from 12' to 30' (-L30)



For mounting heights from 9' to 20' (-L20)



For mounting heights from 21' to 40' (-L40W)

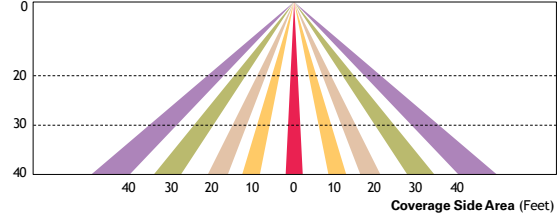


WaveLinx Wireless Control and Monitoring System Available in 7-PIN or 4-PIN configurations, the WaveLinx Outdoor control platform operates on a wireless mesh network based on IEEE 802.15.4 standards enabling wireless control of outdoor lighting. Use the WaveLinx Mobile application for set-up and configuration. At least one Wireless Area Controller (WAC) is required for full functionality and remote communication (including adjustment of any factory pre-sets).

WaveLinx Outdoor Control Module (WOLC-7P-10A) A photocontrol that enables astronomical or time-based schedules to provide ON, OFF and dimming control of fixtures utilizing a 7-PIN receptacle. The out-of-box functionality is ON at dusk and OFF at dawn.

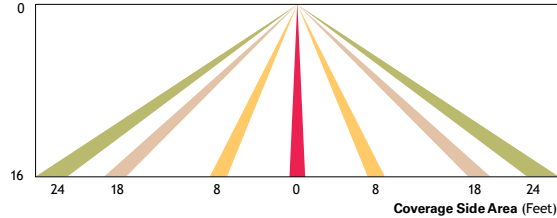
WaveLinx PRO Wireless Sensor (WPS2 and WPS4) These outdoor sensors offer passive infrared (PIR) occupancy and a photocell for closed loop daylight sensing. These sensors are factory preset to dim down to approximately 50 percent power after 15 minutes of no activity detected. These occupancy sensors include an integral photocell for "dusk-to-dawn" control or daylight harvesting that is factory-enabled. A variety of sensor lenses are available to optimize the coverage pattern for mounting heights from 7'-40'.

For mounting heights from 16' to 40' (WPS)

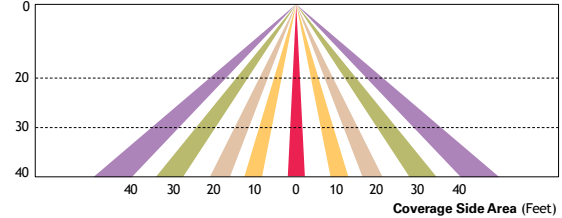


Enlighted Wireless Control and Monitoring System (LWR-LW and LWR-LN) Enlighted is a connected lighting solution that combines LED luminaires with an integrated wireless sensor system. The sensor controls the lighting system in compliance with the latest energy codes and collects valuable data about building performance and use. Software applications turn the granular data into information through energy dashboards and specialized apps that make it simple and help optimize the use of other resources beyond lighting.

For mounting heights from 8' to 16' (LWR-LW)



For mounting heights from 16' to 40' (LWR-LN)



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Invue

DESCRIPTION

The LuxeScope Collection presents a contemporary, architectural dayform providing superior uniformity and efficient illumination. Designed to enhance urban spaces with beautiful visual appearances and integral control solutions, LuxeScope integrates into any environment while providing high visibility by utilizing industry-leading WaveStream™ LED optics.

Other Manufacturers:
KIM "UR20 EDGE-LIT" Series
LITHONIA "RADEAN ARM MOUNT" Series

Catalog #		Type	
Project		OL7	
Comments		Date	
Prepared by			

SPECIFICATION FEATURES

Construction

Housing assembly is IP66 rated and cast from low copper content corrosion resistant aluminum, maintaining strength and precision to sustain long term dayform appearance. 3G rated construction avoids damages from installation generated vibration. Corrosion-resistant color matching hardware are minimized to enhance appearance.

Optics

Designed for complex site or pedestrian applications, WaveStream™ LED optical waveguide technology produces both symmetric NEMA Type V and asymmetric NEMA II, III, IV distributions. The waveguide is manufactured from precision injection molded acrylic delivering visual comfort and optically controlled illumination for improved glare control. Luminaire efficacy measures in excess of 100 lm/W for 4000K (+/- 275K) CCT at 70 CRI (min). Optional 3000K CCT at 70 CRI or 3000K CCT at 80 CRI also available.

Electrical

LED drivers are uniquely positioned and mounted for

maximum thermal performance and extended life. Standard 0-10V dimming drivers and surge protection module are designed to withstand 10kV of transient line surge. Drivers operate at 120-277V 50/60Hz with 347V 60Hz or 480V 60Hz operation optional. Suitable for ambient temperature applications as low as -40°C (40°F) to 40°C (104°F). High ambient options available allow for 50°C operation.

Controls

Control options are designed to be simple, cost-effective, energy code, and regulation compliant solutions featuring WaveLinX. See control options page for more details.

Mounting

Invue's aluminum round decorative pole (ARP) offering provides a seamless transition and complements the contemporary design architecture with its unique sleek taper and base design. The tenon mount pole comes standard with an access door feature integrated into the base.

Arm Mount

The integrated aluminum contemporary upsweep arm is bolted directly to the pole using

an "N" drill pattern. Provides a seamless transition to a 4" or 5" round pole.

Spider & Cantilever Mount

Fitter assembly mounts over 3" O.D. tenon and can be adapted to a 2-3/8" tenon. It is secured via concealed, corrosion resistant set screw and jam screw pairs in six inconspicuous locations. Fitter design provides seamless transition to 4" O.D. round pole top. Optional mounting accessories include a twin arm mount and wall mount arm.

Finish

Cooper Lighting Solutions utilizes premium ultra-weatherable TGIC based polyester powder coatings specifically formulated to withstand extended outdoor exposure while providing decorative appeal. Finish is compliant to 3,000 hour salt spray standard (per ASTM B117). RAL and custom color matches available. Options to meet Buy American Act requirements.

Warranty

Five year limited warranty, consult website for details.
www.cooperlighting.com/legal



LXS LUXESCAPE COLLECTION

DECORATIVE LUMINAIRE

CERTIFICATION DATA

UL/cUL Listed
FCC Class A
IEC 60529 IP66 Housing
ANSI C136.31 3G Vibration
ASTM A356.0 Low Copper Alloy
ASTM B117 Salt Spray Tested
RoHS
ISO 9001
DesignLights Consortium* Qualified*
Dark Sky Approved (3000K CCT and warmer only)

ENERGY DATA

Electronic LED Driver
>0.9 Power Factor
<20% Total Harmonic Distortion
120-277V 50/60Hz, 347V 60Hz, 480V 60Hz
40°C Ambient Temperature Rating
As low as -40°C (-40°F) minimum temperature
*See MINIMUMTEMPERATURE table

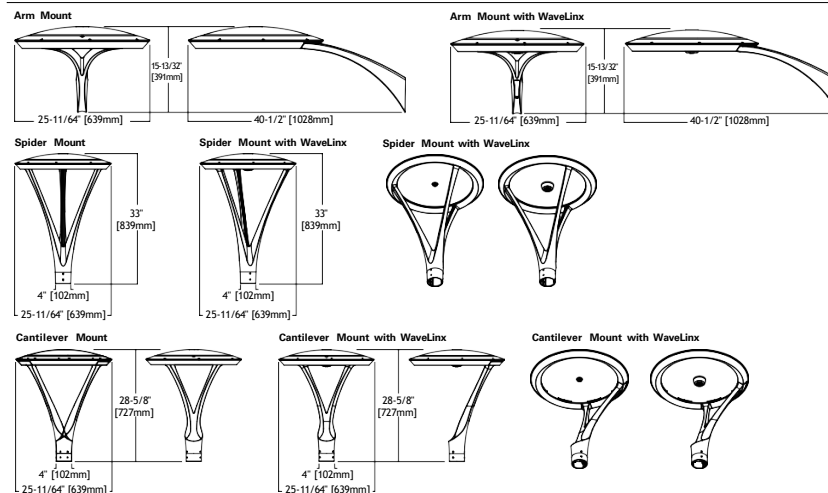
EPA

Effective Projected Area: (Sq. Ft.)
Arm Mount: 1.0
Cantilever Mount: 1.3
Spider Mount: 1.6

SHIPPING DATA

Approximate Net Weight:
Arm Mount Weight: 41 lbs. [18.6 kgs.]
Cantilever Mount Weight: 46 lbs. [20.8 kgs.]
Spider Mount Weight: 53 lbs. [24 kgs.]

DIMENSIONS



www.designlights.org

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ORDERING INFORMATION

Sample Number: LXS-VA3-LED-D1-T2-GM-S

Product Family ^{1,2}	Optic Type	Lumen Package ³	CRI/CCT	Voltage	Distribution	Mounting	Finish			
LXS=LuxeScape Collection BAA-LXS=LuxeScape Collection Buy American Act Compliant ²⁴	VA=Visual Comfort / WaveStream	1=Nominal 2,300 Lumens 2=Nominal 4,500 Lumens 3=Nominal 8,500 Lumens 4=Nominal 9,500 Lumens ⁴	730=70 CRI / 3000K 735=70 CRI / 3500K 740=70 CRI / 4000K 830=80 CRI / 3000K 835=80 CRI / 3500K 840=80 CRI / 4000K AMB=Amber 590nm ^{21, 22}	U=120-277 1=120 2=208 3=240 4=277 8=480 ^{5,6} 9=347 ⁵	ASC=Asymmetric Curbline ⁷ ASW=Asymmetric Wide ⁸ AST=Asymmetric Transverse ⁹ SYM=Symmetric Round ¹⁰	A=Arm Mount S=Spider Mount C=Cantilever Mount	AP=Grey BK=Black BZ=Bronze DP=Dark Platinum GM=Graphite Metallic WH=White RALXX=Custom Color ¹¹			
Options (Add as Suffix)					Accessories (Order Separately) ^{10, 26}					
F=Single Fuse ¹² FF=Double Fuse ¹³ X=Driver Surge only 10MSP=10K MOV Surge Protective Device 20MSP=20kV MOV Surge Protective Device 20K=20kV UL 1449 Fused Surge Protective Device DIM=External 0-10V Dimming Leads ¹⁴ HA=50°C High Ambient Temperature ¹⁵ VS=Vandal Shield ¹⁶ CC=Coastal Construction ¹⁷ DALI=DALI Driver ¹⁸ BPC=Button Type Photocontrol ¹⁹ PR=NEMA 3-PIN Twistlock Photocontrol Receptacle ²⁰ PR7=NEMA 7-PIN Twistlock Photocontrol Receptacle ²⁰ PC=Twistlock NEMA Photocontrol LLPC=Long Life Twistlock NEMA Photocontrol ²² SC=Shorting Cap MS-L08=Motion Sensor for ON/OFF Operation, Up to 8' Mounting Height ^{21, 22, 23}					MS-L20=Motion Sensor for ON/OFF Operation, 9' - 20' Mounting Height ^{21, 22, 23} MS-L40W=Motion Sensor for ON/OFF Operation, 21' - 40' Mounting Height ^{21, 22, 23} MS/DIM-L08=Motion Sensor for Dimming Operation, Up to 8' Mounting Height ^{21, 22, 23} MS/DIM-L20=Motion Sensor for Dimming Operation, 9' - 20' Mounting Height ^{21, 22, 23} MS/DIM-L40W=Motion Sensor for Dimming Operation, 21' - 40' Mounting Height ^{21, 22, 23} DIM10=AirMesh Integrated Control Module WLS2WH=WaveLinx LITE, SR Driver, Dimming Motion and Daylight, Bluetooth Programmable, 7' - 15' Mounting WLS4WH=WaveLinx LITE, SR Driver, Dimming Motion and Daylight, Bluetooth Programmable, 15' - 40' Mounting WFS2WH=WaveLinx PRO, SR Driver, Dimming Motion and Daylight, WAC Programmable, 7' - 15' Mounting ^{26,27,28} WFS4WH=WaveLinx PRO, SR Driver, Dimming Motion and Daylight, WAC Programmable, 15' - 40' Mounting ^{26,27,28}			FSIR-100=Wireless Configuration Tool for Occupancy Sensor ²⁸ ARPA2=2-3/8" O.D. Tenon Sleeve Adapter ²⁹ VA6028-XX=Twin Mount Arm (EPA 1.36 sq./ft.) ^{30, 31} VA6029-XX=Wall Mount Arm ^{30, 31} MA1036-XX=Single Tenon Adapter for 2-3/8" O.D. Tenon ³¹ MA1037-XX=2@180° Tenon Adapter for 2-3/8" O.D. Tenon ³¹ MA1197-XX=2@120° Tenon Adapter for 2-3/8" O.D. Tenon ³¹ MA1188-XX=4@90° Tenon Adapter for 2-3/8" O.D. Tenon ³¹ MA1189-XX=2@90° Tenon Adapter for 2-3/8" O.D. Tenon ³¹ MA1190-XX=3@90° Tenon Adapter for 2-3/8" O.D. Tenon ³¹ MA1191-XX=2@120° Tenon Adapter for 2-3/8" O.D. Tenon ³¹ MA1038-XX=Single Tenon Adapter for 3-1/2" O.D. Tenon ³¹ MA1039-XX=2@180° Tenon Adapter for 3-1/2" O.D. Tenon ³¹ MA1192-XX=3@120° Tenon Adapter for 3-1/2" O.D. Tenon ³¹ MA1183-XX=4@90° Tenon Adapter for 3-1/2" O.D. Tenon ³¹ MA1194-XX=2@90° Tenon Adapter for 3-1/2" O.D. Tenon ³¹ MA1195-XX=3@90° Tenon Adapter for 3-1/2" O.D. Tenon ³¹ WOLC-7P-10A=WaveLinx Outdoor Control Module (7-PIN) ²⁹ TL7-HVG=AirMesh 7-PIN node, 110-480V ²⁹		

ARCHITECT TO SELECT FINISH

NOTES:

1. Customer is responsible for engineering analysis to confirm pole and fixture compatibility for all applications. Refer to our white paper WP513001EN for additional support information. 2. DesignLights Consortium[®] Qualified. Refer to www.designlights.org Qualified Products List under Family Models for details. 3. Lumens are nominal. See lumen table for more information. 4. 9,500 Lumen package available only on SYM distribution. 5. Requires the use of a step-down transformer. 6. Only for use with 480V Wye systems. Per NEC, not for use with ungrounded systems, impedance grounded systems or corner grounded systems (commonly known as Three Phase Three Wire Delta, Three Phase High Leg Delta and Three Phase Corner Grounded Delta systems). 7. IESNA Type III typical. 8. IESNA Type IV typical. 9. IESNA Type IV typical. 10. IESNA Type V typical. 11. Specify RAL number for Custom Color. Custom color matching available upon request. Consult your lighting representative at Cooper Lighting Solutions for more information. 12. Must specify voltage (120V, 277V, or 347V) to fuse the single hot leg. 13. Must specify voltage (208V, 240V, or 480V) to fuse the both hot legs. 14. Low voltage control leads brought out 18" outside fixture. Not available with control options. 15. Not available in VA3 with Type ASC, ASW and AST distributions. 16. Reduce total lumens by a 0.95 multiplier to accommodate losses. 17. Post-coating over the primary finish providing 7,000+ salt spray hours. Extended lead-times can be 4 -10 additional weeks. 18. Only available with VA3 and VA4 lumen packages. 19. Not available with MS-LXX, MS/DIM-LXX, LWR-LW, LWR-LN or 347V or 480V options. 20. Not available with MS-LXX, MS/DIM-LXX, LWR-LW, LWR-LN or 347V or 480V options. 21. Not available with HA option. 22. The FSIR-100 configuration tool is required to adjust parameters including high and low modes, sensitivity, time delay, cutoff and more. Consult your lighting representative at Cooper Lighting Solutions for more information. 23. Approximately 22' detection diameter at 8' mounting height. 24. Approximately 40' detection diameter at 20' mounting height. 25. Approximately 100' detection diameter at 40' mounting height. 26. Cannot be used in conjunction with photocontrol or other controls systems (BPC, PR, PR7, MS). 27. WAC Gateway required to enable field-configurability. Order WAC-POE and WPOE-120 (10V to POE injector) power supply if needed. Only compatible with WaveLinx system and software and requires system components to be installed for operation. See website for more WaveLinx application information. 28. This tool enables adjustment of parameters including high and low modes, sensitivity, time delay, cutoff and more. Consult your lighting representative at Cooper Lighting Solutions for more information. 29. Requires 7-PIN NEMA twistlock photocontrol receptacle. WOLC-7P-10A cannot be used in conjunction with additional sensors or controls. 30. Not vibration rated at this time. Consult your lighting representative at Cooper Lighting Solutions for more information. 31. Replace XX with color designation. 32. Requires photocontrol receptacle PR or PR7. 33. Narrow-band 590nm +/- 5nm for wildlife and observatory use. Choose Lumen Package 1. See IES files for photometric performance. 34. Only product configurations with this designated prefix are built to be compliant with the Buy American Act of 1933 (BAA). Please refer to [DEMESTIC PREFERENCES](http://www.demestic-preferences.com) website for more information. Components shipped separately may be separately analyzed under domestic preference requirements. 35. Accessories sold separately will be separately analyzed under domestic preference requirements. Consult factory for further information. 36. Not available with 5LTD option. 37. Not available with 2300 or 9500 lumen package.

ARP ORDERING INFORMATION (ALUMINUM DECORATIVE POLE)

SAMPLE NUMBER: ARP5L370A822

Product Family	Shaft Size (Inches) ¹	Wall Thickness (Inches)	Pole Top Diameter (Inches)	Mounting Height	Base Type	Finish	Mounting Type	Number and Location of Arms	Options (Add as Suffix)
ARP=Aluminum Round Tapered Decorative BAA-ARP=Aluminum Round Tapered Decorative Buy American Act Compliant ²⁶	5-5"	L=0.156" M=0.188"	3=3" O.D. ² 6=4" O.D. ³			DP=Dark Platinum GM=Graphite Metallic GN=Hartford Green WH=White	Tenon Non	X=None	C=Convenience Outlet ⁵ E=CFCI Convenience Outlet ⁵ G=Ground Lug V=Vibration Dampener ⁴

PROVIDE ROUND TAPERED STEEL POLE. POLE SHALL BE MOUNTED ON 36" HIGH CONCRETE SONOTUBE WHEN IN PARKING LOT. PROVIDE POLE HEIGHT SUCH THAT FIXTURE HEIGHT IS 30'A.F.G.

NOTES: 1 All shaft sizes nominal. 2 Provides 3" O.D. pole top suited for Arbor Post Top. 3 Provides 4" O.D. pole top suited for LuxeScape post tops. 4 Vibration damper recommended over 18 feet add suffix "V" to catalog number. 5 Specify outlet location. Receptacle not included, provision only.



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POWER AND LUMENS

Lumen Package			VA1	VA2	VA3	VA4	
Drive Current							
Power Wattage (Watts)*			24W	48W	96W	99W	
Input Current (mA) @ 120V			200	400	800	830	
Input Current (mA) @ 277V			90	180	350	360	
Power Wattage (Watts)*			28W	55W	114W	108W	
Input Current (mA) @ 347V			79	161	325	328	
Input Current (mA) @ 480V			58	117	235	237	
CRI/CCT (Nominal)	Mounting	Distribution					
730: 70CRI/3000K	A: Arm	ASC: Asymmetric Curbline	Lumens	1,949	3,740	6,730	--
			Lumens per Watt	81.2	77.9	68.0	--
			BUG Rating	B1-U0-G1	B2-U0-G2	B3-U0-G3	--
			IESNA Type	III	III	III	--
		ASW: Asymmetric Wide	Lumens	2,323	4,458	8,022	--
			Lumens per Watt	96.8	92.9	81.0	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--
			IESNA Type	IV	IV	IV	--
		AST: Asymmetric Transverse	Lumens	2,400	4,607	8,291	--
			Lumens per Watt	100.0	96.0	83.7	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--
			IESNA Type	IV	IV	IV	--
	SYM: Symmetric Round	Lumens	2,485	4,958	9,111	10,571	
		Lumens per Watt	118.3	120.9	105.9	110.1	
		BUG Rating	B2-U0-G1	B3-U0-G2	B3-U0-G2	B4-U0-G3	
		IESNA Type	V	V	V	V	
	S: Spider Mount	ASC: Asymmetric Curbline	Lumens	1,780	3,417	6,148	--
			Lumens per Watt	74.2	71.2	62.1	--
			BUG Rating	B1-U0-G1	B2-U0-G2	B3-U0-G3	--
			IESNA Type	III	III	III	--
		ASW: Asymmetric Wide	Lumens	2,097	4,024	7,242	--
			Lumens per Watt	87.4	83.8	73.2	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G2	--
			IESNA Type	IV	IV	IV	--
AST: Asymmetric Transverse		Lumens	2,198	4,218	7,590	--	
		Lumens per Watt	91.6	87.9	76.7	--	
		BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--	
		IESNA Type	IV	IV	IV	--	
SYM: Symmetric Round	Lumens	2,305	4,600	8,452	9,807		
	Lumens per Watt	109.8	112.2	98.3	102.2		
	BUG Rating	B2-U0-G1	B3-U0-G2	B3-U0-G2	B4-U0-G3		
	IESNA Type	V	V	V	V		



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POWER AND LUMENS

Lumen Package			VA1	VA2	VA3	VA4	
CRI/CCT (Nominal)	Mounting	Distribution					
730: 70CRI/3000K	C: Cantilever Mount	ASC: Asymmetric Curbline	Lumens	1,857	3,564	6,414	--
			Lumens per Watt	77.4	74.3	64.8	--
			BUG Rating	B1-U0-G1	B2-U0-G2	B3-U0-G3	--
			IESNA Type	III	III	III	--
		ASW: Asymmetric Wide	Lumens	2,213	4,248	7,645	--
			Lumens per Watt	92.2	88.5	77.2	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--
			IESNA Type	IV	IV	IV	--
		AST: Asymmetric Transverse	Lumens	2,324	4,460	8,025	--
			Lumens per Watt	96.8	92.9	81.1	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--
			IESNA Type	IV	IV	IV	--
		SYM: Symmetric Round	Lumens	2,342	4,674	8,588	9,965
			Lumens per Watt	111.5	114.0	99.9	103.8
			BUG Rating	B2-U0-G1	B3-U0-G2	B3-U0-G2	B4-U0-G3
			IESNA Type	V	V	V	V
740: 70CRI/4000K	A: Arm	ASC: Asymmetric Curbline	Lumens	2,105	4,040	7,270	--
			Lumens per Watt	87.7	84.2	73.4	--
			BUG Rating	B1-U0-G1	B2-U0-G2	B3-U0-G3	--
			IESNA Type	III	III	III	--
		ASW: Asymmetric Wide	Lumens	2,509	4,816	8,666	--
			Lumens per Watt	104.5	100.3	87.5	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--
			IESNA Type	IV	IV	IV	--
		AST: Asymmetric Transverse	Lumens	2,593	4,977	8,956	--
			Lumens per Watt	108.0	103.7	90.5	--
			BUG Rating	B1-U0-G1	B2-U0-G2	B2-U0-G3	--
			IESNA Type	IV	IV	IV	--
		SYM: Symmetric Round	Lumens	2,684	5,356	9,842	11,420
			Lumens per Watt	127.8	130.6	114.4	119.0
			BUG Rating	B2-U0-G1	B3-U0-G2	B3-U0-G3	B4-U0-G3
			IESNA Type	V	V	V	V



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POWER AND LUMENS

Lumen Package			VA1	VA2	VA3	VA4	
CRI/CCT (Nominal)	Mounting	Distribution					
740: 70CRI/4000K	S: Spider Mount	ASC: Asymmetric Curbline	Lumens	1,923	3,691	6,642	--
			Lumens per Watt	80.1	76.9	67.1	--
			BUG Rating	B1-U0-G1	B2-U0-G2	B3-U0-G3	--
			IESNAType	III	III	III	--
		ASW: Asymmetric Wide	Lumens	2,265	4,347	7,823	--
			Lumens per Watt	94.4	90.6	79.0	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G2	--
			IESNAType	IV	IV	IV	--
		AST: Asymmetric Transverse	Lumens	2,374	4,557	8,200	--
			Lumens per Watt	98.9	94.9	82.8	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--
			IESNAType	IV	IV	IV	--
	SYM: Symmetric Round	Lumens	2,490	4,969	9,131	10,595	
		Lumens per Watt	118.6	121.2	106.2	110.4	
		BUG Rating	B2-U0-G1	B3-U0-G2	B3-U0-G3	B4-U0-G3	
		IESNAType	V	V	V	V	
	C: Cantilever Mount	ASC: Asymmetric Curbline	Lumens	2,006	3,850	6,929	--
			Lumens per Watt	83.6	80.2	70.0	--
			BUG Rating	B1-U0-G1	B2-U0-G2	B3-U0-G3	--
			IESNAType	III	III	III	--
		ASW: Asymmetric Wide	Lumens	2,391	4,589	8,258	--
			Lumens per Watt	99.6	95.6	83.4	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--
			IESNAType	IV	IV	IV	--
AST: Asymmetric Transverse		Lumens	2,510	4,818	8,669	--	
		Lumens per Watt	104.6	100.4	87.6	--	
		BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--	
		IESNAType	IV	IV	IV	--	
SYM: Symmetric Round	Lumens	2,530	5,049	9,277	10,765		
	Lumens per Watt	120.5	123.1	107.9	112.1		
	BUG Rating	B2-U0-G1	B3-U0-G2	B3-U0-G3	B4-U0-G3		
	IESNAType	V	V	V	V		



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POWER AND LUMENS

Lumen Package			VA1	VA2	VA3	VA4	
CRI/CCT (Nominal)	Mounting	Distribution					
830: 80CRI/3000K	A: Arm	ASC: Asymmetric Curbline	Lumens	1,758	3,374	6,072	--
			Lumens per Watt	73.2	70.3	61.3	--
			BUG Rating	B1-U0-G1	B2-U0-G2	B3-U0-G3	--
			IESNAType	III	III	III	--
		ASW: Asymmetric Wide	Lumens	2,096	4,022	7,238	--
			Lumens per Watt	87.3	83.8	73.1	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G2	--
			IESNAType	IV	IV	IV	--
		AST: Asymmetric Transverse	Lumens	2,166	4,157	7,480	--
			Lumens per Watt	90.2	86.6	75.6	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--
			IESNAType	IV	IV	IV	--
	SYM: Symmetric Round	Lumens	2,242	4,473	8,220	9,538	
		Lumens per Watt	106.8	109.1	95.6	99.4	
		BUG Rating	B2-U0-G1	B3-U0-G2	B3-U0-G2	B3-U0-G2	
		IESNAType	V	V	V	V	
	S: Spider Mount	ASC: Asymmetric Curbline	Lumens	1,606	3,083	5,547	--
			Lumens per Watt	66.9	64.2	56.0	--
			BUG Rating	B1-U0-G1	B2-U0-G2	B3-U0-G3	--
			IESNAType	III	III	III	--
ASW: Asymmetric Wide		Lumens	1,892	3,631	6,534	--	
		Lumens per Watt	78.8	75.6	66.0	--	
		BUG Rating	B1-U0-G1	B1-U0-G1	B2-U0-G2	--	
		IESNAType	IV	IV	IV	--	
AST: Asymmetric Transverse		Lumens	1,983	3,806	6,848	--	
		Lumens per Watt	82.6	79.3	69.2	--	
		BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--	
		IESNAType	IV	IV	IV	--	
SYM: Symmetric Round		Lumens	2,080	4,150	7,626	8,849	
		Lumens per Watt	99.0	101.2	88.7	92.2	
		BUG Rating	B2-U0-G1	B3-U0-G2	B3-U0-G2	B3-U0-G3	
		IESNAType	V	V	V	V	



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POWER AND LUMENS

Lumen Package			VA1	VA2	VA3	VA4	
CRI/CCT (Nominal)	Mounting	Distribution					
830: 80CRI/3000K	C: Cantilever Mount	ASC: Asymmetric Curbline	Lumens	1,675	3,216	5,787	--
			Lumens per Watt	69.8	67.0	58.5	--
			BUG Rating	B1-U0-G1	B2-U0-G2	B3-U0-G3	--
			IESNA Type	III	III	III	--
		ASW: Asymmetric Wide	Lumens	1,997	3,833	6,897	--
			Lumens per Watt	83.2	79.9	69.7	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G2	--
			IESNA Type	IV	IV	IV	--
		AST: Asymmetric Transverse	Lumens	2,096	4,024	7,241	--
			Lumens per Watt	87.3	83.8	73.1	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--
			IESNA Type	IV	IV	IV	--
	SYM: Symmetric Round	Lumens	2,113	4,217	7,748	8,991	
		Lumens per Watt	100.6	102.9	90.1	93.7	
		BUG Rating	B2-U0-G1	B3-U0-G2	B3-U0-G2	B3-U0-G3	
		IESNA Type	V	V	V	V	

LUMEN MULTIPLIER

Ambient Temperature	Lumen Multiplier
0°C	1.02
10°C	1.01
25°C	1.00
40°C	0.99
50°C	0.97

MINIMUM AMBIENT TEMPERATURE

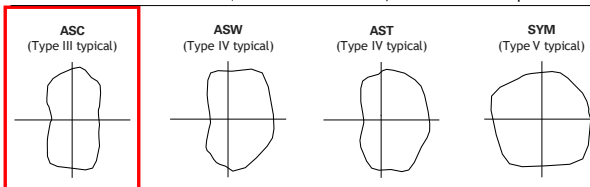
Lumen Package	Temperature
VA1	-40°C
VA2	-35°C
VA3	-35°C
VA4	-40°C
All DALI powered lumen packages	-20°C

LUMEN MAINTENANCE (TM-21)

Ambient Temperature	25,000 hours*	50,000 hours*	60,000 hours*	100,000 hours**	Theoretical L70 (Hours)**
25°C	94.4%	90.4%	89.0%	83.0%	>199,000
40°C	94.6%	90.9%	89.4%	83.9%	>212,000
50°C	91.8%	87.0%	85.2%	78.2%	>151,000

NOTES:
 * Supported by IESTM-21 standards
 ** Theoretical values represent estimations commonly used; however, refer to the IES position on LED Product Lifetime Prediction, IES PS-10-18, that explains proper use of IESTM-21 and LM-80.

OPTICAL DISTRIBUTIONS (Arm mount shown, distribution dependent on mounting)



Cooper Lighting Solutions
 1121 Highway 74 South
 Peachtree City, GA 30269
 P: 770-486-4800
www.cooperlighting.com

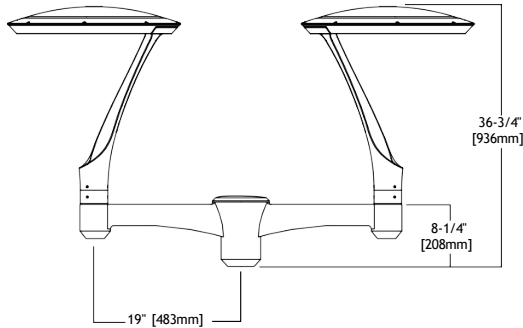
Specifications and dimensions subject to change without notice.

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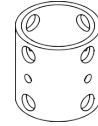
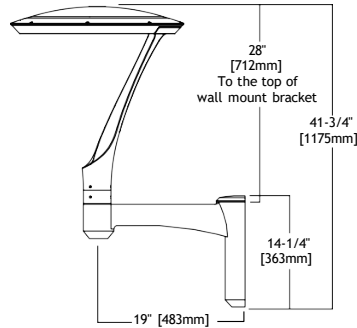
MOUNTING CONFIGURATIONS (EPAS INCLUDES FIXTURE)

MOUNTING REQUIREMENTS OL7

Twin mount arm (shown with Cantilever mount)



Wall mount arm (shown with Cantilever mount)

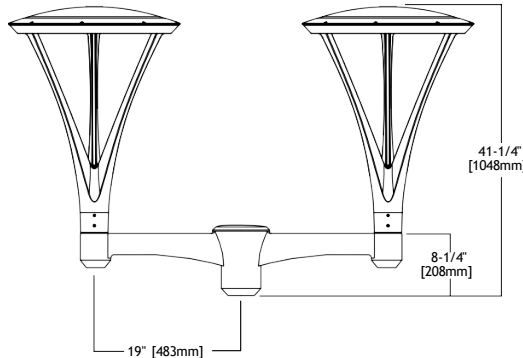


ARP2*

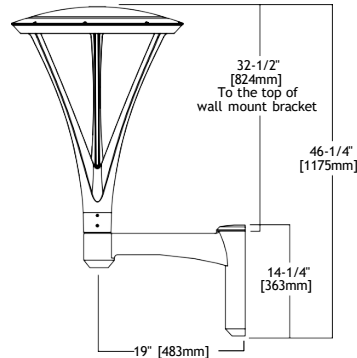
Pole Top O.D. (Inches)	4"	
Tenon O.D. (Inches)	2-3/8" Tenon	3" Tenon
Post Top	ARPA2*	Standard
Twin Mount Arm	ARPA2*	Standard

* Required for stability. Order separately.

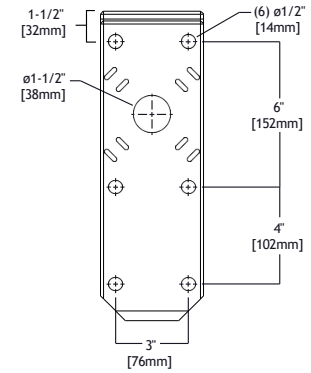
Twin mount arm (shown with Spider mount)



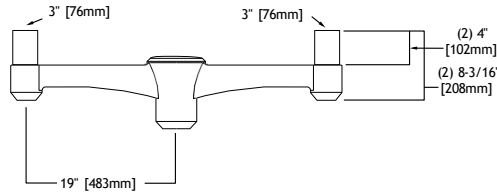
Wall mount arm (shown with Spider mount)



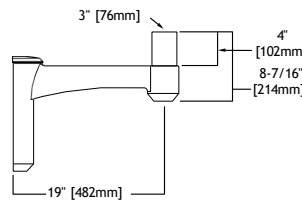
WALL MOUNT ARM DRILL PATTERN



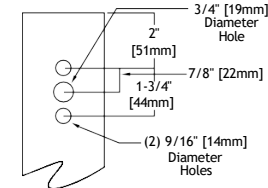
Twin mount arm (EPA 1.36)



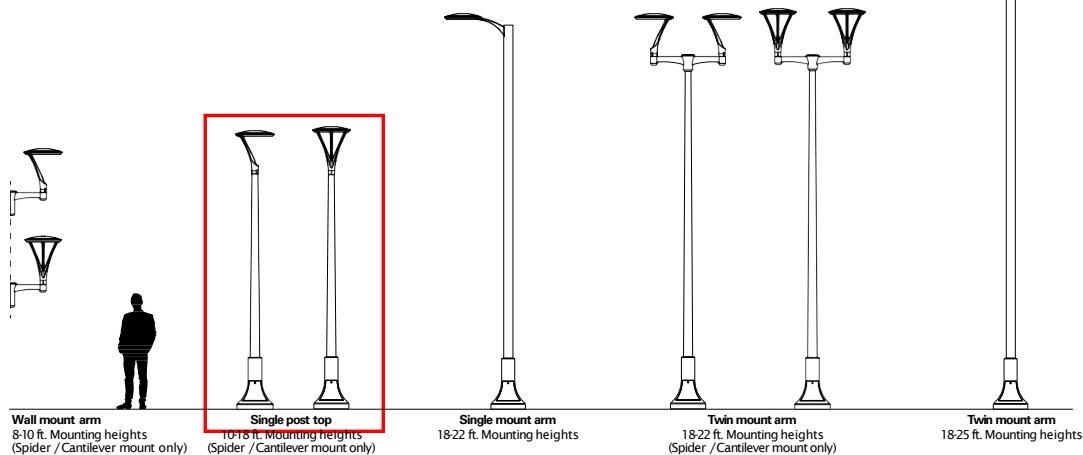
Wall Mount Arm



TYPE "N"



POLE CONFIGURATIONS (~~ARP DECORATIVE POLE SHOWN~~)



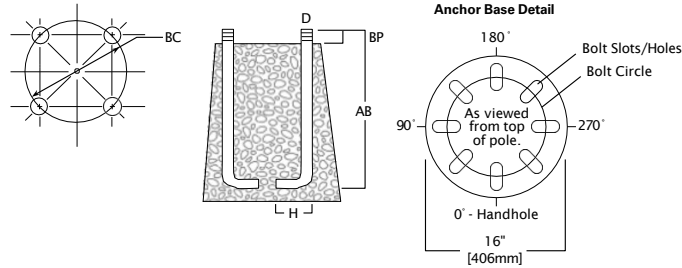
Cooper Lighting Solutions
1121 Highway 74 South
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OL7

ANCHORAGE DATA



Pole	Anchor Bolt and Template Package	Shaft Diameter (inches)	Bolt Circle (inches)	Number of Bolts	Bolt Size (inches)	Template Only
Aluminum Round Decorative Pole (ARP)	317AVE30	4 x 5	9	4	3/4 x 17	407040D

Effective Projected Area (At Pole Top)

Mounting Height (Feet)	Catalog Number	Wall Thickness (Inches)	Bolt Circle Diameter (Inches)	Anchor Bolt Projection (Inches)	Shaft Taper (Inches)	Anchor Bolt Diameter x Length x Hook (Inches)	Net Weight (Pounds)	Maximum Effective Projected Area (Square Feet) (1.3 gust factor)			Max. Load (Pounds)
								80 mph	90 mph	100 mph	
MH			BC	BP	B	AB ¹		80 mph	90 mph	100 mph	
10	ARPSL310A	0.156	9.0	3.5	5 x 3	3/4 x 17 x 3	57	20.0	17.5	14.1	120
10	ARPSL610A	0.156	9.0	3.5	5 X4	3/4 x 17 x 3	57	17.0	13.3	10.7	120
12	ARPSL312A	0.156	9.0	3.5	5 x 3	3/4 x 17 x 3	62	18.2	14.1	11.2	120
12	ARPSL612A	0.156	9.0	3.5	5 X4	3/4 x 17 x 3	62	14.1	10.9	8.7	120
14	ARPSL314A	0.156	9.0	3.5	5 x 3	3/4 x 17 x 3	67	14.8	11.4	9.0	120
14	ARPSL614A	0.156	9.0	3.5	5 X4	3/4 x 17 x 3	67	11.7	9.0	7.1	120
16	ARPSL316A	0.156	9.0	3.5	5 x 3	3/4 x 17 x 3	72	12.0	9.1	7.0	120
16	ARPSL616A	0.156	9.0	3.5	5 X4	3/4 x 17 x 3	72	9.4	7.1	5.6	120
18	ARPSL318A	0.156	9.0	3.5	5 x 3	3/4 x 17 x 3	77	9.5	7.1	5.4	120
18	ARPSL618A	0.156	9.0	3.5	5 X4	3/4 x 17 x 3	77	7.6	5.6	4.3	120
18	ARPSM618A	0.188	9.0	3.5	5 X4	3/4 x 17 x 3	83	9.5	7.1	5.6	120

Effective Projected Area (18" Above Pole Top)

Mounting Height (Feet)	Catalog Number	Wall Thickness (Inches)	Bolt Circle Diameter (Inches)	Anchor Bolt Projection (Inches)	Shaft Taper (Inches)	Anchor Bolt Diameter x Length x Hook (Inches)	Net Weight (Pounds)	Maximum Effective Projected Area (Square Feet) (1.3 gust factor)			Max. Load (Pounds)
								80 mph	90 mph	100 mph	
MH			BC	BP	B	AB ¹		80 mph	90 mph	100 mph	
10	ARPSL310A	0.156	9.0	3.5	5 x 3	3/4 x 17 x 3	57	19.6	15.3	12.3	120
10	ARPSL610A	0.156	9.0	3.5	5 X4	3/4 x 17 x 3	57	17.0	13.3	10.7	120
12	ARPSL312A	0.156	9.0	3.5	5 x 3	3/4 x 17 x 3	62	16.1	12.5	9.9	120
12	ARPSL612A	0.156	9.0	3.5	5 X4	3/4 x 17 x 3	62	14.1	10.9	8.7	120
14	ARPSL314A	0.156	9.0	3.5	5 x 3	3/4 x 17 x 3	67	13.2	10.1	8.0	120
14	ARPSL614A	0.156	9.0	3.5	5 X4	3/4 x 17 x 3	67	11.7	9.0	7.1	120
16	ARPSL316A	0.156	9.0	3.5	5 x 3	3/4 x 17 x 3	72	10.6	8.0	6.2	120
16	ARPSL616A	0.156	9.0	3.5	5 X4	3/4 x 17 x 3	72	9.4	7.1	5.6	120
18	ARPSL318A	0.156	9.0	3.5	5 x 3	3/4 x 17 x 3	77	8.5	6.4	4.8	120
18	ARPSL618A	0.156	9.0	3.5	5 X4	3/4 x 17 x 3	77	7.6	5.6	4.3	120
18	ARPSM618A	0.188	9.0	3.5	5 X4	3/4 x 17 x 3	83	9.5	7.1	5.6	120



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CONTROL OPTIONS

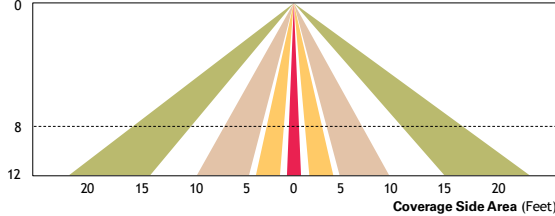
0-10V (D) The dimming option provides 0-10V dimming wire leads for use with a lighting control panel or other control method.

Photocontrol (PER and PER7) Photocontrol receptacles provide a flexible solution to enable "dusk-to-dawn" lighting by sensing light levels. Advanced control systems compatible with NEMA 7-pin standards can be utilized with the PER7 receptacle.

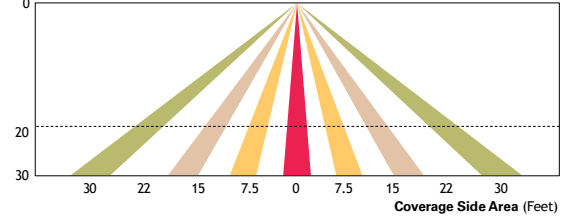
Dimming Occupancy Sensor (MS) These sensors are factory installed in the luminaire housing. When a sensor for dimming operation (/DIM) option is selected, the luminaire will dim down to approximately 50 percent power after five minutes of no activity detected. When activity is detected, the luminaire returns to full light output. When a sensor for ON/OFF operation is selected, the luminaire will turn off after five minutes of no activity.

These occupancy sensors include an integral photocell that can be activated or inactivated with the programming remote /configuration tool for "dusk-to-dawn" control or "daylight harvesting". Note: For MS sensors, the factory preset is OFF (Disabled). The programming remote /tool is a wireless tool that can be utilized to change the dimming level, time delay, sensitivity and other parameters. A variety of sensor lenses are available to optimize the coverage pattern for mounting heights from 8'-40'.

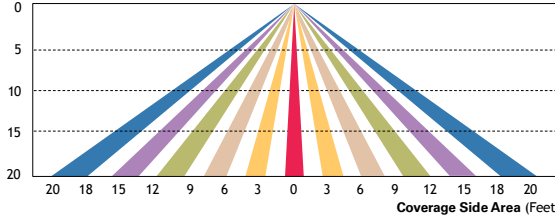
For mounting heights from 8' to 12' (-L12)



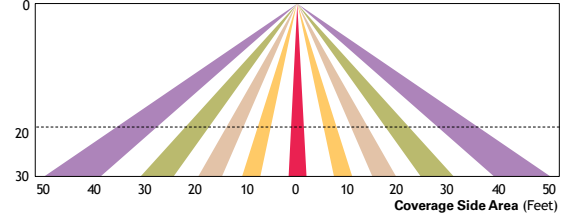
For mounting heights from 12' to 30' (-L30)



For mounting heights from 9' to 20' (-L20)



For mounting heights from 21' to 40' (-L40W)

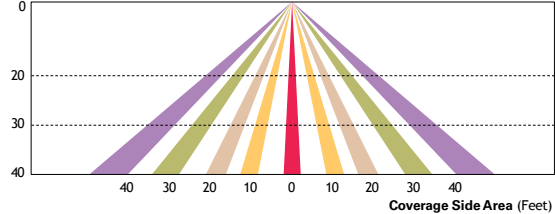


WaveLinx Wireless Control and Monitoring System Available in 7-PIN or 4-PIN configurations, the WaveLinx Outdoor control platform operates on a wireless mesh network based on IEEE 802.15.4 standards enabling wireless control of outdoor lighting. Use the WaveLinx Mobile application for set-up and configuration. At least one Wireless Area Controller (WAC) is required for full functionality and remote communication (including adjustment of any factory pre-sets).

WaveLinx Outdoor Control Module (WOLC-7P-10A) A photocontrol that enables astronomical or time-based schedules to provide ON, OFF and dimming control of fixtures utilizing a 7-PIN receptacle. The out-of-box functionality is ON at dusk and OFF at dawn.

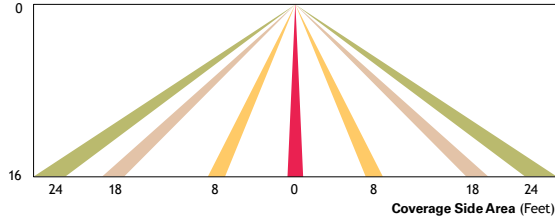
WaveLinx PRO Wireless Sensor (WPS2 and WPS4) These outdoor sensors offer passive infrared (PIR) occupancy and a photocell for closed loop daylight sensing. These sensors are factory preset to dim down to approximately 50 percent power after 15 minutes of no activity detected. These occupancy sensors include an integral photocell for "dusk-to-dawn" control or daylight harvesting that is factory-enabled. A variety of sensor lenses are available to optimize the coverage pattern for mounting heights from 7'-40'.

For mounting heights from 16' to 40' (WPS)

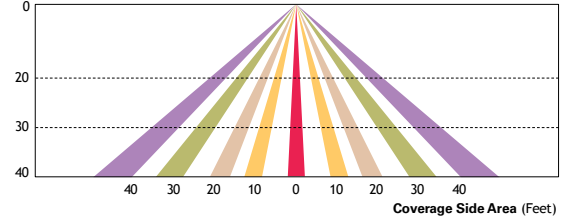


Enlighted Wireless Control and Monitoring System (LWR-LW and LWR-LN) Enlighted is a connected lighting solution that combines LED luminaires with an integrated wireless sensor system. The sensor controls the lighting system in compliance with the latest energy codes and collects valuable data about building performance and use. Software applications turn the granular data into information through energy dashboards and specialized apps that make it simple and help optimize the use of other resources beyond lighting.

For mounting heights from 8' to 16' (LWR-LW)



For mounting heights from 16' to 40' (LWR-LN)



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www.cooperlighting.com

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Invue

DESCRIPTION

The LuxeScope Collection presents a contemporary, architectural dayform providing superior uniformity and efficient illumination. Designed to enhance urban spaces with beautiful visual appearances and integral control solutions, LuxeScope integrates into any environment while providing high visibility by utilizing industry-leading WaveStream™ LED optics.

Other Manufacturers:
KIM "UR20 EDGE-LIT" Series
LITHONIA "RADEAN ARM MOUNT" Series

Catalog #		Type	
Project		OL8	
Comments		Date	
Prepared by			

SPECIFICATION FEATURES

Construction

Housing assembly is IP66 rated and cast from low copper content corrosion resistant aluminum, maintaining strength and precision to sustain long term dayform appearance. 3G rated construction avoids damages from installation generated vibration. Corrosion-resistant color matching hardware are minimized to enhance appearance.

Optics

Designed for complex site or pedestrian applications, WaveStream™ LED optical waveguide technology produces both symmetric NEMA Type V and asymmetric NEMA II, III, IV distributions. The waveguide is manufactured from precision injection molded acrylic delivering visual comfort and optically controlled illumination for improved glare control. Luminaire efficacy measures in excess of 100 lm/W for 4000K (+/- 275K) CCT at 70 CRI (min). Optional 3000K CCT at 70 CRI or 3000K CCT at 80 CRI also available.

Electrical

LED drivers are uniquely positioned and mounted for

maximum thermal performance and extended life. Standard 0-10V dimming drivers and surge protection module are designed to withstand 10kV of transient line surge. Drivers operate at 120-277V 50/60Hz with 347V 60Hz or 480V 60Hz operation optional. Suitable for ambient temperature applications as low as -40°C (40°F) to 40°C (104°F). High ambient options available allow for 50°C operation.

Controls

Control options are designed to be simple, cost-effective, energy code, and regulation compliant solutions featuring WaveLinX. See control options page for more details.

Mounting

Invue's aluminum round decorative pole (ARP) offering provides a seamless transition and complements the contemporary design architecture with its unique sleek taper and base design. The tenon mount pole comes standard with an access door feature integrated into the base.

Arm Mount

The integrated aluminum contemporary upsweep arm is bolted directly to the pole using

an "N" drill pattern. Provides a seamless transition to a 4" or 5" round pole.

Spider & Cantilever Mount

Fitter assembly mounts over 3" O.D. tenon and can be adapted to a 2-3/8" tenon. It is secured via concealed, corrosion resistant set screw and jam screw pairs in six inconspicuous locations. Fitter design provides seamless transition to 4" O.D. round pole top. Optional mounting accessories include a twin arm mount and wall mount arm.

Finish

Cooper Lighting Solutions utilizes premium ultra-weatherable TGIC based polyester powder coatings specifically formulated to withstand extended outdoor exposure while providing decorative appeal. Finish is compliant to 3,000 hour salt spray standard (per ASTM B117). RAL and custom color matches available. Options to meet Buy American Act requirements.

Warranty

Five year limited warranty, consult website for details.
www.cooperlighting.com/legal



LXS LUXESCAPE COLLECTION

DECORATIVE LUMINAIRE

CERTIFICATION DATA

UL/cUL Listed
FCC Class A
IEC 60529 IP66 Housing
ANSI C136.31 3G Vibration
ASTM A356.0 Low Copper Alloy
ASTM B117 Salt Spray Tested
RoHS
ISO 9001
DesignLights Consortium* Qualified*
Dark Sky Approved (3000K CCT and warmer only)

ENERGY DATA

Electronic LED Driver
>0.9 Power Factor
<20% Total Harmonic Distortion
120-277V 50/60Hz, 347V 60Hz, 480V 60Hz
40°C Ambient Temperature Rating
As low as -40°C (-40°F) minimum temperature
*See MINIMUMTEMPERATURE table

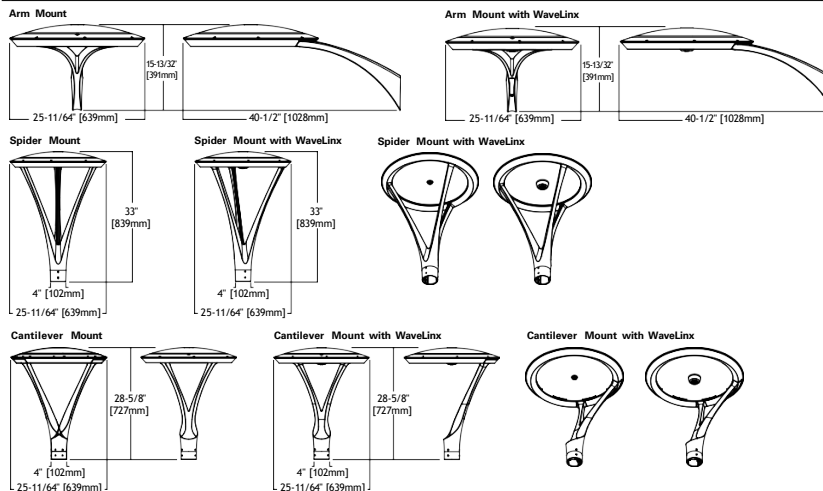
EPA

Effective Projected Area: (Sq. Ft.)
Arm Mount: 1.0
Cantilever Mount: 1.3
Spider Mount: 1.6

SHIPPING DATA

Approximate Net Weight:
Arm Mount Weight: 41 lbs. [18.6 kgs.]
Cantilever Mount Weight: 46 lbs. [20.8 kgs.]
Spider Mount Weight: 53 lbs. [24 kgs.]

DIMENSIONS



www.designlights.org

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OL8

ORDERING INFORMATION

Sample Number: LXS-VA3-LED-D1-T2-GM-S

Product Family ^{1,2}	Optic Type	Lumen Package ³	CRI/CCT	Voltage	Distribution	Mounting	Finish			
LXS=LuxeScape Collection BAA=LXS=LuxeScape Collection Buy American Act Compliant ²⁴	VA=Visual Comfort / WaveStream	1=Nominal 2,300 Lumens 2=Nominal 4,500 Lumens 3=Nominal 8,500 Lumens 4=Nominal 9,500 Lumens ⁴	730=70 CRI / 3000K 735=70 CRI / 3500K 740=70 CRI / 4000K 830=80 CRI / 3000K 835=80 CRI / 3500K 840=80 CRI / 4000K AMB=Amber 590nm ^{21, 22}	U=120-277 1=120 2=208 3=240 4=277 8=480 ^{5,6} 9=347 ⁵	ASC=Asymmetric Curbline ⁷ ASW=Asymmetric Wide ⁸ AST=Asymmetric Transverse ⁹ SYM=Symmetric Round ¹⁰	A=Arm Mount S=Spider Mount C=Cantilever Mount	AP=Grey BK=Black BZ=Bronze DP=Dark Platinum GM=Graphite Metallic WH=White RALXX=Custom Color ¹¹			
Options (Add as Suffix)					Accessories (Order Separately) ^{19, 20}					
F=Single Fuse ¹² FF=Double Fuse ¹³ X=Driver Surge only 10MSP=10K MOV Surge Protective Device 20MSP=20kV MOV Surge Protective Device 20K=20kV UL 1449 Fused Surge Protective Device DIM=External 0-10V Dimming Leads ¹⁴ HA=50°C High Ambient Temperature ¹⁵ VS=Vandal Shield ¹⁶ CC=Coastal Construction ¹⁷ DALI=DALI Driver ¹⁸ BPC=Button Type Photocontrol ¹⁹ PR=NEMA 3-PIN Twistlock Photocontrol Receptacle ²⁰ PR7=NEMA 7-PIN Twistlock Photocontrol Receptacle ²⁰ PC=Twistlock NEMA Photocontrol LLPC=Long Life Twistlock NEMA Photocontrol ²² SC=Shorting Cap MS-L08=Motion Sensor for ON/OFF Operation, Up to 8' Mounting Height ^{21, 22, 23}					MS-L20=Motion Sensor for ON/OFF Operation, 9' - 20' Mounting Height ^{21, 22, 23} MS-L40W=Motion Sensor for ON/OFF Operation, 21' - 40' Mounting Height ^{21, 22, 23} MS/DIM-L08=Motion Sensor for Dimming Operation, Up to 8' Mounting Height ^{21, 22, 23} MS/DIM-L20=Motion Sensor for Dimming Operation, 9' - 20' Mounting Height ^{21, 22, 23} MS/DIM-L40W=Motion Sensor for Dimming Operation, 21' - 40' Mounting Height ^{21, 22, 23} DIM10=AirMesh Integrated Control Module WLS2WH=WaveLinx LITE, SR Driver, Dimming Motion and Daylight, Bluetooth Programmable, 7' - 15' Mounting WLS4WH=WaveLinx LITE, SR Driver, Dimming Motion and Daylight, Bluetooth Programmable, 15' - 40' Mounting WFS2WH=WaveLinx PRO, SR Driver, Dimming Motion and Daylight, WAC Programmable, 7' - 15' Mounting ^{26,27,28} WFS4WH=WaveLinx PRO, SR Driver, Dimming Motion and Daylight, WAC Programmable, 15' - 40' Mounting ^{26,27,28}			FSIR-100=Wireless Configuration Tool for Occupancy Sensor ²⁸ ARPA2=2-3/8" O.D. Tenon Sleeve Adapter ²⁹ VA6028-XX=Twin Mount Arm (EPA 1.36 sq./ft.) ^{30,31} VA6029-XX=Wall Mount Arm ^{30,31} MA1036-XX=Single Tenon Adapter for 2-3/8" O.D. Tenon ³¹ MA1037-XX=2@180° Tenon Adapter for 2-3/8" O.D. Tenon ³¹ MA1197-XX=3@120° Tenon Adapter for 2-3/8" O.D. Tenon ³¹ MA1188-XX=4@90° Tenon Adapter for 2-3/8" O.D. Tenon ³¹ MA1189-XX=2@90° Tenon Adapter for 2-3/8" O.D. Tenon ³¹ MA1190-XX=3@90° Tenon Adapter for 2-3/8" O.D. Tenon ³¹ MA1191-XX=2@120° Tenon Adapter for 2-3/8" O.D. Tenon ³¹ MA1038-XX=Single Tenon Adapter for 3-1/2" O.D. Tenon ³¹ MA1039-XX=2@180° Tenon Adapter for 3-1/2" O.D. Tenon ³¹ MA1192-XX=3@120° Tenon Adapter for 3-1/2" O.D. Tenon ³¹ MA1183-XX=4@90° Tenon Adapter for 3-1/2" O.D. Tenon ³¹ MA1194-XX=2@90° Tenon Adapter for 3-1/2" O.D. Tenon ³¹ MA1195-XX=3@90° Tenon Adapter for 3-1/2" O.D. Tenon ³¹ WOLC-7P-10A=WaveLinx Outdoor Control Module (7-PIN) ²⁹ TL7-HVG=AirMesh 7-PIN node, 110-480V ²⁹		

ARCHITECT TO SELECT FINISH

NOTES:

1. Customer is responsible for engineering analysis to confirm pole and fixture compatibility for all applications. Refer to our white paper WP513001EN for additional support information. 2. DesignLights Consortium® Qualified. Refer to www.designlights.org Qualified Products List under Family Models for details. 3. Lumens are nominal. See lumen table for more information. 4. 9,500 Lumen package available only on SYM distribution. 5. Requires the use of a step-down transformer. 6. Only for use with 480V Wye systems. Per NEC, not for use with ungrounded systems, impedance grounded systems or corner grounded systems (commonly known as Three Phase Three Wire Delta, Three Phase High Leg Delta and Three Phase Corner Grounded Delta systems). 7. IESNA Type III typical. 8. IESNA Type IV typical. 9. IESNA Type IV typical. 10. IESNA Type IV typical. 11. Specify RAL number for Custom Color. Custom color matching available upon request. Consult your lighting representative at Cooper Lighting Solutions for more information. 12. Must specify voltage (120V, 277V, or 347V) to fuse the single hot leg. 13. Must specify voltage (208V, 240V, or 480V) to fuse the both hot legs. 14. Low voltage control leads brought out 18" outside fixture. Not available with control options. 15. Not available in VA3 with Type ASC, ASW and AST distributions. 16. Reduce total lumens by a 0.95 multiplier to accommodate losses. 17. Post-coating over the primary finish providing 7,000+ salt spray hours. Extended lead-times can be 4 -10 additional weeks. 18. Only available with VA3 and VA4 lumen packages. 19. Not available with MS-LXX, MS/DIM-LXX, LWR-LW, LWR-LN or 347V or 480V options. 20. Not available with MS-LXX, MS/DIM-LXX, LWR-LW, LWR-LN or 347V or 480V options. 21. Not available with HA option. 22. The FSIR-100 configuration tool is required to adjust parameters including high and low modes, sensitivity, time delay, cutoff and more. Consult your lighting representative at Cooper Lighting Solutions for more information. 23. Approximately 22' detection diameter at 8' mounting height. 24. Approximately 40' detection diameter at 20' mounting height. 25. Approximately 100' detection diameter at 40' mounting height. 26. Cannot be used in conjunction with photocontrol or other controls systems (BPC, PR, PR7, MS). 27. WAC Gateway required to enable field-configurability. Order WAC-POE and WPOE-120 (10V to POE injector) power supply if needed. Only compatible with WaveLinx system and software and requires system components to be installed for operation. See website for more WaveLinx application information. 28. This tool enables adjustment of parameters including high and low modes, sensitivity, time delay, cutoff and more. Consult your lighting representative at Cooper Lighting Solutions for more information. 29. Requires 7-PIN NEMA twistlock photocontrol receptacle. WOLC-7P-10A cannot be used in conjunction with additional sensors or controls. 30. Not vibration rated at this time. Consult your lighting representative at Cooper Lighting Solutions for more information. 31. Replace XX with color designation. 32. Requires photocontrol receptacle PR or PR7. 33. Narrow-band 590nm +/- 5nm for wildlife and observatory use. Choose Lumen Package 1. See IES files for photometric performance. 34. Only product configurations with this designated prefix are built to be compliant with the Buy American Act of 1933 (BAA). Please refer to [DEMESTIC-PREFERENCES](http://www.demestic-preferences.com) website for more information. Components shipped separately may be separately analyzed under domestic preference requirements. 35. Accessories sold separately will be separately analyzed under domestic preference requirements. Consult factory for further information. 36. Not available with 5LTD option. 37. Not available with 2300 or 9500 lumen package.

ARP ORDERING INFORMATION (ALUMINUM DECORATIVE POLE)

SAMPLE NUMBER: ARP5L370A822

Product Family	Shaft Size (Inches) ¹	Wall Thickness (Inches)	Pole Top Diameter (Inches)	Mounting Height	Base Type	Finish	Mounting Type	Number and Location of Arms	Options (Add as Suffix)
ARP=Aluminum Round Tapered Decorative BAA-ARP=Aluminum Round Tapered Decorative Buy American Act Compliant ²⁶	5-5"	L=0.156" M=0.188"	3=3" O.D. ² 6=4" O.D. ³			DP=Dark Platinum GM=Graphite Metallic GN=Hartford Green WH=White	Tenon non	X=None	C=Convenience Outlet ⁵ E=CFCI Convenience Outlet ⁵ G=Ground Lug V=Vibration Dampener ⁴

PROVIDE ROUND TAPERED STEEL POLE. POLE SHALL BE MOUNTED ON 6" HIGH CONCRETE SONOTUBE WHEN IN GREEN SPACE. PROVIDE POLE HEIGHT SUCH THAT FIXTURE HEIGHT IS 15'A.F.G.

NOTES: 1 All shaft sizes nominal. 2 Provides 3" O.D. pole top suited for Arbor Post Top. 3 Provides 4" O.D. pole top suited for LuxeScape post tops. 4 Vibration damper recommended over 18 feet add suffix "V" to catalog number. 5 Specify outlet location. Receptacle not included, provision only.



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OL8

POWER AND LUMENS

Lumen Package			VA1	VA2	VA3	VA4	
Drive Current							
Power Wattage (Watts)*			24W	48W	96W	99W	
Input Current (mA) @ 120V			200	400	800	830	
Input Current (mA) @ 277V			90	180	350	360	
Power Wattage (Watts)*			28W	55W	114W	108W	
Input Current (mA) @ 347V			79	161	325	328	
Input Current (mA) @ 480V			58	117	235	237	
CRI/CCT (Nominal)	Mounting	Distribution					
730: 70CRI/3000K	A: Arm	ASC: Asymmetric Curbline	Lumens	1,949	3,740	6,730	--
			Lumens per Watt	81.2	77.9	68.0	--
			BUG Rating	B1-U0-G1	B2-U0-G2	B3-U0-G3	--
			IESNA Type	III	III	III	--
		ASW: Asymmetric Wide	Lumens	2,323	4,458	8,022	--
			Lumens per Watt	96.8	92.9	81.0	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--
			IESNA Type	IV	IV	IV	--
		AST: Asymmetric Transverse	Lumens	2,400	4,607	8,291	--
			Lumens per Watt	100.0	96.0	83.7	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--
			IESNA Type	IV	IV	IV	--
	SYM: Symmetric Round	Lumens	2,485	4,958	9,111	10,571	
		Lumens per Watt	118.3	120.9	105.9	110.1	
		BUG Rating	B2-U0-G1	B3-U0-G2	B3-U0-G2	B4-U0-G3	
		IESNA Type	V	V	V	V	
	S: Spider Mount	ASC: Asymmetric Curbline	Lumens	1,780	3,417	6,148	--
			Lumens per Watt	74.2	71.2	62.1	--
			BUG Rating	B1-U0-G1	B2-U0-G2	B3-U0-G3	--
			IESNA Type	III	III	III	--
		ASW: Asymmetric Wide	Lumens	2,097	4,024	7,242	--
			Lumens per Watt	87.4	83.8	73.2	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G2	--
			IESNA Type	IV	IV	IV	--
AST: Asymmetric Transverse		Lumens	2,198	4,218	7,590	--	
		Lumens per Watt	91.6	87.9	76.7	--	
		BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--	
		IESNA Type	IV	IV	IV	--	
SYM: Symmetric Round	Lumens	2,305	4,600	8,452	9,807		
	Lumens per Watt	109.8	112.2	98.3	102.2		
	BUG Rating	B2-U0-G1	B3-U0-G2	B3-U0-G2	B4-U0-G3		
	IESNA Type	V	V	V	V		



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POWER AND LUMENS

Lumen Package			VA1	VA2	VA3	VA4	
CRI/CCT (Nominal)	Mounting	Distribution					
730: 70CRI/3000K	C: Cantilever Mount	ASC: Asymmetric Curbline	Lumens	1,857	3,564	6,414	--
			Lumens per Watt	77.4	74.3	64.8	--
			BUG Rating	B1-U0-G1	B2-U0-G2	B3-U0-G3	--
			IESNA Type	III	III	III	--
		ASW: Asymmetric Wide	Lumens	2,213	4,248	7,645	--
			Lumens per Watt	92.2	88.5	77.2	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--
			IESNA Type	IV	IV	IV	--
		AST: Asymmetric Transverse	Lumens	2,324	4,460	8,025	--
			Lumens per Watt	96.8	92.9	81.1	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--
			IESNA Type	IV	IV	IV	--
		SYM: Symmetric Round	Lumens	2,342	4,674	8,588	9,965
			Lumens per Watt	111.5	114.0	99.9	103.8
			BUG Rating	B2-U0-G1	B3-U0-G2	B3-U0-G2	B4-U0-G3
			IESNA Type	V	V	V	V
740: 70CRI/4000K	A: Arm	ASC: Asymmetric Curbline	Lumens	2,105	4,040	7,270	--
			Lumens per Watt	87.7	84.2	73.4	--
			BUG Rating	B1-U0-G1	B2-U0-G2	B3-U0-G3	--
			IESNA Type	III	III	III	--
		ASW: Asymmetric Wide	Lumens	2,509	4,816	8,666	--
			Lumens per Watt	104.5	100.3	87.5	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--
			IESNA Type	IV	IV	IV	--
		AST: Asymmetric Transverse	Lumens	2,593	4,977	8,956	--
			Lumens per Watt	108.0	103.7	90.5	--
			BUG Rating	B1-U0-G1	B2-U0-G2	B2-U0-G3	--
			IESNA Type	IV	IV	IV	--
		SYM: Symmetric Round	Lumens	2,684	5,356	9,842	11,420
			Lumens per Watt	127.8	130.6	114.4	119.0
			BUG Rating	B2-U0-G1	B3-U0-G2	B3-U0-G3	B4-U0-G3
			IESNA Type	V	V	V	V



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POWER AND LUMENS

Lumen Package			VA1	VA2	VA3	VA4	
CRI/CCT (Nominal)	Mounting	Distribution					
740: 70CRI/4000K	S: Spider Mount	ASC: Asymmetric Curbline	Lumens	1,923	3,691	6,642	--
			Lumens per Watt	80.1	76.9	67.1	--
			BUG Rating	B1-U0-G1	B2-U0-G2	B3-U0-G3	--
			IESNAType	III	III	III	--
		ASW: Asymmetric Wide	Lumens	2,265	4,347	7,823	--
			Lumens per Watt	94.4	90.6	79.0	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G2	--
			IESNAType	IV	IV	IV	--
		AST: Asymmetric Transverse	Lumens	2,374	4,557	8,200	--
			Lumens per Watt	98.9	94.9	82.8	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--
			IESNAType	IV	IV	IV	--
	SYM: Symmetric Round	Lumens	2,490	4,969	9,131	10,595	
		Lumens per Watt	118.6	121.2	106.2	110.4	
		BUG Rating	B2-U0-G1	B3-U0-G2	B3-U0-G3	B4-U0-G3	
		IESNAType	V	V	V	V	
	C: Cantilever Mount	ASC: Asymmetric Curbline	Lumens	2,006	3,850	6,929	--
			Lumens per Watt	83.6	80.2	70.0	--
			BUG Rating	B1-U0-G1	B2-U0-G2	B3-U0-G3	--
			IESNAType	III	III	III	--
		ASW: Asymmetric Wide	Lumens	2,391	4,589	8,258	--
			Lumens per Watt	99.6	95.6	83.4	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--
			IESNAType	IV	IV	IV	--
AST: Asymmetric Transverse		Lumens	2,510	4,818	8,669	--	
		Lumens per Watt	104.6	100.4	87.6	--	
		BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--	
		IESNAType	IV	IV	IV	--	
SYM: Symmetric Round	Lumens	2,530	5,049	9,277	10,765		
	Lumens per Watt	120.5	123.1	107.9	112.1		
	BUG Rating	B2-U0-G1	B3-U0-G2	B3-U0-G3	B4-U0-G3		
	IESNAType	V	V	V	V		



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POWER AND LUMENS

Lumen Package			VA1	VA2	VA3	VA4	
CRI/CCT (Nominal)	Mounting	Distribution					
830: 80CRI/3000K	A: Arm	ASC: Asymmetric Curbline	Lumens	1,758	3,374	6,072	--
			Lumens per Watt	73.2	70.3	61.3	--
			BUG Rating	B1-U0-G1	B2-U0-G2	B3-U0-G3	--
			IESNAType	III	III	III	--
		ASW: Asymmetric Wide	Lumens	2,096	4,022	7,238	--
			Lumens per Watt	87.3	83.8	73.1	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G2	--
			IESNAType	IV	IV	IV	--
		AST: Asymmetric Transverse	Lumens	2,166	4,157	7,480	--
			Lumens per Watt	90.2	86.6	75.6	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--
			IESNAType	IV	IV	IV	--
	SYM: Symmetric Round	Lumens	2,242	4,473	8,220	9,538	
		Lumens per Watt	106.8	109.1	95.6	99.4	
		BUG Rating	B2-U0-G1	B3-U0-G2	B3-U0-G2	B3-U0-G2	
		IESNAType	V	V	V	V	
	S: Spider Mount	ASC: Asymmetric Curbline	Lumens	1,606	3,083	5,547	--
			Lumens per Watt	66.9	64.2	56.0	--
			BUG Rating	B1-U0-G1	B2-U0-G2	B3-U0-G3	--
			IESNAType	III	III	III	--
ASW: Asymmetric Wide		Lumens	1,892	3,631	6,534	--	
		Lumens per Watt	78.8	75.6	66.0	--	
		BUG Rating	B1-U0-G1	B1-U0-G1	B2-U0-G2	--	
		IESNAType	IV	IV	IV	--	
AST: Asymmetric Transverse		Lumens	1,983	3,806	6,848	--	
		Lumens per Watt	82.6	79.3	69.2	--	
		BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--	
		IESNAType	IV	IV	IV	--	
SYM: Symmetric Round		Lumens	2,080	4,150	7,626	8,849	
		Lumens per Watt	99.0	101.2	88.7	92.2	
		BUG Rating	B2-U0-G1	B3-U0-G2	B3-U0-G2	B3-U0-G3	
		IESNAType	V	V	V	V	



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POWER AND LUMENS

Lumen Package			VA1	VA2	VA3	VA4	
CRI/CCT (Nominal)	Mounting	Distribution					
830: 80CRI/3000K	C: Cantilever Mount	ASC: Asymmetric Curbline	Lumens	1,675	3,216	5,787	--
			Lumens per Watt	69.8	67.0	58.5	--
			BUG Rating	B1-U0-G1	B2-U0-G2	B3-U0-G3	--
			IESNA Type	III	III	III	--
		ASW: Asymmetric Wide	Lumens	1,997	3,833	6,897	--
			Lumens per Watt	83.2	79.9	69.7	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G2	--
			IESNA Type	IV	IV	IV	--
		AST: Asymmetric Transverse	Lumens	2,096	4,024	7,241	--
			Lumens per Watt	87.3	83.8	73.1	--
			BUG Rating	B1-U0-G1	B1-U0-G2	B2-U0-G3	--
			IESNA Type	IV	IV	IV	--
		SYM: Symmetric Round	Lumens	2,113	4,217	7,748	8,991
			Lumens per Watt	100.6	102.9	90.1	93.7
			BUG Rating	B2-U0-G1	B3-U0-G2	B3-U0-G2	B3-U0-G3
			IESNA Type	V	V	V	V

LUMEN MULTIPLIER

Ambient Temperature	Lumen Multiplier
0°C	1.02
10°C	1.01
25°C	1.00
40°C	0.99
50°C	0.97

MINIMUM AMBIENT TEMPERATURE

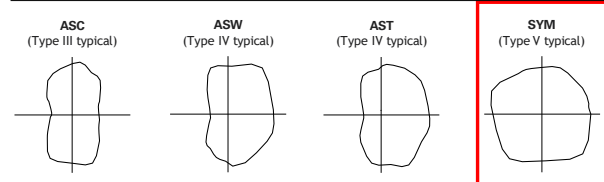
Lumen Package	Temperature
VA1	-40°C
VA2	-35°C
VA3	-35°C
VA4	-40°C
All DALI powered lumen packages	-20°C

LUMEN MAINTENANCE (TM-21)

Ambient Temperature	25,000 hours*	50,000 hours*	60,000 hours*	100,000 hours**	Theoretical L70 (Hours)**
25°C	94.4%	90.4%	89.0%	83.0%	>199,000
40°C	94.6%	90.9%	89.4%	83.9%	>212,000
50°C	91.8%	87.0%	85.2%	78.2%	>151,000

NOTES:
 * Supported by IESTM-21 standards
 ** Theoretical values represent estimations commonly used; however, refer to the IES position on LED Product Lifetime Prediction, IES PS-10-18, that explains proper use of IESTM-21 and LM-80.

OPTICAL DISTRIBUTIONS (Arm mount shown, distribution dependent on mounting)



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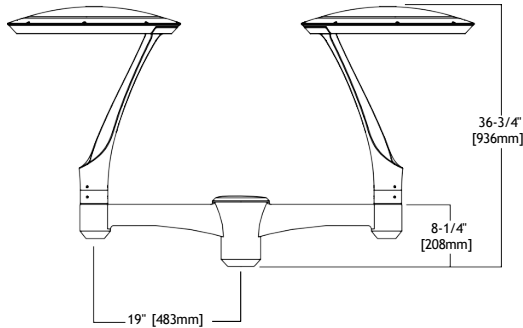
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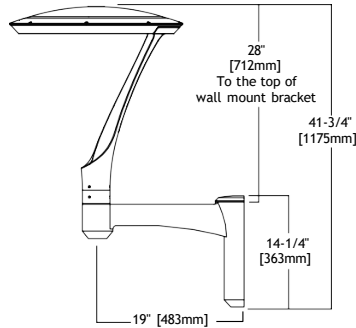
MOUNTING CONFIGURATIONS (EPAS INCLUDES FIXTURE)

MOUNTING REQUIREMENTS OL8

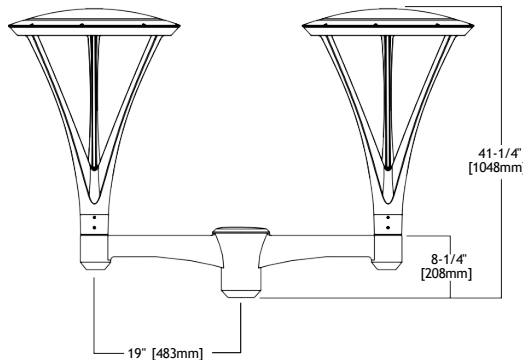
Twin mount arm (shown with Cantilever mount)



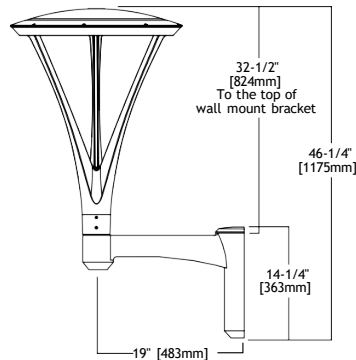
Wall mount arm (shown with Cantilever mount)



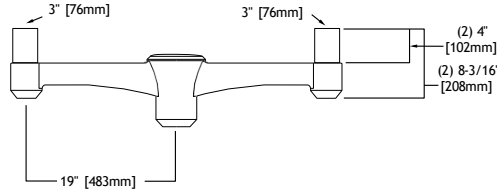
Twin mount arm (shown with Spider mount)



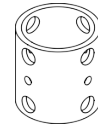
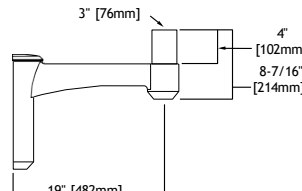
Wall mount arm (shown with Spider mount)



Twin mount arm (EPA 1.36)



Wall Mount Arm

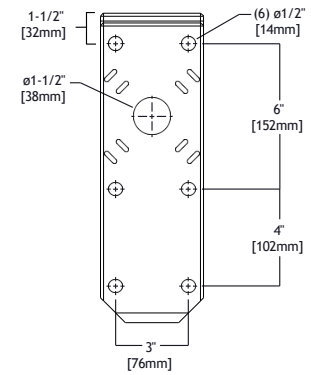


ARP2*

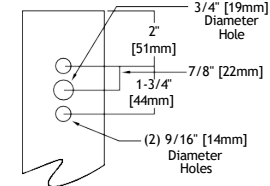
Pole Top O.D. (Inches)	4"	
Tenon O.D. (Inches)	2-3/8" Tenon	3" Tenon
Post Top	ARPA2*	Standard
Twin Mount Arm	ARPA2*	Standard

* Required for stability. Order separately.

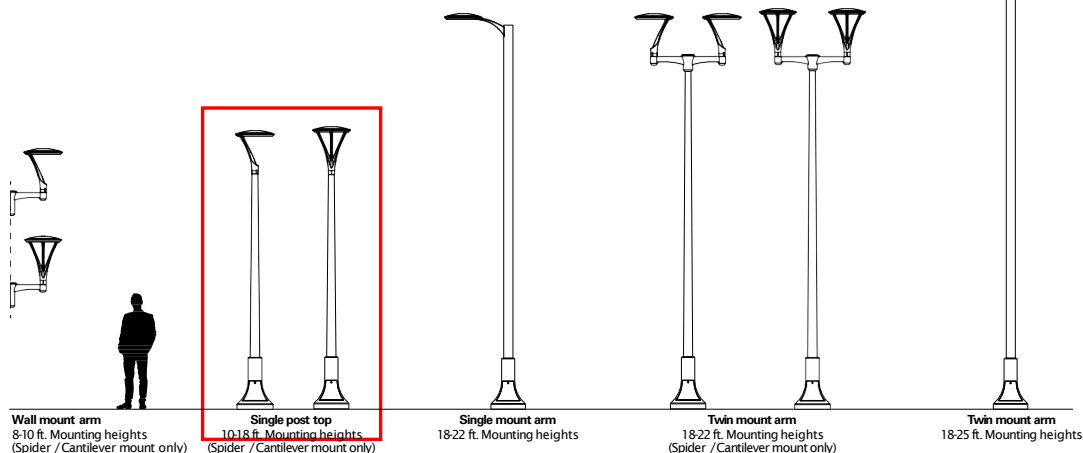
WALL MOUNT ARM DRILL PATTERN



TYPE "N"



POLE CONFIGURATIONS (ARP DECORATIVE POLE SHOWN)



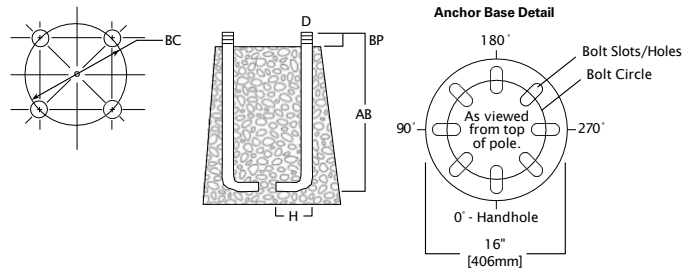
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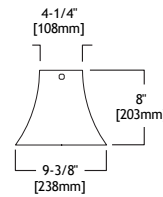
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ANCHORAGE DATA



ACCESS DOOR



Pole	Anchor Bolt and Template Package	Shaft Diameter (inches)	Bolt Circle (inches)	Number of Bolts	Bolt Size (inches)	Template Only
Aluminum Round Decorative Pole (ARP)	317AVE30	4 x 5	9	4	3/4 x 17	407040D

Effective Projected Area (At Pole Top)

Mounting Height (Feet)	Catalog Number	Wall Thickness (Inches)	Bolt Circle Diameter (Inches)	Anchor Bolt Projection (Inches)	Shaft Taper (Inches)	Anchor Bolt Diameter x Length x Hook (Inches)	Net Weight (Pounds)	Maximum Effective Projected Area (Square Feet) (1.3 gust factor)			Max. Load (Pounds)
								80 mph	90 mph	100 mph	
MH			BC	BP	B	AB ¹		80 mph	90 mph	100 mph	
10	ARPSL310A	0.156	9.0	3.5	5 x 3	3/4 x 17 x 3	57	20.0	17.5	14.1	120
10	ARPSL610A	0.156	9.0	3.5	5 X4	3/4 x 17 x 3	57	17.0	13.3	10.7	120
12	ARPSL312A	0.156	9.0	3.5	5 x 3	3/4 x 17 x 3	62	18.2	14.1	11.2	120
12	ARPSL612A	0.156	9.0	3.5	5 X4	3/4 x 17 x 3	62	14.1	10.9	8.7	120
14	ARPSL314A	0.156	9.0	3.5	5 x 3	3/4 x 17 x 3	67	14.8	11.4	9.0	120
14	ARPSL614A	0.156	9.0	3.5	5 X4	3/4 x 17 x 3	67	11.7	9.0	7.1	120
16	ARPSL316A	0.156	9.0	3.5	5 x 3	3/4 x 17 x 3	72	12.0	9.1	7.0	120
16	ARPSL616A	0.156	9.0	3.5	5 X4	3/4 x 17 x 3	72	9.4	7.1	5.6	120
18	ARPSL318A	0.156	9.0	3.5	5 x 3	3/4 x 17 x 3	77	9.5	7.1	5.4	120
18	ARPSL618A	0.156	9.0	3.5	5 X4	3/4 x 17 x 3	77	7.6	5.6	4.3	120
18	ARPSM618A	0.188	9.0	3.5	5 X4	3/4 x 17 x 3	83	9.5	7.1	5.6	120

Effective Projected Area (18" Above Pole Top)

Mounting Height (Feet)	Catalog Number	Wall Thickness (Inches)	Bolt Circle Diameter (Inches)	Anchor Bolt Projection (Inches)	Shaft Taper (Inches)	Anchor Bolt Diameter x Length x Hook (Inches)	Net Weight (Pounds)	Maximum Effective Projected Area (Square Feet) (1.3 gust factor)			Max. Load (Pounds)
								80 mph	90 mph	100 mph	
MH			BC	BP	B	AB ¹		80 mph	90 mph	100 mph	
10	ARPSL310A	0.156	9.0	3.5	5 x 3	3/4 x 17 x 3	57	19.6	15.3	12.3	120
10	ARPSL610A	0.156	9.0	3.5	5 X4	3/4 x 17 x 3	57	17.0	13.3	10.7	120
12	ARPSL312A	0.156	9.0	3.5	5 x 3	3/4 x 17 x 3	62	16.1	12.5	9.9	120
12	ARPSL612A	0.156	9.0	3.5	5 X4	3/4 x 17 x 3	62	14.1	10.9	8.7	120
14	ARPSL314A	0.156	9.0	3.5	5 x 3	3/4 x 17 x 3	67	13.2	10.1	8.0	120
14	ARPSL614A	0.156	9.0	3.5	5 X4	3/4 x 17 x 3	67	11.7	9.0	7.1	120
16	ARPSL316A	0.156	9.0	3.5	5 x 3	3/4 x 17 x 3	72	10.6	8.0	6.2	120
16	ARPSL616A	0.156	9.0	3.5	5 X4	3/4 x 17 x 3	72	9.4	7.1	5.6	120
18	ARPSL318A	0.156	9.0	3.5	5 x 3	3/4 x 17 x 3	77	8.5	6.4	4.8	120
18	ARPSL618A	0.156	9.0	3.5	5 X4	3/4 x 17 x 3	77	7.6	5.6	4.3	120
18	ARPSM618A	0.188	9.0	3.5	5 X4	3/4 x 17 x 3	83	9.5	7.1	5.6	120



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1121 Highway 74 South
Peachtree City, GA 30269
P: 770-486-4800
www.cooperlighting.com

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CONTROL OPTIONS

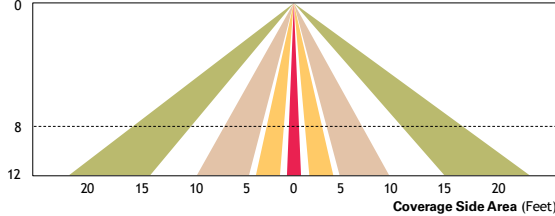
0-10V (D) The dimming option provides 0-10V dimming wire leads for use with a lighting control panel or other control method.

Photocontrol (PER and PER7) Photocontrol receptacles provide a flexible solution to enable "dusk-to-dawn" lighting by sensing light levels. Advanced control systems compatible with NEMA 7-pin standards can be utilized with the PER7 receptacle.

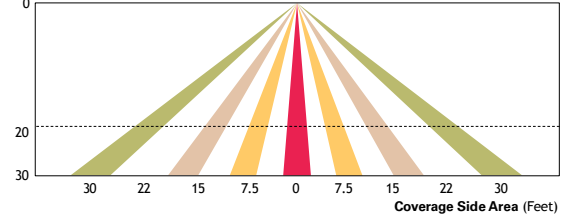
Dimming Occupancy Sensor (MS) These sensors are factory installed in the luminaire housing. When a sensor for dimming operation (/DIM) option is selected, the luminaire will dim down to approximately 50 percent power after five minutes of no activity detected. When activity is detected, the luminaire returns to full light output. When a sensor for ON/OFF operation is selected, the luminaire will turn off after five minutes of no activity.

These occupancy sensors include an integral photocell that can be activated or inactivated with the programming remote /configuration tool for "dusk-to-dawn" control or "daylight harvesting". Note: For MS sensors, the factory preset is OFF (Disabled). The programming remote /tool is a wireless tool that can be utilized to change the dimming level, time delay, sensitivity and other parameters. A variety of sensor lenses are available to optimize the coverage pattern for mounting heights from 8'-40'.

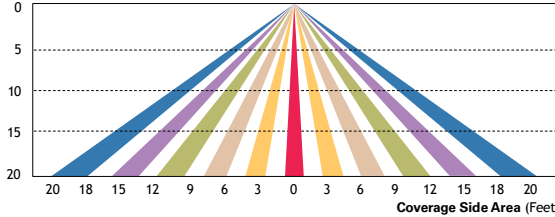
For mounting heights from 8' to 12' (-L12)



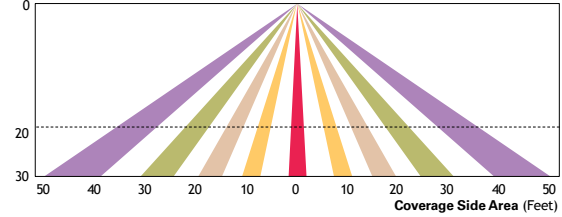
For mounting heights from 12' to 30' (-L30)



For mounting heights from 9' to 20' (-L20)



For mounting heights from 21' to 40' (-L40W)

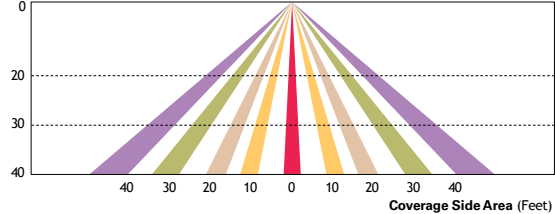


WaveLinx Wireless Control and Monitoring System Available in 7-PIN or 4-PIN configurations, the WaveLinx Outdoor control platform operates on a wireless mesh network based on IEEE 802.15.4 standards enabling wireless control of outdoor lighting. Use the WaveLinx Mobile application for set-up and configuration. At least one Wireless Area Controller (WAC) is required for full functionality and remote communication (including adjustment of any factory pre-sets).

WaveLinx Outdoor Control Module (WOLC-7P-10A) A photocontrol that enables astronomical or time-based schedules to provide ON, OFF and dimming control of fixtures utilizing a 7-PIN receptacle. The out-of-box functionality is ON at dusk and OFF at dawn.

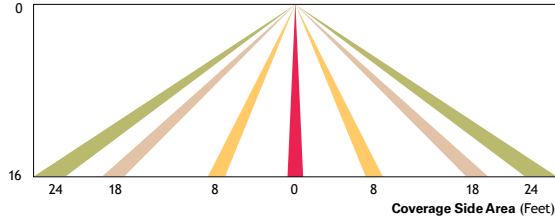
WaveLinx PRO Wireless Sensor (WPS2 and WPS4) These outdoor sensors offer passive infrared (PIR) occupancy and a photocell for closed loop daylight sensing. These sensors are factory preset to dim down to approximately 50 percent power after 15 minutes of no activity detected. These occupancy sensors include an integral photocell for "dusk-to-dawn" control or daylight harvesting that is factory-enabled. A variety of sensor lenses are available to optimize the coverage pattern for mounting heights from 7'-40'.

For mounting heights from 16' to 40' (WPS)

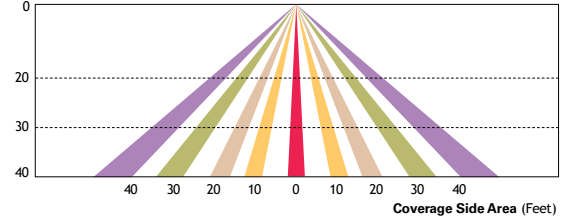


Enlighted Wireless Control and Monitoring System (LWR-LW and LWR-LN) Enlighted is a connected lighting solution that combines LED luminaires with an integrated wireless sensor system. The sensor controls the lighting system in compliance with the latest energy codes and collects valuable data about building performance and use. Software applications turn the granular data into information through energy dashboards and specialized apps that make it simple and help optimize the use of other resources beyond lighting.

For mounting heights from 8' to 16' (LWR-LW)



For mounting heights from 16' to 40' (LWR-LN)



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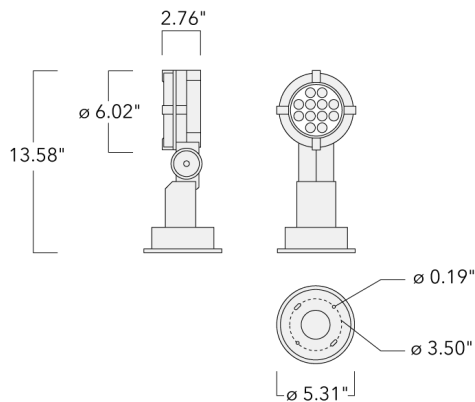
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Other Manufacturers:
INSIGHT "PROSPOT 6" Series
HYDREL "SAF7" Series



Description

IP66. Class I. IK07. Marine-grade, die-cast aluminum alloy. 5CE superior corrosion protection including PCS hardware. Silicone CCG® Controlled Compression Gasket. Safety glass lens. CAD-optimized optics for superior illumination and glare control. Integral driver in thermally separated compartment. OLC® One LED Concept. Factory-installed LED circuit board. 0-10V Dimming comes standard with luminaire. Luminaire is factory-sealed and does not need to be opened during installation.

Specify product with 7 Digit product code - Finish Color. Accessories, such as mounting, optical, and electrical, must be specified separately.

Example: XXX-XXXX-9004 (Black).
+ XXX-XXXX (Accessory 1)

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Specifications

Material description

Body	Marine-grade, die-cast aluminium alloy
Lens	Safety glass lens
Colors	 RAL9004 Black  RAL9007 Grey Metallic  RAL9016 White  RAL8019 Dark Bronze
Gasket	Silicone rubber gasket
Fasteners	PCS polymer coated stainless steel
Ingress protection	IP66
Impact resistance	IK07
Corrosion resistance	5CE
Windage	0.041 m ²

FINISH TO BE
SELECTED BY
ARCHITECT

Electrical description

Power supply	Integral [ECG] electronic driver 120V-277V. 0-10V dimmable, to be specified with order.
Driver / Ballast	Integral EC electronic converter in thermally-separated compartment.

Additional information

Lifetime	Ta=25°/40° L90B10 > 90000h
Listings	ETL, UL-1598, CSA-C22.2#250.0. Suitable for Wet Locations.

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Options

Light distribution



symmetric, medium beam [M]



symmetric, very narrow beam, 'sharp cut-off' [VNS]



linear spread, very narrow beam, 'sharp cut-off'



symmetric, wide beam [W]



symmetric, very narrow beam [VN]



linear spread, very narrow beam [VN]



wallwash

Color temperature



3000 K



4000 K



2700 K

3500K

Nominal Watt

3 W

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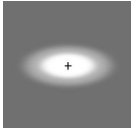




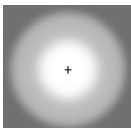
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Configurations

Light distribution	Part ID	Light source	Rated lumens	Rated input power	CRI	Weight (lb)
linear spread, very narrow beam [VN] 	146-0497+146-0418	LED-12/24W / 700 mA - 3000 K	2744.2	27 W	80	5.50
	146-0498+146-0418	LED-12/24W / 700 mA - 4000 K	2933.4	27 W	80	5.50
	146-0951+146-0418	LED-12/24W / 700 mA - 2700 K	2554.9	27 W	80	5.51
linear spread, very narrow beam, 'sharp cut-off' 	146-0402+146-0418	LED-12/24W / 700 mA - 3000 K	2865.9	27 W	80	5.50
	146-0403+146-0418	LED-12/24W / 700 mA - 4000 K	3063.5	27 W	80	5.50
	146-0971+146-0418	LED-12/24W / 700 mA - 2700 K	2668.2	27 W	80	5.51
symmetric, medium beam [M] 	146-0399	LED-12/24W / 700 mA - 3000 K	2998.6	27 W	80	5.50
	146-0400	LED-12/24W / 700 mA - 4000 K	3205.4	27 W	80	5.50
	146-0922	LED-12/24W / 700 mA - 2700 K	2791.8	27 W	80	5.51
symmetric, very narrow beam [VN] 	146-0497	LED-12/24W / 700 mA - 3000 K	2883.7	27 W	80	5.50
	146-0498	LED-12/24W / 700 mA - 4000 K	3082.5	27 W	80	5.50
	146-0951	LED-12/24W / 700 mA - 2700 K	2684.8	27 W	80	5.51
symmetric, very narrow beam, 'sharp cut-off' [VNS] 	146-0402	LED-12/24W / 700 mA - 3000 K	3077.9	27 W	80	5.50
	146-0403	LED-12/24W / 700 mA - 4000 K	3290.2	27 W	80	5.50
	146-0971	LED-12/24W / 700 mA - 2700 K	2865.6	27 W	80	5.51
symmetric, wide beam [W] 	146-0494	LED-12/24W / 700 mA - 3000 K	2709.2	27 W	80	5.50
	146-0495	LED-12/24W / 700 mA - 4000 K	2896	27 W	80	5.50
	146-0796	LED-12/24W / 700 mA - 2700 K	2522.3	27 W	80	5.51
wallwash	146-0399+146-0645	LED-12/24W / 700 mA - 3000 K	2405.6	27 W	80	5.50
	146-0400+146-0645	LED-12/24W / 700 mA - 4000 K	2571.5	27 W	80	5.50
	146-0922+146-0645	LED-12/24W / 700 mA - 2700 K	2239.7	27 W	80	5.51

3500K

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Light distribution	Part ID	Light source	Rated lumens	Rated input power	CRI	Weight (lb)
						

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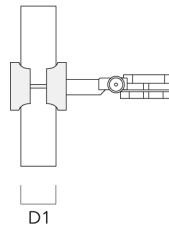
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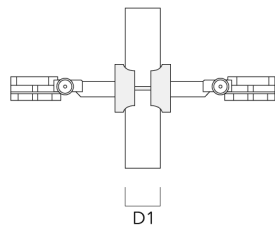
Mounting Accessories

Pipe clamp SP

Description	Part ID	D1	M1	Weight (lb)	D
SP1-2/M8 Pipe clamp, single (Ø 3"-3.5")	146-0246	3-3.5		1.20	76-89



SP2-2/M8 Pipe clamp, double (Ø 1.5"-2.36")	146-0247	1.50"-2.36"	.35	2.20 lbs	38-66
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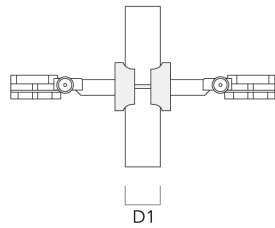
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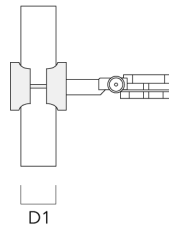
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Description	Part ID	D1	M1	Weight (lb)	D
SP2-2/M8 Pipe clamp, double (Ø 3"-3.5")	146-0248	3.0"-3.5"		2.65 lbs	76-89



SP1-2/M8 Pipe clamp, single (Ø 1.5"-2.36")	146-0245	38-60	1		38-66
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Short post EM

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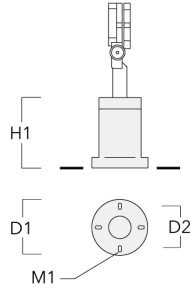
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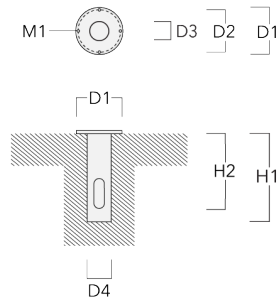
OL9

Description	Part ID	D1	D2	H1	M1	Weight (lb)
EM1-2/M8	146-0253	6.3	5.12	7.87	0.35	3.00



Planted root

Description	Part ID	D1	D2	D3	D4	H1	H2	M1	Weight (lb)
Planted root ESV4	300-0461	5.71	5.12	4.01	4.25	15.75	13.78	.31	15.50



Junction box JB1

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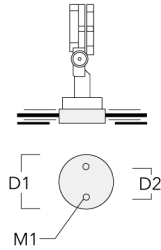
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Description	Part ID	D1	D2	M1	Weight (lb)
JB1 Junction box	310-9000	5.31	2.64	0.35	3.53



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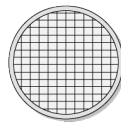
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Optical Accessories

Softening Lens

Description	Part ID	C1
10-360	146-0623	4.33"



Linear spread lens

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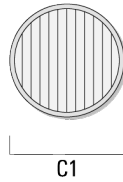
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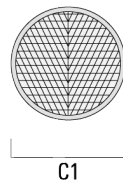
OL9

Description	Part ID	C1
IO-180-FLC131-LED	146-0418	4.30



Wallwash lens

Description	Part ID	C1
IO-20-WW-FLC131-LED	146-0645	4.33



Honeycomb louvre

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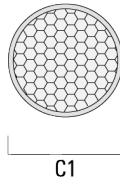
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Description	Part ID	C1
IW-FLC131-LED	146-0625	4.33



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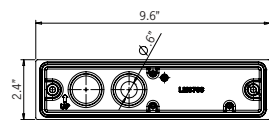
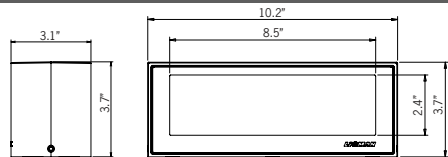
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ULEE-30021

Leeds 6 Large Surface Downlight



20w LED 2422 Lumens • 28w LED 3200 Lumens
IP65 • Suitable For Wet Locations
IK07 • Impact Resistant
Weight 4 lbs

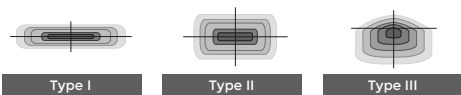


Mounting Detail

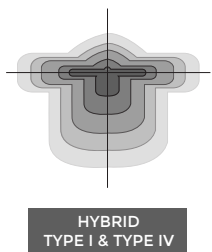
4" junction box cover plate is available as an option



Ligman's micro Variable Optical System provides the ability to interchange, mix & rotate optics to provide specific light distributions for optimized spacing and uniformity.



The variable optic system allows for the designer to create hybrid distributions for precise lighting requirements.



Construction

Aluminum
Less than 0.1% copper content – Marine Grade 6060 extruded & LM6 Aluminum High Pressure die casting provides excellent mechanical strength, clean detailed product lines and excellent heat dissipation.

Pre paint
8 step degrease and phosphate process that includes deoxidizing and etching as well as a zinc and nickel phosphate process before product painting.

Memory Retentive -Silicon Gasket
Provided with special injection molded "fit for purpose" long life high temperature memory retentive silicon gaskets. Maintains the gaskets exact profile and seal over years of use and compression.

Thermal management
LM6 Aluminum is used for its excellent mechanical strength and thermal dissipation properties in low and high ambient temperatures. The superior thermal heat sink design by Ligman used in conjunction with the driver, controls thermals below critical temperature range to ensure maximum luminous flux output, as well as providing long LED service life and ensuring less than 10% lumen depreciation at 50,000 hours.

Surge Suppression
Standard 10kv surge suppressor provided with all fixtures.

BUG Rating
B1 - U0 - G0 [EW, T2, T4]
B1 - U0 - G1 [ME, T3, T1]
B2 - U0 - G0 [M, W]

Finishing
All Ligman products go through an extensive finishing process that includes fettling to improve paint adherence.

Paint
UV Stabilized 4.9Mil thick powder coat paint and baked at 200 Deg C. This process ensures that Ligman products can withstand harsh environments. Rated for use in natatoriums.

Inspired by Nature Finishes
The Inspired by nature Finishing is a unique system of decorative powder coating. Our metal decoration process can easily transform the appearance of metal or aluminum product into a wood grain finish.

This patented technology enables the simulation of wood grain, and even marble or granite finish through the use of decorative powder coating.

The wood grain finish is so realistic that it's almost undistinguishable from real wood, even from a close visual inspection. The system of coating permeates the entire thickness of the coat and as a result, the coating cannot be removed by normal rubbing, chipping, or scratching.

The Coating Process
After pre-treatment the prepared parts are powder coated with a specially formulated polyurethane powder. This powder provides protection against wear, abrasion, impact and corrosion and acts as the relief base color for the finalized metal decoration.

The component is then wrapped with a sheet of non-porous film with the selected decoration pattern printed on it using special high temperature inks.

This printed film transfer is vacuum-sealed to the surface for a complete thermo print and then transferred into a customized oven. The oven transforms the ink into different forms within the paint layer before it becomes solid. Finally, the film is removed, and a vivid timber look on aluminum remains.

Wood grain coating can create beautiful wood-looking products of any sort. There are over 300 combinations of designs currently in use. Wood grains can be made with different colors, designs, etc.

Our powder coatings are certified for indoor and outdoor applications and are backed by a comprehensive warranty. These coatings rise to the highest conceivable standard of performance excellence and design innovation.

- Added Benefits**
- Resistance to salt-acid room, accelerated aging
 - Boiling water, lime and condensed water resistant
 - Anti-Graffiti, Anti-Slip, Anti-Microbial, Anti-Scratch
 - Super durable (UV resistant)
 - TGIC free (non-toxic)

Hardware
Provided Hardware is Marine grade 316 Stainless steel.

Anti Seize Screw Holes
Tapped holes are infused with a special anti seize compound designed to prevent seizure of threaded connections, due to electrolysis from heat, corrosive atmospheres and moisture.

Crystal Clear Low Iron Glass Lens
Provided with tempered, impact resistant crystal clear low iron glass ensuring no green glass tinge.

Optics & LED
Precise optic design provides exceptional light control and precise distribution of light. LED CRI > 80

Lumen - Maintenance Life
L80 /B10 at 50,000 hours (This means that at least 90% of the LED still achieve 80% of their original flux)

Clean, beautiful, surface wall fixtures with class leading performance. Minimalist form, yet the most powerful and flexible lighting tool of its type, offering packages up to 4000 lumens and microVos technology.

A range of small, square and rectangular, ADA compliant wall mounted luminaires with options of upward or downward light distributions. Ideally suited to illuminate the wall and surfaces in front of wall and for light accents on vertical surfaces using high efficiency LED's. The Leeds is suitable for indoor and outdoor applications and provides a clean, visually appealing solution for small, non-obtrusive wall mounted luminaires.

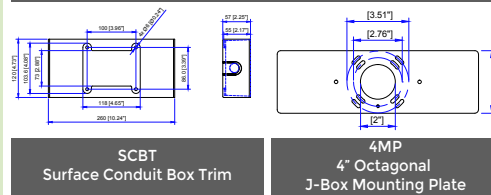
This luminaire is available in 3 different sizes and in combinations of down, up or up/down light distributions.

This fixture utilizes microVos technology, meaning the ability to do Type I,II,III,IV & V distributions as well as hybrid distributions to suit the designer's requirements.

Using the microVos optics allows for very wide spacing to mounting height ratios, while still providing perfect uniformity and code compliant light levels.

To meet International Dark Sky criteria, 3000k or warmer LEDs must be selected and luminaire fix mounted (+/- 15° allowable to permit leveling).

Additional Options (Consult Factory For Pricing)



NOTE: This trim covers a shallow single gang surface mount junction box (Provided by contractor)
Example: Hubbell® - 5322-0 - 1-Gang Weatherproof Box, Five 1/2" in. Threaded Outlets - or - 5332-0 - 1-Gang Weatherproof Box, Five 3/4 in. Threaded Outlets

Ligman Lighting USA reserves the right to change specifications without prior notice, please contact factory for latest information. Due to the continual improvements in LED technology data and components may change without notice.

ULEE-30021

Leeds 6 Large Surface Downlight



OL10



PROJECT				
QUANTITY		TYPE		NOTE

Other Manufacturers:
GARDCO "GEOFORM GBM" Series
PERFORMANCE IN LIGHTING "MIMIK 30" Series
BEGA "B22360" Series

ORDERING EXAMPLE || ULEE - 30021 - 20w - T2 - W30 - 02 - 120/277v - Options

ULEE-30021	LAMP	BEAM	LED COLOR	FINISH COLOR	VOLTAGE
	<p>20w LED 2422 Lumens</p> <p>28w LED 3200 Lumens</p>	<p>T1 - Type I Distribution</p> <p>T2 - Type II Distribution</p> <p>T3 - Type III Distribution</p> <p>T4 - Type IV Distribution</p> <p>ME - Type ME Distribution</p> <p>M - Medium 30"</p> <p>W - Wide 56"</p> <p>EW - Extra Wide 109"x102"</p>	<p>W27 - 2700K</p> <p>W30 - 3000K</p> <p>W35 - 3500K</p> <p>W40 - 4000K</p>	<p>01 - BLACK RAL 9011</p> <p>02 - DARK GREY RAL 7043</p> <p>03 - WHITE RAL 9003</p> <p>04 - METALLIC SILVER RAL 9006</p> <p>05 - MATTE SILVER RAL 9006</p> <p>06 - LIGMAN BRONZE</p> <p>07 - CUSTOM RAL</p>	<p>120v/277v</p> <p>Other - Specify</p>

--	--	--

ADDITIONAL OPTIONS

- NAT - Natatorium Rated
- SCBT - Surface Conduit Box Trim
- F - Frosted Lens**
- DIM - 0-10v Dimming**

- AMB - Turtle Friendly Amber LED
- 4MP - 4" Octagonal J-Box Mounting Plate
- HCL - Honeycomb Louvre

FIXTURE TO BE SPECIFIED WITH DUAL BOARDS / DUAL CIRCUITS

INSPIRED BY NATURE FINISHES

SW01 - OAK FINISH	
SW02 - WALNUT FINISH	
SW03 - PINE FINISH	
DF - DOUGLAS FIR FINISH	
CW - CHERRY WOOD FINISH	
NW - NATIONAL WALNUT FINISH	
SU01 - CONCRETE FINISH	
SU02 - SOFTSCAPE FINISH	
SU03 - STONE FINISH	
SU04 - CORTEN FINISH	

THERE IS AN ADDITIONAL COST FOR THESE FINISHES

FINISH TO BE SELECTED BY ARCHITECT

More Custom Finishes Available Upon Request

Consult factory for pricing and lead times

Oak	Cherry	Beech	Carbon
Walnut	Chestnut	Bamboo	Galvanized
Pine	Mahogany	Birch	Steel



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Leeds Product Family

OL10



Leeds 1 - Up/Down

• ULEE-30031-2x5.5w-2x570lm



Leeds 2 - Down

• ULEE-30001-5.5w-570lm



Leeds 3 - Up/Down

• ULEE-30041-2x14w-2x1660lm



Leeds 4 - Down

• ULEE-30011-14w-1660lm



Leeds 5 - Up/Down

• ULD-30051-2x20w-2x2422lm



Leeds 6 - Down

• ULEE-30021-20w-2422lm

PH 4½-4 PENDANT

Designed by Poul Henningsen

P1

Other Manufacturers:
CAMMAN "CUSTOM" Series
NAL "CUSTOM" Series



Technical specifications

Materials

Shades: Hand blown white opal glass. Suspension: High lustre chrome plated, extruded aluminum.

Finishes

High lustre chrome plated. White opal glass.

Mounting

Canopy: White. Cord type: 3-conductor, 18 AWG black PVC power cord. Cord length: 12'. For mounting instructions, see download section on the product detail page.

Information

Electrical:
System Wattage: 22W
LED Wattage: 20 W
Delivered lumens: 1,367
Efficacy: 62.1 lm/W

Certifications:

cULus, Dry Location
Protection class IP20
Controllability: Phase dimming
Actual performance dependent upon screw-base lamp used. For the E-socket product variants, bulbs are not included. LED light source is part of the product.

[Showroom](#)

louis poulsen

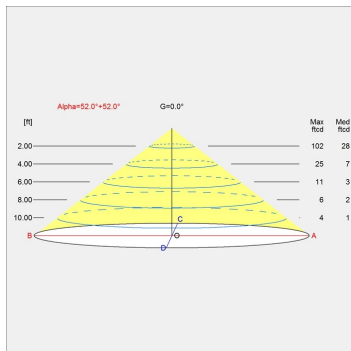
[Light source guide](#)

PH 4½-4 PENDANT

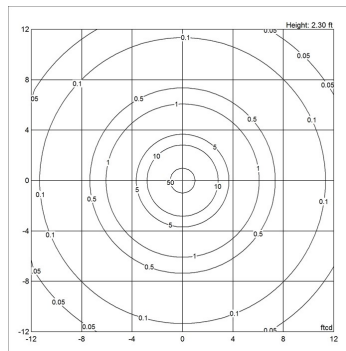
Designed by Poul Henningsen

Light distribution diagrams

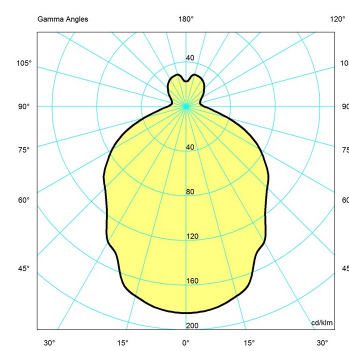
CARTESIAN



ISOLUX



POLAR



Variant Options

For particular variant options, please check our online Product Variants Configurator on the product detail page.

VARIANT NO.	LIGHT SOURCE	VOLTAGE/FRQ	LUMEN	FEATURES	CABLE
5741902381	1x22W A-21/medium	120V	1367	-	Black cord

Variants

VARIANT NUMBER	COLOR, RAL	W / H / L (IN) / W (LB)
5741902381	HIGH LUSTRE CHROME PLATED, 900	17.7 / 16.1 / 17.7 IN / 9.5 LB

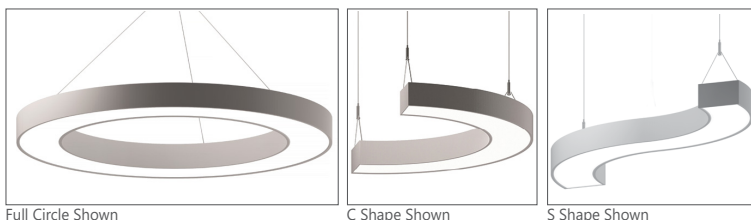
[Showroom](#)

louis pulsen

[Light source guide](#)

Sketch | Pendant

P2



Other Manufacturers:
STARFIRE "CPH4-L" Series
CORONET "LS4 CURVE UPDN" Series
LUMENWERX "CURVIA 4" Series

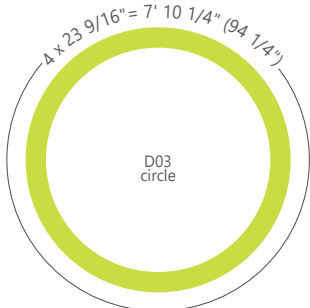
PERFORMANCE AT 3500K

NOMINAL LUMEN OUTPUT	INPUT WATTS*	EFFICACY
1000 lm/ft	10.4 W/ft	96 lm/W

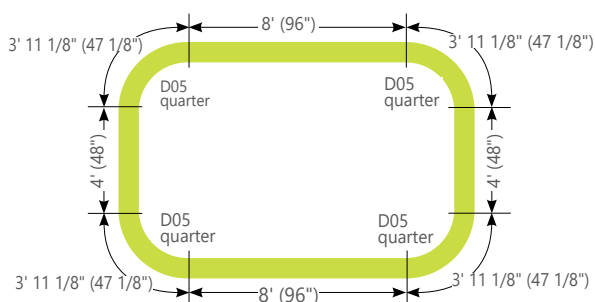
*for a 48" diameter with 60%up/40%down



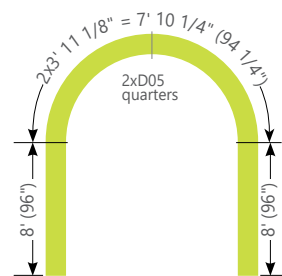
1 Patent pending 1 Drawings are not to scale



SKPE-10003-SL60/40-CIR-AL7' 10 1/4"
Circle Pattern



SKPE-#-SL60/40-REC-AL43' 8 1/4"
Rectangle Pattern



SKPE-#-SL60/40-ASO-AL23' 10 1/4"
Other Shape Pattern

ALL ORDERS MUST BE SUBMITTED WITH DRAWINGS INDICATING DIMENSIONS, ANGLES AND DIAMETER

SKPE	PROJECT REFERENCE #	LIGHT ENGINE	PATTERNS	LENGTH
SKPE Sketch Pendant	10003 D03-30" diameter circle 10004 D04-48" diameter circle 10005 D05-60" diameter circle 10008 D08-90" diameter circle 10013 D13-150" diameter circle 10018 D18-210" diameter circle 10023 D23-270" diameter circle # for all other shapes *	SL 60/40 surroundlite 60%up/40%down - direct/indirect SL 0/100 surroundlite 0%up/100%down - direct	REC rectangle CIR circle ARC arc section ASO other shape LIN linear run	AL(L) pattern length *

*For different radius consult factory.

FINISH TO BE SELECTED BY ARCHITECT

* Nominal length

NOM. LUMENS/FT	CRI	COLOR TEMP.	SHIELDING	FINISH	VOLTAGE	DRIVER
400 400 lm/ft - Minimum	80 80 CRI	27 2700 K	SO spotless lens	AP aluminum paint	120 120 V	DP dimming (0-10V) 1%
700 700 lm/ft- Maximum for SL0/100	90 90 CRI	30 3000 K		W white	277 277 V	LT Lutron *
1000 1000 lm/ft- Maximum for SL60/40		35 3500 K		BLK black	UNV universal	O other *
800 lm/ft		40 4000 K		C custom	DC low voltage*	POE(#) POE drivers**

Applies for both up and down
Outputs between listed min and max are available
Consult factory for outputs outside of the provided range.

* Only available with POE drivers.

** Not available for 10003, 10004, 10005 or 10008
** Please consult factory; see page 4;

CIRCUITS	MOUNTING/SUSPENSION	BATTERY (OPT.)	OTHER (OPT.)	IC CONTROLS (OPTIONAL)	CUSTOM (OPT.)
1 1 circuit +E(#) emergency circuit * +NL(#) night light circuit * +GTD(#) generator transfer device *	CA(#) drywall+cable length (36" std.) CT9(#) TB/TG 9/16+cable length (36" std.) CT15(#) TB/TG15/16+cable length (36" std.) CTS(#) ST+cable length (36" std.) SA(#) drywall+stem length >48" (18" std.) +SM seismic option	B(#) battery pack 4' sections *	F fuse	DS(#) daylight sensor OS(#) occupancy sensor DOS(#) daylight & occupancy sensor WC(#) wireless control dimming	C custom

* Specify system

* Remote only for 10003, 10004, 10005 or 10008; Not available with 347V; Please consult factory

Requires 120V or 277V

Applies to both UP & DOWN. See pages 6-7 for more details. See integrated controls guide for more details.

Please specify

Product design and development is an ongoing process at Axis Lighting. We reserve the right to change specifications. Contact Axis for the latest product information.

1 / 13
March 23, 2021

FILE NAME:Sketch Pendant.SPEC

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Sketch | Pendant

P2

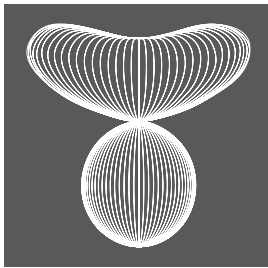
● SURROUNDLITE TECHNOLOGY

Sketch with SurroundLite provides the flexibility of high efficacy spherical three dimensional wide batwing distributions and shielding options that all result in true lighting effectiveness. Sketch is only 2 3/4" in depth with integral driver and a light guide with proper cutoff and no view of bugs or dust particles.

An innovative technology to get much more out of LEDs: Axis SurroundLite is based on the fundamental physics of how light interacts with matter. The specially engineered lightguide is made of precisely coded and aligned molecules that shape LED output in all three dimensions.

With SurroundLite extra-wide, multidimensional light distribution, light is directed in all three planes and sent in every corner of the room. SurroundLite brings the promise of balanced brightness, facilitating lighting design.

3D Polar Curve (SL 60/40)



● SURROUNDLITE BENEFITS



With **SurroundLite**



Without **SurroundLite**

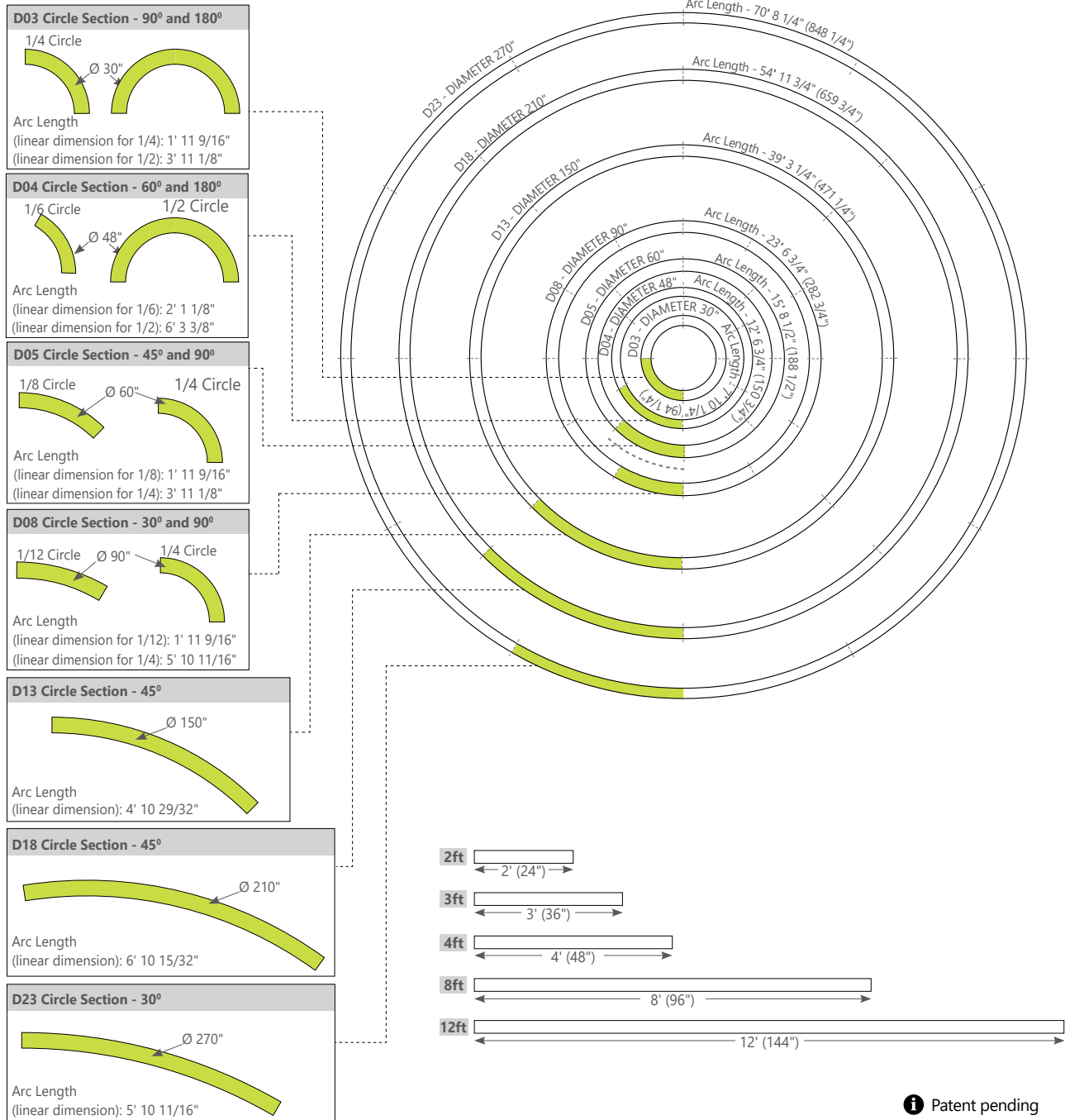
Sketch | Pendant

P2

ALL ORDERS MUST BE SUBMITTED WITH DRAWINGS INDICATING DIMENSIONS, ANGLES AND DIAMETER

LUMINAIRE SECTIONS

The center line indicates the diameter at the center of the curve. Regardless to the mounting style, the centre line remains the same. This is the dimension that should be used when planning a layout.



Product design and development is an ongoing process at Axis Lighting. We reserve the right to change specifications. Contact Axis for the latest product information.

Patent pending



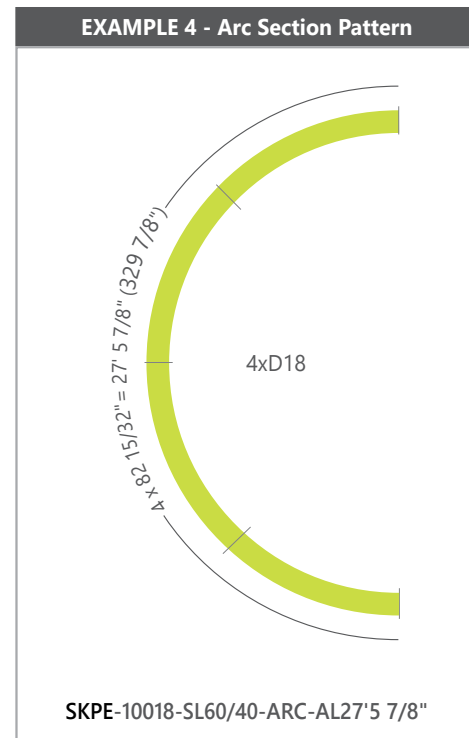
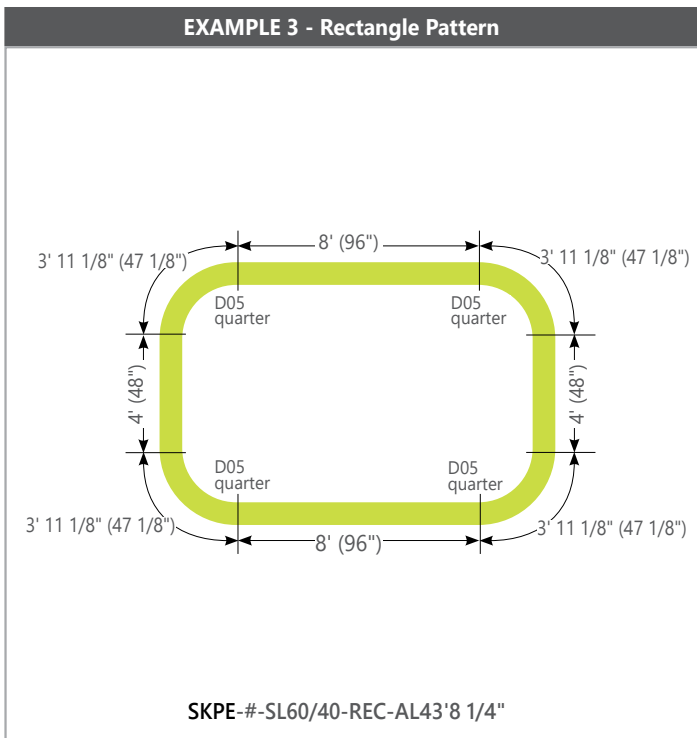
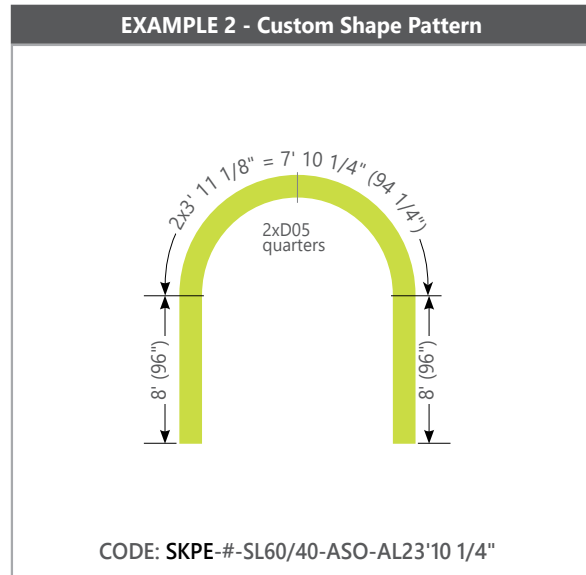
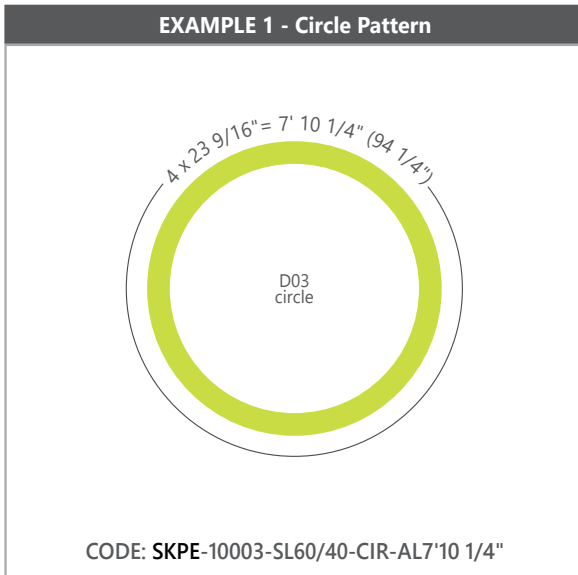
Sketch | Pendant

P2

ALL ORDERS MUST BE SUBMITTED WITH DRAWINGS INDICATING DIMENSIONS, ANGLES AND DIAMETER

● HOW TO ORDER?

i Drawings are not to scale



i Patent pending

Product design and development is an ongoing process at Axis Lighting. We reserve the right to change specifications. Contact Axis for the latest product information.

4 / 13
March 23, 2021

FILE NAME: Sketch Pendant.SPEC

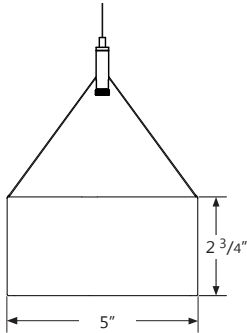
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Sketch | Pendant

P2

● DIMENSIONS - SECTION VIEWS



● PRODUCT DESCRIPTION

Sketch allows freedom to create shapes of continuous light. Its modules offer a wide range of options making possible to build partial and complete circles with 3', 5', 8', 13', and 23' nominal diameters. These can be combined with straight sections.

- i** Consult your Axis Representative to coordinate specification. A detailed drawing of the intended installation must be provided with each order.

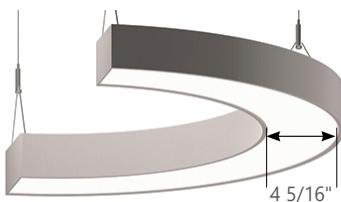
● CONSTRUCTION

Housing walls	Extruded aluminum (0.075" nominal)
Housing top	Die formed cold rolled sheet steel (24 gauge)
Interior reflectors	Die formed cold rolled sheet steel (24 gauge)
Mounting brkts.	Die formed cold rolled sheet steel (16 gauge)
Joining brackets.	Die formed zinc
Incap & Cross Brkt.	Die cast aluminum (0.10" nominal)

● WEIGHT

Approximately 2.9lbs/ft = 1.3kg/ft (linear)

● SKETCH APERTURE DIMENSIONS



● LENS

Spotless Lens Highly transmissive polycarbonate (0.08" thick).

● ELECTRICAL

Lutron driver* LDE1 - EcoSystem H-Series (1%)
LTE - Hi-Lume® A-series 2Wires Forward Phase (1%)
*Consult factory

Other drivers* DALI - Digital Addressable Lighting Interface
DMX - Digital Multiplex
LV - line voltage - Advance Mark 10
Xitanium SR - For wireless sensor
*Consult factory

Power over Ethernet MOLEX

POE drivers* IGOR
(consult factory for more information) O - Other (Consult factory)

UL2108 certified for integral or remote driver

Emergency* Integral emergency battery pack or emergency circuit optional.
*Consult factory


Input Voltage 120V, 277V, UNV.

- i** Incorporating these components may have limitations or effect the length of the luminaire, please contact factory for more details.

● FINISH

Highly reflective, white powder coat finish paint for high efficiency. Matte texture to diffuse glare and lamp image on the surface within the optical chamber exterior. Custom finishes are also available.

● APPROVALS

Certified to CSA standards 
Meets NYC requirements
Suitable for damp locations.

● WARRANTY

Axis Lighting will warrant defective LEDs, boards, and drivers for 5 years from date of purchase. Warranty is valid if luminaire is installed and used according to specifications. If defective, Axis will send replacement boards or drivers at no cost along with detailed replacement instructions and instructions on how to return defective components to Axis.

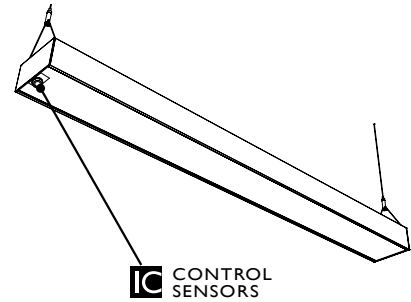
Sketch | Pendant

P2

● INTEGRATED CONTROLS

Sketch luminaires allow the use of integrated controls such as daylight sensors (DS), occupancy sensors (OS) and combination daylight/occupancy sensors (DOS). These options can be seamlessly integrated into our luminaires. The control system could be used to optimize the lighting of the space by reducing energy consumption through daylight harvesting and occupancy, thereby improving the overall interior environment and allowing for LEED credits.

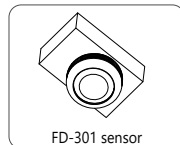
- Consult factory for other options.



The integrated control systems offered are:

● DAYLIGHT HARVESTING (DS):

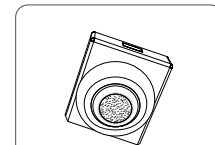
With daylight sensors, maximum lamp output is reduced according to the available amount of natural light. By reducing maximum lamp output, energy consumption is reduced by up to 20 percent in a process known as "Daylight Harvesting".



EC-DIR-WH, FD-301

● OCCUPANCY (OS):

When a room is vacated, occupancy sensors ensure the light will be turned off after a programmed delay as well as ensuring that light remains on while the room is occupied.



FS-205 sensor

FS-205

● DAYLIGHT HARVESTING AND OCCUPANCY (DOS):

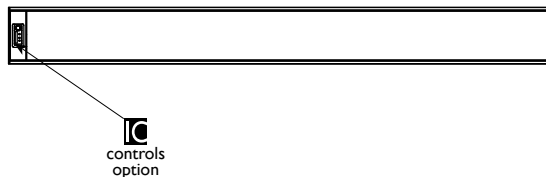
A combination of Daylight & Occupancy sensor from Philips, EasySense can be used with SimpleSet drivers for better control



EasySense sensor

● INSTALLATION EXAMPLES

Sensor location option



Sketch | Pendant

P2

● INTEGRATED CONTROL OPTIONS

SENSORS	BRAND	Model	TYPE
Daylight Sensor (DS)	Lutron	EC-DIR-WH (1)	Daylight
	Wattstopper	FD-301 (1)	Daylight
	Lutron	LRF2-DCRB-WH	Wireless Daylight Sensor
Occupancy Sensor (OS)	Wattstopper	FS-205v2 (1)	PIR Occupancy & Ambient light level
	Lutron	LRF2-OCR2B-P-WH	Wireless Daylight Sensor
Daylight & Occupancy Sensors (DOS)	Philips	Easysense (1)	Daylight & PIR Occupancy
	Lutron	LRF2-DCRB-WH & LRF2-OCR2B-P-WH	Daylight & PIR Occupancy

(1) Not available for 10003, 10005 or 10008;
Please consult factory

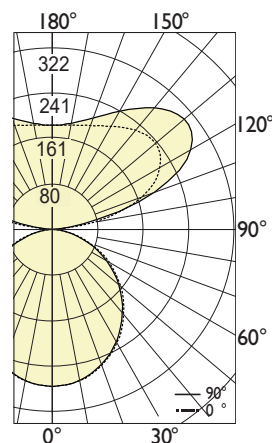
Sketch | Pendant

P2

PHOTOMETRIC DATA

PHOTOMETRIC CURVE

SKPE-10003-SL60/40-ARC-AL1'-11 9/16"-1000-80-35-SO
60% up / 40% down at 1000 lm/ft



Luminaire Lumens: 2000 lm
Input Watts: 23.44 W
Efficacy: 85 lm/W

IES FILE:
(D03 CIR Section)
SKPE-10003-SL60/40-ARC-AL1'-11 9/16"-1000-80-35-SO.ies

TESTED ACCORDING TO IES LM-79-2008

i All IES files are available for download at: www.axislighting.com

CANDELA DISTRIBUTION

Vertical Angle	Horizontal Angles				
	0	22.5	45	67.5	90
0	294	294	294	294	294
5	292	292	292	292	292
15	281	281	280	280	280
25	258	258	257	256	256
35	227	226	225	224	223
45	188	188	186	185	184
55	145	145	143	141	141
65	99	98	96	94	94
75	51	50	48	47	47
85	11	10	10	10	10
90	1	1	2	3	3
95	26	22	17	17	19
105	136	129	129	127	130
115	212	218	234	254	263
125	246	256	281	307	318
135	249	257	280	303	313
145	232	238	254	270	276
155	214	217	225	233	237
165	202	202	205	208	209
175	196	196	196	196	196
180	195	195	195	195	195

ZONAL LUMENS

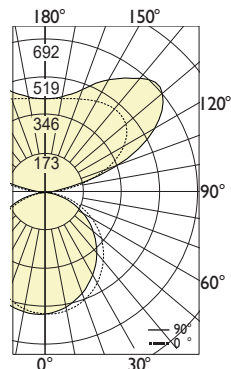
Zone	Lumens
0	
0-10	28
10-20	79
20-30	118
30-40	141
40-50	144
50-60	128
60-70	95
70-80	52
80-90	13
90	
90-100	27
100-110	136
110-120	231
120-130	251
130-140	216
140-150	160
150-160	105
160-170	59
170-180	19
180	

LUMINANCE DATA (cd/m²)

Vertical Angle	Horizontal Angles		
	0	45	90
45	3904	3861	3816
55	3713	3649	3591
65	3417	3329	3255
75	2863	2741	2655
85	1812	1737	1707

PHOTOMETRIC CURVE

SKPE-4'-SL60/40-LIN-AL4'-1000-80-35-SO
60% up / 40% down at 1000 lm/ft



Luminaire Lumens: 3845 lm
Input Watts: 49.7 W
Efficacy: 77 lm/W

IES FILE:
(4' LIN Section)
SKPE-4'-SL60/40-LIN-AL4'-1000-80-35-SO.ies

TESTED ACCORDING TO IES LM-79-2008

i All IES files are available for download at: www.axislighting.com

CANDELA DISTRIBUTION

Vertical Angle	Horizontal Angles				
	0	22.5	45	67.5	90
0	538	538	538	538	538
5	530	531	533	535	538
15	499	502	509	515	522
25	451	457	467	476	487
35	391	398	410	422	434
45	322	329	343	355	367
55	246	253	267	279	290
65	164	171	184	195	204
75	83	88	98	107	114
85	17	21	25	29	33
90	1	1	2	4	6
95	24	26	31	50	42
105	179	201	229	234	194
115	456	457	441	378	345
125	633	618	560	468	442
135	691	660	572	505	481
145	619	594	543	494	476
155	534	520	491	464	453
165	452	455	446	435	431
175	419	421	420	419	418
180	417	417	417	417	417

ZONAL LUMENS

Zone	Lumens
0	
0-10	51
10-20	145
20-30	219
30-40	261
40-50	269
50-60	241
60-70	181
70-80	100
80-90	26
90	
90-100	46
100-110	225
110-120	411
120-130	485
130-140	447
140-150	342
150-160	229
160-170	127
170-180	40
180	

LUMINANCE DATA (cd/m²)

Vertical Angle	Horizontal Angles		
	0	45	90
45	3388	3612	3868
55	3192	3463	3768
65	2890	3239	3597
75	2375	2831	3276
85	1484	2138	2815

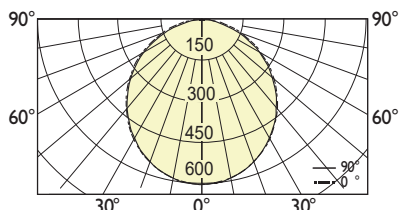
Sketch | Pendant

P2

PHOTOMETRIC DATA

PHOTOMETRIC CURVE

SKPE-10004-SL0-100-ARC-AL2_1 18-700-80-35-SO.IES
0% up / 100% down at 700 lm/ft



Luminaire Lumens: 1647 lm
Input Watts: 23.87 W
Efficacy: 69 lm/W

IES FILE:
(D04 CIR Section)

SKPE-10004-SL0-100-ARC-AL2_1 18-700-80-35-SO.IES

TESTED ACCORDING TO IES LM-79-2008

CANDELA DISTRIBUTION

Vertical Angle	Horizontal Angles				
	0	22.5	45	67.5	90
0	600	600	600	600	600
5	597	596	596	597	596
15	573	573	572	572	571
25	527	527	526	525	524
35	464	464	462	460	459
45	387	386	384	381	381
55	299	298	296	294	292
65	204	203	201	198	197
75	107	106	104	102	101
85	26	25	24	23	22
90	1	1	1	1	1

ZONAL LUMENS

Zone	Lumens
0	
0-10	57
10-20	161
20-30	242
30-40	289
40-50	296
50-60	264
60-70	199
70-80	110
80-90	28
90	

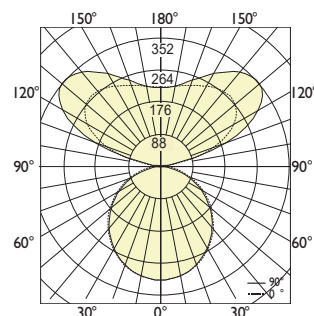
LUMINANCE DATA (cd/m²)

Vertical Angle	Horizontal Angles		
	0	45	90
45	7890	7824	7773
55	7531	7443	7353
65	6965	6854	6732
75	5958	5800	5629
85	4262	3939	3676

i All IES files are available for download at: www.axislighting.com

PHOTOMETRIC CURVE

SKPE-10004-SL60-40-ARC-AL2 1 18-1000-80-35-SO.IES
60% up / 40% down at 1000 lm/ft



Luminaire Lumens: 2081 lm
Input Watts: 21.63 W
Efficacy: 96 lm/W

IES FILE:
(D04 CIR Section)

SKPE-10004-SL60-40-ARC-AL2 1 18-1000-80-35-SO.IES

TESTED ACCORDING TO IES LM-79-2008

CANDELA DISTRIBUTION

Vertical Angle	Horizontal Angles				
	0	22.5	45	67.5	90
0	309	309	309	309	309
5	308	308	308	308	308
15	296	296	296	295	295
25	273	273	272	271	271
35	240	240	239	238	238
45	201	200	199	198	197
55	156	155	154	152	152
65	106	106	105	103	103
75	56	56	54	53	53
85	14	13	13	12	12
90	1	0	0	0	0
95	21	16	9	7	7
105	110	110	106	100	97
115	199	206	223	247	258
125	251	262	290	324	339
135	266	276	304	335	349
145	257	264	284	306	315
155	239	243	254	265	270
165	224	225	229	232	234
175	216	216	216	217	217
180	215	215	215	215	215

ZONAL LUMENS

Zone	Lumens
0	
0-10	29
10-20	83
20-30	125
30-40	150
40-50	154
50-60	137
60-70	103
70-80	58
80-90	15
90	
90-100	16
100-110	110
110-120	221
120-130	260
130-140	236
140-150	179
150-160	118
160-170	65
170-180	21
180	

LUMINANCE DATA (cd/m²)

Vertical Angle	Horizontal Angles		
	0	45	90
45	4097	4060	4026
55	3914	3866	3817
65	3630	3568	3500
75	3119	3028	2939
85	2258	2084	1949

i All IES files are available for download at: www.axislighting.com

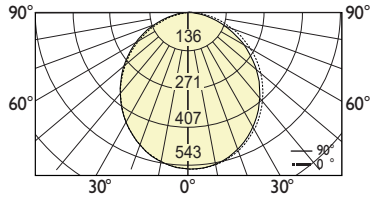
Sketch | Pendant

P2

PHOTOMETRIC DATA

PHOTOMETRIC CURVE

SKPE-10003-SL0-100-ARC-AL1 11916-700-80-35-SO
0% up / 100% down at 700 lm/ft



Luminaire Lumens: 1465 lm
Input Watts: 23.6 W
Efficacy: 62 lm/W

IES FILE:
(D03 ARC Section)
SKPE-10003-SL0-100-ARC-AL1 11916-700-80-35-SO.ies

TESTED ACCORDING TO IES LM-79-2008

CANDELA DISTRIBUTION

Vertical Angle	Horizontal Angles				
	0	22.5	45	67.5	90
0	542	542	542	542	542
5	541	540	540	540	540
15	521	521	519	518	518
25	482	480	477	475	474
35	426	422	418	414	413
45	357	351	345	341	339
55	278	272	264	257	254
65	194	185	175	167	164
75	106	96	85	78	75
85	29	21	15	11	10
90	4	1	1	1	1

ZONAL LUMENS

Zone	Lumens
0	
0-10	51
10-20	146
20-30	218
30-40	259
40-50	264
50-60	235
60-70	175
70-80	95
80-90	23
90	

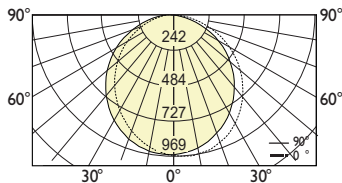
LUMINANCE DATA (cd/m²)

Vertical Angle	Horizontal Angles		
	0	45	90
45	8182	7919	7769
55	7878	7456	7199
65	7442	6723	6311
75	6657	5346	4696
85	5382	2810	1811

i All IES files are available for download at: www.axislighting.com

PHOTOMETRIC CURVE

SKPE-SL0-100-LIN-AL4-700-80-35-SO.IES
0% up / 100% down at 700 lm/ft



Luminaire Lumens: 2632 lm
Input Watts: 45.9W
Efficacy: 57 lm/W

IES FILE:
(4' LIN Section)
SKPE-SL0-100-LIN-AL4-700-80-35-SO.ies
TESTED ACCORDING TO IES LM-79-2008

CANDELA DISTRIBUTION

Vertical Angle	Horizontal Angles				
	0	22.5	45	67.5	90
0	948	948	948	948	948
5	960	960	961	956	943
15	960	960	952	935	913
25	918	914	905	883	848
35	834	832	818	792	753
45	719	718	704	677	635
55	582	581	568	542	500
65	428	428	416	392	352
75	264	264	253	233	197
85	107	107	98	83	58
90	44	44	37	27	11

ZONAL LUMENS

Zone	Lumens
0	
0-10	90
10-20	255
20-30	384
30-40	458
40-50	471
50-60	422
60-70	319
70-80	180
80-90	53
90	

LUMINANCE DATA (cd/m²)

Vertical Angle	Horizontal Angles		
	0	45	90
45	7579	7413	6693
55	7559	7374	6495
65	7542	7331	6204
75	7589	7294	5664
85	9145	8391	4930

i All IES files are available for download at: www.axislighting.com

Sketch | Pendant

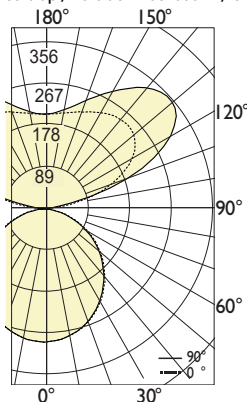
P2

PHOTOMETRIC DATA

PHOTOMETRIC CURVE

SKPE-10005-SL60-40-ARC-AL1 11 9 16-1000-80-35-SO.IES

60% up / 40% down at 1000 lm/ft



Luminaire Lumens: 1981 lm

Input Watts: 23.3 W

Efficacy: 85 lm/W

IES FILE:

(D05 CIR Section)

SKPE-10005-SL60-40-ARC-AL1 11 9 16-1000-80-35-SO.IES

TESTED ACCORDING TO IES LM-79-2008

CANDELA DISTRIBUTION

Vertical Angle	Horizontal Angles				
	0	22.5	45	67.5	90
0	284	284	284	284	284
5	282	282	282	282	282
15	271	271	271	270	270
25	249	249	249	248	248
35	219	219	218	217	216
45	182	182	181	179	179
55	141	141	139	138	137
65	96	95	94	93	92
75	50	49	48	47	47
85	11	11	11	10	10
90	1	0	1	0	1
95	20	15	9	7	7
105	107	107	107	104	101
115	189	198	221	248	260
125	238	251	287	326	344
135	253	266	299	336	352
145	245	254	277	302	314
155	228	233	246	259	264
165	213	215	219	224	226
175	203	204	204	205	205
180	202	202	202	202	202

ZONAL LUMENS

Zone	Lumens
0	
0-10	27
10-20	76
20-30	115
30-40	136
40-50	139
50-60	124
60-70	93
70-80	51
80-90	13
90	
90-100	17
100-110	112
110-120	218
120-130	256
130-140	232
140-150	175
150-160	114
160-170	63
170-180	20
180	

LUMINANCE DATA (cd/m²)

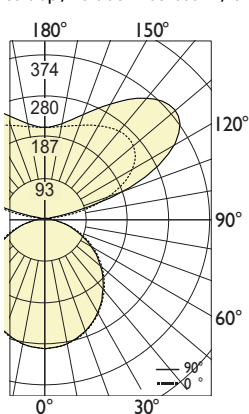
Vertical Angle	Horizontal Angles		
	0	45	90
45	3642	3610	3574
55	3465	3425	3372
65	3193	3142	3076
75	2705	2627	2543
85	1852	1720	1604

i All IES files are available for download at: www.axislighting.com

PHOTOMETRIC CURVE

SKPE-10008-SL60-40-ARC-AL1 11 9 16-1000-80-35-SO

60% up / 40% down at 1000 lm/ft



Luminaire Lumens: 2021 lm

Input Watts: 23.5 W

Efficacy: 86 lm/W

IES FILE:

(D08 CIR Section)

SKPE-10008-SL60-40-ARC-AL1 11 9 16-1000-80-35-SO.IES

TESTED ACCORDING TO IES LM-79-2008

CANDELA DISTRIBUTION

Vertical Angle	Horizontal Angles				
	0	22.5	45	67.5	90
0	286	286	286	286	286
5	285	285	285	285	285
15	274	274	273	273	273
25	252	252	251	251	250
35	222	221	220	219	219
45	185	185	183	181	181
55	143	142	140	139	138
65	97	96	94	93	92
75	50	49	48	46	46
85	11	11	10	9	9
90	1	1	0	0	0
95	23	16	9	8	8
105	113	113	113	108	104
115	196	206	232	262	277
125	244	257	296	342	364
135	256	268	304	346	366
145	245	255	279	307	320
155	227	232	246	260	266
165	211	213	218	223	226
175	202	203	203	203	204
180	201	201	201	201	201

ZONAL LUMENS

Zone	Lumens
0	
0-10	27
10-20	77
20-30	116
30-40	138
40-50	141
50-60	125
60-70	93
70-80	51
80-90	12
90	
90-100	18
100-110	117
110-120	229
120-130	266
130-140	237
140-150	177
150-160	115
160-170	62
170-180	20
180	

LUMINANCE DATA (cd/m²)

Vertical Angle	Horizontal Angles		
	0	45	90
45	3691	3651	3605
55	3513	3454	3389
65	3235	3151	3067
75	2720	2602	2489
85	1779	1618	1487

i All IES files are available for download at: www.axislighting.com

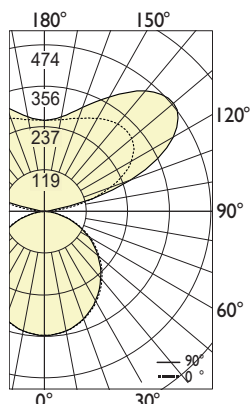
Sketch | Pendant

P2

● PHOTOMETRIC DATA

PHOTOMETRIC CURVE

SKPE-10013-SL60-40-ARC-AL2 5 1 532-1000-80-35-SO.IES
60% up / 40% down at 1000 lm/ft



Luminaire Lumens: 2537 lm
Input Watts: 30.3 W
Efficacy: 84 lm/W

IES FILE:
(D13 CIR Section)
SKPE-10013-SL60-40-ARC-AL2 5 1 532-1000-80-35-SO.IES
TESTED ACCORDING TO IES LM-79-2008

CANDELA DISTRIBUTION

Vertical Angle	Horizontal Angles				
	0	22.5	45	67.5	90
0	350	350	350	350	350
5	348	348	348	348	348
15	335	334	334	334	334
25	309	308	308	307	306
35	272	272	270	269	269
45	228	227	225	223	223
55	176	175	174	172	171
65	120	119	118	116	115
75	62	62	60	59	59
85	14	14	14	13	13
90	1	1	1	1	2
95	28	20	9	9	9
105	141	141	143	143	140
115	246	258	291	332	351
125	307	324	376	434	460
135	325	341	388	443	467
145	313	325	357	393	410
155	291	297	315	333	341
165	270	273	279	285	288
175	259	259	260	260	261
180	257	257	257	257	257

ZONAL LUMENS

Zone	Lumens
0	
0-10	33
10-20	94
20-30	142
30-40	169
40-50	174
50-60	155
60-70	116
70-80	64
80-90	17
90	
90-100	20
100-110	148
110-120	289
120-130	337
130-140	302
140-150	226
150-160	147
160-170	80
170-180	25
180	

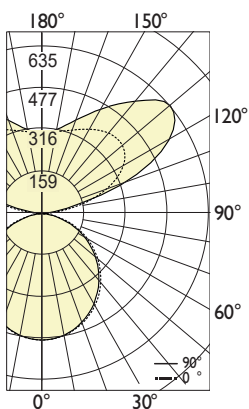
LUMINANCE DATA (cd/m²)

Vertical Angle	Horizontal Angles		
	0	45	90
45	4325	4277	4232
55	4128	4067	4003
65	3811	3739	3657
75	3233	3139	3037
85	2206	2109	2026

i All IES files are available for download at: www.axislighting.com

PHOTOMETRIC CURVE

SKPE-10018-SL60-40-ARC-AL3 5 14-1000-80-35-SO.IES
60% up / 40% down at 1000 lm/ft



Luminaire Lumens: 3326 lm
Input Watts: 42.3 W
Efficacy: 79 lm/W

IES FILE:
(D18 CIR Section)
SKPE-10018-SL60-40-ARC-AL3 5 14-1000-80-35-SO.IES
TESTED ACCORDING TO IES LM-79-2008

CANDELA DISTRIBUTION

Vertical Angle	Horizontal Angles				
	0	22.5	45	67.5	90
0	478	478	478	478	478
5	476	476	476	476	475
15	458	458	457	456	456
25	424	423	421	419	418
35	375	374	370	367	366
45	314	312	308	305	303
55	244	242	238	234	232
65	166	165	161	157	155
75	86	85	82	79	78
85	20	19	18	17	17
90	1	1	1	0	1
95	40	26	13	12	12
105	181	197	190	165	158
115	311	344	396	432	455
125	385	411	496	575	616
135	403	425	487	565	608
145	384	401	440	486	507
155	352	361	383	406	416
165	324	327	335	343	346
175	308	309	310	310	311
180	306	306	306	306	306

ZONAL LUMENS

Zone	Lumens
0	
0-10	45
10-20	129
20-30	194
30-40	232
40-50	238
50-60	212
60-70	159
70-80	88
80-90	22
90	
90-100	30
100-110	193
110-120	380
120-130	440
130-140	382
140-150	279
150-160	178
160-170	96
170-180	30
180	0

LUMINANCE DATA (cd/m²)

Vertical Angle	Horizontal Angles		
	0	45	90
45	3558	3490	3434
55	3402	3317	3242
65	3149	3045	2942
75	2671	2543	2423
85	1828	1662	1538

i All IES files are available for download at: www.axislighting.com

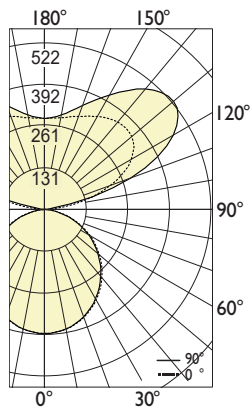
Sketch | Pendant

P2

● PHOTOMETRIC DATA

PHOTOMETRIC CURVE

SKPE-10023-SL60-40-ARC-AL2 11 1132-1000-80-35-SO.IES
60% up / 40% down at 1000 lm/ft



Luminaire Lumens: 2786 lm

Input Watts: 36.3 W

Efficacy: 88 lm/W

IES FILE:

(D23 CIR Section)

SKPE-10023-SL60-40-ARC-AL2 11 1132-1000-80-35-SO.IES

TESTED ACCORDING TO IES LM-79-2008

CANDELA DISTRIBUTION

Vertical Angle	Horizontal Angles				
	0	22.5	45	67.5	90
0	386	386	386	386	386
5	384	384	384	384	384
15	370	369	369	369	368
25	342	341	339	338	338
35	302	300	298	296	295
45	252	250	248	246	244
55	195	194	191	189	187
65	133	132	129	127	126
75	68	68	66	64	63
85	15	14	14	13	13
90	1	0	1	0	1
95	33	21	12	12	11
105	160	158	159	156	151
115	275	288	325	371	393
125	340	358	414	480	511
135	355	373	424	484	510
145	339	352	386	426	445
155	311	319	338	358	366
165	288	291	299	306	308
175	275	276	277	278	278
180	274	274	274	274	274

ZONAL LUMENS

Zone	Lumens
0	
0-10	36
10-20	104
20-30	156
30-40	187
40-50	191
50-60	171
60-70	128
70-80	70
80-90	17
90	
90-100	23
100-110	164
110-120	322
120-130	372
130-140	330
140-150	245
150-160	158
160-170	85
170-180	27
180	

LUMINANCE DATA (cd/m²)

Vertical Angle	Horizontal Angles		
	0	45	90
45	3335	3282	3235
55	3181	3115	3058
65	2940	2862	2780
75	2473	2373	2275
85	1575	1469	1382

i All IES files are available for download at: www.axislighting.com

APERTURE 4256

PROJECT PROJÉT
SPEC TYPE
NOTES

Other Manufacturers:
NAL "CUSTOM" Series
CAMMAN "CUSTOM" Series



FINISH FINI



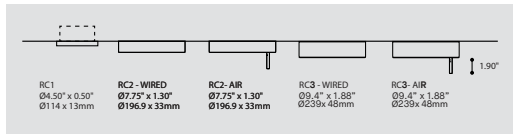
WHM-WHM WHM-GOL ANTE-WHM ANTE-GOL GOL-WHM GOL-GOL

FAMILY FAMILLE

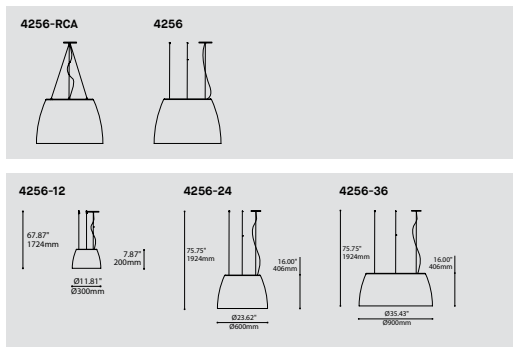


4256-12 4256-24 4256-36

MOUNTING OPTIONS OPTIONS DE MONTAGE



MOUNTING CABLE OPTIONS OPTION DE MONTAGE DE CÂBLE



QUICKSHIP [CLICK HERE / CLIQUEZ ICI](#) **P3**

ORDERING SPECIFICATION SPÉCIFICATION DE COMMANDE

MODEL MODÈLE

- 4256-12 APERTURE 12"
- 4256-24 APERTURE 24"
- 4256-36 APERTURE 36"

LIGHT SOURCE SOURCE LUMINEUSE

- LED* REGULAR OUTPUT
- LED.HO* HIGH OUTPUT

*3983 ACCESSORY IS PROVIDED ONLY FOR 4256-12

COLOR TEMPERATURE TEMPÉRATURE DE COULEUR

- 27 2700K
- 30 3000K
- 35 3500K
- 40 4000K

COLOR RENDERING INDEX (CRI) INDICE DE RENDU DE COULEUR (IRC)

- 80 80+ CRI
- 90* 90+ CRI

* LONGER LEAD TIME MAY APPLY, PLEASE CONTACT YOUR EUREKA REPRESENTATIVE

VOLTAGE VOLTAGE

- 120V 120 VOLT
- 277V 277 VOLT

CONTROL OPTION OPTION DE CONTRÔLE

- DV 0-10V DIMMING (120V-277V)
- DP** PHASE DIMMING (120V ONLY)

- NLTAIR2* NLIGHT AIR CONTROL GEN 2
- NLIGHT* NLIGHT WIRED CONTROL

* REQUIRES RC2 OR RC3 CANOPY
* EMERGENCY BATTERY NOT AVAILABLE WITH NLIGHT OPTIONS
* REFER TO NLIGHT GUIDE AND INSTALLATION SHEET FOR ALL REQUIREMENTS.
** PHASE DIMMING (DP) IS NOT AVAILABLE WITH HIGH OUTPUT (HO)

EMERGENCY BATTERY BATTERIE D'URGENCE

AVAILABLE WITH LED SOURCES 120-277V. EM DRIVER BOX INCLUDED, INSTALLED REMOTELY. SEE EM GUIDE FOR DETAILS.
WITH DV DIMMING OPTION, AN ADDITIONAL POWER CABLE WILL DROP FROM CEILING NEXT TO MAIN CABLE.

- EMB* EMERGENCY BATTERY FOR REMOTE BOX
- *3981EA ACCESSORY IS REQUIRED

CABLE CÂBLE

- AC AIRCRAFT MOUNTING & CLEAR CABLE, FIELD ADJUSTABLE

CABLE LENGTH LONGUEUR DE CÂBLE

- 60 60" AIRCRAFT CABLE (STD LENGTH)
- ** CUSTOM AIRCRAFT CABLE LENGTH (PLEASE SPECIFY)
FOR OVERALL LENGTH, PLEASE CONTACT YOUR EUREKA REPRESENTATIVE

MOUNTING MONTAGE

- ROUND CANOPY / PAVILLON ROND
- RC1 SCREWLESS 0.5" CANOPY (2471C)
- RC2 NLIGHT SCREWLESS CANOPY 07.75" X 1.30" (2474H) (FOR 4256-12 & 4256-24 REG)
- RC3 NLIGHT SCREWLESS CANOPY 09.4" X 1.88" (2475I) (FOR 4256-24 HO & 4256-36)

MOUNTING CABLE OPTION OPTION DE MONTAGE DE CÂBLE

- RCA CENTERED ROUND CANOPY - AIRCRAFT CABLES ANGLED TO CENTER
IF NO OPTION IS SELECTED, AN OFF-CENTERED ROUND CANOPY WITH STRAIGHT AIRCRAFT CABLE IS STANDARD

CANOPY FINISH FINI PAVILLON

- WHM MATTE WHITE
- ANTE ANTHRACITE FINE TEXTURE
- GOL GOLD

EXTERIOR SHADE FINISH FINI ABAT-JOUR EXTÉRIEUR

- WHM MATTE WHITE
- ANTE ANTHRACITE FINE TEXTURE WITH MATTE WHITE INSIDE
- GOL GOLD WITH MATTE WHITE INSIDE

FINISH TO BE
SELECTED BY
ARCHITECT

INTERIOR SHADE FINISH FINI ABAT-JOUR INTÉRIEUR

- WHM MATTE WHITE
- GOL GOLD

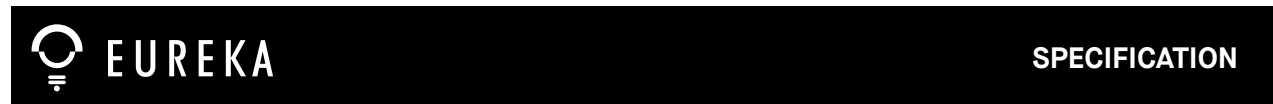
ACCESSORY ACCESSOIRE

- 3983 DEEP JUNCTION BOX (PROVIDED FOR 4256-12 AS PER ABOVE)

EMERGENCY BATTERY ACCESSORY ACCESSOIRE BATTERIE D'URGENCE

- 3981EA ELECTRICAL BOX FOR EMB EMERGENCY BATTERY

PRODUCT CHARACTERISTICS CARACTÉRISTIQUES DU PRODUIT



P3

APERTURE 4256 TUNABLE WHITE

PROJECT PROJÉT
SPEC TYPE
NOTES



FINISH FINI



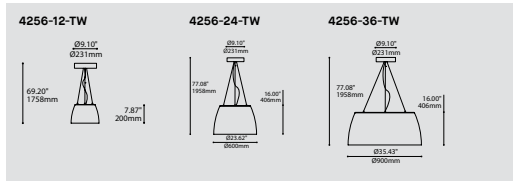
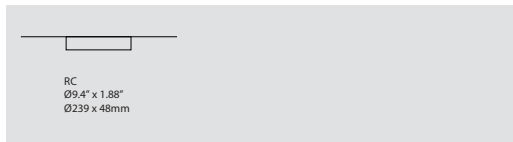
WHM-WHM WHM-GOL ANTE-WHM ANTE-GOL GOL-WHM GOL-GOL

FAMILY FAMILLE



4256-12 4256-24 4256-36

MOUNTING OPTIONS OPTIONS DE MONTAGE



ORDERING SPECIFICATION SPÉCIFICATION DE COMMANDE

MODEL MODÈLE	CODE
4256-12 APERTURE 12"	
4256-24 APERTURE 24"	
4256-36 APERTURE 36"	
LIGHT SOURCE SOURCE LUMINEUSE	LED
LED REGULAR OUTPUT	
COLOR TEMPERATURE TEMPÉRATURE DE COULEUR	TW
TW* TUNABLE WHITE (2700 TO 5000K)	
TW** TUNABLE WHITE HO(2700 TO 5000K)	
* LONGER LEAD TIME MAY APPLY, PLEASE CONTACT YOUR EUREKA REPRESENTATIVE	
** NOT AVAILABLE FOR 4256-36	
COLOR RENDERING INDEX (CRI) INDICE DE RENDU DE COULEUR (IRC)	80
80 80+ CRI	
VOLTAGE VOLTAGE	
120V 120 VOLT	
277V 277 VOLT	
CONTROL OPTION OPTION DE CONTRÔLE	
DDV DUAL 0-10V DIMMING	
NLT* NLIGHT NTUNE CONTROL	
* REFER TO NLIGHT GUIDE AND INSTALLATION SHEET FOR ALL REQUIREMENTS.	
CABLE CÂBLE	AC
AC AIRCRAFT MOUNTING & CLEAR CABLE, FIELD ADJUSTABLE	
CABLE LENGTH LONGUEUR DE CÂBLE	
60 60\"/>	
** CUSTOM AIRCRAFT CABLE LENGTH (PLEASE SPECIFY)	
FOR OVERALL LENGTH, PLEASE CONTACT YOUR EUREKA REPRESENTATIVE	
MOUNTING MONTAGE	RC
RC ROUND CANOPY / PAVILLON ROND	
RC SCREWLESS CANOPY Ø9.4\"/>	
MOUNTING CABLE OPTION OPTION DE MONTAGE DE CÂBLE	RCA
RCA CENTERED ROUND CANOPY - AIRCRAFT CABLES ANGLED TO CENTER	
CANOPY FINISH FINI PAVILLON	
WHM MATTE WHITE	
ANTE ANTHRACITE FINE TEXTURE	
GOL GOLD	
EXTERIOR SHADE FINISH FINI ABAT-JOUR EXTÉRIEUR	
WHM MATTE WHITE	
ANTE ANTHRACITE FINE TEXTURE WITH MATTE WHITE INSIDE	
GOL GOLD WITH MATTE WHITE INSIDE	
INSIDE SHADE FINISH FINI ABAT-JOUR INTÉRIEUR	
WHM MATTE WHITE	
GOL GOLD	

PRODUCT CHARACTERISTICS CARACTÉRISTIQUES DU PRODUIT



DESIGN: Hidden inside of an elegant form is a beautiful soft glow of LED illumination that encircles a surprising hollow core. Aperture is available in three formats, small, large and extra-large. Easy to install, adjust and level triple aircraft cable mounting.

INSTALLATION: Aperture features a custom LED light engine that is available with a standard dimming driver. White, Anthracite or Gold polyester powder coating, with a inside matte white finish.

LIGHT SOURCE: White, Anthracite or Gold polyester powder coating, with a inside matte white finish.

EXTERIOR FINISH: White, Anthracite or Gold polyester powder coating, with a inside matte white finish.

INSIDE FINISH: White or Gold polyester powder coating.

CERTIFIED: c-CSA-us



SPECIFICATION

APERTURE 4256

P3

QUICKSHIP

PROJECT PROJET

SPEC TYPE

NOTES



FINISH FINI



WHM

ANTE

FAMILY FAMILLE

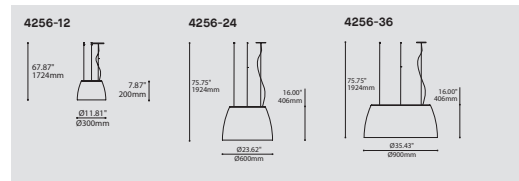
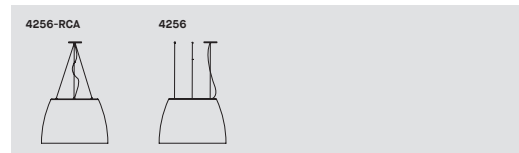


4256-12

4256-24

4256-36

MOUNTING CABLE OPTIONS OPTION DE MONTAGE DE CÂBLE



ORDERING SPECIFICATION SPÉCIFICATION DE COMMANDE

CODE

QUICKSHIP

Q55 QUICKSHIP 5 DAYS - MAXIMUM 5 UNITS QUICKSHIP 5 JOURS - MAXIMUM 5 UNITÉS
Q510 QUICKSHIP 10 DAYS - MAXIMUM 20 UNITS QUICKSHIP 10 JOURS - MAXIMUM 20 UNITÉS

MODEL MODÈLE

4256-12 APERTURE 12"
4256-24 APERTURE 24"
4256-36 APERTURE 36"

LIGHT SOURCE SOURCE LUMINEUSE

LED* REGULAR OUTPUT
*3983 ACCESSORY IS PROVIDED ONLY FOR 4256-12

COLOR TEMPERATURE TEMPÉRATURE DE COULEUR

30 3000K
35 3500K
40 4000K

COLOR RENDERING INDEX (CRI) INDICE DE RENDU DE COULEUR (IRC)

80 80+ CRI

VOLTAGE VOLTAGE

120V 120 VOLT
277V 277 VOLT

DIMMING OPTION OPTION DE GRADATION

DV 0-10V DIMMING (120V-277V)
DP PHASE DIMMING (120V ONLY)
LED DIMMING DRIVER IS STANDARD IN THIS PRODUCT, PLEASE SPECIFY YOUR DIMMING TYPE

CABLE CÂBLE

AC AIRCRAFT MOUNTING & CLEAR CABLE, FIELD ADJUSTABLE

CABLE LENGTH LONGUEUR DE CÂBLE

60 60" AIRCRAFT CABLE (STD LENGTH)
** CUSTOM AIRCRAFT CABLE LENGTH (PLEASE SPECIFY)
FOR OVERALL LENGTH, PLEASE CONTACT YOUR EUREKA REPRESENTATIVE

MOUNTING CABLE OPTION OPTION DE MONTAGE DE CÂBLE

RCA CENTERED ROUND CANOPY - AIRCRAFT CABLES ANGLED TO CENTER
IF NO OPTION IS SELECTED, A ROUND CANOPY WITH STRAIGHT AIRCRAFT CABLES WILL BE PROVIDED

CANOPY FINISH FINI PAVILLON

WHM MATTE WHITE

EXTERIOR SHADE FINISH FINI ABAT-JOUR EXTÉRIEUR

WHM MATTE WHITE
ANTE ANTHRACITE FINE EXTERIOR WITH MATTE WHITE INSIDE

INTERIOR SHADE FINISH FINI ABAT-JOUR INTÉRIEUR

WHM MATTE WHITE

ACCESSORY ACCESSOIRE

3983 DEEP JUNCTION BOX (PROVIDED FOR 4256-12 AS PER ABOVE)

PRODUCT CHARACTERISTICS CARACTÉRISTIQUES DU PRODUIT

BIM DIM EMB IES LED

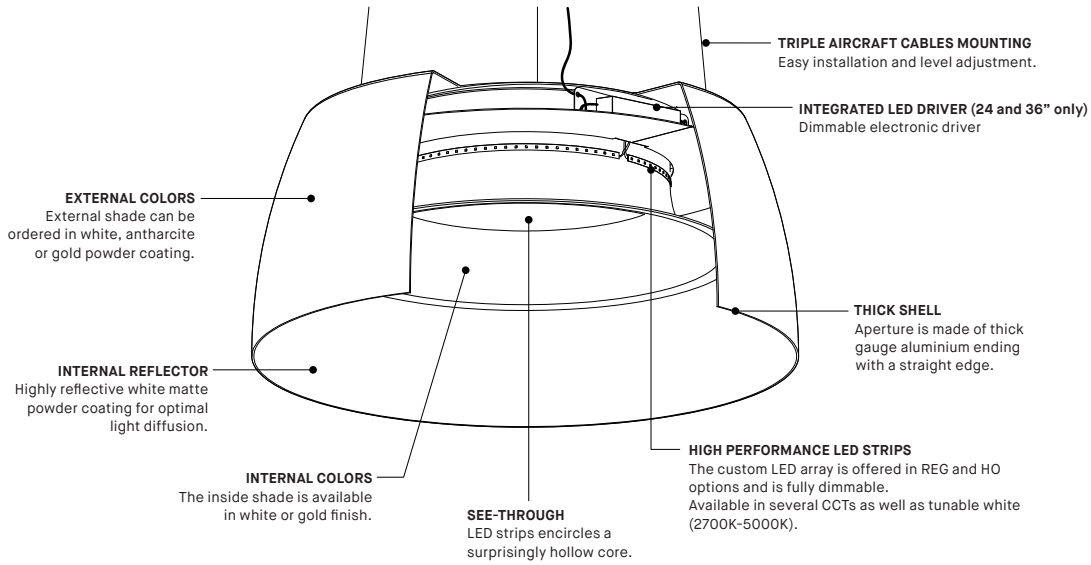
DESIGN: Hidden inside of an elegant form is a beautiful soft glow of LED illumination that encircles a surprising hollow core. Aperture is available in three formats, small, large and extra-large.
INSTALLATION: Easy to install, adjust and level triple aircraft cable mounting.
LIGHT SOURCE: Aperture features a custom LED light engine that is available with a standard dimming driver.
EXTERIOR FINISH: White or Anthracite matte polyester powder coating.
INTERIOR FINISH: Highly reflective matte white polyester powder coating.
CERTIFIED: c-CSA-us



SPECIFICATION

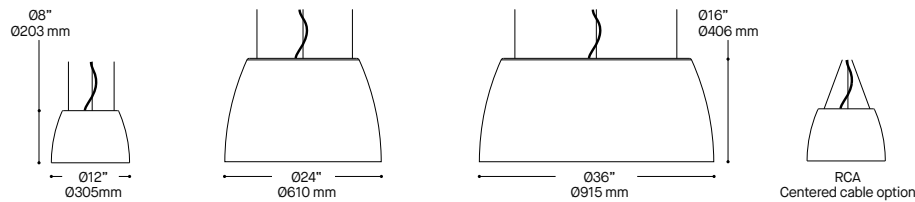
APERTURE 4256-XX

P3



VERSATILITY

Available in three different diameters, all versions feature the same shape making it a complete family. All sizes are available with aircraft cables angled to center (RCA option shown below).

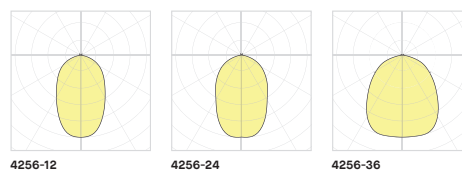


PRODUCT SPECIFICATION	4256-12				4256-24				4256-36		
	TW	TW HO	REG	HO	TW	TW HO	REG	HO	TW	REG	HO
PERFORMANCE											
SYSTEM WATTAGE	17.3W	26.6W	21.6W	32.6W	32.1W	49.2W	40.5W	57.4W	49.4W	62.1W	86.1W
DELIVERED LUMENS (4000K)	563LM	789LM	736LM	1166LM	1163LM	1632LM	1533LM	2302LM	2244LM	2948LM	4402LM
OTHER INFORMATIONS											
LUMINAIRE'S WEIGHT	4,62 LBS / 2,1 KG				15,7 LBS / 7,14 KG				30,69 LBS / 13,95 KG		
L70 (LUMEN MAINTENANCE)	> 60 000 HRS				> 60 000 HRS				> 60 000 HRS		
WELL & LEED STANDARD REQUIREMENTS											
MAX. LUMINANCE 45°-90° OF NADIR	4653 CD/M ² (AT HO)				2321 CD/M ² (AT HO)				1928 CD/M ² (AT HO)		
LIGHT QUALITY	R9 > 50 (90 CRI OPTION)										
FLICKERING TOLERANCE	LOW FLICKER, COMPLIANT TO CALIFORNIA TITLE 24										

EFFICACY MULTIPLIERS

CRI	CCT	FACTOR	TW FACTOR
80+	5000K	-	0.93
80+	4000K	1,00	1,00
80+	3500K	0,98	0,99
80+	3000K	0,94	0,98
80+	2700K	0,91	0,91
90+	4000K	0,88	-
90+	3500K	0,85	-
90+	3000K	0,81	-
90+	2700K	0,77	-

LIGHT DISTRIBUTION



Visit our website for warranty terms and conditions.

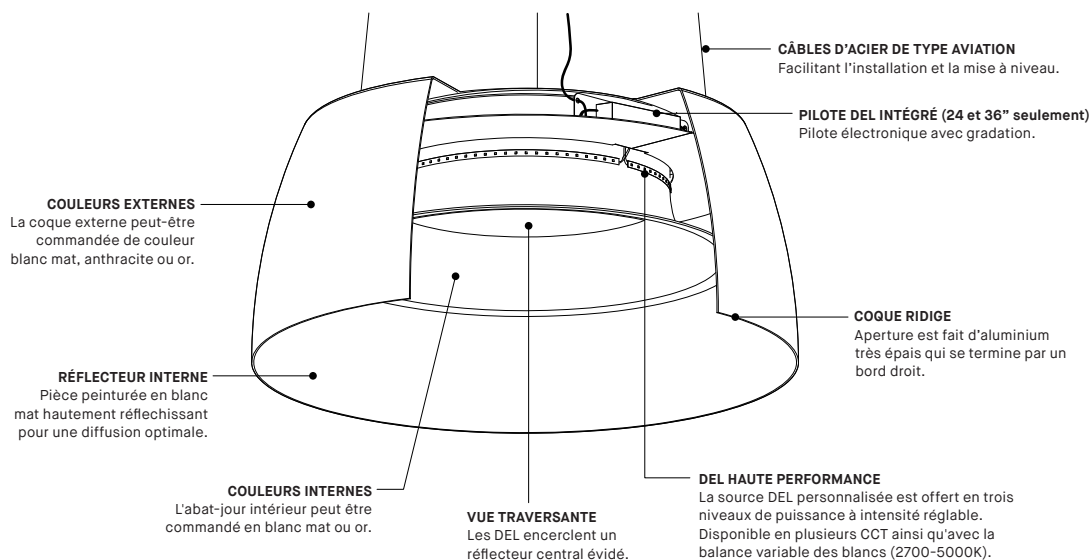
TECHNICAL DATA

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V2.0 — 2022.07

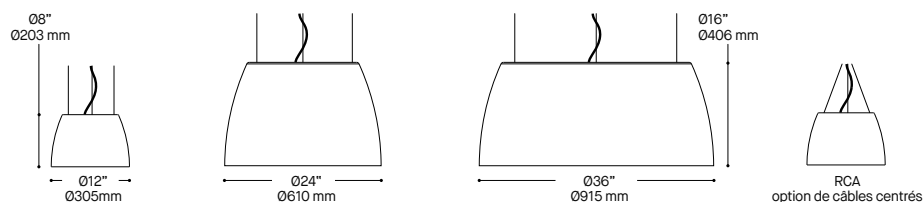
APERTURE 4256-XX

P3



POLYVALENCE

Aperture est disponible en trois diamètres de même forme, pour un agencement complet. Tous les grandeurs sont offerts avec l'option des câbles d'acier en angle au centre (option RCA illustré ci-bas).



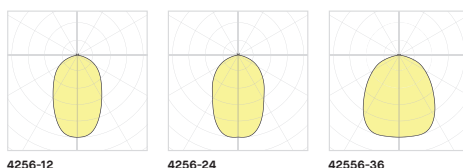
SPÉCIFICATION PRODUIT

	4256-12				4256-24				4256-36			
PERFORMANCE	TW	TW HO	REG	HO	TW	TW HO	REG	HO	TW	REG	HO	
PUISSANCE TOTALE LUMENS RÉELS (4000K)	17.3W 563LM	26.6W 789LM	21.6W 736LM	32.6W 1166LM	32.1W 1163LM	49.2W 1632LM	40.5W 1533LM	57.4W 2302LM	49.4W 2244LM	62.1W 2948LM	86.1W 4402LM	
AUTRES INFORMATIONS												
POIDS DU LUMINAIRE L70 (MAINTENANCE DE LA LUMIÈRE)	4,62 LB / 2,1 KG > 60 000 H				15,7 LB / 7,14 KG > 60 000 H				30,69 LB / 13,95 KG > 60 000 H			
CRITÈRES DE CERTIFICATION WELL & LEED												
MAX. LUMINANCE 45°-90° NADIR	4653 CD/M ² (HO)				2321 CD/M ² (HO)				1928 CD/M ² (HO)			
QUALITÉ DE LA LUMIÈRE	R9 > 50 (OPTION 90 IRC)											
TOLÉRANCE DE CLIGNOTEMENTS	PEU DE CLIGNOTEMENT (CONFORME À CALIFORNIA TITLE 24)											

FACTEUR D'EFFICACITÉ

IRC	CCT	FACTEUR	FACTEUR TW
80+	5000K	-	0.93
80+	4000K	1,00	1,00
80+	3500K	0,98	0,99
80+	3000K	0,94	0,98
80+	2700K	0,91	0,91
90+	4000K	0,88	-
90+	3500K	0,85	-
90+	3000K	0,81	-
90+	2700K	0,77	-

DISTRIBUTION LUMINEUSE



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V2.0 — 2022.07

P3

JUNCTION BOX 3981E

PROJECT PROJET
SPEC TYPE
NOTES



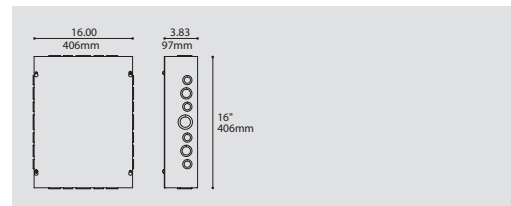
ORDERING SPECIFICATION SPÉCIFICATION DE COMMANDE

CODE

MODEL MODÈLE	
3981EA	APPROX. 10W MAX EMERGENCY BACKUP POWER
3981EB	APPROX. 5W MAX EMERGENCY BACKUP POWER

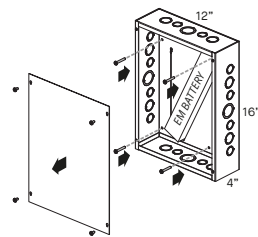
PRODUCT CHARACTERISTICS CARACTÉRISTIQUES DU PRODUIT

DESIGN:	Remote junction box and cover with an emergency backup driver. Features matching wires and labelling to simplify installation. Is required to complete luminaires ordered with EMB remote emergency box option (selected models, refer to specification sheets. Other models possible upon request). Available in several power outputs, selected according to the luminaire power.
STRUCTURE:	Die-stamped 16 gauge grey painted steel. Knockouts on all 4 sides from 1/2" to 1-1/4".
CERTIFIED:	c-CSA-us, UL, RoHS, NEMA Type 1, FCC
CONCEPTION:	Boîte de jonction à distance avec couvercle avec batterie d'urgence intégré. Contient des fils avec couleurs et étiquetage pour simplifier l'installation. Requis pour compléter un luminaire commandée avec l'option EMB (voir pages de spécification pour produits avec l'option EMB. Autres produits possibles sur demande). Disponible en plusieurs puissances, sélectionnées en fonction du luminaire.
STRUCTURE:	Acier plié de 16 jauge peinturé gris avec coins soudés. Débouchures sur 4 côtés 1/2" à 1-1/4".
CERTIFIÉ:	c-CSA-us, UL, RoHS, NEMA Type 1, FCC



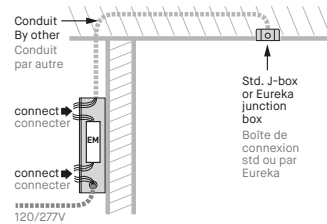
INSTALLATION SUMMARY SOMMAIRE D'INSTALLATION

STEP 1 ÉTAPE 1



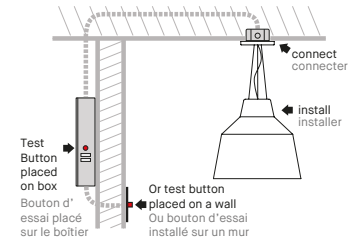
Remove cover and fasten box remotely to a wall or a ceiling.
Enlever le couvercle et fixer la boîte à distance sur un mur ou un plafond.

STEP 2 ÉTAPE 2



Run conduit from box to junction box of luminaire. Conduit must have a minimum of 5 wires with wire gauge and maximum distance as per EM driver distance chart. Connect EM driver to conduit wires and ac branch circuit. Faites passer le conduit de la boîte EM à la boîte de connexion du luminaire. Consultez le tableau de "distance maximale" disponible dans la feuille d'installation. Branchez la batterie EM avec les fils du conduit ainsi que la ligne 120V ou 277V.

STEP 3 ÉTAPE 3



Install luminaire & connect its wires to conduit. Install test button on wall or box (wall plate not supplied). Installez le luminaire & connecter les fils au conduit. Installer le bouton d'essai sur le mur ou boîtier (plaque murale non fournie).

REFER ALSO TO INSTALLATION DRAWING AND EM GUIDE FOR MORE INFORMATION.
CONSULTEZ LE DESSIN D'INSTALLATION ET LE GUIDE EM POUR PLUS D'INFORMATIONS.



SPECIFICATION

P3

3981E REMOTE EMERGENCY BOX KIT - IOTA EM DRIVER

SAFETY GUIDELINES :

- > Follow safety instructions and guidelines of EM battery/driver manufacturer for the specific model.
- > Install by qualified personnel in accordance with the National Electrical Code and local regulations.
- > Turn off power supply before installation or servicing the fixture.

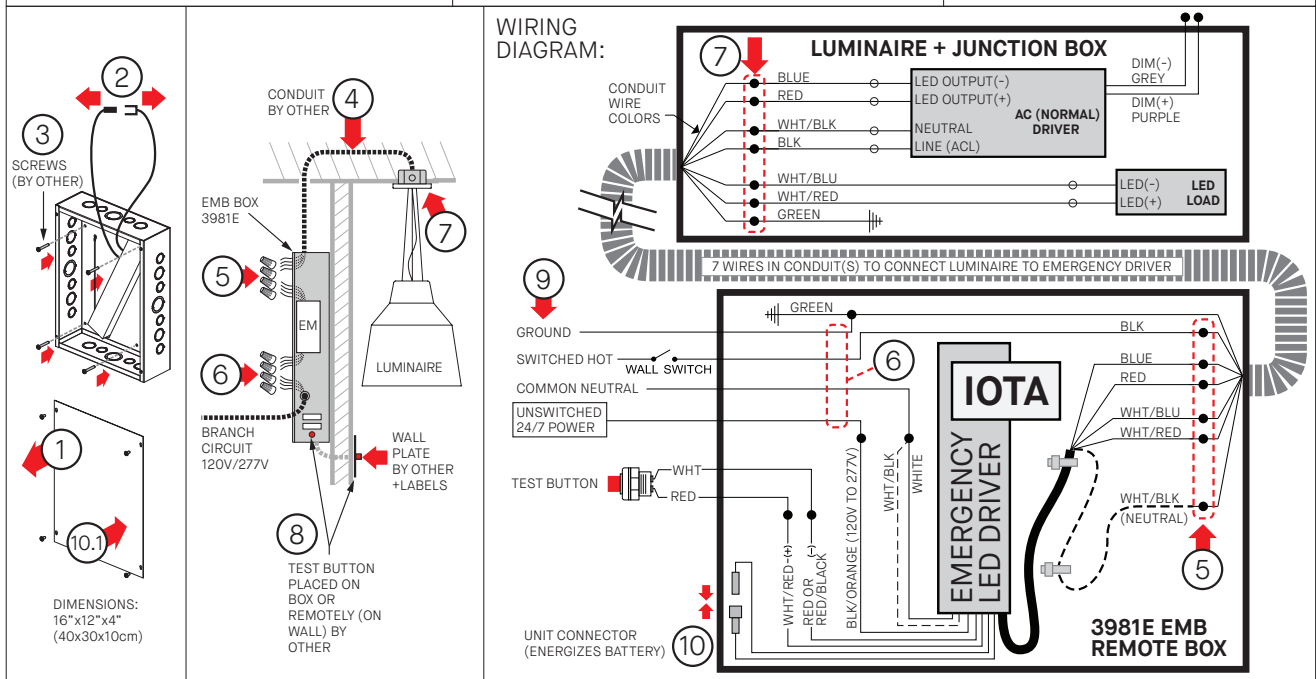
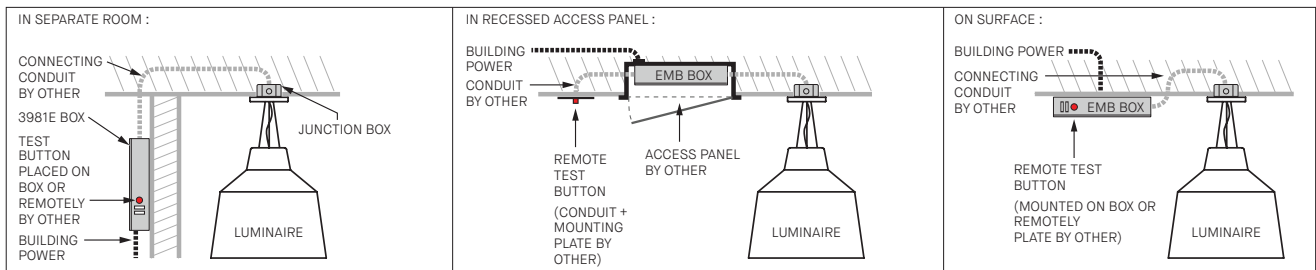
EMB LOCATION :

- > The 3981E box connects to a luminaire ordered with an EMB option (which has specific EM WIRING).
- > Consult our chart for maximum remote distance of EM battery to luminaire leds.
- > Establish desired location for EMB box & EM test button on box or on a wall.

EM Remote Distance Chart

MAX EM BOX DISTANCE (Ft)	LUMINAIRE DRIVER OUTPUT CURRENT* (Amps)	CONDUIT WIRE GAUGE (AWG)							
		10	12	14	16	18	20	22	
200mA		1043'	651'	413'	259'	163'	103'	65'	
350mA		596'	372'	236'	148'	93'	59'	37'	
500mA		417'	261'	165'	104'	65'	41'	26'	
700mA		298'	186'	118'	74'	47'	29'	18'	
1000mA		209'	130'	83'	52'	33'	21'	13'	
*Contact Eureka	1400mA	149'	93'	59'	37'	23'	15'	9'	
	2000mA	104'	65'	41'	26'	16'	10'	6'	
	3000mA	70'	43'	28'	17'	11'	7'	4'	

EMB PLACEMENT EXAMPLES :



INSTALLATION

- 1 - REMOVE BOX COVER.
- 2 - IF CONNECTED, DISCONNECT THE EM BATTERY 'UNIT CONNECTOR' (WHITE).
- 3 - SCREW BOX TO MOUNTING SURFACE (SCREWS NOT SUPPLIED)
- 4 - RUN CONDUIT FROM EMB BOX TO ELECTRICAL JUNCTION BOX OF LUMINAIRE. CONDUIT MUST HAVE MIN. 7 WIRES AND WIRE GAUGE AS PER DISTANCE CHART.
- 5 - CONNECT CONDUIT WIRES TO EM BATTERY AS PER WIRING DIAGRAM.
CAREFULLY NOTE WHICH WIRE COLORS ARE CONNECTED TOGETHER ON EACH END.
- 6 - CONNECT BATTERY TO AC BRANCH CIRCUIT : GROUND, NEUTRAL, 24/7 UNSWITCHED LINE (HOT) AND SWITCHED LINE (ON SAME CIRCUIT AS LUMINAIRE ON/OFF CONTROL).
- 7 - INSTALL SPECIFIC EM LUMINAIRE, CONNECT WIRES TO CONDUIT USING THE SAME CORRESPONDING COLORS NOTED AT THE EM BATTERY-CONDUIT CONNECTION.
- 8 - INSTALL EM BATTERY TEST BUTTON IN DESIRED LOCATION. WALL PLATE BY OTHER. ADD LABELS "PUSH TO TEST" & CHARGING INDICATOR LIGHT".

- 9 - SWITCH ON AC POWER.
- 10 - JOIN THE EM BATTERY CONVERTOR CONNECTOR. 10.1 - INSTALL BOX COVER.
- 11 - IF EMB IS FAR FROM THE LUMINAIRE, IDENTIFY TO WHICH LUMINAIRE IT IS CONNECTED.

AT THIS POINT POWER SHOULD BE CONNECTED TO BOTH THE AC DRIVER AND THE EMERGENCY DRIVER & TEST/CHARGE LIGHT SHOULD ILLUMINATE, INDICATING BATTERY IS CHARGING.

TESTING & EM DRIVER/BATTERY MAINTENANCE:

CONDUCT A SHORT-TERM DISCHARGE TEST AFTER THE EMERGENCY DRIVER HAS BEEN CHARGED FOR MINIMUM ONE HOUR. CHARGE FOR 24 HOURS BEFORE CONDUCTING A LONG-TERM DISCHARGE TEST.

FOLLOW GUIDELINES FROM THE EM DRIVER/BATTERY MANUFACTURER INSTRUCTIONS FOR THE REQUIRED PERIODIC TESTING AND MAINTENANCE GUIDELINES.

EUREKA

INSTALLATION

P3

3981E BOÎTE D'URGENCE À DISTANCE - DRIVER EM IOTA

DIRECTIVES DE SÉCURITÉ:

- > Suivre les consignes de sécurité et les directives d'installation du fabricant de la batterie d'urgence.
- > Installer par du personnel qualifié conformément au code électrique national et local.
- > Fermer l'alimentation avant l'installation ou l'entretien.

EMPLACEMENT :

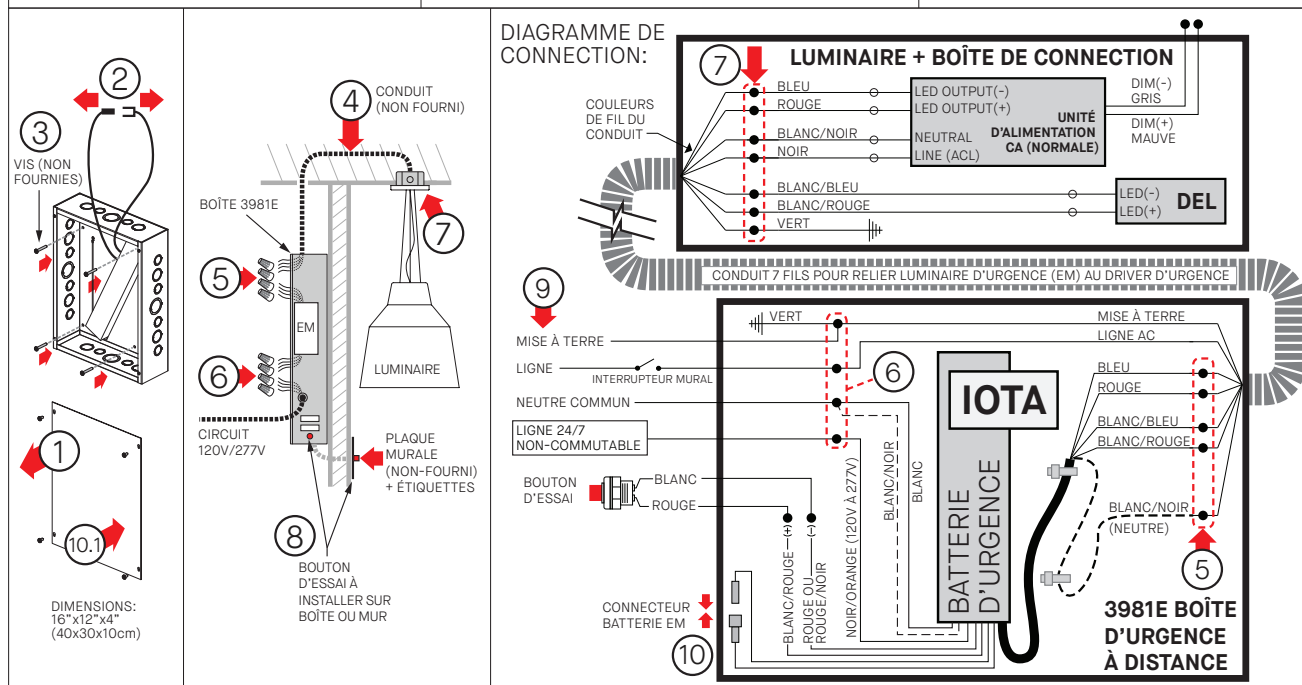
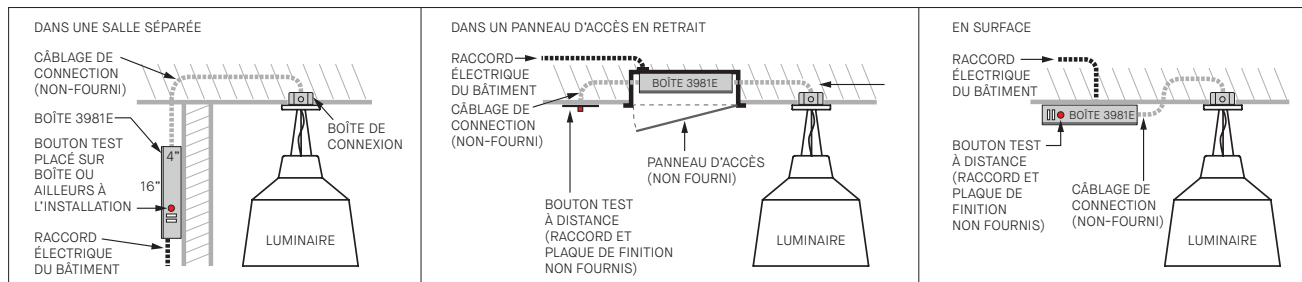
- > Cette boîte 3981E se connecte à un luminaire commandé avec l'option EMB (qui a du filage spécifique).
- > Consulter le tableau pour la distance maximale de la batterie d'urgence aux DELs du luminaire.
- > Déterminer l'emplacement souhaité pour la boîte EMB et le bouton de test d'urgence.

Charte de distance d'installation EM

Distance maximale entre Batterie d'urgence et DELs du luminaire (Pi)

DISTANCE MAX D'INSTALLATION (Pi)	GAUGE DE FILS DU CONDUIT (AWG)						
	10	12	14	16	18	20	22
COURANT	200mA	1043'	651'	413'	259'	163'	103'
ALIMENTATION DU LUMINAIRE*	350mA	596'	372'	236'	148'	93'	59'
(Amp)	500mA	417'	261'	165'	104'	65'	41'
	700mA	298'	188'	118'	74'	47'	29'
	1000mA	209'	130'	83'	52'	33'	21'
*Contacter Eureka	1400mA	149'	93'	59'	37'	23'	15'
	2000mA	104'	65'	41'	26'	16'	10'
	3000mA	70'	43'	28'	17'	11'	7'

EXEMPLES D'EMPLACEMENT:



INSTALLATION

- 1 - DÉVISSER LE COUVERCLE.
- 2 - DÉCONNECTER LE CONNECTEUR BLANC DE BATTERIE EM (UNIT CONNECTOR).
- 3 - FIXER LA BOÎTE SUR LE MUR/PALFOND AVEC VIS (NON FOURNIES)
- 4 - PASSER DU CONDUIT DU EMB VERS LA BOÎTE DE CONNEXION ÉLECTRIQUE DE LUMINAIRE. LE CONDUIT DOIT AVOIR 7 FILS AVEC GAUGE DE FIL SELON CHARTRE DE DISTANCE.
- 5 - CONNECTER LES FILS DE CONDUIT À LA BATTERIE EM SELON LE SCHÉMA DE CÂBLAGE.
- 6 - CONNECTER LA BATTERIE AU CIRCUIT DE DÉRIVATION AC (FILS: MISE À LA TERRE, NEUTRE, LIGNE & LIGNE SANS INTERRUPTEUR 24H/7* (*DOIT ÊTRE LE MEME CIRCUIT QUE LE CONTROLE DU LUMINAIRE)).
- 7 - INSTALLER LUMINAIRE SPÉCIFIQUE EM, CONNECTER LES FILS AU CONDUIT AVEC MÊMES COULEURS CORRESPONDANTES DE LA BATTERIE EM AUX FILS DE CONDUIT.
- 8 - INSTALLEZ LE BOUTON D'ESSAI DE BATTERIE EM DANS L'ENDROIT SOUHAITÉ (PLAQUE MURALE PAR AUTRE). COLLER ÉTIQUETTES "PUSH TO TEST" & CHARGING INDICATOR LIGHT".

- 9 - ALIMENTER LE CIRCUIT AC.
- 10 - JOINDRE CONNECTEUR BLANC DE BATTERIE EM. 10.1 - INSTALLER COUVERCLE DE BOITE.
- 11 - SI LE EMB EST LOIN DU LUMINAIRE, IDENTIFIER À QUEL LUMINAIRE IL EST CONNECTÉ.

A CE STADE, L'ALIMENTATION DEVRAIT ÊTRE CONNECTÉE À L'UNITÉ D'ALIMENTATION AC ET LA BATTERIE D'URGENCE ET LA LUMIÈRE DE TEST/CHARGE S'ILLUMINE, INDICANT QUE LA BATTERIE SE CHARGE.

ESSAIS & ENTRETIEN DE LA BATTERIE:

FAITES UN TEST DE DÉCHARGE À COURT TERME APRÈS AVOIR CHARGÉ LA BATTERIE D'URGENCE AU MINIMUM UNE HEURE. CHARGEZ 24 HEURES AVANT D'EFFECTUER UN TEST DE DÉCHARGE À LONG TERME.

SUIVRE LES DIRECTIVES DU FABRICANT DE BATTERIE / CONDUCTEUR EM (SITE WEB) POUR LES DIRECTIVES PÉRIODIQUES REQUISES EN MATIÈRE DE TEST ET D'ENTRETIEN.



LINEAR FIXTURE TRACK - MOUNTING & ACCESSORIES

Other Manufacturers:
CORONET "MULTI" Series
LUMENWERX "PIVOT SURFACE" Series



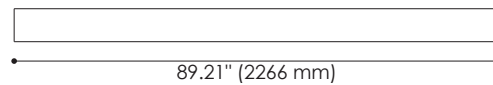
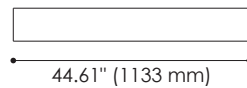
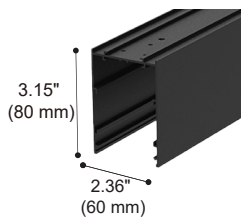
LFT60

The LFT 60 Series provides innovative mechanics for display lighting solutions, with its simplistic trimless and trimmed track section mounting and accessories installation. Whether recessed, pendant or surface mounted, each track section and a vast range of accessories correspond to each mounting option for every fixture within the LFT 60 Series adding a harmonious visual experience.



MOUNTING SPECIFICATIONS

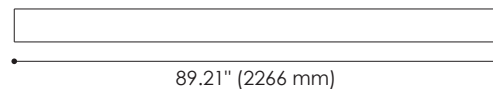
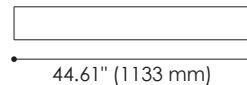
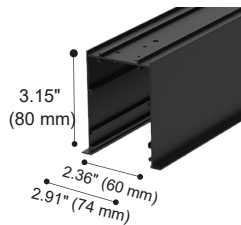
TRIMLESS: LFT-T-11



TRIMLESS TRACK SECTION

Article number	TYPE
LFT-T-11-44	Channel
LFT-T-11-89	Channel

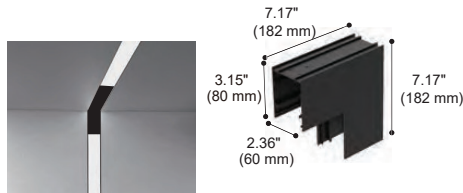
TRIM: LFT-F-11



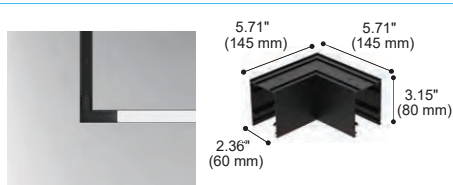
TRIMMED TRACK SECTION

Article number	TYPE
LFT-F-11-44	Channel
LFT-F-11-89	Channel

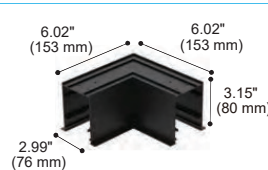
PANEL MOUNTING SPECIFICATIONS



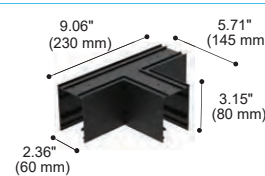
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Type : 7 Type vertical corner



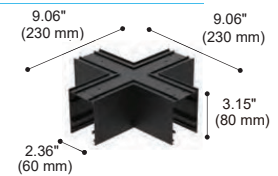
SKU : LFT-T-12
Type : L Type horizontal connector



SKU : LFT-F-12
Type : T Type horizontal connector



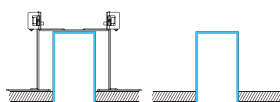
SKU : LFT-T-14
Type : T Type horizontal connector



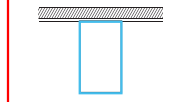
SKU : LFT-T-15
Type : X Type horizontal connector

MOUNTING OPTIONS

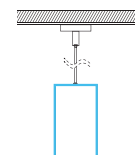
Recessed



Surface mounted



Pendant



LINEAR FIXTURE TRACK - MOUNTING & ACCESSORIES



LFT60

ACCESSORIES

ALL MODELS

3PCS
SKU : LFT-NC-02
Type : Surface mounted & Pendant reinforced plate

SKU : LFT-NC-07
Type : Light Leak-proof aluminium extrusion reinforce plate

Colours
● Black ○ White

SKU : LFT-NE-02-11 11.14" (283 mm)
LFT-NE-02-22 22.28" (566 mm)
Type : Blank cover

SKU : LFT-SA-41
Type : Power cord connector

SKU : LFT-PA-41-180 71" (1800 mm)
Type : Power cord connect to AC

SKU : LFT-SA-41-30 12" (300 mm)
LFT-SA-41-60 24" (600 mm)
Type : Power cord connect between modules

SKU : LFT-PSA-31-180 71" (1800 mm)
Type : Signal wire connect to system / dimmer

SKU : LFT-SSA-31-30 12" (300 mm)
LFT-SSA-31-60 24" (600 mm)
Type : Signal wire connect between modules

PENDANT

SKU : LFT-DI-15
Type : Pendant Kit for power connection (without power cord)

SKU : LFT-DI-15-V
Type : Pendant Kit for power connection (without power cord and single wire)

SKU : LFT-DI-16
Type : Pendant kit

TRIM

2PCS
SKU : LFT-NC-05
Type : Trim end cap

TRIMLESS

2PCS
SKU : LFT-NC-03
Type : End cap

2PCS
SKU : LFT-NR-01
Type : Trimless bracket

MOUNTABLE FIXTURES



LINEAR FIXTURE TRACK - MOUNTING & ACCESSORIES

Other Manufacturers:
CORONET "MULTI UP/DN" Series
LUMENWERX "PIVOT PENDANT" Series



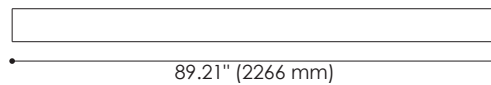
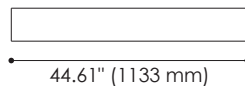
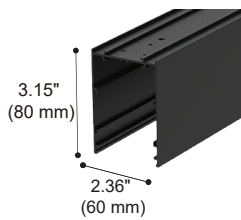
LFT60

The LFT 60 Series provides innovative mechanics for display lighting solutions, with its simplistic trimless and trimmed track section mounting and accessories installation. Whether recessed, pendant or surface mounted, each track section and a vast range of accessories correspond to each mounting option for every fixture within the LFT 60 Series adding a harmonious visual experience.



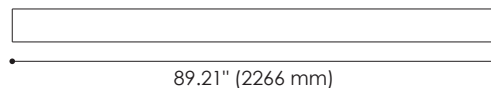
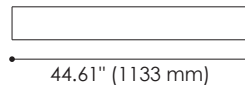
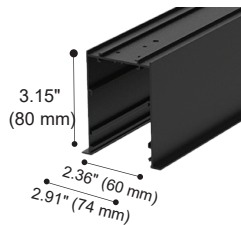
MOUNTING SPECIFICATIONS

TRIMLESS: LFT-T-11



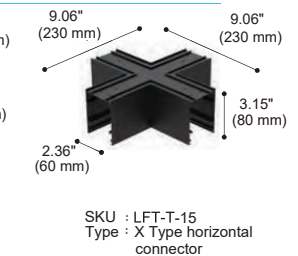
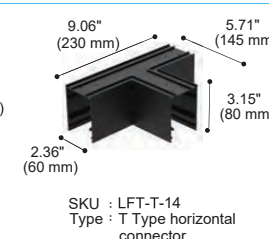
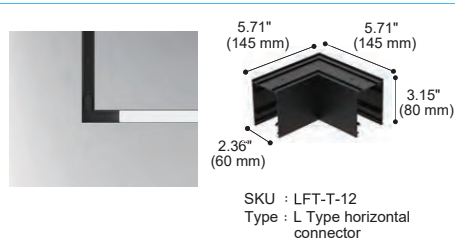
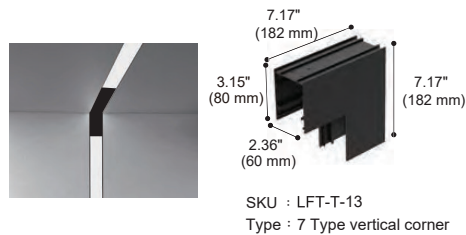
TRIMLESS TRACK SECTION	
Article number	TYPE
LFT-T-11-44	Channel
LFT-T-11-89	Channel

TRIM: LFT-F-11

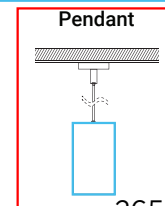
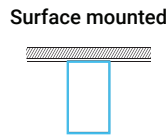
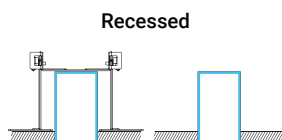


TRIMMED TRACK SECTION	
Article number	TYPE
LFT-F-11-44	Channel
LFT-F-11-89	Channel

PANEL MOUNTING SPECIFICATIONS



MOUNTING OPTIONS



LUMINAIRE PRODUCT DATA

LFT Series

YYZ Lighting Inc., 1175 Squires Beach Rd., Unit 2, Pickering, ON, Canada. L1W 3V3
www.yyzlighting.com

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LINEAR FIXTURE TRACK - MOUNTING & ACCESSORIES



LFT60

ACCESSORIES

ALL MODELS

3PCS
SKU : LFT-NC-02
Type : Surface mounted & Pendant reinforced plate

SKU : LFT-NC-07
Type : Light Leak-proof aluminium extrusion reinforce plate

Colours
Black White

SKU : LFT-NE-02-11 11.14" (283 mm)
LFT-NE-02-22 22.28" (566 mm)
Type : Blank cover

SKU : LFT-SA-41
Type : Power cord connector

SKU : LFT-PA-41-180 71" (1800 mm)
Type : Power cord connect to AC

SKU : LFT-SA-41-30 12" (300 mm)
LFT-SA-41-60 24" (600 mm)
Type : Power cord connect between modules

SKU : LFT-PSA-31-180 71" (1800 mm)
Type : Signal wire connect to system / dimmer

SKU : LFT-SSA-31-30 12" (300 mm)
LFT-SSA-31-60 24" (600 mm)
Type : Signal wire connect between modules

PENDANT

SKU : LFT-DI-15
Type : Pendant Kit for power connection (without power cord)

SKU : LFT-DI-15-V
Type : Pendant Kit for power connection (without power cord and single wire)

SKU : LFT-DI-16
Type : Pendant kit

TRIM

2PCS
SKU : LFT-NC-05
Type : Trim end cap

TRIMLESS

2PCS
SKU : LFT-NC-03
Type : End cap

2PCS
SKU : LFT-NR-01
Type : Trimless bracket

MOUNTABLE FIXTURES



LINEAR FIXTURE TRACK - MOUNTING & ACCESSORIES

Other Manufacturers:
CORONET "MULTI RECESSED" Series
LUMENWERX "PIVOT RECESSED" Series



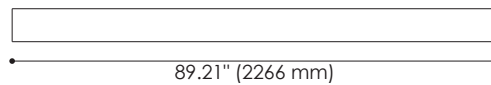
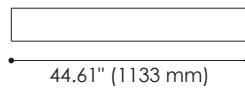
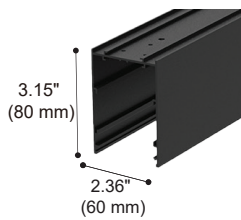
LFT60

The LFT 60 Series provides innovative mechanics for display lighting solutions, with its simplistic trimless and trimmed track section mounting and accessories installation. Whether recessed, pendant or surface mounted, each track section and a vast range of accessories correspond to each mounting option for every fixture within the LFT 60 Series adding a harmonious visual experience.



MOUNTING SPECIFICATIONS

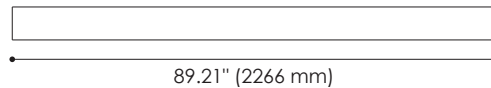
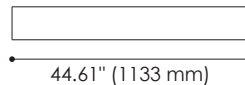
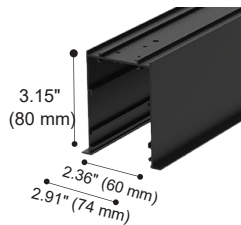
TRIMLESS: LFT-T-11



TRIMLESS TRACK SECTION

Article number	TYPE
LFT-T-11-44	Channel
LFT-T-11-89	Channel

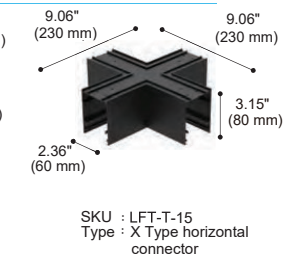
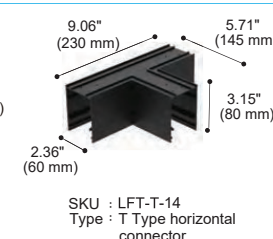
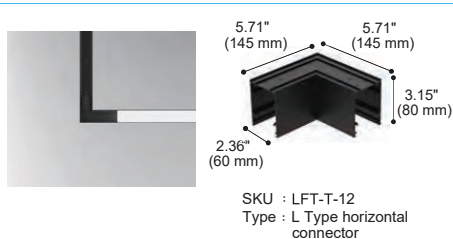
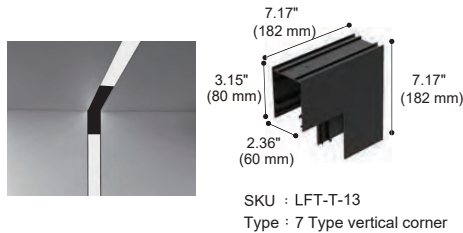
TRIM: LFT-F-11



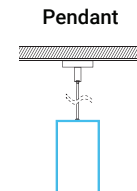
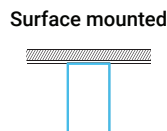
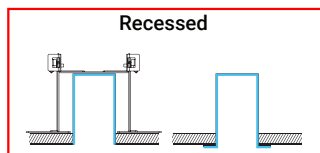
TRIMMED TRACK SECTION

Article number	TYPE
LFT-F-11-44	Channel
LFT-F-11-89	Channel

PANEL MOUNTING SPECIFICATIONS



MOUNTING OPTIONS



LUMINAIRE PRODUCT DATA

LFT Series

YYZ Lighting Inc., 1175 Squires Beach Rd., Unit 2, Pickering, ON, Canada. L1W 3V3
www.yyzlighting.com

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Page 1 of 2

LINEAR FIXTURE TRACK - MOUNTING & ACCESSORIES



LFT60

ACCESSORIES

ALL MODELS

3PCS
SKU : LFT-NC-02
Type : Surface mounted & Pendant reinforced plate

SKU : LFT-NC-07
Type : Light Leak-proof aluminium extrusion reinforce plate

Colours
Black White

SKU : LFT-NE-02-11 11.14" (283 mm)
LFT-NE-02-22 22.28" (566 mm)
Type : Blank cover

SKU : LFT-SA-41
Type : Power cord connector

SKU : LFT-PA-41-180 71" (1800 mm)
Type : Power cord connect to AC

SKU : LFT-SA-41-30 12" (300 mm)
LFT-SA-41-60 24" (600 mm)
Type : Power cord connect between modules

SKU : LFT-PSA-31-180 71" (1800 mm)
Type : Signal wire connect to system / dimmer

SKU : LFT-SSA-31-30 12" (300 mm)
LFT-SSA-31-60 24" (600 mm)
Type : Signal wire connect between modules

PENDANT

SKU : LFT-DI-15
Type : Pendant Kit for power connection (without power cord)

SKU : LFT-DI-15-V
Type : Pendant Kit for power connection (without power cord and single wire)

SKU : LFT-DI-16
Type : Pendant kit

TRIM

2PCS
SKU : LFT-NC-05
Type : Trim end cap

TRIMLESS

2PCS
SKU : LFT-NC-03
Type : End cap

2PCS
SKU : LFT-NR-01
Type : Trimless bracket

MOUNTABLE FIXTURES



Other Manufacturers:
CORONET "MULTI" Series
LUMENWERX "PIVOT" Series



MYRIAD TRACK LIGHT

MRD

Mono IP20 CE

YYZ myriad track lights houses driver unit to the track adapter allowing better thermal performance and hence the light output.

Options of various optics on a 1-circuit, 3-circuit adapter with wide range of dimming options makes the system versatile.



FEATURES

FINISH	BLACK, GREY, WHITE
WORKING VOLTAGE	220-240V 50/60Hz
RATED POWER	20W
RADIANCE ANGLE	NARROW, MEDIUM, WIDE, ULTRA WIDE
LAMP LIFE	50,000 HRS
MOUNTING	TRACK MOUNTED
CONNECTION	INDOOR RATED CONNECTIONS
DIMENSIONS	Ø58 x 188 x 185mm
OPERATION TEMP	-20° C - +50° C
CONTROL	ON/OFF, TRIAC, 1-10V, DALI

CITIZEN/LUMILEDS
LED Quality

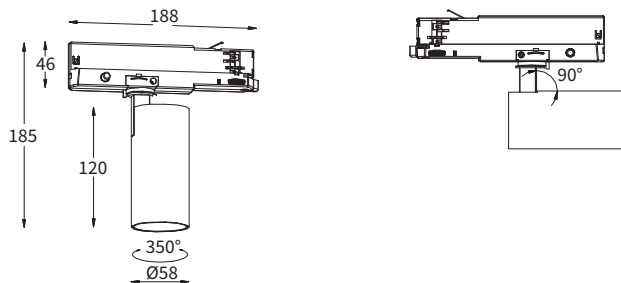
240 VOLTS
Working Voltage

20 W
Rated power

ELECTRICAL DATA

POWER CONSUMPTION	20W
SUPPLY VOLTAGE	220-240VAC
COLORS	2700K, 3000K, 3500K, 4000K
CRI	90+
LUMEN	90lm/W

DIMENSIONS



ORDERING LOGIC

FINISH TO BE
SELECTED BY
ARCHITECT

PRODUCT	CONTROL	WATTAGE	COLOR TEMPERATURE	VOLTAGE	BEAM ANGLE	FINISH	ACCESSORIES
MRD-20	ON/OFF	20 - 20W	(CT27) 2700K	240VAC	N - Narrow	BL - Black	HCL - Honey Combo Louver
	TRIAC		(CT30) 3000K		120V	M - Medium	GR - Grey
	1-10V	(CT35) 3500K	W - Wide	WH - White	WWV - Wall Washer Visor		
	DALI	(CT40) 4000K	UW - Ultra wide		SP - Spread Lens	BD - Barn Doors	

Sample: MRD-20 - ON/OFF - 20 - CT27 - 240 - N - BL - HCL - XX



LINEAR FIXTURE TRACK - PA SPEC SHEET

Other Manufacturers:
CORONET "MULTI" Series
LUMENWERX "PIVOT" Series



LFT60-P



The LFT60-P Series is a seamless collection of diffused linear fixture panels with exceptional lighting performance within any setting. With its wide range of track mounting options, the LFT60-P is compatible with recessed, surface and suspended pendant mounting. The series is equipped with dimming and standard color temperature of 3000K. The LFT60-P12 in particular is a diffused linear fixture panel with a length of 566mm and a power rating of 18 Watts.



LFT60-P12

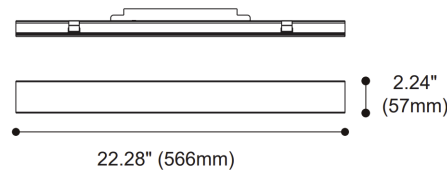
SPECIFICATIONS

OPERATING VOLTAGE	120 VAC
POWER	18W
CONTROL	0/1-10 V Dimming
LUMEN	948 lm
CRI	90+
FINISH	Black, White
MOUNTING	Track Mounted
BEAM	100°

V 120 VAC
Operating Voltage

W 18W
Rated Power

DIMENSIONS



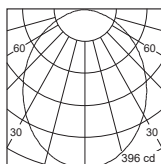
ORDERING CODE

FINISH TO BE
SELECTED BY
ARCHITECT

SERIES	TYPE	POWER	VOLTAGE	CRI	COLOR TEMPERATURE	BEAM ANGLE	TRACK MOUNTING	FINISH
LFT60	P12 - Panel 12	18W - 18 WATTS	AC - 120VAC	90 - CRI90	CT30 - 3000K CTXX - CUSTOM CT35 - 3500K	100D-100 DEGREES	RM - Recessed Mount SM - Surface Mount PM - Pendant Mount	BK - BLACK WH - WHITE

Sample: LFT 60-P12 - 18W - AC - 90 - CT30 - 100D - SM - BK

DIAGRAM



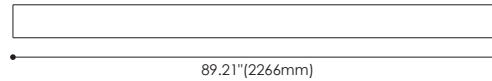
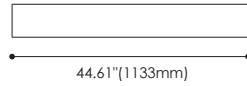
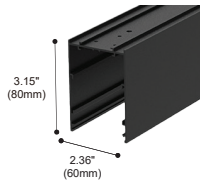
LINEAR FIXTURE TRACK - MOUNTING & ACCESSORIES



LFT60-P

MOUNTING OPTIONS

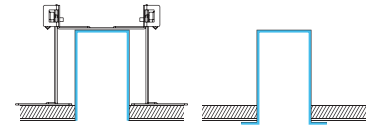
TRIMLESS: LFT-T-11



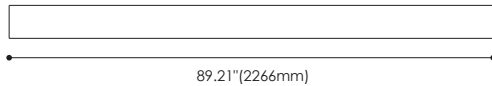
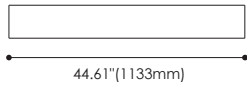
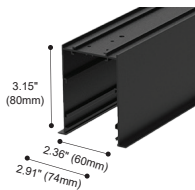
TRIMLESS TRACK SECTION

Article number	TYPE
LFT-T-11-44	Channel
LFT-T-11-89	Channel

Recessed



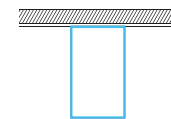
TRIM: LFT-F-11



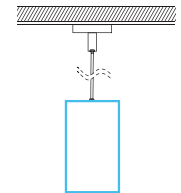
TRIMMED TRACK SECTION

Article number	TYPE
LFT-F-11-44	Channel
LFT-F-11-89	Channel

Surface mounted

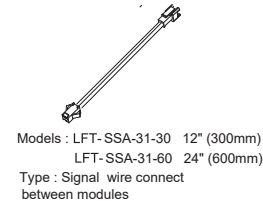
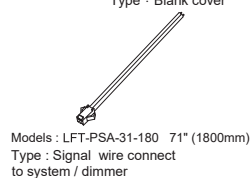
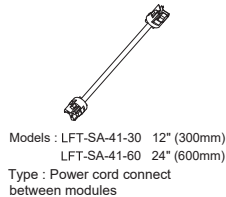
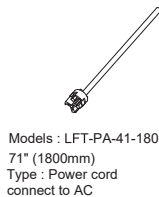
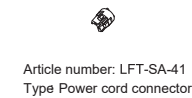
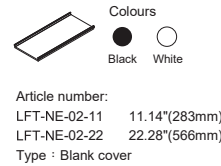
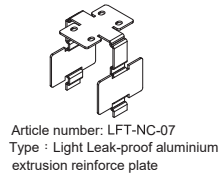
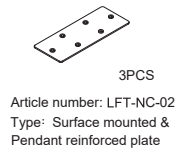
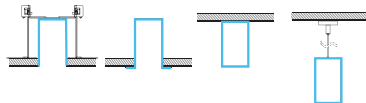


Pendant

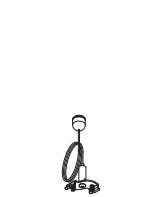
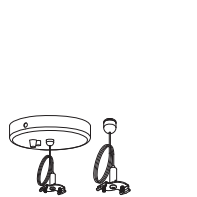
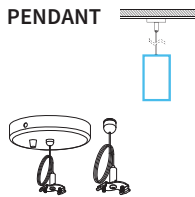


ACCESSORIES

COMMON



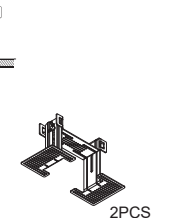
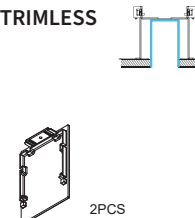
PENDANT



TRIM



TRIMLESS



LINEAR FIXTURE TRACK - SP SPEC SHEET

LFT60-S

Other Manufacturers:
CORONET "MULTI" Series
LUMENWERX "PIVOT" Series



The LFT60-S Series is a range of spotlight solution ideal for galleries or focus lighting on specific subject or wall. With its wide range of track mounting options, the LFT60-S are compatible with recessed, surface and suspended pendant mounting. The series is equipped with dimming and standard color temperature of 3000K. With the versatility of 355-degree rotation and 90-degree tilt angle, the LFT60-S Series can direct its light to almost any direction. The LFT60-S1 in particular has one light engine with a power rating of 10 Watts and has three beam angles options.



LFT60-S1

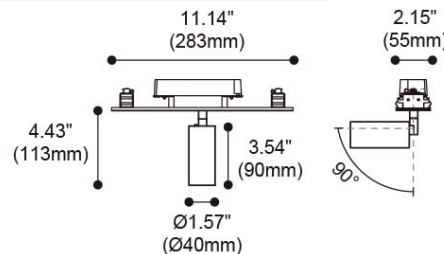
SPECIFICATIONS

OPERATING VOLTAGE	120 VAC
POWER	10W
UGR	<19
CONTROL	0/1-10 V Dimming
LUMEN	567 lm
CRI	90+
FINISH	Black, White
BAFFLE FINISH	Black, White, Copper
MOUNTING	Track Mounted
BEAM	20° / 25° / 36°
ROTATION	355°
ANGLE	90°

V 120 VAC
Operating Voltage

W 10W
Rated Power

DIMENSIONS



ORDERING CODE

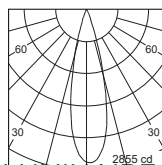
FINISH TO BE
SELECTED BY
ARCHITECT

SERIES	TYPE	POWER	VOLTAGE	CRI	COLOR TEMPERATURE	BEAM ANGLE	TRACK MOUNTING	FINISH	BAFFLE
LFT60	S1 - Spot 1	10W - 10 WATTS	AC - 120VAC	90 - CRI90	CT30 - 3000K	20D - 20 DEGREES	RM - Recessed Mount	BK - BLACK	BK - BLACK
					CTXX - CUSTOM	25D - 25 DEGREES	SM - Surface Mount	WH - WHITE	WH - WHITE
					CT35 - 3500K	36D - 36 DEGREES	PM - Pendant Mount	CO - COPPER	CO - COPPER

Sample: LFT 60-S1 - 10W - AC - 90 - CT30 - 20D - SM - BK - CO - ACHO-13

ACCESSORIES		
ACSN-11	-	Long Baffle
ACSG-9	-	Striped Glass
ACWG-10	-	Woven Glass
ACDS-8	-	Diffusion Sheet
ACHO-13	-	Honeycomb Louver

DIAGRAM



ACCESSORIES



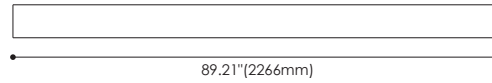
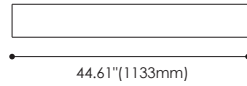
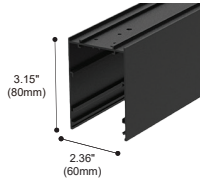
LINEAR FIXTURE TRACK - MOUNTING & ACCESSORIES



LFT60-S

MOUNTING OPTIONS

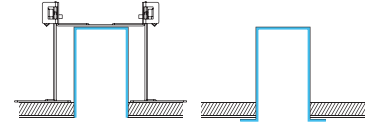
TRIMLESS: LFT-T-11



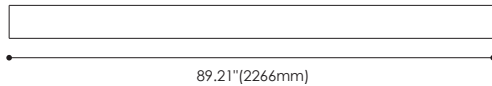
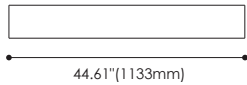
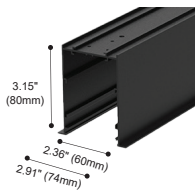
TRIMLESS TRACK SECTION

Article number	TYPE
LFT-T-11-44	Channel
LFT-T-11-89	Channel

Recessed



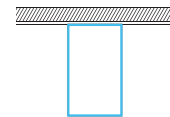
TRIM: LFT-F-11



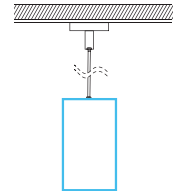
TRIMMED TRACK SECTION

Article number	TYPE
LFT-F-11-44	Channel
LFT-F-11-89	Channel

Surface mounted

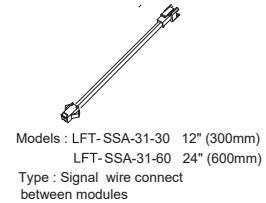
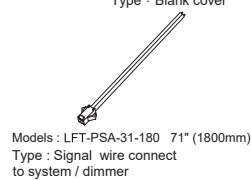
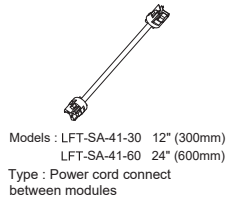
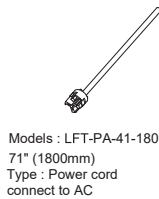
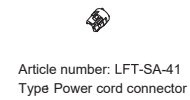
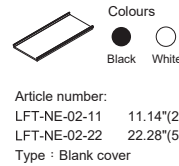
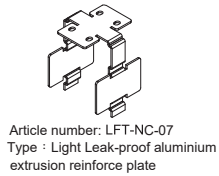
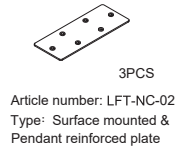
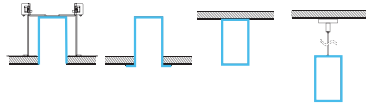


Pendant

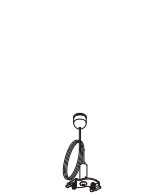
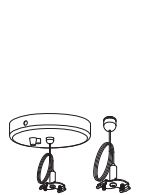
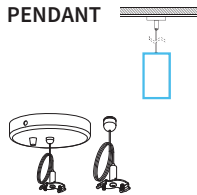


ACCESSORIES

COMMON



PENDANT



TRIM



TRIMLESS



LINEAR FIXTURE TRACK - SP SPEC SHEET

Other Manufacturers:
CORONET "MULTI" Series
LUMENWERX "PIVOT" Series



LFT60-S



The LFT60-S Series is a range of spotlight solution ideal for galleries or focus lighting on specific subject or wall. With its wide range of track mounting options, the LFT60-S are compatible with recessed, surface and suspended pendant mounting. The series is equipped with dimming and standard color temperature of 3000K. With the versatility of 355-degree rotation and 90-degree tilt angle, the LFT60-S Series can direct its light to almost any direction. The LFT60-S1-2 in particular has two light engines with a power rating of 17 Watts and has three beam angles options.



LFT60-S1-2

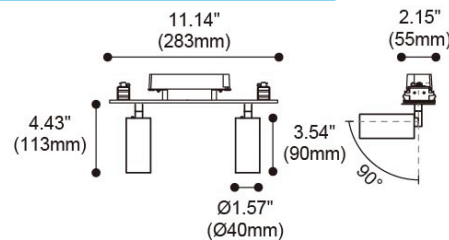
SPECIFICATIONS

OPERATING VOLTAGE	120 VAC
POWER	17W
UGR	<19
CONTROL	0/1-10 V Dimming
LUMEN	1147 lm
CRI	90+
FINISH	Black, White
BAFFLE FINISH	Black, White, Copper
MOUNTING	Track Mounted
BEAM	20° / 25° / 36°
ROTATION	355°
ANGLE	90°

V 120 VAC
Operating Voltage

W 17W
Rated Power

DIMENSIONS



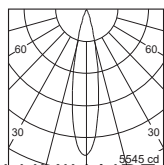
ORDERING CODE

FINISH TO BE
SELECTED BY
ARCHITECT

SERIES	TYPE	POWER	VOLTAGE	CRI	COLOR TEMPERATURE	BEAM ANGLE	TRACK MOUNTING	FINISH	BAFFLE
LFT60	S1-2 - Spot 1-2	17W - 17 WATTS	AC - 120VAC	90 - CRI90	CT30 - 3000K	20D - 20 DEGREES	RM - Recessed Mount	BK - BLACK	BK - BLACK
					CTXX - CUSTOM	25D - 25 DEGREES	SM - Surface Mount	WH - WHITE	WH - WHITE
					CT35 - 3500K	36D - 36 DEGREES	PM - Pendant Mount		CO - COPPER

Sample: LFT 60-S1-2 - 17W - AC - 90 - CT30 - 20D - SM - BK - CO - ACHO-13

DIAGRAM



ACCESSORIES	
ACSN-11	Long Baffle
ACSG-9	Striped Glass
ACWG-10	Woven Glass
ACDS-8	Diffusion Sheet
ACHO-13	Honeycomb Louver

ACCESSORIES



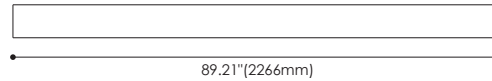
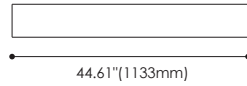
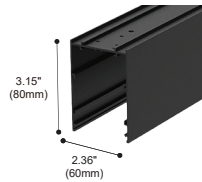
LINEAR FIXTURE TRACK - MOUNTING & ACCESSORIES



LFT60-S

MOUNTING OPTIONS

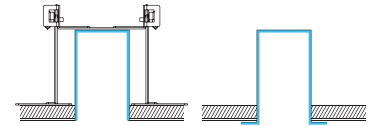
TRIMLESS: LFT-T-11



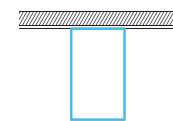
TRIMLESS TRACK SECTION

Article number	TYPE
LFT-T-11-44	Channel
LFT-T-11-89	Channel

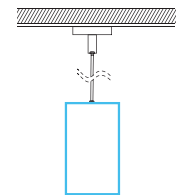
Recessed



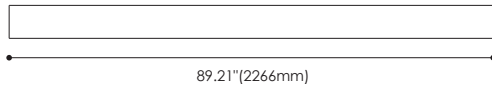
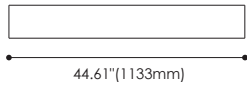
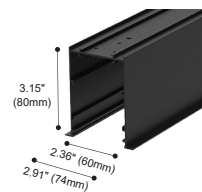
Surface mounted



Pendant



TRIM: LFT-F-11

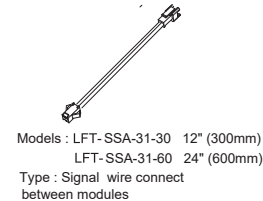
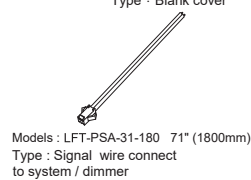
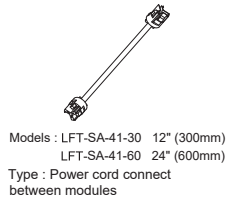
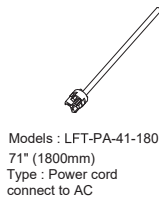
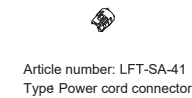
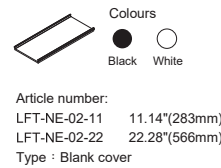
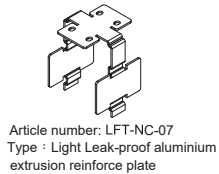
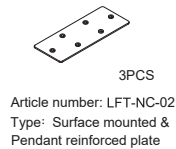
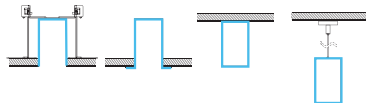


TRIMMED TRACK SECTION

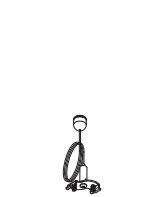
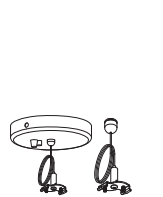
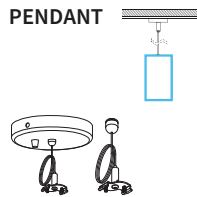
Article number	TYPE
LFT-F-11-44	Channel
LFT-F-11-89	Channel

ACCESSORIES

COMMON



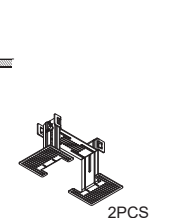
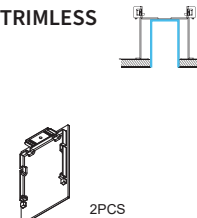
PENDANT



TRIM



TRIMLESS



LFX AC120V OUTDOOR SPEC SHEET



LFX-AC



Our LFX series flexible linear LED light strips is a simple, effective solution for a wide range of lighting applications where crisp, single colour light is desired. Ideal for indirect accent lighting, as well as a store fixtures, display cases, steps, and stairwells, furniture, kitchen and cabinet lighting, along with other task and specialty applications.

FEATURES

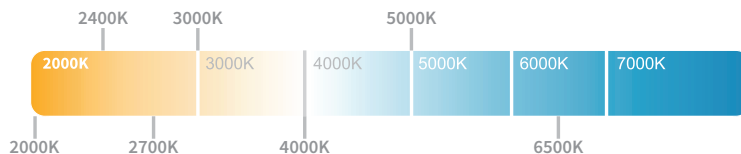
BENDING DIAMETER	Ø50mm
RESISTANT	IP65 (Water Proof) UL94 VO (Flame Resistant) UV Resistant Solvents Resistant Saltwater Resistant
BEAM ANGLE	150°
WARRANTY	3 Years

TECHNICAL DATA

OPERATING VOLTAGE	AC120V, 60Hz	
LED Qty/ft	36 LEDs/ft (120LEDs/m)	
LED TYPE	SMD 2835	
CRI	CRI>90	CRI>95
RATED POWER/ft	<4W/ft	<4W/ft
LIGHT EFFICIENCY ±10%	100Lm/W	90Lm/W
LED DISTANCE	0.33" (8.33mm)	
MIN. CUTTING LED	12 LEDs	
MIN. CUTTING LENGTH	4" (10cm)	
BINNING	3 Step Binning	
WEIGHT/ft	0.088 lb/ft (40g)	
STORAGE TEMPERATURE	-13~140°F (-20~60°C)	
WORKING TEMPERATURE	-4~113°F (-20~45°C)	
IP RATING	IP65 (uncut) void if cut	
COLOR	2000K, 2400K, 2725K, 3045K, 4000K, 5000K, 6500K	

COLOR TEMPERATURE DATA

Colour	Wavelength	CCT	Lumen/ft (CRI 90)	Lumen/ft (CRI 95)
Ultra WW	/	2000K±100K	290 lm/ft	270 lm/ft
Super WW	/	2400K±100K	320 lm/ft	300 lm/ft
Warm White	/	2725K±100K	360 lm/ft	322 lm/ft
Warm White	/	3045K±150K	380 lm/ft	346 lm/ft
Natural White	/	4000K±150K	400 lm/ft	360 lm/ft
Day White	/	5000K±200K	402 lm/ft	365 lm/ft
Cool White	/	6500K±250K	405 lm/ft	405 lm/ft
RED	620-630nm	/	/	/
GREEN	520-530nm	/	/	/
BLUE	465-475nm	/	/	/
AMBER	585-595nm	/	/	/



SMD 2835
LED Quality

AC 120V, 60Hz
Operating Voltage

4W / ft
Rated Power

Application



LFX AC120V OUTDOOR SPEC SHEET

Other Manufacturers:
CORONET "MULTI" Series
LUMENWERX "PIVOT" Series



LFX-AC

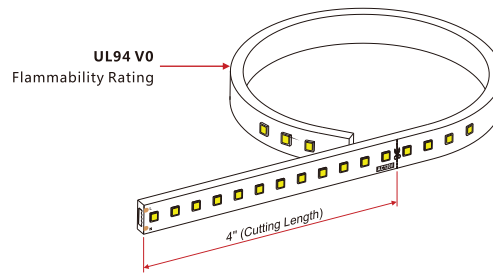
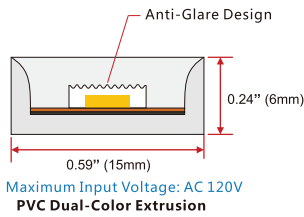
ORDERING LOGIC

CT35 - 3500K

PRODUCT SERIES	TYPE	POWER	COLOR TEMPERATURE		LED TYPE	BIN	NO. OF LED	VOLTAGE	CIRCUIT	PCB	CRI	NO. OF LED ROWS	CONNECTION
LFX	O-OUTDOOR (PVC)	4W - <4W/ft	(CT20)	2000K	2835-SMD 2835	Z3 - 3 Step Binning	36 - 36/ft	120 - 120V	AC - Alternating Current	15 - 15mm (0.59")	H - HIGH (90) VH - VHIGH (95)	1 - 1per row	PL - Plug HW - Hardwire
			(CT24)	2400K									
			(CT27)	2725K									
			(CT30)	3045K									
			(CT40)	4000K									
			(CT50)	5000K									
			(CT65)	6500K									
			(CTRD)	RED									
			(CTGR)	GREEN									
			(CTBL)	BLUE									
			(CTAM)	AMBER									

Sample: LFX-O-4W-CT20-2835-Z5-120-120-AC-15-H-1-PL

EXTERNAL DIMENSIONS



Notice:

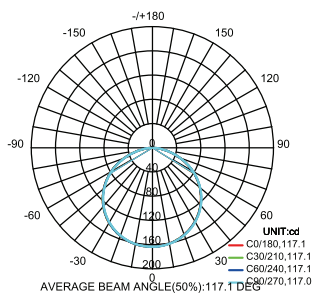
Input Voltage: AC 110V – AC 120V

Size of each section is 4", and cutting at "black line" place.

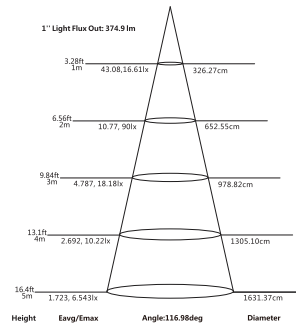
The dimension tolerance of height is $\pm 0.012"$ ($\pm 0.3mm$), and tolerance of width is $\pm 0.012"$ ($\pm 0.3mm$).

DIAGRAM

Luminous Intensity Distribution



Illumination Diagram



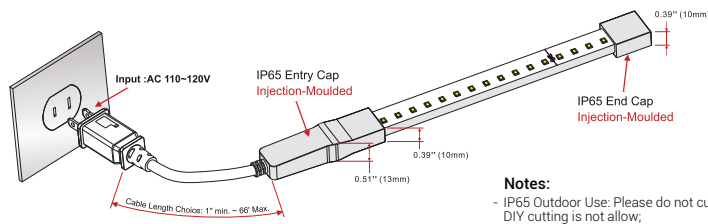
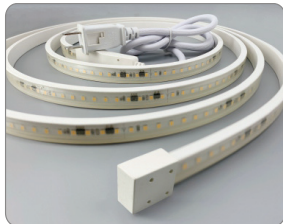
LFX AC120V OUTDOOR SPEC SHEET

LFX-AC

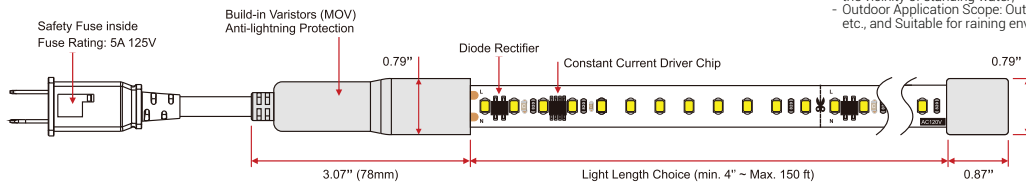


CONNECTION TYPES

Outdoor Use & IP65 Waterproof Connector



- Notes:**
- IP65 Outdoor Use: Please do not cut off the LED Tape Light, and DIY cutting is not allow;
 - All kinds of customized length of the light are available, from 4" minimum ~ 150 ft maximum;
 - Do not submerge LED Tape light in any liquids, or use the light in the vicinity of standing water;
 - Outdoor Application Scope: Outer Wall of building, Overbridge etc., and Suitable for raining environments



Indoor Use & DIY IP65 Connector

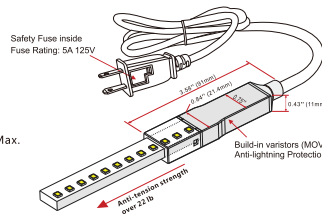


Power Cord

Connects light to power supply
IP65 DIY connector (indoor use)
Cable Length available in 1ft min ~ 66ft Max.

Screwless Terminal, DIY assembly

- DC Connector (2 Pin) *1
- Anti-tension Shell *1
- PC Fixing Clip *1

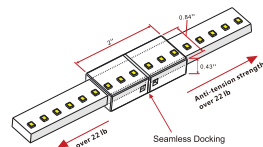


Docking Connector

Combine two pieces of the lights together
IP65 DIY connector (indoor use)

Seamless Docking, Screwless Terminal

- Anti-tension Shell *1
- Feed Connector (2 Pin) *1
- PC Fixing Clip *2

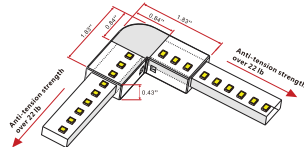


L-Type Connector

Combine two pieces of the lights together
IP65 DIY connector (indoor use)

Corner Docking, Screwless Terminal

- L-Type Anti-tension Shell *1
- L-Type Feed Connector (2 Pin) *1
- PC Fixing Clip *2

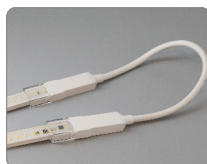
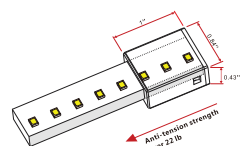


End Cap

Termination Protection of the light,
IP65 DIY connector (indoor use)

Screwless Terminal, DIY assembly

- Anti-tension Shell *1
- PC Fixing Clip *1



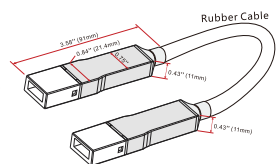
Jumper Connector

Connects two pieces of lights together
IP65 DIY connector (indoor use)

Rubber Cable Length available in 1ft min ~ 66ft Max.

Jumper Docking, Screwless Terminal

- Double-end feed connector (2 Pin) *1
- Anti-tension Shell *2
- PC Fixing Clip *2



- Notes:**
- Before making any cuts, installation, maintenance or connection, and be sure the light is power-off!
 - IP65 Indoor Use: Please cut the light and assemble all connectors according to their instruction manual;
 - Don't install and light up and use the light under water, Only IP65 indoor application places can be used for this light;
 - Indoor Application Scope: Cove of Theater / Hotel Lobby etc., and Suitable for damp environments (e.g. Toilet, Balcony Cove etc.)

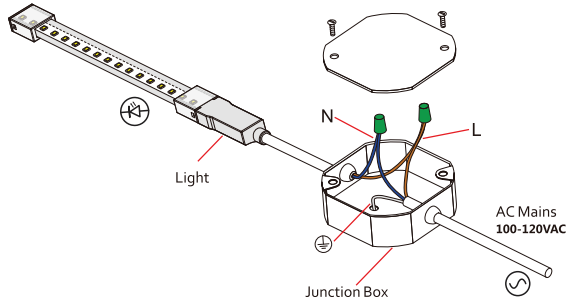
LFX AC120V OUTDOOR SPEC SHEET



LFX-AC

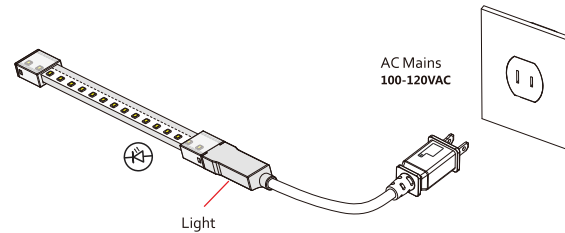
WIRING DIAGRAMS

Hardwire Connection



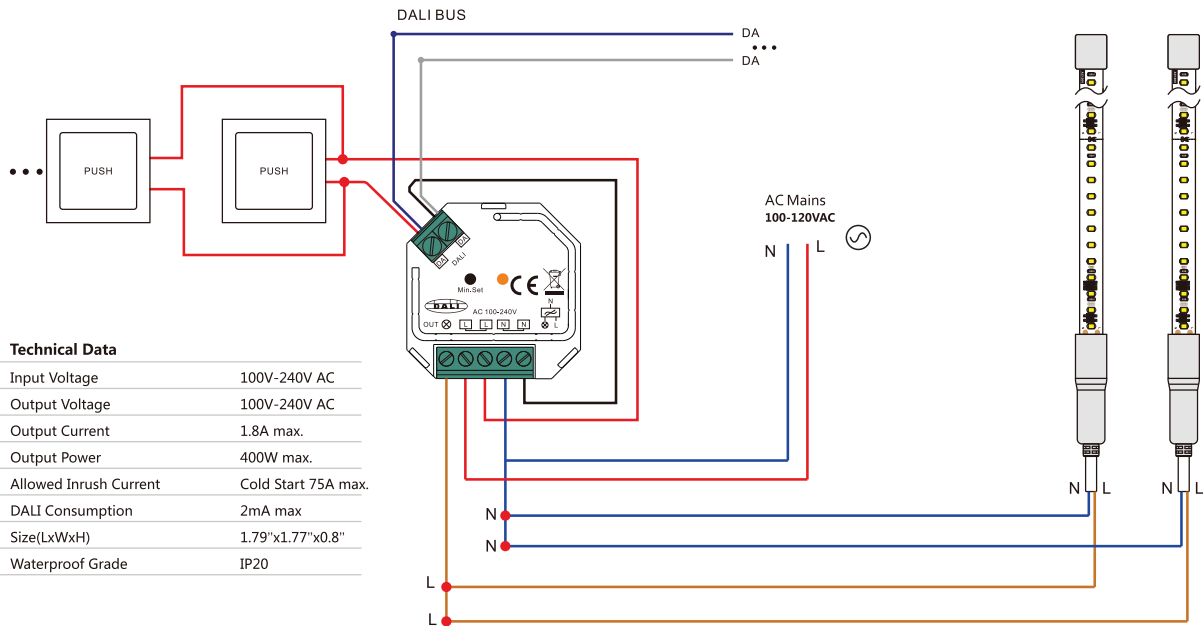
- The light can be used in conjunction with a AC100V~AC120V input ,Ensure that the power cable carried current is no greater than 80% of its capacity, and The light not exceed the maximum length 50m.

Plug-in Connection



- The light can be used in conjunction with a AC100V~AC120V input ,Ensure that the power cable carried current is no greater than 80% of its capacity, and The light not exceed the maximum length 50m.

Wiring diagrams for dimming



Technical Data

Input Voltage	100V-240V AC
Output Voltage	100V-240V AC
Output Current	1.8A max.
Output Power	400W max.
Allowed Inrush Current	Cold Start 75A max.
DALI Consumption	2mA max
Size(LxWxH)	1.79"x1.77"x0.8"
Waterproof Grade	IP20

- The number of parallel connected luminaires not more than 10, Otherwise the dimmer damaged due to the high inrush current at the moment of starting.
- This phase dimmer adopts trailing edge dimming (reverse phase control), make sure the connected loads support reverse phase control.

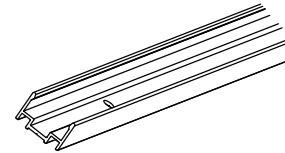
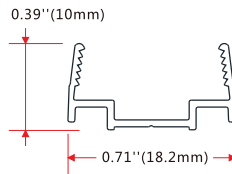
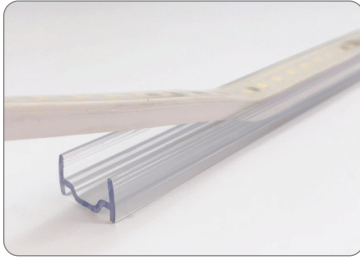
LFX AC120V OUTDOOR SPEC SHEET



LFX-AC

INSTALLATION & PROFILE

Mounting Profile

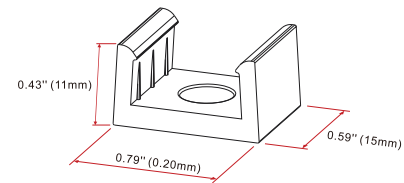
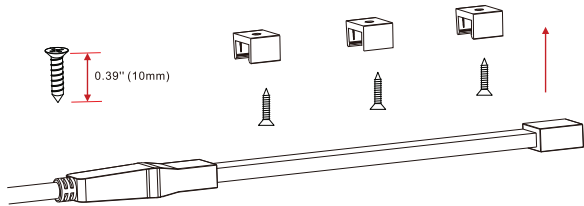


Code	W*H(ft)	Profile Length(feet)	Hole Size (inch)	Hole Number (pcs)
MT-PJ-01825	0.39" x 0.71"	3 ft	Φ0.13" (Φ3.5mm)	3
		5 ft	Φ0.13" (Φ3.5mm)	4
		6 ft	Φ0.13" (Φ3.5mm)	6

Notes:

1. The raw material is plastic PC, 100% transparent, and Any customized Length available too, such as 0.5m or 1m or 2m length maximum;
2. Each 1 ft length with 1 hole and 1 screw, and installation referece to the user manual;

Mounting Clip



Notes:

1. Mounting Clip's raw material is PC, and transparent/white/black/red paint available;
2. Each 1ft length with 1 Mounting Clip + 1 screw, and installation referece to the user manual;



FEATURES & SPECIFICATIONS

INTENDED USE — Suitable for cold weather (down to -40°C with CW option), wet location (4X option), security/prisons and high-abuse applications.

CONSTRUCTION — The housing is .25" to .525" thick rugged, low-profile cast aluminum.

Clear, UV-stable polycarbonate cover is .130" thick to prevent cracking or breaking. Cover is secured with four stainless steel Torx T20, tamper-resistant screws with center pin. Cover is secured with four stainless steel Phillips head screws, with the FPA option.

.1" thick polycarbonate faceplate incorporates universal directional chevron knockouts that are concealed and easily removed and replaced.

Universal mount (UM) option available — top, back, end mounting or conduit entry. (canopy provided)

Letters 6" high with 3/4" stroke, with 100 ft viewing distance rating, based upon UL924 standards.

U.S. Patent No. 5,611,163 and D383,501.

OPTICS — Lamp is constructed using new LED technology. Provides perfectly uniform illumination.

The typical life of the exit LED lamp is 10 years. Single-face exit uses one LED lamp; double-face exit uses two LED lamps. Low energy consumption — red lamp consumes 3.3 watts (120V); green lamp consumes 1.7 watts (120V).

ELECTRICAL — Dual voltage input capability (120/277V).

Sealed, maintenance-free nickel-cadmium battery delivers 90 minutes capacity to lamp. Constant-current series charger, automatic recharge after battery discharge.

Vandal-resistant magnetic test switch (magnet included) and LED indicator mounted on bottom of housing provide a safe, easy means for testing. Manual test switch also provided inside housing.

Polarized battery connector simplifies installation and maintenance; prevents charger damage from improper connection.

Brownout protection.

Low voltage disconnect allows battery connection before AC power is applied and prevents battery damage from deep discharge.

Self-diagnostics (optional). Automatically tests once a month for five minutes and once every six months for 30 minutes. Bi-color LED status indicator, test and service required.

INSTALLATION — Back mount standard for single face (no canopy), unless universal mount (UM) specified. Conduit entry (1/2" - 1 1/4" UNC) included with universal mounting.

Cast-aluminum canopy attaches to 10-gauge steel mounting plate for top or end mounting (not required for back mounting).

Canopy mounting bracket provides 160 lbs. of mounting strength when mounted to suitable structure. Bracket will only fit a 2-gang junction box.

LISTINGS — UL Listed (standard). NOM certified (see Option). 4X option is UL Listed to NEMA 4X ratings. CW and 4X option is UL 924 wet location listed. NSF certified (FPA option). Meets UL 924, NFPA 101 (current Life Safety Code), NEC and OSHA illumination standards, and State of Minnesota energy-efficient legislation requiring less than 20W consumption. Suitable for ambient temperatures 10°C (50°F) to 40°C (104°F).

Catalog Number	X1 FOR BACK OF HOUSE
Notes	
Type	

Other Manufacturers:
SURE-LITES "UX" Series
CHLORIDE "C4XE" Series
DUAL LITE "EVE4X" Series

EXTREME

All-Conditions Exits

LV EL N



White on white
w/red letter color



Black on black
w/green letter color

LED LAMPS EMERGENCY
NEMA 4X Rating Available



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.

WARRANTY — 5-year limited warranty. Complete warranty terms located at: www.acuitybrands.com/resources/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.

ORDERING INFORMATION For shortest lead times, configure products using **bolded options**. Example: LV3W4R120/277ELN

LV	S	Faceplate/ housing color	Number of faces	Letter color	Input voltage	Emergency operation	Mounting	Options
LV	S Stencil	(blank) Black faceplate on black housing W White on white WB White on black BW Black on white AB Aluminum on black AW Aluminum on white	1 Single face 2 Double face ¹	R Red G Green	120/277 Dual voltage	ELN Nickel-cadmium battery ELN	(blank) Back mount ² UM Universal mount	(Blank) None F Flashing emergency operation (45 flashes/min) ³ FI Fire alarm flashing interface ³ DL UL Listed for damp locations (10°C - 40°C) 4X UL Listed for NEMA 4X CW Cold temperature and NEMA 4X wet location battery pack (down to -40°C) ⁴ SD Self-diagnostics NOM NOM certified FPA Food protection area (National Sanitation Foundation Certified - splash zone) ⁵ BAA Buy America(n) Act Compliant

AS SELECTED BY ARCHITECT

Accessories: Order as separate catalog number.

ELA TPS T20	Torx tamper-resistant bit for T20 center-pin screw
ELA VSA	Stem/Conduit mounting kit (see spec sheet ELA-VSA)

Notes

- Available with universal mounting.
- Back mount standard with single face unless UM is specified. Not available on double face.
- Choice of F or FI. Not available with both.
- Not Energy Star qualified.
- Torx tamper-resistant screws not included with FPA.

EMERGENCY

LV-EL-N_E

LV EL N Emergency LED, Extreme

SPECIFICATIONS

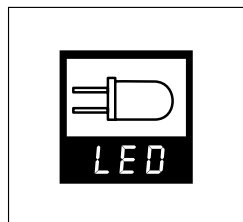
ELECTRICAL							
Primary Circuit							
Type	Typical LED life ¹	Supply voltage	Number of lamps ²	Input watts	Max. amps	Cold weather amps watts	
Red	10 years	120	1	3.3	.14	.22	18.2
			2	4.8	.13	.28	29.1
Red	10 years	277	1	3.3	.13	.26	16.6
			2	5.2	.13	.31	24.5
Green	10 years	120	1	2.2	.10	.17	17.0
			2	3.2	.09	.24	27.3
Green	10 years	277	1	2.5	.10	.19	12.2
			2	4.0	.10	.27	24.2

BATTERY				
Sealed Nickel-Cadmium				
Type	Typical shelf life ³	Typical life ³	Maintenance ⁴	Temperature range ⁵
STD-DL	3 years	7 - 9 years	none	50°F - 104°F (10°C - 40°C)
CW	3 years	7 - 9 years	none	-40°F - 104°F (-40°C - 40°C)

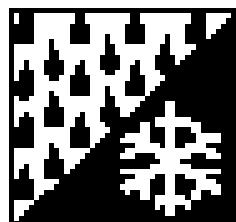
Notes

- 1 Based on continuous operation. The typical life of the exit LED lamp is 10 years.
- 2 Two-lamp version available with double-face only.
- 3 At 77°F (25°C).
- 4 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.
- 5 Optimum ambient temperature range where unit will provide capacity for 90 minutes. Higher and lower temperatures affect life and capacity.

KEY FEATURES



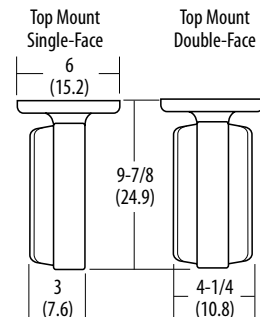
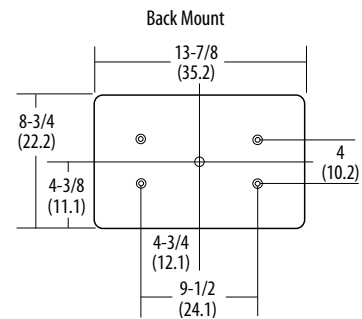
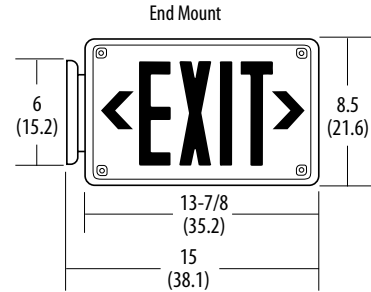
The typical life of the exit LED lamp is 10 years.



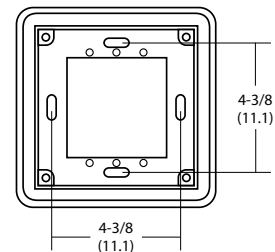
UL approved for damp, NEMA 4X wet or cold locations (see options).

MOUNTING

All dimensions are in inches (centimeters).
Shipping weight: 12 lbs. (5.45 kgs.)



NEMA 4X Mounting Plate



Housing or canopy mounting bracket should be attached to mounting surface using suitable fastener for type of wall material. All four mounting hole positions should be used, and anchors or screws should have a minimum pullout rating of 160 lbs. Bracket will only fit a 2-gang junction box.



FEATURES & SPECIFICATIONS

INTENDED USE — Suitable for applications requiring attractive edge-lit exit signage, universal installation and low energy consumption.

CONSTRUCTION — Extruded brushed aluminum finish.

Clear acrylic panels- letters measure 6" high with 3/4" stroke, with 100 ft viewing distance rating, based upon UL 924 standard.

For single-face clear panels, EXIT is seen as a reversed image from the back.

OPTICS — LEDs mounted on printed circuit board. The typical life of the exit LED lamp is 5 years, based on 24/7 operation.

The LED operating frequency is 120Hz.

ELECTRICAL — Dual voltage input capacity (120/277V).

Battery: (EL Option) – Sealed, maintenance free nickel-cadmium battery delivers 90 minutes capacity to emergency lamps. Test switch provides manual activation of 30-second diagnostic testing for on-demand visual inspection.

Self-diagnostic testing (EL Option Only) for 30 seconds every 30 days and 90 minutes annually. Diagnostic evaluation of LED light source, AC to DC transfer, charging and battery condition.

INSTALLATION — EDG – Universal mounting canopy for top or end mount. Back mount standard for single face only. Canopy provided.

EDGR – Recessed mounting. Bar hanger and brackets provided for both new or restricted ceiling access installation applications. Available for use in drop ceiling applications. Back wall mount (WM) option.

Universal directional indicators. Field selected and attached.

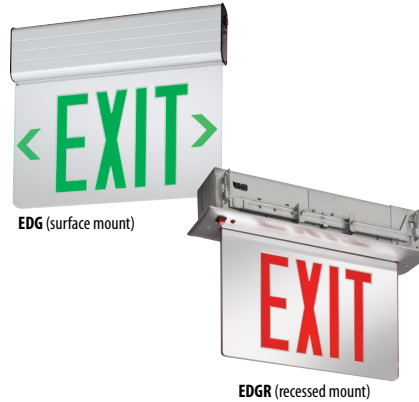
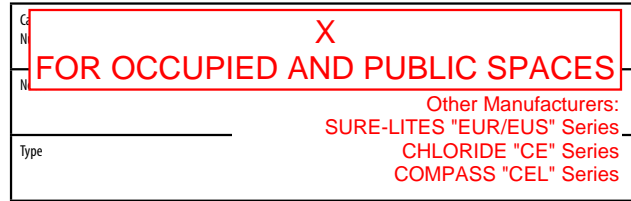
LISTINGS — UL damp location listed 32°-122°F (0°-50°C) standard. Meets UL924, NFPA 101 (current Life Safety Code), NEC and OSHA illumination standards. Meets all applicable FCC Title 47, Part 15, Subpart B requirements.

BUY AMERICAN ACT — Product with the BAA option is assembled in the USA and meets the Buy America(n) government procurement requirements under FAR, DFARS and DOT regulations. Please refer to www.acuitybrands.com/buy-american for additional information.

WARRANTY — 5-year limited warranty. This is the only warranty provided and no other statements in this specification sheet create any warranty of any kind. All other express and implied warranties are disclaimed. 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.



LED Edge-Lit Exits

EDG EDGR

LED Lamps



Specifications

EDG (End Mount)	EDG (Top Mount)
Length: 13 (33.0)	Length: 13-5/8 (34.6)
Depth: 5-1/2 (14.0)	Depth: 4-5/16 (11.0)
Height: 11-1/8 (28.3)	Height: 11-3/4 (29.8)
Shipping Weight: 4 lbs (1.8 kgs)	Shipping Weight: 4 lbs (1.8 kgs)
EDG (Back Mount)	EDGR
Length: 13 (33.0)	Length: 13 (33.0)
Depth: 3 (7.6)	Depth: 1-3/4 (4.4)
Height: 11-1/8 (28.3)	Height: 8 (20.3)
Shipping Weight: 4 lbs (1.8 kgs)	Shipping Weight: 6.8 lbs (3.1 kgs)
	Shipping Weight (WM option): 8.1 lbs (3.7 kgs)

All dimensions are inches (centimeters) unless otherwise noted.



Items marked by a shaded background qualify for the Design Select program and ship in 15 days or less. To learn more about Design Select, visit www.acuitybrands.com/designselect.

*See ordering tree for details

ds Design Select options indicated by this color background.

ORDERING INFORMATION

For shortest lead times, configure products using **bolded options**

SEE DRAWINGS FOR # OF FACES

DOUBLE FACE ONLY

Example: EDG 1 R EL

Family	Housing color	Number of faces	Letter color	Operations	Options
EDG Surface mount LED edge-lit exit	(blank) Brushed aluminum	1 Single face	R Red on clear (single face only) ¹	(blank) AC only	(blank) None
EDGR Recessed LED edge-lit exit	W White	2 Double face	G Green on clear (single face only) ¹	EL Nickel-cadmium battery	WM Recessed wall mount ⁷
			RMR Red on mirror ²	X2 Lamp wired on two separate AC circuits (specify 120V or 277V) ^{3,5}	BAA Buy America(n) Act Compliant
			GMR Green on mirror ²	SD Self-diagnostics ⁶	
			RW Red on white ³		
			GW Green on white ³		

Accessories: Order as separate item.

ELA US12	12" stem kit with brushed aluminum canopy ⁸
ELA W US12	12" stem kit with white canopy ⁸
ELA WG1	Wireguard (13 3/4"H x 15 1/4"W x 6" D, back mount only)

Notes

- For single-face clear panels, EXIT is seen as a reversed image from the back.
- Available with single and double face.
- White panel standard for double and single face.
- Both circuits can be energized at the same time.
- Not available with EL and SD options.
- Available with EL option only.
- Available on EDGR single face only
- See spec sheet [ELA-StemKits](#). Only available for EDG.

EMERGENCY

EDG-EDGR

EDG-EDGR LED, Surface and Recessed Mount Edge-Lit Exits

SPECIFICATIONS

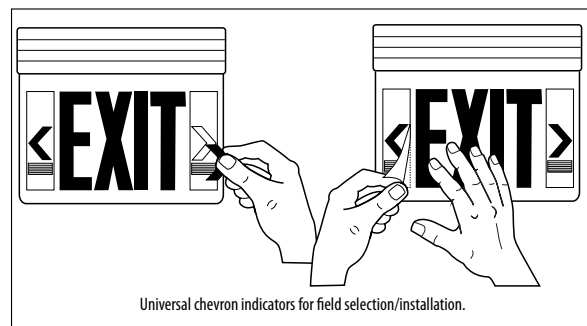
ELECTRICAL						
Primary Circuit						
Type	Typical LED life ¹	Supply voltage	EDG		EDGR	
			Input Watts	Max amps.	Input Watts	Max amps.
Red LED AC only	>5 years	120	2.5	0.020	3.8	0.030
		277	2.8	0.010	4.5	0.014
Green LED AC only	>5 years	120	2.2	0.020	3.8	0.030
		277	2.2	0.010	4.5	0.020
Red LED emergency	>5 years	120	3.0	0.030	3.8	0.031
		277	3.1	0.010	4.5	0.015
Green LED emergency	>5 years	120	2.6	0.020	3.8	0.031
		277	2.8	0.010	4.5	0.020

BATTERY (EL option)			
Sealed Nickel-Cadmium			
Shelf life ²	Typical life ²	Maintenance ³	Temperature range ⁴
3 years	6-8 years	none	32-122°F (0-50°C)

Notes

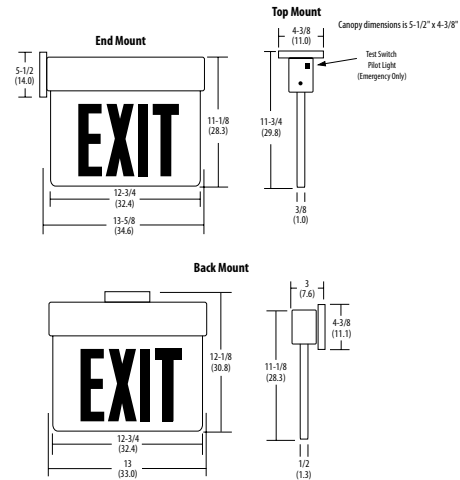
- Based on 24/7 operation. The typical life of the exit LED lamp is 5 years.
- At 77°F (25°C).
- All life safety equipment, including emergency lighting for path of egress must be maintained, serviced, and tested in accordance with all National Fire Protection Association (NFPA) and local codes. Failure to perform the required maintenance, service, or testing could jeopardize the safety of occupants and will void all warranties.
- Temperature range where unit will provide capacity for 90 minutes. Higher and lower temperatures affect life and capacity.

KEY FEATURES



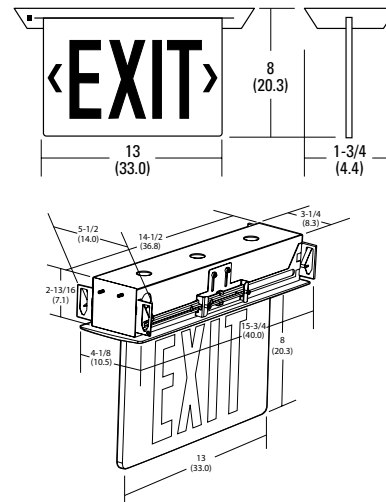
MOUNTING

EDG

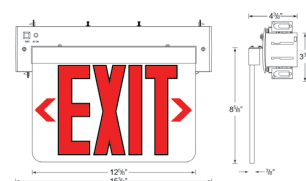


EDGR

Note: For drop ceiling applications refer to the standard installation section of the instruction sheet. Not applicable for "bracket mount" installation.



EDGR WM option



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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 SUMMARY

- A. This Section includes telecommunications 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 COORDINATION WITH OTHER TRADES

- A. The Contractor shall coordinate the installation of the telecommunications wiring devices, equipment, supports, pathways etc., with all other trades prior to installation. Verify and coordinate routing of cable trays, conduits, wireways, etc., intended to support routings of telecommunications cabling.

1.4 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.
- 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 for resolution.

1.5 INSPECTION OF SITE

- A. Visit the site, examine and verify the conditions under which the work must be conducted before submitting proposal.
- B. The submitting of a proposal implies that the contractor has visited the site and understands the conditions under which the work must be conducted.

1.6 CONTRACT BREAKDOWN

- A. Within two (2) weeks following award of contract, submit to the Architect/Engineer for approval a contract amount breakdown. Breakdown shall be submitted on a form similar to the form available at the Architect's/Engineer's office. All requests for payment shall be based on the approved breakdown.

1.7 TEMPORARY FACILITIES

- A. Provide and remove upon completion of the project, in accordance with the general conditions, a complete temporary telephone service during construction, as required.

1.8 GUARANTEE

- A. Contractor guarantees that the installation is free from defects and agrees to replace or repair, any part of this installation which becomes defective within a period of one year following final acceptance, provided that such failure is due to defects in the

equipment, material or installation or to follow the specifications and drawings. File with the Owner any and all guarantees from the equipment manufacturers.

1.9 CODES, PERMITS AND FEES

- A. Unless otherwise indicated, all required permits, licenses, inspections, approvals and fees for telecommunications 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 service providers shall be complied with. Check with the local exchange carrier supplying service to the installation and determine all raceways and devices required including, but not limited to, all terminal cabinets, backboards, space requirements, etc.
- 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.

1.10 STANDARDS OF MATERIAL AND WORKMANSHIP:

- 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:
 - A.N.S.I. American National Standards Institute
 - A.S.T.M. American Society for Testing Materials
 - BICSI Building Industry Consulting Services International
 - I.C.E.A. Insulated Cable Engineer's Association
 - I.E.E.E. Institute of Electrical and Electronics Engineers
 - N.E.C. National Electrical Code
 - N.E.M.A. National Electrical Manufacturer's Association
 - TIA/EIA Telecommunications Industry Association/Electronic Industries Association
 - U.L. Underwriters Laboratories, Inc.
- B. Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the Trades involved.
- C. All equipment of the same or similar systems shall be by the same manufacturer.

1.11 RECORD DRAWINGS

- A. Provide complete operating and maintenance instruction manuals covering all telecommunications equipment herein specified, together with parts lists. All literature shall be furnished in triplicate for Owner and shall be bound in book or ring binder form as directed by Architect/Engineer.
- B. 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. Shop drawings.
 5. Recommended spare parts lists.
 6. Names and telephone numbers of major material suppliers.
- C. Provide revised telecommunications working drawings indicating "as-built" conditions. Drawings shall indicate all changes that have occurred during construction. Properly identify backbone and horizontal wiring pathways. Locate all network and workstation devices. Identify all devices on plan with proper labeling. "As-Built" drawings shall be submitted on AutoCAD 2010 or compatible electronic format.
- D. Provide certified test records for all installed cable showing compliance with specifications. Provide in single bound volume arranged by function and geographic location.

1.12 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 telecommunications equipment and shall be of the manufacturer's latest design.
- B. Any equipment offered as a substitution shall be equal in quality, durability, appearance, and performance 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. All costs to make these items of equipment comply with these requirements including, but not limited to, conduit, wiring, enclosures and building alterations shall be included in the original bid. Similar equipment shall be by one manufacturer.

1.13 SHOP DRAWINGS/SUBMITTALS

- A. All shop drawings shall be submitted in groupings of similar and/or related items (cable and connectors, equipment cabinets and racks, etc.). Incomplete submittal groupings will be returned unchecked.
- B. Provide detailed layout shop drawings of backbone and horizontal cabling distribution, pathways, equipment room layouts, details and related information necessary of installation and maintenance. After review by the Engineer, a copy of drawings will be stamped and returned to the contractor.
- C. Submit for approval eight (8) copies of shop drawings for all telecommunications systems or equipment but not limited to the items listed below. Where items are referred to by symbolic designation on the drawings and specifications, all submittals shall bear the same designation. Refer to other sections of the specifications for additional requirements.
1. Structured cabling system components
 2. Structured cable system J-hooks, cable runway, cable management, innerduct, etc.
 3. Outside plant cabling and components
 4. Equipment racks and cabinets including management components
 5. Labeling equipment
 6. Audio/video system components
 7. Access control system components

8. Closed circuit television system components

1.14 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.

1.15 WORK PROVIDED BY OTHERS

- A. Conduit, cabletrays, sleeves, boxes, floor boxes, surface raceways and grounding shall be provided by the Electrical Contractor under Division 26.
- B. Coordinate installation of telecommunications work with work provided by Electrical Contractor in paragraph A above.
- C. The Owner will provide network electronics equipment in all Communication Rooms and all voice cross-connect jumpers and voice/data patch cords as required.

1.16 CONTRACTOR QUALIFICATIONS

- A. The Installing Contractor for each communications system shall have a minimum of 5 years of experience with the types of systems specified.
- B. The Installing Contractor shall submit a reference list consisting of a minimum of 3 installations of equivalent size and complexity of this contract. The reference list shall contain the following information for each installation:
 - 1. Name of project, square footage, location and brief description of systems.
 - 2. Date of completed installation.
 - 3. Contact name and phone number of facility representative.
 - 4. Total bid amount of each system installed.
 - 5. Final contract amount of each system installed, including all change orders and bulletins.
- C. The Installing Contractor shall submit with the bid the names and registration numbers of members of the firm that have a valid membership and are certified with BICSI as registered Communications Distribution Designers (RCDD). This contractor shall identify at least one RCDD assigned to this project in the bid.
- D. The bidding, shop drawing submittal, procurement of materials, the installation as-builts and record documents shall be reviewed and overseen by the RCDD(s) assigned to the project.
- E. The contractor's bid, shop drawing submittals, as-builts and record documents shall bear the valid seal of the RCDD(s) assigned to this project.
- F. The Installing Contractor of the video system shall submit with the bid names and license numbers of all members of the firm that hold a valid commercial general class license with the FCC. The contractor shall identify at least one FCC licensed technician/engineer assigned to this project with the bid.

- G. All calculations, shop drawings, testing, certification and as-built documents shall be directly supervised by the licensed technician/engineer assigned to the project.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 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.

3.2 DEMOLITION WORK

- A. All demolition of existing telecommunications equipment and materials shall be done by this contractor unless otherwise indicated. Include all items such as, but not limited to, cable, patch panels, devices, 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 systems 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 outlet boxes or at the panels.

3.3 WORK IN EXISTING BUILDINGS

- A. The Owner will provide access to existing buildings as required. However, this 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 this 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 telecommunications services 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.

3.4 COORDINATION

- A. Install work to avoid interference with work of other trades including, but not limited to, architectural, mechanical and electrical trades. Remove and relocate any work that causes interference at this contractor's expense. Disputes regarding the cause of interference will be resolved by the Owner's representative or Architect/Engineer.

3.5 CHASES AND RECESSES

- A. Chases and recesses shall be provided by the Architectural Trades, but this contractor shall be responsible for coordinating their accurate location and size.

3.6 SLEEVES

- A. Provide and install rigid steel conduit sleeves cut to length wherever conduits or cabling pass through floors or cables pass through openings in walls.
- B. All sleeves through the floor are to extend 2 inches above floor, unless otherwise noted. Provide escutcheons at each sleeve in finished areas and adequate spacing between sleeves to accommodate escutcheons.

3.7 CUTTING, PATCHING AND DAMAGE TO OTHER WORK

- A. Refer to General Conditions for requirements.
- B. All cutting, patching and repair work will be done by the trades who installed the work and paid for by the trades for whom the work is done.
- C. All cutting, patching and repair work shall be done by the contractor.
- D. 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.

3.8 EXCAVATION AND BACKFILLING

- A. Provide all excavation, trenching, tunneling, dewatering and backfilling required for the telecommunications 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.
- F. Refer to electrical drawing and the architectural specifications for excavating and backfilling methods and materials.

3.9 ACCESS DOORS

- A. Provide access doors for installation by architectural trades. In the walls, provide Milcor No. "DW" or "M" as required to make all controls, electrical boxes and other equipment installed by the contractor accessible. Minimum size 12 inches x 12 inches. In the ceiling, provide Milcor No. 3210, 3105 or 3206 for accessibility as mentioned above, 24 inches x 24 inches minimum size. The plaster or acoustical tile insert shall be by the architectural trades. Areas with accessible ceilings (ceilings where tiles are not fastened in place and can be individually removed without removal of adjacent tiles) will not require access doors.
- B. When access doors are in fire resistant wall or ceilings, they must bear the Underwriters Laboratories, Inc., Label, with time design rating equal to or exceeding that of the wall or ceiling unless they were a part of the tested assembly.

3.10 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, cleaning all telecommunications equipment spaces, devices, cover plates, and removing all scrap cable and debris from pathways.

3.11 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. Equipment set in place in unprotected areas must be provided with temporary protection.

3.12 EXTRA WORK

- A. For any extra telecommunications work that 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. This contractor shall proceed only after receiving a written order from the General Contractor establishing the agreed price and describing the work to be done.

3.13 DRAWINGS AND MEASUREMENTS

- A. These Specifications and accompanying drawings are intended to describe and provide for finished work. They are intended to be cooperative, and what is called for by either shall be as binding as if call for by both. The Contractor will understand that the work herein described shall be complete in every detail.
- B. The drawings are not intended to be scaled for rough-in measurements or to serve as Shop Drawings. Field measurements, necessary for ordering materials and fitting the installation to the building construction and arrangement, shall be taken by this contractor.

END OF SECTION 270500

SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING

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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. Section Includes:

- 1. Pathways.
- 2. UTP cabling.
- 3. Cable connecting hardware, patch panels, and cross-connects.
- 4. Telecommunications outlet/connectors.
- 5. Cabling system identification products.
- 6. Cable management system.

B. Related Sections:

1. Division 27 Section "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
2. Division 28 Section "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

- A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- B. BICSI: Building Industry Consulting Service International.
- C. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel.
- D. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.
- E. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- F. EMI: Electromagnetic interference.
- G. IDC: Insulation displacement connector.
- H. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- I. LAN: Local area network.
- J. RCDD: Registered Communications Distribution Designer.
- K. UTP: Unshielded twisted pair.

1.4 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.
 1. TIA/EIA-568-C.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
 2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
 3. Bridged taps and splices shall not be installed in the horizontal cabling.
- B. A work area is approximately 100 sq. ft., and includes the components that extend from the telecommunications outlet/connectors to the station equipment.

- C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet in the horizontal cross-connect.

1.5 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-C.1, when tested according to test procedures of this standard.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 - 2. Cabling administration drawings and printouts.
 - 3. Wiring diagrams to show typical wiring schematics, including the following:
 - a. Cross-connects.
 - b. Patch panels.
 - c. Patch cords.
 - 4. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
 - 5. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
 - a. Vertical and horizontal offsets and transitions.
 - b. Clearances for access above and to side of cable trays.
 - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Field quality-control reports.

1.8 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For splices and connectors to include in maintenance manuals.
- B. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.

2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

C. Warranty certificates

1.9 WARRANTY

A. General

1. The cabling system shall be warranted by the manufacturer(s) of the components for a period of not less than 15 years from the time the installation is deemed complete.
2. It shall be the sole responsibility of the Contractor to register the project with the manufacturer(s) and meet all manufacturers' warranty requirements.
3. Contractor shall provide Owner with all manufacturers' warranty certificates with Record Documents.

B. Warranty Coverage

1. Product - all passive components of the cabling system shall be warranted to be free from defects in material and workmanship.
2. Performance - all passive components, as installed, shall be warranted to exceed TIA and ISO performance specifications for Permanent Link and Channel, as required, at all frequencies specified and shall meet or exceed all manufacturer's published performance data.
3. Applications - the installed Permanent Link and Channel shall be warranted to support all current applications, as well as those introduced in the future, that require the specified cabling system per TIA and ISO specifications.

C. Warranty Requirements

1. Provide a warranty for all data drops.
2. Warranty shall cover repair or replacement of all defective components free of charge, including all labor performed by a manufacturer-certified installer. All replacements components shall be furnished new. No used, reconditioned, or refurbished components shall be allowed.
3. The installing contractor shall be certified by the cabling and connector manufacturers as an approved and trained installer of their equipment. Submit letter of certification from the manufacturer to the engineer at time of submittal. No exception to this will be allowed

1.10 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

- B. Testing Agency Qualifications: An NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 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: 50 or less.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
- F. Grounding: Comply with ANSI-J-STD-607-A.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - 1. Test each pair of UTP cable for open and short circuits.

1.12 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.13 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.
- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-A.
- B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
 - 1. Support brackets with cable tie slots for fastening cable ties to brackets.

2. Lacing bars, spools, J-hooks, and D-rings.
3. Straps and other devices.

C. Cable Tray Requirements

1. Refer to Division 26 section "Cable Trays" for cable tray intended to support backbone cabling.

D. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceways and Boxes."

1. Outlet boxes shall be no smaller than 4 inches wide, 4 inches high, and 2-1/2 inches deep.

E. Innerduct:

1. Manufacturers:

- a. Carlon.
- b. Endot.

2. Install innerduct through conduits and sleeves for optical fiber cabling installations.
3. Description: UL listed, non-metallic, corrugated flexible conduit for use in plenum or outdoor installations as applicable. Provide each innerduct with one ¼" W. pulltape with a tensile rating of 900 lbs.

2.2 UTP CABLE

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

1. Belden CDT Inc.; Electronics Division.
2. Berk-Tek; a Nexans company.
3. CommScope, Inc.
4. General Cable
5. Mohawk; a division of Belden CDT.Superior Essex Inc.
6. SYSTIMAX Solutions; a CommScope, Inc. brand.
7. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. Description: 100-ohm, 4-pair UTP, with a blue thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-C.1 for performance specifications.
3. Comply with TIA/EIA-568-C.2, Category 5e.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - a. Communications, Plenum Rated: Type CMP or MPP, complying with NFPA 262.

2.3 UTP CABLE HARDWARE

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

1. Commscope Uniprise
 2. Hubbell Premise Wiring.
 3. Panduit
 4. Ortronics
 5. Siemon Co. (The).
 6. Systimax Solutions
 7. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
- B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- C. Connecting Blocks: 110-style IDC for Category 5e. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.
- D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
1. Number of Terminals per Field: One for each conductor in assigned cables.
- E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
1. Number of Jacks per Field: One for each four-pair UTP cable indicated.
- F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.
- G. Patch Cords: Factory-made, four-pair cables in lengths; terminated with eight-position modular plug at each end.
1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
 2. Patch cords shall have color-coded boots for circuit identification.

2.4 TELECOMMUNICATIONS OUTLET/CONNECTORS

- A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-C.1.
- B. Workstation Outlets: Four-port-connector assemblies mounted in multigang faceplate.
1. Plastic Faceplate: High-impact plastic. Coordinate color with Division 26 Section "Wiring Devices."
 2. Metal Faceplate: Stainless steel, complying with requirements in Division 26 Section "Wiring Devices."
 3. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.
 - a. Flush mounting jacks, positioning the cord at a 45-degree angle.
 - b. Front loading jacks.

4. Legend: Factory labeled by silk-screening or engraving for stainless steel faceplates.
5. Legend: Machine printed, in the field, using adhesive-tape label.
6. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

2.5 GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding" for grounding conductors and connectors.
- B. Comply with ANSI-J-STD-607-A.
- C. Ground all equipment to ground buses in IDF and MDF rooms. Ground buses provided by others.

2.6 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Division 26 Section "Electrical Identification."
- C. Coordinate all labeling and naming convention with owner prior to installation

2.7 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test UTP on reels according to TIA/EIA-568-C.1.
- C. Factory test UTP cables according to TIA/EIA-568-C.2.
- D. Cable will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
 1. Install plenum cable in environmental air spaces, including plenum ceilings.

2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceways and Boxes."
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
 - C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.
- B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 27 Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.
- C. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- D. Comply with requirements in Division 26 Section "Raceways and Boxes" for installation of conduits and wireways.
- E. Pathway Installation in Communications Equipment Rooms:
 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
 2. Install cable trays to route cables if conduits cannot be located in these positions.
 3. Secure conduits to backboard when entering room from overhead.
 4. Extend conduits 3 inches above finished floor.
 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- F. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.4 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 1. Comply with TIA/EIA-568-C.1.
 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 3. Install 110-style IDC termination hardware unless otherwise indicated.
 4. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, and patch panels.
 5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
 8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 10. In the communications equipment room, install a 10-foot- long service loop on each end of cable.
 11. At the work area outlet, provide a 12-inch slack loop in each cable.
 12. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. UTP Cable Installation:
1. Comply with TIA/EIA-568-B.2.
 2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.
- D. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- E. Group connecting hardware for cables into separate logical fields.
- F. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA/EIA-569-A for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
 4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.

- c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
- 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.

3.5 FIRESTOPPING

- A. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems."
- B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.7 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Electrical Identification."
 - 1. Administration Class: 3.
 - 2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.
- B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.
- C. Comply with requirements in Division 9 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- D. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 3 level of administration.
- E. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations.

Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

- F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.
- G. Cable and Wire Identification:
1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.
 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
 6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.
- H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.
1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
 2. Visually confirm Category 5e, marking of outlets, cover plates, outlet/connectors, and patch panels.

3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
5. UTP Performance Tests:
 - a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:
 - 1) Wire map.
 - 2) Length (physical vs. electrical, and length requirements).
 - 3) Insertion loss.
 - 4) Near-end crosstalk (NEXT) loss.
 - 5) Power sum near-end crosstalk (PSNEXT) loss.
 - 6) Equal-level far-end crosstalk (ELFEXT).
 - 7) Power sum equal-level far-end crosstalk (PSELFEXT).
 - 8) Return loss.
 - 9) Propagation delay.
 - 10) Delay skew.
6. Final Verification Tests: Perform verification tests for UTP systems after the complete communications cabling and workstation outlet/connectors are installed.
 - a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
 - b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.
- D. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

3.9 DEMONSTRATION

- A. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets.

END OF SECTION 271500

SECTION 283100 - FIRE ALARM

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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 26 Section "Electrical General Requirements."

1.2 SUMMARY

- A. This Section includes design and installation of a new fire alarm system
- B. Related Sections include the following:
 - 1. Division 8 Section "Door Hardware" for door closers and holders with associated smoke detectors, electric door locks, and release devices that interface with the fire alarm system.

1.3 DEFINITIONS

- A. FACP: Fire alarm control panel.
- B. LED: Light-emitting diode.
- C. NICET: National Institute for Certification in Engineering Technologies.
- D. Definitions in NFPA 72 apply to fire alarm terms used in this Section.

1.4 SYSTEM DESCRIPTION

- A. Noncoded, addressable system; multiplexed signal transmission dedicated to fire alarm service only.
- B. Fire alarm system shall consist of the following:
 - 1. All new fire alarm control panel, devices, and wiring.
 - 2. System smoke detection above all control panels and notification appliance power supply panels.
 - 3. System smoke detection as required at air handling units, smoke rated transfer openings, and smoke damper locations.
 - 4. System smoke detection in areas identified on plans
 - 5. All flow and tamper switches to monitor fire sprinkler and standpipe systems and report appropriate alarm and supervisory signals.
 - 6. Manual fire alarm boxes at each building exit (prior to entering exit stairwells at each floor).
 - 7. Audible and visual notification appliances in all public and common areas of the building.

1.5 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 72.
- B. Comply with NFPA 70.
- C. Comply with NFPA 720.
- D. A complete functional system meeting the requirements of this specification, including alarm initiating devices and notification appliances at locations and ratings to meet the requirements of the Authorities Having Jurisdiction and all applicable codes shall be provided.

- E. Coordinate and avoid conflicts with casework, markerboards, feature walls, and other areas where fire alarm devices would interfere with furnishings, finishes, etc.
- F. Fire alarm system vendor shall provide sound pressure level calculations demonstrating compliance with NFPA 72 and establish quantities and tap settings of audible devices.
- G. No additional charges for work or equipment required for a code compliant system approved by the Authority Having Jurisdiction will be allowed.
- H. Obtain and refer to mechanical drawings for smoke damper locations, smoke rated transfer openings, and air handling equipment CFM's. Provide smoke detection as required by applicable codes.
- I. Premises protection includes business Type building use group Type special occupancy type.
 - 1. Refer to drawings for complete code analysis including construction type, use groups, special occupancy types, rated walls, smoke barriers and partitions, etc.
- J. System functional performance shall be as indicated on the fire alarm matrix on the drawings.

1.6 ACTION SUBMITTALS

- A. Approved Permit Submittal: Submittals must be approved by authorities having jurisdiction prior to submitting them to Architect.
- B. Product Data: For each type of product indicated.
 - 1. Include construction details, material descriptions, dimensions, profiles, and finishes.
 - 2. Include rated capacities, operating characteristics, and electrical characteristics.
- C. Shop Drawings: For fire-alarm system.
 - 1. Comply with recommendations and requirements in "Documentation" section of "Fundamentals" chapter in NFPA 72.
 - 2. Include plans, elevations, sections, and details, including details of attachments to other Work.
 - 3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
 - 4. Annunciator panel details as required by authorities having jurisdiction.
 - 5. Detail assembly and support requirements.
 - 6. Include voltage drop calculations for notification-appliance circuits.
 - 7. Include battery-size calculations.
 - 8. Include input/output matrix.
 - 9. Include written statement from manufacturer that equipment and components have been tested as a system and comply with requirements in this Section and in NFPA 72.
 - 10. Include performance parameters and installation details for each detector.
 - 11. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 - 12. Provide program report showing that air-sampling detector pipe layout balances pneumatically within airflow range of air-sampling detector.

13. Provide control wiring diagrams for fire-alarm interface to HVAC; coordinate location of duct smoke detectors and access to them.
 - a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
 - b. Show field wiring and equipment required for HVAC unit shutdown on alarm.
 - c. Locate detectors in accordance with manufacturer's written instructions.
 14. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
 15. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.
- D. Delegated Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.
1. Drawings showing location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of device.
 2. Design Calculations: Calculate requirements for selecting spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
 3. Indicate audible appliances required to produce square wave signal per NFPA 72.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Statements: For Installer.
- B. Field quality-control test reports.
- C. Sample Warranty: Submittal must include line item pricing for replacement parts and labor.

1.8 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction:
 - a. Comply with "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - b. Provide "Fire-Alarm and Emergency Communications System Record of Completion Documents" in accordance with "Completion Documents" Article in "Documentation" section of "Fundamentals" chapter in NFPA 72.
 - c. Complete wiring diagrams showing connections between devices and equipment. Each conductor must be numbered at every junction point with indication of origination and termination points.
 - d. Riser diagram.

- e. Device addresses.
- f. Air-sampling system sample port locations and modeling program report showing layout meets performance criteria.
- g. Record copy of site-specific software.
- h. Provide "Inspection and Testing Form" in accordance with "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
 - 1) Equipment tested.
 - 2) Frequency of testing of installed components.
 - 3) Frequency of inspection of installed components.
 - 4) Requirements and recommendations related to results of maintenance.
 - 5) Manufacturer's user training manuals.
- i. Manufacturer's required maintenance related to system warranty requirements.
- j. Abbreviated operating instructions for mounting at FACU and each annunciator unit.

B. Software and Firmware Operational Documentation:

- 1. Software operating and upgrade manuals.
- 2. Program Software Backup: On USB media.
- 3. Device address list.
- 4. Printout of software application and graphic screens.

1.9 MAINTENANCE MATERIAL SUBMITTALS

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

- 1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
- 2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
- 3. Smoke Detectors and Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
- 4. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
- 5. Keys and Tools: One extra set for access to locked or tamper-proofed components.
- 6. Audible and Visual Notification Appliances: One of each type installed.
- 7. Fuses: Two of each type installed in system. Provide in box or cabinet with compartments marked with fuse types and sizes.
- 8. Filters for Air-Sampling Detectors: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
- 9. Air-Sampling Fan: Quantity equal to one for every five detectors, but no fewer than one unit of each type.

1.10 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Installer Qualifications: Work of this Section be performed by a UL-listed company.

- C. Installer Qualifications: Personnel certified by NICET as Fire Alarm Level III.
- 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.

1.11 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. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but not less than 1 unit.
 - 2. Smoke, Fire, and Flame Detectors: Quantity equal to 10 percent of amount of each type installed, but not less than 1 unit of each type.
 - 3. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but not less than 1 unit of each type.
 - 4. Keys and Tools: One extra set for access to locked and tamperproofed components.
 - 5. Audible and Visual Notification Appliances: One of each type installed.
 - 6. Fuses: Two of each type installed in the system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. FACP and Equipment:
 - a. Edwards Systems Technology Inc.
 - b. NOTIFIER; a Honeywell Company.
 - c. Siemens Building Technologies, Inc.; a Cerberus Division.
 - d. SimplexGrinnell LP; a Tyco International Company.
 - e. Gamewell-FCI; a Honeywell Company.
 - f. National Time & Signal.
 - g. Xtralis.

2.2 FACP

- A. General Description:
 - 1. Modular, power-limited design with electronic modules, UL 864, 9th edition, listed.
 - 2. Addressable initiation devices that communicate device identity and status.
 - a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at the FACP.
 - b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.

3. Addressable control circuits for operation of mechanical equipment.
 4. Mounting: Flush.
- B. Alphanumeric Display and System Controls: Arranged for interface between human operator at the FACP and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.
 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands; and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.
- C. Circuits:
1. Signaling Line Circuits between control panels: NFPA 72, Class A, Style 7
 2. Signaling Line Circuits from control panel to devices: NFPA 72, Class A, Style 6.
 3. Signaling Line Circuits from control panel to devices: NFPA 72, Class B, Style 4.
 - a. System Layout: Install no more than 50 addressable devices on each signaling line circuit.
 4. Notification-Appliance Circuits: NFPA 72, Class A, Style Z.
 5. Notification-Appliance Circuits: NFPA 72, Class B, Style Y.
 6. Actuation of alarm notification appliances, annunciation, shall occur within 10 seconds after the activation of an initiating device.
 7. Electrical monitoring for the integrity of wiring external to the FACP for mechanical equipment shutdown and magnetic door-holding circuits is not required, provided a break in the circuit will cause doors to close and mechanical equipment to shut down.
- D. Smoke-Alarm Verification:
1. Initiate audible and visible indication of an "alarm verification" signal at the FACP.
 2. Activate a listed and approved "alarm verification" sequence at the FACP and the detector.
 3. Record events by the system printer.
 4. Sound general alarm if the alarm is verified.
 5. Cancel FACP indication and system reset if the alarm is not verified.
- E. Notification-Appliance Circuit: Operation shall sound in a temporal pattern, complying with ANSI S3.41.
- F. Alarm Silencing, Trouble, and Supervisory Alarm Reset: Manual reset at the FACP after initiating devices are restored to normal.
1. Silencing-switch operation halts alarm operation of notification appliances and activates an "alarm silence" light. Display of identity of the alarm zone or device is retained.
 2. Subsequent alarm signals from other devices or zones reactivate notification appliances until silencing switch is operated again.
 3. When alarm-initiating devices return to normal and system reset switch is operated, notification appliances operate again until alarm silence switch is reset.
- G. Walk Test: A test mode to allow one person to test alarm and supervisory features of initiating devices. Enabling of this mode shall require the entry of a password. The FACP and annunciators shall display a test indication while the test is underway. If

testing ceases while in walk-test mode, after a preset delay, the system shall automatically return to normal.

- H. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and control of changes in those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and make a print-out of the final adjusted values on the system printer.
- I. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, trouble, and supervisory signals to a remote alarm station through a digital alarm communicator transmitter and telephone lines.
- J. Voice/Alarm Signaling Service: A central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided as a special module that is part of the FACP.
 - 1. Indicated number of alarm channels for automatic, simultaneous transmission of different announcements to different zones, or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall be UL 1711 listed.
 - a. Allow the application of and evacuation signal to indicated number of zones and, at the same time, allow voice paging to the other zones selectively or in any combination.
 - b. Programmable tone and message sequence selection.
 - c. Standard digitally recorded messages for "Evacuation" and "All Clear."
 - d. Generate tones to be sequenced with audio messages of the type recommended by NFPA 72 and that are compatible with tone patterns of the notification-appliance circuits of the FACP.
 - 2. Status Annunciator: Indicate the status of various voice/alarm speaker zones.
 - 3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.
- K. Service Modem: The dial-in port shall allow remote access to the FACP for programming changes and system diagnostic routines. Access by a remote terminal shall be by encrypted password algorithm.
- L. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble), and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including the same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.
- M. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signal, supervisory and digital alarm communicator transmitter shall be powered by the 24-V dc source.
 - 1. The alarm current draw of the entire fire alarm system shall not exceed 80 percent of the power-supply module rating.
 - 2. Power supply shall have a dedicated fused safety switch for this connection at the service entrance equipment. Paint the switch box red and identify it with "FIRE ALARM SYSTEM POWER."

- N. Secondary Power: 24-V dc supply system with batteries and automatic battery charger and an automatic transfer switch.
 - 1. Battery and Charger Capacity: Comply with NFPA 72.
- O. Surge Protection:
 - 1. Install surge protectors recommended by FACP manufacturer. Install on all system wiring external to the building housing the FACP.
- P. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.3 MANUAL FIRE ALARM BOXES

- A. Description: UL 38 listed; finished in red with molded, raised-letter operating instructions in contrasting color. Station shall show visible indication of operation. Mounted on recessed outlet box; if indicated as surface mounted, provide manufacturer's surface back box.
 - 1. Single-action mechanism, pull-lever type. With integral addressable module, arranged to communicate manual-station status (normal, alarm, or trouble) to the FACP.
 - 2. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type. With integral addressable module, arranged to communicate manual-station status (normal, alarm, or trouble) to the FACP. Double action pull stations shall meet ADA guidelines.
 - 3. Station Reset: Key- or wrench-operated switch.
 - 4. Indoor Protective Shield: Factory-fabricated clear plastic enclosure, hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
 - 5. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure, hinged at the top to permit lifting for access to initiate an alarm.

2.4 SYSTEM SMOKE DETECTORS

- A. General Description:
 - 1. UL 268 listed, operating at 24-V dc, nominal.
 - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
 - 3. Multipurpose type, containing the following:
 - a. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
 - b. Piezoelectric sounder rated at 88 dBA at 10 feet according to UL 464.
 - c. Heat sensor, combination rate-of-rise and fixed temperature.
 - 4. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection of building wiring.
 - 5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.

6. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status.
 7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.
 - a. Rate-of-rise temperature characteristic shall be selectable at the FACP for 15 or 20 deg F per minute.
 - b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at the FACP to operate at 135 or 155 deg F.
 - c. Provide multiple levels of detection sensitivity for each sensor.
- B. Photoelectric Smoke Detectors:
1. Sensor: LED or infrared light source with matching silicon-cell receiver.
 2. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.
- C. Ionization Smoke Detector:
1. Sensor: Responsive to both visible and invisible products of combustion. Self-compensating for changes in environmental conditions.
 2. Detector Sensitivity: Between 0.5 and 1.7 percent/foot smoke obscuration when tested according to UL 268A.
- D. Duct Smoke Detectors:
1. Photoelectric Smoke Detectors:
 - a. Sensor: LED or infrared light source with matching silicon-cell receiver.
 - b. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.
 2. Ionization Smoke Detectors:
 - a. Sensor: Responsive to both visible and invisible products of combustion. Self-compensating for changes in environmental conditions.
 - b. Detector Sensitivity: Between 0.5 and 1.7 percent/foot smoke obscuration when tested according to UL 268A.
 3. UL 268A listed, operating at 24-V dc, nominal.
 4. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
 5. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. The fixed base shall be designed for mounting directly to the air duct. Provide terminals in the fixed base for connection to building wiring.
 - a. Weatherproof Duct Housing Enclosure: UL listed for use with the supplied detector. The enclosure shall comply with NEMA 250 requirements for Type 4X.
 6. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
 7. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status. Provide remote status and alarm indicator and test station where required.

8. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.
9. Each sensor shall have multiple levels of detection sensitivity.
10. Sampling Tubes: Design and dimensions as recommended by manufacturer for the specific duct size, air velocity, and installation conditions where applied.
11. Relay Fan Shutdown: Provide two (2) sets of contacts rated to interrupt fan motor-control circuit.

2.5 HEAT DETECTORS

- A. General: UL 521 listed.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or rate-of-rise of temperature that exceeds 15 deg F per minute, unless otherwise indicated.
 1. Mounting: Plug-in base, interchangeable with smoke-detector bases.
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
- C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F.
 1. Mounting: Plug-in base, interchangeable with smoke-detector bases.
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
- D. Continuous Linear Heat-Detector System: Consists of detector cable and control unit.
 1. Detector Cable: Rated detection temperature 155 deg F. Listed for "regular" service and a standard environment. Cable includes two steel actuator wires twisted together with spring pressure, wrapped with protective tape, and finished with PVC outer sheath. Each actuator wire is insulated with heat-sensitive material that reacts with heat to allow the cable twist pressure to short circuit wires at the location of elevated temperature.
 2. Control Unit: Two-zone or multizone unit as indicated. Provides same system power supply, supervision, and alarm features as specified for the central FACP.
 3. Signals to the Central FACP: Any type of local system trouble is reported to the central FACP as a composite "trouble" signal. Alarms on each detection zone are individually reported to the central FACP as separately identified zones.
 4. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

2.6 NOTIFICATION APPLIANCES

- A. Description: Equipped for mounting as indicated and with screw terminals for system connections.
 1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly.
 2. Finishes:
 - a. Wall mounted appliances: Provide red finish with white lettering or white finish with red lettering coordinate finish type locations with architect.
 - b. Ceiling Mounted Appliances: Provide white finish.

B. Voice/Tone Speakers:

1. UL 1480 listed.
2. High-Range Units: Rated 2 to 15 W.
3. Low-Range Units: Rated 1 to 2 W.
4. Matching Transformers: Tap range matched to the acoustical environment of the speaker location.

2.7 REMOTE STATUS AND ALARM INDICATORS

- A. Remote status and alarm indicator and test stations, with LED indicating lights. Light is connected to flash when the associated device is in an alarm or trouble mode. Lamp is flush mounted in a single-gang wall plate. A red, laminated, phenolic-resin identification plate at the indicating light identifies, in engraved white letters, device initiating the signal and room where the smoke detector or valve is located. For water-flow switches, the identification plate also designates protected spaces downstream from the water-flow switch.

2.8 REMOTE ANNUNCIATOR

- A. Description: Duplicate annunciator functions of the FACP for alarm, supervisory, and trouble indications. Also duplicate manual switching functions of the FACP, including acknowledging, silencing, resetting, and testing.
1. Mounting: Flush cabinet, NEMA 250, Class 1.
- B. Display Type and Functional Performance: Alphanumeric display same as the FACP. Controls with associated LEDs permit acknowledging, silencing, resetting, and testing functions for alarm, supervisory, and trouble signals identical to those in the FACP.

2.9 ADDRESSABLE MONITORING MODULE

- A. Description: Microelectronic monitor module listed for use in providing a system address for listed alarm-initiating devices for wired applications with normally open contacts.

2.10 ADDRESSABLE CONTROL MODULE

- A. Provide for integration of auxiliary control functions into the analog signaling circuit. Intelligent analog signaling circuit control module shall have the following capabilities:
1. Communication interaction with the analog signaling circuit having the capability of initiating a control function to an auxiliary device based on a specified event.
 2. Provide NO/NC contact pairs rated at 2 amps 120 VAC or 24 VDC.

2.11 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Listed and labeled according to UL 632.
- B. Functional Performance: Unit receives an alarm, supervisory, or trouble signal from the FACP, and automatically captures one or two telephone lines and dials a preset

number for a remote central station. When contact is made with the central station(s), the signal is transmitted. The unit supervises up to two telephone lines. Where supervising 2 lines, if service on either line is interrupted for longer than 45 seconds, the unit initiates a local trouble signal and transmits a signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. When telephone service is restored, unit automatically reports that event to the central station. If service is lost on both telephone lines, the local trouble signal is initiated.

- C. Secondary Power: Integral rechargeable battery and automatic charger. Battery capacity is adequate to comply with NFPA 72 requirements.
- D. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.12 SYSTEM PRINTER

- A. Listed and labeled as an integral part of the fire alarm system.

2.13 GUARDS FOR PHYSICAL PROTECTION

- A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
 - 1. Factory fabricated and furnished by manufacturer of the device.
 - 2. Finish: Paint of color to match the protected device.

2.14 WIRE AND CABLE

- A. Wire and cable for fire alarm systems shall be UL listed and labeled as complying with NFPA 70, Article 760.
- B. Fire alarm wire and cable shall be as specified by the system manufacturer including conductor gage, conductor quantity, conductor twists and shielding required to meet NFPA class and style performance specified.
- C. Signaling Line Circuits and other power limited fire alarm circuits (PLFA):
 - 1. PLFA circuits installed in conduit or raceway: U.L. Listed type FPL
 - 2. PLFA circuit cable installed exposed in accessible ceiling spaces, risers and elsewhere: U.L. Listed type FPLP.
 - 3. PLFA circuits installed where 2 hr rating is required to meet the survivability requirements of NFPA 72: Circuit integrity cable, NFPA 70 Article 760, Classification CI, UL listed as Type FPL, FPLR or FPLP as required, and complying with requirements in UL 1424 and in UL 2196 for a 2-hour rating.
- D. Non-Power-Limited Fire Alarm Circuits (NPLFA):
 - 1. NPLFA circuits installed in conduit: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
 - a. Low-Voltage Circuits: No. 16 AWG, minimum.
 - b. Line-Voltage Circuits: No. 12 AWG, minimum.

2. NPLFA circuit cable installed exposed in ceiling spaces, risers and elsewhere: Multi-conductor cable, U.L Listed type NPLFP.
3. NPLFA circuits installed where 2 hr rating is required to meet the survivability requirements of NFPA 72: Multi-conductor cable, U.L Listed type NPLFP-CI
4. NPLFA circuit cable installed exposed in ceiling spaces, shafts and elsewhere: Multi-conductor Armored Cable, NFPA 70 Type MC, copper conductors, copper drain wire, aluminum or steel armor with red identifier stripe, UL listed for fire alarm and cable tray installation, plenum rated, and complying with requirements in UL 2196 for a 2-hour rating.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Smoke or Heat Detector Spacing:

1. Smooth ceiling spacing shall not exceed 30 feet, or the listed spacing of the detectors, whichever is less.
2. Spacing of heat detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas, shall be determined according to Appendix A in NFPA 72.
3. Spacing of heat detectors shall be determined based on guidelines and recommendations in NFPA 72.

B. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.

C. Duct Smoke Detectors: Comply with NFPA 72. Install sampling tubes so they extend the full width of the duct.

D. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.

E. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

F. Remote Status and Alarm Indicators: Install near each smoke detector, each duct detector and each sprinkler water-flow switch and valve-tamper switch that is above 10'-0" aff, concealed, or otherwise not readily visible from normal viewing position. Coordinate exact locations with local fire department and submit to architect for approval.

G. Audible Alarm Notification Appliances: Install wall mounted appliances not less than 6 inches below the ceiling.

H. Visible Alarm Notification Appliances: Install wall mounted appliances at 96" AFF or 6 inches below the ceiling, whichever is less.

I. Coordinate ceiling mounted appliances with reflected ceiling plans. Do not install visual appliances where pendant mounted or suspended lighting fixtures will obstruct intended viewing angles.

J. Install wall mounted and ceiling mounted notification appliances flush on recessed j-box or back box for all new work and on existing gyp-board partition walls.

- K. Install notification appliances on existing CMU walls on surface back-boxes matching the dimensions and finish of the notification appliance.
- L. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- M. FACP: Surface mounted with tops of cabinets not more than 72 inches above the finished floor.
 - 1. Install smoke detector above panel. Install on ceiling for ceilings under 10 ft. For ceilings above 10', wall mount a smoke detector listed for releasing service 10' AFF or 1' below finished ceiling (whichever is lower).
- N. Annunciator: Install with top of panel not more than 72 inches above the finished floor.
- O. Antenna for Radio Alarm Transmitter: Mount to building structure where indicated. Use mounting arrangement and substrate connection that will resist 100-mph wind load with a 1.3 gust factor without damage.
- P. Provide all 120V branch circuits for all control panels, sub panels, and ancillary equipment required for the system.

3.2 WIRING INSTALLATION

- A. Install wiring according to the following:
 - 1. NECA 1.
 - 2. TIA/EIA 568-A.
- B. Wiring Method: Install wiring in metal raceway according to Division 26 Section "Raceways and Boxes."
 - 1. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.
- C. Wiring Method:
 - 1. Fire alarm circuits shall consist of multi-conductor cables installed in accessible ceiling spaces.
 - 2. Where ceilings consist of exposed construction, fire alarm multi-conductor cable shall be installed on top of joists, beams etc. and shall be concealed from view. Where the structural elements do not allow for the cable to be installed in a concealed fashion, then install the cable in conduit.
 - 3. Install fire alarm cable in conduit in mechanical rooms, loading docks and similar service spaces.
 - 4. Drops to surface mounted devices shall be installed in conduit or surface raceway. No exposed cable shall be visible below the ceiling. Where the ceiling is exposed, route the conduit or raceway up to the structural member that will conceal the cable.
 - 5. Drops to devices recessed in partition walls shall be installed in conduit.
 - 6. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
 - 7. Signaling Line Circuits: Power-limited fire alarm cables may be installed in the same cable or raceway as signaling line circuits, if the system manufacturer permits it.

- D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
- F. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.
- G. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum 1-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.
- H. Wiring to Remote Alarm Transmitting Device: 1-inch conduit between the FACP and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals according to Division 26 Section "Electrical Identification."
- B. Install instructions frame in a location visible from the FACP.
- C. Paint power-supply disconnect switch red and label "FIRE ALARM."

3.4 GROUNDING

- A. Ground the FACP and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to the FACP.

3.5 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, and to assist in field testing. Report results in writing.
- B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- C. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
- D. Perform the following field tests and inspections and prepare test reports:

1. Before requesting final approval of the installation, submit a written statement using the form for Record of Completion shown in NFPA 72.
2. Perform each electrical test and visual and mechanical inspection listed in NFPA 72. Certify compliance with test parameters. All tests shall be conducted under the direct supervision of a NICET technician certified under the Fire Alarm Systems program at Level III.
 - a. Include the existing system in tests and inspections.
3. Visual Inspection: Conduct a visual inspection before any testing. Use as-built drawings and system documentation for the inspection. Identify improperly located, damaged, or nonfunctional equipment, and correct before beginning tests.
4. Testing: Follow procedure and record results complying with requirements in NFPA 72.
 - a. Detectors that are outside their marked sensitivity range shall be replaced.
5. Test and Inspection Records: Prepare according to NFPA 72, including demonstration of sequences of operation by using the matrix-style form in Appendix A in NFPA 70.

3.6 PROGRAMMING

- A. Coordinate final address descriptions for alarm, supervisory and trouble indication that appear on FACP and Annunciator displays with the Owners representative. This shall include all room names, room numbers, building areas for fire protection zones, exit door descriptions and similar items. This coordination shall take place and be implemented in the programming prior to Demonstration and Owner Training.

3.7 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 Project outside normal occupancy hours for this purpose.
- B. Follow-Up Tests and Inspections: After date of Substantial Completion, test the fire alarm system complying with testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for three monthly, and one quarterly, periods.
- C. Semiannual Test and Inspection: Six months after date of Substantial Completion, test the fire alarm system complying with the testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- D. Annual Test and Inspection: One year after date of Substantial Completion, test the fire alarm system complying with the testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for monthly, quarterly, semiannual, and annual periods. Use forms developed for initial tests and inspections.

3.8 WARRANTY

- A. All newly installed equipment shall be warranted by the contractor for a period of one year following acceptance. The warranty shall include parts, labor, prompt field service, pickup and delivery.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the fire alarm system, appliances, and devices. Refer to Division 1 Section " Demonstration and Training."

END OF SECTION 283100

SECTION 311000 - SITE CLEARING

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. Protecting existing vegetation to remain.
 - 2. Removing existing vegetation.
 - 3. Clearing and grubbing.
 - 4. Stripping and stockpiling topsoil.
 - 5. Removing above- and below-grade site improvements.
 - 6. Disconnecting, capping or sealing, and removing site utilities or abandoning site utilities in place.
 - 7. Temporary erosion and sedimentation control if permanent project measures have not already been put in place.

1.3 DEFINITIONS

- A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects larger than 2 inches in diameter; and free of weeds, roots, toxic materials, or other nonsoil materials.
- D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.
- E. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated according to requirements in Section 015639 "Temporary Tree and Plant Protection."

- F. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 PREINSTALLATION MEETINGS

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

1.5 MATERIAL OWNERSHIP

- A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.6 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed trafficways if required by Owner or authorities having jurisdiction.
- B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- C. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.
- D. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.
- E. Tree- and Plant-Protection Zones: Protect according to requirements in Section 015639 "Temporary Tree and Plant Protection."
- F. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."
 - 1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed according to requirements in Section 015639 "Temporary Tree and Plant Protection."
- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures, if permanent project measures are not already in place, to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.
- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

- A. Protect trees and plants remaining on-site according to requirements in Section 015639 "Temporary Tree and Plant Protection."
- B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.4 EXISTING UTILITIES

- A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.
 - 1. Arrange with utility companies to shut off indicated utilities.

- B. Locate, identify, and disconnect utilities indicated to be abandoned in place.
- C. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Architect not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Architect's written permission.
- D. Excavate for and remove underground utilities indicated to be removed.
- E. Removal of underground utilities is included in earthwork sections; and utilities sections; and in Section 024116 "Structure Demolition" and Section 024119 "Selective Demolition."

3.5 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
 - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 - 2. Push down and grub out trees and vegetation that can be removed in this manner without damage to surrounding areas.
 - 3. Grind down stumps and remove roots larger than 2 inches in diameter, obstructions, and debris to a depth of 24 inches below exposed subgrade.
 - 4. Use only hand methods or air spade for grubbing within protection zones.
 - 5. Chip removed tree branches and stockpile in areas approved by Owner or dispose of if requested and approved by Owner.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
 - 1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.
- C. Flag clearing limits for inspection by Landscape Architect. If clearing limits are associated with a trail or roadway corridor, use a continuous flagging line between clearing points. No clearing shall take place until limits have been inspected and approved by the Landscape Architect. Landscape Architect may make minor adjustments to clearing limits to protect trees and/or better fit with existing topographic conditions.
- D. When working immediately adjacent to trees to be preserved, do not push trees down with equipment. Individually cut trees and direct their fall so to avoid damage to trees to remain.
- E. During cleaning operations, carefully operate equipment to avoid bumping, skinning, gouging, or otherwise damaging trees to be preserved. Any limbs on trees to be

saved damaged by clearing operations shall be pruned as directed by the Landscape Architect.

- F. Do not grub stumps along clearing limit lines that are within 10 feet of trees to be preserved. These stumps shall be ground to 24 inches below existing grade.
- G. At the conclusion of construction operations, further prune or remove any trees that have been damaged during construction operations, as determined by the Landscape Architect.

3.6 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to depth in a manner to prevent intermingling with underlying subsoil or other waste materials.
 - 1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
 - 1. Do not stockpile topsoil within protection zones.
 - 2. Stockpile surplus topsoil to allow for respreading deeper topsoil in areas directed by Architect and/or Owner.

3.7 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
 - 2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove soil material, unsuitable as fill, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
- B. Burning tree, shrub, and other vegetation waste is not permitted.

- C. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials, and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000

SECTION 31 10 01
CLEARING AND REMOVAL OF MISCELLANEOUS STRUCTURES

PART 1 - GENERAL

1.01 Work Included

This work includes, but is not limited to, clearing, topsoil removal, tree and stump removal, and the removal and protection of miscellaneous items within the project area.

1.02 Related Work

A. Section 02 41 13.13 – Pavement Removal

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.01 Location of Underground Utilities

The Contractor shall call MISS DIG at least three work days before excavating in an area so that utility companies can identify their buried utilities. The Contractor shall notify area municipalities and other utilities in the area that do not participate in the MISS DIG program for location of their utilities.

3.02 Stripping and Stockpiling of Topsoil

Prior to excavating, the existing topsoil surface shall be stripped and stockpiled from within the limits of the proposed excavation.

3.03 Removal of Fences, Signs, Mailboxes, Ornaments, and Other Objects

Fences, signs, mailboxes, ornaments, irrigation lines, solar landscaping lights, and similar objects that fall within the project area shall either be protected or removed. If removed, the materials shall be carefully taken apart and stored in a place where they will not be damaged or stolen.

Traffic signs shall not be removed unless approved by the agency responsible for them. If approved for removal, traffic signs and posts shall be reinstalled in accordance with the requirements of the agency responsible for them.

If any of the materials to be removed are damaged or badly deteriorated before the Contractor removes them, the Contractor shall notify the Owner before the object is removed. Materials that are damaged, stolen, or lost after they have been removed shall be replaced by the Contractor at no increase in project cost. The Contractor shall coordinate with the Owner as to what, if any, items scheduled for removal are to be re-used.

3.04 Conflicts with Utility Poles

Where the proposed excavation requires that a pole or guy be supported or temporarily relocated, the Contractor shall make arrangements with the appropriate utility to have the pole or guy supported or relocated. Any costs for this shall be the Contractor's expense.

If the Contractor supports the pole or relocates the guy themselves, the method used shall meet the approval of the appropriate utility. The Contractor shall be solely responsible for any supporting work to the utility company.

3.05 Trees and Brush

Brush lying within the limits of the proposed excavation shall be cleared by the Contractor. Brush shall be removed from the project area and disposed of properly.

Trees lying within the limits of the proposed excavation that are to be removed shall be cut down by the Contractor. Plans may not show all trees of all nature and the Contractor shall become familiar with the project and base their work on their own assessment. The Contractor shall coordinate with the Owner as to which trees are to be left in place and those that will be acceptable to remove. The Contractor shall notify the property owner (or the adjacent property owner if the tree is located in a public right-of-way) in advance of cutting down tree(s). The wood from the tree(s) shall be offered to the landowner. If the landowner wants the wood, the tree shall be cut into sections 8 feet long and stacked adjacent to the project area.

Small branches, limbs, and other debris shall be removed from the area by the Contractor and disposed of properly. If the landowner does not want wood from the trees, all wood including branches, limbs, and other debris shall be removed from the area by the Contractor and disposed of properly.

Stumps shall be removed in their entirety and disposed of away from the project area in an acceptable manner. Burning or burying along the project route is not acceptable.

END OF SECTION

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating and filling for rough grading the Site.
2. Preparing subgrades for walks, pavements, turf and grasses, and plants.
3. Base course for concrete walks and pavements.
4. Subsurface drainage backfill for walls and trenches.
5. Excavating and backfilling trenches for utilities and pits for buried utility structures.

B. Related Requirements:

1. Section 311000 "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
2. Section 329200 "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.
3. Section 329300 "Plants" for finish grading in planting areas and tree and shrub pit excavation and planting.
4. Section 321313 Concrete Paving for subgrade preparation and tolerances.

1.2 COORDINATION WITH ENGINEERING PLANS AND SPECIFICATIONS

- A. The Contractor shall call a meeting with WTA Architects and ROWE Engineering to review and coordinate all requirements related to this section.

1.3 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

- B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

- E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices changes in the Work.
 - 2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
 - 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, will be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Rock:
 - 1. Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. for bulk excavation or 3/4 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock-excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
 - a. Equipment for Footing, Trench, and Pit Excavation: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch maximum-width, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,700 lbf and stick-crowd force of not less than 18,400 lbf with extra-long reach boom.
 - b. Equipment for Bulk Excavation: Late-model, track-mounted loader; rated at not less than 230-hp flywheel power and developing a minimum of 47,992-lbf breakout force with a general-purpose bare bucket.
 - 2. Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by a geotechnical testing agency, according to ASTM D1586.
- I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other fabricated stationary features constructed above or below the ground surface.
- J. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- K. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- L. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct preexcavation conference at Project site
 - 1. Review methods and procedures related to earthmoving, including, but not limited to, the following:
 - a. Personnel and equipment needed to make progress and avoid delays.
 - b. Coordination of Work with utility locator service.
 - c. Coordination of Work and equipment movement with the locations of tree- and plant-protection zones.
 - d. Extent of trenching by hand or with air spade.
 - e. Field quality control.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of the following manufactured products required or necessitated later in the construction process:
 - 1. Geotextiles.
 - 2. Controlled low-strength material, including design mixture.
 - 3. Warning tapes.
- B. Samples for Verification: For the following products, in sizes indicated below:
 - 1. Geotextile: 12 by 12 inches
 - 2. Warning Tape: 12 inches long; of each color.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:
 - 1. Classification according to ASTM D2487.
 - 2. Laboratory compaction curve according to ASTM D698.

1.7 QUALITY ASSURANCE

- A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E329 and ASTM D3740 for testing indicated.

1.8 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth-moving operations.
- C. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified in Section 015000 "Temporary Facilities and Controls" and Section 311000 "Site Clearing" are in place.
- D. Do not commence earth-moving operations until plant-protection measures specified in Section 015639 "Temporary Tree and Plant Protection" are in place.
- E. The following practices are prohibited within protection zones:
1. Storage of construction materials, debris, or excavated material.
 2. Parking vehicles or equipment.
 3. Foot traffic.
 4. Erection of sheds or structures.
 5. Impoundment of water.
 6. Excavation or other digging unless otherwise indicated.
 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- F. Do not direct vehicle or equipment exhaust towards protection zones.
- G. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D2487 and Groups A-1, A-2-4, A-2-5, and A-3 according to AASHTO M 145, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D2487 and Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7 according to AASHTO M 145, or a combination of these groups.
1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.
- F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
- H. Drainage Course: Narrowly graded mixture of [washed]crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and zero to 5 percent passing a No. 8 sieve.
- I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and zero to 5 percent passing a No. 4 sieve.
- J. Sand: ASTM C33/C33M; fine aggregate.
- K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.
- L. Drainage and base courses for specific situation as detailed in the plans and in plans provided by ROWE Engineering.

2.2 GEOTEXTILES

- A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 - 1. Survivability:
 - a. Class 2; AASHTO M 288.
 - b. As follows:
 - 1) Grab Tensile Strength: 157 lbf; ASTM D4632.
 - 2) Sewn Seam Strength: 142 lbf; ASTM D4632.
 - 3) Tear Strength: 56 lbf; ASTM D4533.
 - 4) Puncture Strength: 56 lbf; ASTM D4833.

- c. Apparent Opening Size: No. 40 sieve, maximum; ASTM D4751.
 - d. Permittivity: 0.2 per second, minimum; ASTM D4491.
 - e. UV Stability: 50 percent after 500 hours' exposure; ASTM D4355.
- B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
- 1. Survivability:
 - a. Class 2; AASHTO M 288.
 - b. As follows:
 - 1) Grab Tensile Strength: 247 lbf; ASTM D4632.
 - 2) Sewn Seam Strength: 222 lbf; ASTM D4632.
 - 3) Tear Strength: 90 lbf; ASTM D4533.
 - 4) Puncture Strength: 90 lbf; ASTM D4833.
 - c. Apparent Opening Size: No. 60 sieve, maximum; ASTM D4751.
 - d. Permittivity: 0.02 per second, minimum; ASTM D4491.
 - e. UV Stability: 50 percent after 500 hours' exposure; ASTM D4355.

2.3 CONTROLLED LOW-STRENGTH MATERIAL

- A. Controlled Low-Strength Material: Self-compacting, low-density, flowable concrete material produced from the following:
- 1. Portland Cement: ASTM C150/C150M, Type I.
 - 2. Fly Ash: ASTM C618, Class C or F.
 - 3. Normal-Weight Aggregate: ASTM C33/C33M, 3/4-inch nominal maximum aggregate size.
 - 4. Foaming Agent: ASTM C869/C869M.
 - 5. Water: ASTM C94/C94M.
 - 6. Air-Entraining Admixture: ASTM C260/C260M.
- B. Produce low-density, controlled low-strength material with the following physical properties:
- 1. As-Cast Unit Weight: 30 to 36 lb/cu. ft. at point of placement, when tested according to ASTM C138/C138M.
 - 2. Compressive Strength: 140 psi, when tested according to ASTM C495/C495M.
- C. Produce conventional-weight, controlled low-strength material with 140-psi compressive strength when tested according to ASTM C495/C495M.

2.4 ACCESSORIES

- A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6

inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.
6. Verify color with local jurisdiction.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth-moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

- A. Provide dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.
- B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
- D. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

3.3 EXPLOSIVES

- A. Explosives:

1. Do not use explosives.

3.4 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
 2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
 - a. 24 inches outside of concrete forms other than at footings.
 - b. 12 inches outside of concrete forms at footings.
 - c. 6 inches outside of minimum required dimensions of concrete cast against grade.
 - d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
 - e. 6 inches beneath bottom of concrete slabs-on-grade.
 - f. 6 inches beneath pipe in trenches and the greater of 24 inches wider than pipe or 42 inches wide.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 1. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.
- B. Excavations at Edges of Tree- and Plant-Protection Zones:
 1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
 2. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
 - 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.
 - 1. Clearance: 12 inches each side of pipe or conduit.
- C. Trench Bottoms:
 - 1. Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
 - a. For pipes and conduit less than 6 inches in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
 - b. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
 - c. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
 - d. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
 - 2. Excavate trenches 4 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.
 - a. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- D. Trenches in Tree- and Plant-Protection Zones:
 - 1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
 - 2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
 - 3. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.8 SUBGRADE INSPECTION

- A. Notify Architect when excavations have reached required subgrade.

- B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade below pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 - 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
 - 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
- D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect.
 - 1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.10 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 - 2. Surveying locations of underground utilities for Record Documents.
 - 3. Testing and inspecting underground utilities.
 - 4. Removing concrete formwork.

5. Removing trash and debris.
6. Removing temporary shoring, bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.

- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

- C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 033000 "Cast-in-Place Concrete."

- D. Trenches under Roadways: Provide 4-inch thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase course. Concrete is specified in Section 033000 "Cast-in-Place Concrete."

- E. Backfill voids with satisfactory soil while removing shoring and bracing.

- F. Initial Backfill:

1. Soil Backfill: Place and compact initial backfill of subbase material or satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.
 - a. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

- G. Final Backfill:

1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.

- H. Warning Tape: Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.13 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory topsoil material.
 - 2. Under walks and pavements. See Plan Details.
 - 3. Under steps and ramps. See Plan Details.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
 - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 6 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D698.
 - 1. Under structures, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 100 percent.
 - 2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 100 percent.
 - 3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
 - 4. For utility trenches, compact each layer of initial and final backfill soil material at 95 percent.

3.16 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:
 - 1. Turf or Unpaved Areas: Plus or minus 1 inch.
 - 2. Walks: Plus 1 inch, minus ¼”.
 - 3. Pavements: Plus 1/2 inch minus 0”.

3.17 SUBSURFACE DRAINAGE

- A. Subsurface Drain: Prepare subsurface drainage lines or systems per details in Plans.
 - 1. Compact each filter material layer to 95 percent of maximum dry unit weight according to ASTM D698.

3.18 BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place base course under pavements and walks as follows:
 - 1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends, if indicated in Plan details in WTA or Civil engineering plans.
 - 2. Place base course material over subbase course under hot-mix asphalt pavement.
 - 3. Shape base course to required crown elevations and cross-slope grades.
 - 4. Place base course 6 inches or less in compacted thickness in a single layer.
 - 5. Place base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 - 6. Compact base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 100 percent of maximum dry unit weight according to ASTM D698.
- C. Pavement Shoulders: Place shoulders along edges of subbase course and base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 100 percent of maximum dry unit weight according to ASTM D698.

3.19 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade if and as detailed in WTA or Civil Engineering Plans.
 - 1. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D698.

3.20 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
 - 2. Determine that fill material classification and maximum lift thickness comply with requirements.
 - 3. Determine, during placement and compaction, that in-place density of compacted fill complies with requirements.
- B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.
- E. Testing agency will test compaction of soils in place according to ASTM D1556, ASTM D2167, ASTM D2937, and ASTM D6938, as applicable. Tests will be performed at the following locations and frequencies:
 - 1. Paved Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 1000 sq. ft. or less of paved area or building slab but in no case fewer than three tests.
 - 2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 50 feet or less of wall length but no fewer than two tests.
 - 3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 100 feet or less of trench length but no fewer than two tests.
- F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.21 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.22 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Stock pile and reuse all topsoil in the final 6-12 inches of landfill for landscaped areas.
- B. Stockpile and reuse all satisfactory non-topsoil soils for berm building.
- C. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000

SECTION 31 23 01
EXCAVATING, FILLING, AND GRADING

PART 1 - GENERAL

1.01 Work Included

The work of excavating, filling, and grading includes, but is not necessarily limited to:

- A. Excavating for footings and foundations;
- B. Filling and backfilling to attain indicated grades;
- C. Trenching and trench backfilling;
- D. Rough and finish grading of the site; and
- E. Furnishing and installing granular cushion under concrete slabs on grade.

1.02 References

Where materials or methods of construction are listed as being in conformance with a standard specification, it shall refer to the latest edition of the standard specification or any interim revision.

- A. ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- B. Michigan Department of Transportation 2020 Standard Specifications for Construction

1.03 Related Work

- A. Section 01 45 16.02 – Density and Aggregate Testing
- B. Section 02 41 13.13 – Pavement Removal
- C. Section 31 25 00 – Soil Erosion and Sedimentation Control

1.04 Job Conditions

A. Protection

The Contractor shall use all means necessary to protect all materials before, during, and after installation and to protect all objects designated to remain.

In the event of damage, the Contractor shall immediately make all repairs and replacements necessary to the approval of the Engineer and at no additional cost to the Owner.

B. Safety

The Contractor is responsible for conducting operations in a safe and orderly manner and in conformance with MIOSHA P.A. 154.

C. Permits

Unless otherwise provided, the Contractor is responsible to obtain and comply with permits required under Parts 31 and 91 of Michigan PA 451 of 1994 (Natural Resources and Environmental Protection Act) and any local ordinances.

PART 2 - PRODUCTS

2.01 Fill Material – General

All fill material shall be subject to the approval of the Engineer.

For approval of fill material, notify the Engineer at least four working days in advance of intention to import material, designate the proposed borrow area, and permit the Engineer to sample, as necessary, from the borrow area for the purpose of making acceptance tests to prove the quality of the material.

2.02 Fill, Trench, and Structural Backfill Material

Fill material, unless specified otherwise, shall be soil or soil-rock mixture that is free from organic matter and other deleterious substance. It shall contain no rocks or lumps over 6 inches in greatest dimension and not more than 15 percent of the rocks or lumps shall be larger than 2½ inches in greatest dimension.

Fill material obtained from offsite sources shall meet the requirements of the preceding paragraph and additionally, shall be predominantly granular with a maximum particle size of 2 inches and a plasticity index of 12 or less.

Fill material placed within 2 feet horizontally of the base of building foundations and/or slabs shall have a plasticity index of 15 or less.

2.03 Sand

Sand shall meet the requirements of Granular Material Class II, as specified in the Michigan Department of Transportation 2020 Standard Specifications for Construction.

2.04 Granular Cushion

Granular cushion under slabs shall meet the requirements of Granular Material Class II, as specified in the Michigan Department of Transportation 2020 Standard Specifications for Construction.

2.05 Sand for Backfill and Pipe Bedding

Sand shall meet the requirements of Granular Material Class II, as specified in the Michigan Department of Transportation 2020 Standard Specifications for Construction.

2.06 Aggregate for Pipe Bedding

Aggregate shall meet the requirements of Series 6AA aggregate, as specified in the Michigan Department of Transportation 2020 Standard Specifications for Construction.

2.07 Aggregate for Backfill

Aggregate shall meet the requirements of 21AA crushed aggregate or 4G open-graded aggregate, as specified in the Michigan Department of Transportation 2020 Standard Specifications for Construction.

2.08 Flowable Fill

Flowable fill shall be a mixture of Portland cement, fly ash, sand, and water in the following proportions.

Flowable Fill Mixture Ratios		
Material	Type	Quantity
Portland Cement	Type I or IA	50 lb/cyd
Fly Ash	ASTM C618, Class C or F	500 lb/cyd
Sand	MDOT 2NS	2,850 lb/cyd
Water		Approx. 376 lb/cyd (sufficient to produce desired flowability)

Flowable fill shall be produced and delivered at a minimum temperature of 50 degrees Fahrenheit. Mixtures shall be transported to the point of placement in a revolving drum mixer or agitator.

2.09 Geotextile

Geosynthetics must be composed of long-chain synthetic fiber of at least 85 percent, by weight, polyolefins or polyesters. Geosynthetics must be capable of resisting degradation from chemicals, mildew, rot, and ultraviolet (UV) light.

Geotextile used to prevent intermixing of soft subgrade and subbase materials shall meet the requirements per the Michigan Department of Transportation 2020 Standard Specifications for Construction, as shown in Table 910-1 for geotextile stabilization and separator.

2.10 Other Materials

All other materials not specifically described, but required for a complete and proper installation, shall be as selected by the Contractor and subject to the approval of the Engineer.

PART 3 - EXECUTION

3.01 General

Prior to all work of this section, the Contractor shall become thoroughly familiar with the site, the site conditions, and all portions of the work falling within this section. The Contractor shall not allow or cause any of the work performed or installed to be covered up or enclosed by work of this section prior to all required inspections, tests, and approvals. Should any of the work be enclosed or covered up before it has been approved, the Contractor shall uncover all such work at no additional cost to the Owner. After the work has been completely tested, inspected, and approved, the Contractor shall make all repairs and replacements necessary to restore the work to the condition in which it was found at the time of uncovering, all at no additional cost to the Owner.

The Contractor shall excavate ahead of the proposed utility installation to expose any existing buried utilities. If existing utility grades conflict with the proposed utility grade, the proposed utility grade may be adjusted by the Engineer, if necessary, to miss the existing utility grade at no additional expense to the contract.

3.02 Geotextile Stabilization and Geotextile Separator

Deliver and store geosynthetics in packaging capable of resisting UV radiation, contaminants, and moisture. Label each unit of material with product information, including supplier and lot identification. Do not expose geosynthetics to direct sunlight for prolonged periods. Repair or replace damaged geosynthetics at no additional cost to the project.

A. Geotextile Placement

Place or install geotextile products in accordance with the manufacturer's installation guidelines and this subsection.

Do not operate equipment required to place backfill directly on geotextile products. Eliminate wrinkles or waves that develop during placement. Place the products in direct contact with the soil below before placing backfill on the geotextile products.

Shingle-lap longitudinal and transverse joints at least 2 feet, or seam the joints in accordance with the manufacturer's recommendations. Ensure field or factory seams meet the minimum grab tensile strength for the product application. Place seams facing upward for inspection purposes.

Repair tears or damage to the geotextile in accordance with the manufacturer's recommendations.

B. Aggregate or Granular Material Placement

Spread and grade the first layer of aggregate or granular material after placing geotextile to create a stable work platform before compaction. Place additional aggregate or granular material, as required, and compact. Fill ruts with additional aggregate or granular material and compact before placing each subsequent layer. The cost of aggregate or granular

material, including additional quantities required to fill ruts, is included in the unit prices for related pay item(s).

3.03 Excavating

Where depressions result from, or have resulted from, the removal of surface or subsurface obstructions, the Contractor shall open the depression and remove all debris and soft material as directed by the Engineer.

The Contractor shall excavate to the grades shown on the drawings. Where excavation grades are not shown on the drawings, excavation shall be completed, as required, to accommodate the installation.

All over-excavated areas shall be backfilled and compacted at no additional cost to the Owner.

3.04 Preparation of Subgrade

After the site has been cleared, stripped, and excavated to within 6 inches of the specified depths for recompaction, the exposed surface shall be scarified to a minimum depth of 6 inches, thoroughly moisture-conditioned, and compacted to the requirements specified below for fill.

All ruts, hummocks, and other uneven surfaces shall be removed by surface grading prior to placement of fill.

3.05 Subgrade Undercutting

Subgrade undercutting shall be performed to replace material susceptible to frost heaving, differential frost action, or unstable soil conditions, as determined by the Engineer.

After the subgrade has been excavated to the approximate grade, the Engineer will inspect the grade to determine if subgrade undercutting is required and to determine the limits of such undercutting. The Contractor shall provide suitable equipment for proof rolling the grade. The inspection, proof rolling, and subgrade undercutting shall be completed prior to placing any embankment, road base, or pavement.

The Contractor shall undercut the subgrade within the limits defined by the Engineer. All excavated material resulting from the undercutting shall become the Contractor's property disposed of outside the project limits, unless otherwise directed. The volume of earth removed by subgrade undercutting shall be replaced by suitable soils as follows:

- A. Type I Subgrade Undercutting - backfill with selected clay or similar material approved by the Engineer.
- B. Type II Subgrade Undercutting - backfill with sand.
- C. Type III Subgrade Undercutting

Backfill with the material excavated from subgrade undercut areas after mixing the excavated material to break up the undesirable strata of soils or with other Engineer-approved backfill material.

D. Type IV Subgrade Undercutting

Backfill with 21AA crushed aggregate or 4G open-graded aggregate. Encapsulate 4G aggregate with geotextile separator.

Backfill material shall be compacted according to Section 01 45 16.02 – Density and Aggregate Testing.

3.06 Excess Water Control

Fill material shall not be placed, spread, or rolled during unfavorable weather conditions. Operations shall not resume until moisture content and fill density are satisfactory to the Engineer. Berms or channels shall be provided to prevent flooding of subgrade. All water collecting in depressions shall be promptly removed.

Where soil has been softened or eroded by flooding or placement during unfavorable weather, all damaged areas shall be removed and compacted as specified below for fill and compaction.

The Contractor shall provide suitable means and equipment to maintain excavations and other parts of the work free from water.

Dewatering means and methods shall provide dry excavations and the preservation of the final lines and grades of bottoms of excavations.

3.07 Fill and Compaction

After subgrade compaction has been approved by the Engineer, the Contractor shall place approved fill material in layers not exceeding 8 inches in uncompacted thickness.

The fill material shall be watered or aerated, as necessary, and thoroughly mixed to obtain a moisture content that will permit proper compaction.

Each soil layer shall be compacted to at least the specified minimum degree. The filling and compaction process shall be repeated until plan grade is attained.

A. Compaction Requirements

Unless otherwise specified on the drawings or in other sections of the specifications, fill and backfill shall be placed in 8-inch lifts and each lift shall be compacted to not less than the percentages of the maximum density stated in Section 01 45 16.02 – Density and Aggregate Testing.

Compaction by jetting will not be permitted unless specifically authorized by the Engineer.

3.08 Grading

Except as otherwise directed by the Engineer, the Contractor shall perform all rough and finish grading required to attain the elevations shown on the drawings.

Tolerances For Grading			
Rough Grade		Finish Grade	
Building, roads, and parking areas	Plus or minus 0.1 feet	Granular cushion under concrete slabs	Plus or minus 0.05 feet
Landscaped areas	Plus or minus 0.25 feet	Parking areas	Plus or minus 0.03 feet
		Landscaped areas	Plus or minus 0.1 feet

After grading is completed and has been accepted by the Engineer, the Contractor shall permit no further excavating, filling, or grading.

The Contractor shall use all means necessary to prevent erosion of freshly graded areas during construction and until such time as permanent drainage and erosion control measures have been installed.

3.09 Excavating for Footings

Earth surfaces, upon which footings will be placed, shall be compacted in accordance with the compaction requirements established in this section of these specifications.

The Contractor shall verify that all compaction is complete and approved prior to excavating for footings.

The Contractor shall excavate to the required lines and grades. The bottom of trenches shall be cut level and all loose soil shall be removed. Where soft spots are encountered, unsuitable materials shall be removed and replaced with flowable fill at no additional cost to the Owner.

3.10 Placing Granular Cushion

The Contractor shall carefully place the specified granular cushion in areas to receive concrete slabs on grade, uniformly attaining the thickness indicated on the drawings, and providing all required transition planes.

3.11 Trenching

The Contractor shall perform all trenching required for the installation of items where the trenching is not specifically described in other sections of these specifications.

All trenches shall be open construction, with sufficient width to provide free working space at both sides of the trench and around the installed item as required for pipelaying, backfilling, and compacting.

Trenching shall be completed, as required, to provide the elevations shown on the drawings. Where elevations are not shown on the drawings, trench to sufficient depth to give a minimum of 18 inches of fill above the top of the pipe, measured from the adjacent finished grade.

Where trench excavation is inadvertently carried below proper elevations, the over-excavated area shall be backfilled with material approved by the Engineer, and then compacted to provide a firm and unyielding subgrade and/or foundation to the approval of the Engineer and at no additional cost to the Owner.

The Contractor shall properly support all trenches in accordance with all applicable rules and regulations.

The Contractor shall brace, sheet, and support trench walls in such a manner that they will be safe and that the ground alongside the excavation will not slide or settle, and that all existing improvements of every kind, whether on public or private property, will be fully protected from damage.

In the event of damage to such improvements, the Contractor shall immediately make all repairs and replacements necessary to the approval of the Engineer and at no additional cost to the Owner.

Bracing, sheeting, and shoring shall be constructed so as to not place stress on any portion of the completed work until the general construction thereof has proceeded far enough to provide sufficient strength. The Contractor shall exercise care in the drawing and removal of sheeting, shoring, bracing, and timbering to prevent collapse and caving of the excavation faces being supported.

Trenched material shall be stockpiled in a manner to prevent water running into the excavations. Surface drainage shall not be obstructed. A means shall be provided whereby storm and wastewaters are diverted into existing gutters, other surface drains, or temporary drains.

3.12 Foundation for Pipes

Trench bottoms shall be graded to provide a smooth, firm, and stable foundation free from rock points throughout the length of the pipe.

A minimum of 4 inches of sand or aggregate bedding shall be placed in the bottom of the trench.

In areas where soft, unstable materials are encountered at the surface where the bedding is to be placed, the unstable material shall be removed and replaced with material approved by the Engineer. The area shall be undercut to a sufficient depth to develop a firm foundation for the item being installed. Over excavation and replacement of material shall be the responsibility of the Contractor and shall be completed at no additional cost to the Owner.

At each joint in pipe, the bottom of the trench shall be recessed, as required, to relieve the bell of the pipe of all load and to ensure continuous bearing of the pipe barrel on the firm foundation.

The pipe subgrade shall be shaped to fit the bottom of the trench to the pipe shape.

3.13 Bedding for Pipes

Pipe bedding shall be in accordance with the details in the construction plans.

The pipe bedding shall be shaped to match the bottom $\frac{1}{4}$ of the pipe's shape. The bedding shall be excavated to accommodate the pipe bells. The completed bedding shall provide uniform support of the entire length of pipe.

The bedding material shall be compacted after placing along both sides of the pipe.

3.14 Backfill for Pipes

Unless otherwise directed, all trenches and excavation shall be backfilled as the pipe is laid. No pipes shall be backfilled until the sewer elevations, gradient, alignment, and the pipe joints have been observed by the Engineer.

The trench shall be backfilled to the proposed final elevations with suitable materials. Unless other compaction methods are demonstrated and approved by the Engineer, backfill shall be placed in 8-inch lifts and compacted to the required density as stated in Section 01 45 16.02 – Density and Aggregate Testing.

In areas which are not to be restored with a pavement or aggregate surface, the backfill shall be graded to a height slightly above the adjacent surface. When final restoration of the area is completed by the Contractor, the backfill surface shall be excavated (or filled if settlement has occurred), trimmed, or graded, as necessary, to provide for the required depth of topsoil and its transition to adjacent, undisturbed areas.

The Contractor shall correct any areas where the trench backfill settles by adding fill, topsoil, and re-seeding.

3.15 Miscellaneous Pipe Repair

When an existing sewer pipe, drain pipe, field tile, or other existing pipe is damaged as a result of construction activities and is not designated for removal or abandonment on the plans or by the Engineer, it shall be repaired by the Contractor.

The section of damaged pipe shall be removed to existing joints or to sawed joints where the existing pipe is sound and undamaged. A length of new pipe of the same size as the original pipe shall be furnished and installed to replace the section of pipe removed. The new pipe may be any one of the following materials:

- A. Same material, class or thicknesses, as the original pipe
- B. PVC Schedule 40, for pipes 8 inches or less in diameter
- C. PVC SDR 26, for pipes 8 inches or greater in diameter

D. Other pipe material approved by the Engineer

Each end of the new section of pipe shall be connected to the remaining sections of existing pipe using a rubber gasketed sleeve, suitable for the pipe materials and sizes being joined, to provide a watertight connection. The repaired section of pipe shall be firmly bedded in sand or aggregate, compacted according to Section 01 45 16.02 – Density and Aggregate Testing.

END OF SECTION

SECTION 312319 - DEWATERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Construction dewatering.

B. Related Requirements:

1. Section 312000 "Earth Moving" for excavating, backfilling, site grading, and controlling surface-water runoff and ponding.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review condition of site to be dewatered, including coordination with temporary erosion-control measures and temporary controls and protections.
2. Review proposed site clearing and excavations.

B. Delegated Design Submittals: For dewatering system, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 FIELD CONDITIONS

A. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from this data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of groundwater and permit excavation and construction to proceed on dry, stable subgrades.

1. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, prevention of flooding in excavation, and prevention of damage to subgrades and permanent structures.

2. Prevent surface water from entering excavations by grading, dikes, or other means.
3. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
4. Remove dewatering system when no longer required for construction.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.
 1. Prevent surface water and subsurface or groundwater from entering excavations, from ponding on prepared subgrades, and from flooding site or surrounding area.
 2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
- B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Provide temporary grading to facilitate dewatering and control of surface water.
- D. Protect and maintain temporary erosion and sedimentation controls.

3.2 INSTALLATION

- A. Place dewatering system into operation to lower water to specified levels before excavating below groundwater level.
- B. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.

3.3 OPERATION

- A. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.
- B. Operate system to lower and control groundwater to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Drain

water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.

1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
 2. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
- C. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.
- D. Remove dewatering system from Project site on completion of dewatering.

3.4 FIELD QUALITY CONTROL

- A. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.
- B. Prepare reports of observations.

3.5 PROTECTION

- A. Protect and maintain dewatering system during dewatering operations.
- B. Promptly repair damages to adjacent facilities caused by dewatering.

END OF SECTION 312319

SECTION 31 25 00
SOIL EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.01 Work Included

The Contractor shall provide permanent and/or temporary erosion and sedimentation control as called for on the plans and as required by the county soil erosion agent and permit.

1.02 Definitions

A. Major rainfall event – ¼-inch or more precipitation over a period, delineated by dry periods of at least 24 hours.

1.03 References

Where materials or methods of construction are listed as being in conformance with a standard specification, it shall refer to the latest edition of the standard specification or any interim revision.

- A. ASTM D3786 – Standard Test Method for Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method
- B. ASTM D4355 – Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
- C. ASTM D4491 – Standard Test Method for Water Permeability of Geotextiles by Permittivity
- D. ASTM D4533 – Standard Test Method for Trapezoid Tearing Strength of Geotextiles
- E. ASTM D4632 – Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
- F. ASTM D4751 – Standard Test Method for Determining Apparent Opening Size of a Geotextile
- G. ASTM D4833 – Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
- H. Michigan Department of Transportation 2020 Standard Specifications for Construction

1.04 Related Work

A. Section 32 92 00 – Turf Establishment

1.05 Permit

The Contractor shall apply for and obtain an Act 451 permit from the local Soil Erosion and Sedimentation Control Enforcing Agent. The Contractor shall pay all permit fees and provide any required bonds or insurance.

1.06 Scheduling

- A. Control measures shall be constructed by the Contractor prior to the time construction starts uphill or upstream from the control measure location.
- B. The Contractor shall inspect all temporary erosion control measures weekly and within 18 hours of major rainfall events.
- C. Maintenance and replacement of erosion control measures shall be completed by the Contractor when necessary, or as directed by the soil erosion control agent or the Engineer.
- D. Removal and cleanup of temporary control structures shall be provided by the Contractor within one week after the control measure is no longer needed.

1.07 General Soil Erosion and Sedimentation Control Procedures

- A. Keep disturbed areas small.
- B. Stabilize and protect disturbed areas as soon as possible.
- C. Keep storm water runoff velocities low.
- D. Protect disturbed areas from runoff.
- E. Retain sediment within the construction area.

PART 2 - PRODUCTS

2.01 Materials

A. Geotextiles

Geotextiles for filters shall be non-woven, meeting the requirements of the table below.

Silt fence geotextiles shall meet the requirements of the following table and shall be designed to collect eroded sediment transported in storm water runoff. The fabric shall have at least 70 percent minimum retained strength after 500 hours of U.V. exposure when tested according to ASTM D4355.

Geotextile Category	Property/Test Method					
	Grab Tensile Strength (min) ASTM D4632 lbs	Trapezoid Tear Strength (min) ASTM D4533 lbs	Puncture Strength (min) ASTM D4833 lbs	Mullen burst strength (min) ASTM D3786 psi (a)	Permittivity ASTM D4491 Per second	Apparent Opening Size (max) ASTM D4751 (b) Millimeters
Filters	90	45	45	140	0.5	0.21
Silt Fence	100(c)	45	--	--	0.1	0.60
(a) ASTM D3786. The fluid displacement rate for the Mullen burst test equipment must be 170± 5 ml/minute. Subtract tare strength from the ultimate burst strength as specified by ASTM. (b) Filtration opening size (FOS, Canadian General Standards Board, method 148.1 No. 10) is permitted as an alternate test method to ASTM D4751 for non-woven geotextiles. (c) Elongation at the specified grab tensile strength not to exceed 40 percent for silt fence.						

B. Stone

Unless otherwise directed, stone shall meet the requirements of Series 6AA as specified in Michigan Department of Transportation 2020 Standard Specifications for Construction.

2.02 Mixtures

A. Seed

Seed shall meet the requirements of Section 32 92 00 – Turf Establishment.

2.03 Fabricated Items

A. Silt Fence

Geotextile for silt fences shall meet the requirements of Section 2.01. The geotextile shall be attached to machine pointed No. 2 common grade hardwood posts, using at least 5 staples through wood lath a minimum of $\frac{3}{8}$ -inch thick and 2 feet long. Post spacing shall not exceed $6\frac{1}{2}$ feet. Posts must be of sufficient length and cross-section to support the installed silt fence under full sediment load; however, posts shall have cross-sectional area of at least $2\frac{1}{4}$ square inches and shall be a minimum of 36 inches in length. Silt fence fabric must be a minimum height of $2\frac{1}{2}$ feet. Silt fence shall have at least two permanent markings or affixed labels per assembled roll which positively identifies the fabricator.

B. Mulch Blankets

Mulch blankets shall meet the requirements of Section 32 92 00 – Turf Establishment.

C. Filter Sacks

All materials shall adhere to the requirements of the Michigan Department of Transportation 2020 Standard Specifications for Construction, except fabric drop, which shall consist of a geotextile filter sack inserted into the drainage structure under the cover.

Filter sack shall be as manufactured by “Siltsack”, “Catch-All”, “Ultra-Urban Filter”, “Flogard + Plus”, or approved equal. The filter sacks shall be installed and maintained in accordance with the manufacturer’s specifications.

PART 3 - EXECUTION

3.01 General Requirements

The Contractor shall perform work on the project in a manner which prevents or reduces erosion and controls sedimentation. The Contractor shall provide controls which keep sedimentation from the project area, within the limits of the project area, and out of any lake, river, stream, wetland, or storm drain.

The Contractor shall install appropriate controls or measures to control or prevent erosion or sedimentation from the project area before beginning any earth disturbance operations. Temporary erosion and sedimentation control measures shall be maintained by the Contractor, until such times as disturbed areas have become permanently stabilized.

During the life of the project, the Contractor shall provide any additional soil erosion or sedimentation control measures necessary to address specific problems which develop in and adjacent to the project area.

3.02 Time Limitations

Grading operations shall be completed as soon as practical. Permanent soil erosion controls for disturbed areas shall be completed within 5 calendar days of the completion of grading, except that permanent measures shall be completed within 24 hours when the disturbed area is within 150 feet of a lake, stream, river, or wetland area.

Temporary soil erosion measures shall be implemented when it is not practical to complete the permanent measures.

3.03 Area Limitations

For linear projects (roads, sewers, water main, etc.), the length of the disturbed area shall be limited to ½-mile, unless otherwise approved by the Engineer.

Areas outside the project right-of-way or outside the grading limits shown on the drawings shall not be disturbed, unless otherwise approved by the Engineer.

3.04 Construction of Erosion and Sedimentation Controls

The Contractor shall provide all permanent and temporary erosion and sedimentation controls shown on the drawings, required by the permitting agency, or necessary to appropriately control erosion and sedimentation from the project area.

A. Check Dams

Check dams shall be installed and maintained across ditches and watercourses, which might convey surface runoff from disturbed areas within the project area, or where shown on the drawings or required by the Engineer or permitting agency.

B. Silt Fence

The Contractor shall furnish, erect, and maintain silt fence around the perimeter of the project area where earth will be disturbed and sediment from the disturbed area could be conveyed.

C. Filters

Fabric or stone filters shall be installed in waterways or in advance of inlets to drainage courses or storm sewers.

D. Sediment Traps and Basins

Sediment traps shall be excavated upstream of check dams and where shown on the drawings or directed by the Engineer or permitting agency. Check dams shall be installed downstream of the sediment traps and basins prior to the sediment traps and basins being excavated.

E. Seeding

Earth areas shall be stabilized with turf immediately following the completion of earthwork and grading activities. Where permanent seeding cannot be completed, earth areas shall be stabilized with temporary seeding. Areas which are properly seeded temporarily for stabilization shall be permanently seeded, as shown, as the work can be appropriately completed.

F. Mulch Blankets

Areas susceptible to erosion from moving water, which are not to be paved, shall be seeded and protected with high velocity mulch blankets.

3.05 Maintenance and Erosion and Sedimentation Control

The Contractor shall maintain all temporary erosion and sedimentation controls until such time as the permanent measures have been completed and established.

The Contractor shall inspect all erosion and sedimentation controls weekly and within 18 hours of a major rain event.

Damaged controls or measures shall be replaced or repaired. Sediment shall be cleaned from traps, sumps, basins, filters, and fences periodically. Sediment shall be removed to prevent the accumulation of sediment from exceeding half of the volume of traps, sumps, and basins. Sediment or debris along silt fences shall be removed before the accumulation reaches half the height of the fence.

Sediment and debris removed from soil erosion and sedimentation control devices shall be disposed of properly by the Contractor. Sediment shall not be used for fill or backfill in the project area, except when an area is specifically designated on the plans or by the Engineer.

Drainage filters shall be cleaned when an accumulation of silt might reduce flow and result in flooding.

Any sediment from the construction area which enters storm sewers or drainage ditches shall be removed by the Contractor. Since sediment can be carried great distances within storm sewers,

it may be necessary for many segments of downstream storm sewer segments to be televised, jetted, and vacuumed. If the Engineer believes that the Contractor has allowed or provided the potential for sediment to enter storm sewers or drainage courses, the Contractor will be responsible for the costs of inspection and removing sediment from downstream drains, whether it can be conclusively proven that the sediment was the result of the Contractor's actions (or inaction).

3.06 Removal of Erosion and Sedimentation Control Devices

Temporary soil erosion and sedimentation control devices shall be removed or obliterated by the Contractor when the permanent measures are in place and established. Any areas damaged by the removal of the temporary devices shall be corrected by the Contractor.

Mulch used for temporary erosion control may either be removed or worked into the soil before the permanent topsoil and seeding is completed.

END OF SECTION

SECTION 32 11 16
GRANULAR SUBBASE

PART 1 - GENERAL

1.01 Work Included

This specification describes the requirements for constructing granular subbase under a proposed aggregate surface.

1.02 References

A. Michigan Department of Transportation 2020 Standard Specifications for Construction

1.03 Related Work

A. Section 01 45 16.02 – Density and Aggregate Testing

PART 2 - PRODUCTS

2.01 Materials

A. Granular subbase shall meet the requirements of Class II Sand, as described in the Michigan Department of Transportation 2020 Standard Specifications for Construction, unless otherwise noted on the plans, proposal, or specifications.

PART 3 - EXECUTION

3.01 Subgrade Preparation

Granular subbase shall not be placed until the subgrade is properly prepared. The subgrade shall be graded to the required elevations and shape for placement of the specified granular subbase thickness. The subgrade shall be compacted according to Section 01 45 16.02 – Density and Aggregate Testing. Soft or yielding spots shall be excavated and replaced with sound material.

3.02 Placement

Granular subbase shall be placed in a manner that provides a uniform cross section of the specified thickness and the required surface grades. The edges of the area of granular subbase shall be straight and uniform.

Material shall not be placed over frozen, soft, unstable, or rutted subgrade.

Granular subbase shall be placed in lifts not exceeding 12 inches (loose measure) and compacted according to Section 01 45 16.02 – Density and Aggregate Testing.

END OF SECTION

SECTION 32 11 23
AGGREGATE BASE

PART 1 - GENERAL

1.01 Work Included

This specification describes the requirements for constructing an aggregate base under a proposed pavement surface.

1.02 References

A. Michigan Department of Transportation 2020 Standard Specifications for Construction

1.03 Related Work

A. Section 01 45 16.02 – Density and Aggregate Testing

PART 2 - PRODUCTS

2.01 Materials

A. Aggregate shall meet the requirements of Series 21AA aggregate limestone, as described in the Michigan Department of Transportation 2020 Standard Specifications for Construction, unless otherwise noted on the plans, proposal, or specifications.

PART 3 - EXECUTION

3.01 Subgrade Preparation

Aggregate shall not be placed until the subgrade is properly prepared. The subgrade shall be graded to the required elevations and shape for placement of the specified aggregate thickness. The subgrade shall be compacted according to Section 01 45 16.02 – Density and Aggregate Testing. Soft or yielding spots shall be excavated and replaced with sound material.

3.02 Placement

Aggregate shall be placed in a manner that provides a uniform cross section of the specified thickness and the required surface grades. The edges of the area of aggregate surface shall be straight and uniform.

Aggregate shall be placed in lifts not exceeding 8 inches (loose measure) and compacted according to Section 01 45 16.02 – Density and Aggregate Testing.

END OF SECTION

SECTION 32 12 16
HMA PAVING

PART 1 - GENERAL

1.01 Work Included

This work includes preparation for and construction of one or more courses of plant mixed Hot Mix Asphalt (HMA).

1.02 References

- A. Michigan Department of Transportation 2020 Standard Specifications for Construction
- B. Michigan Testing Methods (MTM)
- C. Michigan Department of Transportation HMA Production Manual
- D. ASTM E965 – Standard Test Method for Measuring Pavement Macrottexture Depth Using a Volumetric Technique

1.03 Related Work

- A. Section 01 45 16.02 – Density and Aggregate Testing
- B. Section 32 11 23 – Aggregate Base

1.04 Quality Assurance and Quality Control

- A. The Engineer will take 20,000 gram samples of the HMA mixture using the mini-stockpile method. The rate of sampling will be determined by the Engineer.

PART 2 - PRODUCTS

2.01 Submittals

The Contractor shall submit material source and mix designs to the Engineer for approval prior to the start of construction.

2.02 Mixtures

Materials shall meet the requirements of Sections 501.02, 902, and 904 of the Michigan Department of Transportation 2020 Standard Specifications for Construction. If milling, the mix design to initially cover the milled surface must be approved prior to milling operations.

Provide aggregates, mineral filler (if required) and asphalt binder to produce a mixture proportioned within Superpave Final Aggregate Blend Gradation Requirements, and meeting the uniformity tolerance limits in the Uniformity Tolerance Limits for HMA Mixtures tables below.

Superpave Final Aggregate Blend Gradation Requirements					
Standard Sieve	Mix Number				
	5	4	3 Leveling Course	3 Base Course	2
% Passing Criteria (Control Points)					
1½ inch	-	-	-	-	100
1 inch	-	-	100	100	90-100
¾ inch	-	100	90-100	90-100	≤90
½ inch	100	90-100	≤90	≤90	-
⅜ inch	90-100	≤90	-	-	-
No. 4	≤90	-	-	-	-
No. 8	47-67	39-58	35-52	23-52	19-45
No. 16	-	-	-	-	-
No. 30	-	-	-	-	-
No. 50	-	-	-	-	-
No. 100	-	-	-	-	-
No. 200	2.0-10.0	2.0-10.0	2.0-8.0	2.0-8.0	1.0-7.0

Uniformity Tolerance Limits for HMA Mixtures					
Parameter		Top and Leveling Course		Base Course	
Number	Description	Range 1 (a)	Range 2 (b)	Range 1 (a)	Range 2 (b)
1	% Binder Content	-0.3 to +.4	+/- 0.5	-0.3 to +0.4	+/- 0.5
2	% passing # 8 and Larger Sieves	+/- 5	+/-8	+/- 7	+/- 9
		+/- 4	+/- 6	+/-6	+/-9
		+/- 1	+/- 2	+/- 2	+/- 3
3	Crushed Particle Content	Below 10%	Below 15%	Below 10%	Below 15%
(a) This range allows for normal mixture and testing variations. The mixture must be proportioned to test as closely as possible to the Job-Mix-Formula (JMF).					
(b) Deviation from JMF.					

Parameter Number 2, as shown in the Uniformity Tolerance Limits for HMA Mixtures table, is aggregate gradation. Each sieve will be evaluated on one of the three gradation tolerances. If more than one sieve is exceeding Range 1 or Range 2 tolerances, only the one with the largest exceedance will be counted as the gradation parameter.

The master gradation should be maintained throughout production; however, price adjustments will be based on the Uniformity Tolerance Limits for HMA Mixtures table. Aggregates which are used in plant-mixed HMA mixtures must not contain topsoil, clay, or loam.

The mixture will be considered out-of-specification, as determined by the acceptance tests, if for any one mixture, two consecutive tests per parameter, (for Parameter 2, two consecutive aggregate gradations on one sieve) are outside Range 1 or Range 2 tolerance limits. If a parameter is outside of Range 1 tolerance limits and the second consecutive test shows that the parameter is outside of Range 2, then it will be considered to be a Range 1 out-of-specification. Consecutive

refers to the production order and not necessarily the testing order. Out-of-specification mixtures are subject to a price adjustment of 50 percent of the bid amount.

HMA mixtures and application rates shall be as shown on the plans.

Reclaimed Asphalt Pavement (RAP) shall be limited to 0 percent to 17 percent RAP by weight of the total binder in the mixture. No binder grade adjustment is made to compensate for the stiffness of the asphalt binder in the RAP.

Reclaimed Asphalt Shingles (RAS) will not be allowed in the mixture.

Oil bottoms/recycled motor oil will not be allowed in the mixture.

PART 3 - EXECUTION

3.01 Equipment

Equipment shall meet the requirements of Section 501.03 of the Michigan Department of Transportation 2020 Standard Specifications for Construction.

3.02 HMA Sampling and Testing

The Contractor shall submit to the Engineer for approval the rate at which the HMA will be sampled. Samples will be obtained using the "Mini-stockpile" method in accordance with MTM 324.

Quantitative Extraction of Bitumen from HMA Paving Mixtures (MTM 325) will be used to determine the asphalt content of the HMA mixture.

The Contractor is responsible for HMA testing.

The Contractor shall submit test results to the Engineer within seven days of HMA placement.

At the Engineer's discretion, original samples of asphalt binder will be taken by the Contractor and delivered to the Engineer prior to incorporation into the mixture. The frequency of sampling will be determined by the Engineer. The cost of obtaining and delivering the samples to the Engineer will be included in the HMA pay item(s). The Contractor must certify, in writing, that the materials used in the HMA mixture are from the same source as the materials used in developing the HMA mixture design and the bond coat is from an approved supplier, as stated in the Material Quality Assurance Procedures Manual.

3.03 Preparation

- A. Aggregate Base (for Pavements Constructed on an Aggregate Base)
See Section 32 11 23 – Aggregate Base.

B. Removal of Existing Pavement Surface

1. Edge Trimming

Where the edge of an existing HMA pavement is required, the HMA pavement shall be cut its full depth in a manner that provides a vertical, straight edge.

C. Hand Patching

When hand patching is called for on the plans or directed by the Engineer, the Contractor shall fill holes, depressions, joints and cracks, and areas to be repaired in an existing pavement. HMA material used for hand patching may be any HMA material approved for use as a top course. A bond coat shall be applied to the exposed pavement surfaces within the area to be patched. The HMA material shall be placed in lifts to the level of the surface of the adjacent existing pavement surface. Each lift shall be within the minimum and maximum thickness range allowed for the mix design, and shall be compacted using a mechanical vibrator or an approved roller.

D. Bond Coat

Bond coat shall be applied to existing pavement surfaces, only when they are clean and dry. Bond coats shall be uniformly applied to the pavement surface with a pressure applicator. Bond coat shall be placed in advance of HMA placement to provide for its curing prior to HMA placement.

Bond coat shall not be allowed to pool on the surface; pooling shall be removed. The adjacent pavement surfaces which are not to be overlaid shall not be sprayed with bond coat.

Bond coat shall be applied to each layer of the HMA pavement and to the vertical edges of the adjacent pavements before placing subsequent courses.

E. Transportation of HMA

HMA shall be transported to the project site in accordance with the requirements of Section 501.03.E of the Michigan Department of Transportation 2020 Standard Specifications for Construction.

Each load of HMA delivered to the project site shall be weighed on an approved scale with automatic print out system. Weights shall be measured to the nearest 20 pounds. Scales and print out systems shall meet the requirements of Section 109 of the Michigan Department of Transportation 2020 Standard Specifications for Construction.

F. Placement of HMA

HMA shall be placed in accordance with the requirements of Section 501.03.F of the Michigan Department of Transportation 2020 Standard Specifications for Construction and at the rate shown in the HMA Application Rate table in the project plans.

G. Rolling

HMA shall be rolled in accordance with the requirements of Section 501.03.G of the Michigan Department of Transportation 2020 Standard Specifications for Construction.

H. Smoothness requirements as per the requirements of Section 501.03.H of the Michigan Department of Transportation 2020 Standard Specifications for Construction shall be adhered to.

I. Weather and Seasonal Limitations

1. The Contractor shall not place bond coat or HMA when precipitation is imminent or when there is moisture on the existing surface to be overlaid.
2. HMA shall not be placed when the underlying base is frozen, and the surface being paved is at least 35 degrees Fahrenheit.
3. Unless otherwise approved by the Engineer in writing, HMA shall not be placed before May 15 or after November 15.

J. Protection

The Contractor shall protect surfaces, structures, signs, poles, vehicles, and other items adjacent to the area to be paved from being discolored or damaged. Damaged items shall be corrected at the Contractor's expense. The Contractor shall protect the newly placed HMA surface from damage by traffic and construction activities.

END OF SECTION

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes concrete paving, including the following:
 - 1. Driveways.
 - 2. Parking lots.
 - 3. Curbs and gutters.
 - 4. Walks.

- B. Related Requirements:
 - 1. Section 321373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.
 - 2. Section 321713 "Parking Bumpers."
 - 3. Section 321723 "Pavement Markings."
 - 4. Section 321726 "Tactile Warning Surfacing" for detectable warning tiles.

1.2 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.

- B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to concrete paving, including but not limited to, the following:
 - a. Concrete mixture design.
 - b. Quality control of concrete materials and concrete paving construction practices.

 - 2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete paving Subcontractor.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color selection.
- C. Samples for Verification: For each type of product or exposed finish, prepared as Samples of size indicated below:
 - 1. Exposed Aggregate: 10-lb Sample of each mix.
- D. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer of exposed aggregate walkways.
- B. Material Certificates: For the following, from manufacturer:
 - 1. Cementitious materials.
 - 2. Steel reinforcement and reinforcement accessories.
 - 3. Fiber reinforcement.
 - 4. Admixtures.
 - 5. Curing compounds.
 - 6. Applied finish materials.
 - 7. Bonding agent or epoxy adhesive.
 - 8. Joint fillers.
- C. Material Test Reports: For each of the following:
 - 1. Aggregates: Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.
- D. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").
- B. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests must be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Build mockups of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship.
 2. Build mockups of concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Architect and not less than 96 inches by 96 inches.
 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 FIELD CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 2. Do not use frozen materials or materials containing ice or snow.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.
- C. Hot-Weather Concrete Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

2.2 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
 - 1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

- A. Epoxy-Coated Welded-Wire Reinforcement: ASTM A884/A884M, Class A, plain steel.
- B. Epoxy-Coated Reinforcing Bars: ASTM A775/A775M or ASTM A934/A934M; with ASTM A615/A615M, Grade 60 deformed bars.
- C. Epoxy-Coated, Joint Dowel Bars: ASTM A775/A775M; with ASTM A615/A615M, Grade 60 plain-steel bars.
- D. Tie Bars: ASTM A615/A615M, Grade 60; deformed.
- E. Hook Bolts: ASTM A307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
- F. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
 - 1. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
- G. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

2.4 CONCRETE MATERIALS

- A. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:
 - 1. Portland Cement: ASTM C150/C150M, gray portland cement Type I.
- B. Normal-Weight Aggregates: ASTM C33/C33M, Class 4S uniformly graded. Provide aggregates from a single source.
 - 1. Maximum Coarse-Aggregate Size: 3/4 inch (19 mm) nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Exposed Aggregate: Selected, hard, and durable; washed; free of materials with deleterious reactivity to cement or that cause staining; from a single source, with gap-graded coarse aggregate as follows:
 - 1. Aggregate Sizes: 3/8 to 5/8 inch nominal.
 - 2. Aggregate Source, Shape, and Color: Rounded river stone, type and color range consistent with stone typically used throughout Dow Gardens.
- D. Air-Entraining Admixture: ASTM C260/C260M.
- E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
 - 1. Retarding Admixture: ASTM C494/C494M, Type B, or submit alternative for opposed aggregate.
- F. Water: Potable and complying with ASTM C94/C94M.

2.5 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182; or
- B. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

2.6 RELATED MATERIALS

- A. Joint Fillers: ASTM D1751, asphalt-saturated cellulosic fiber ASTM D1752 in preformed strips.

- B. Chemical Surface Retarder: Water-soluble, liquid, set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch.

2.7 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
 - 2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that comply with or exceed requirements.
- B. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
 - 1. Air Content, 3/4-inch Nominal Maximum Aggregate Size: 7 percent plus or minus 1 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- D. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
- E. Concrete Mixtures: Normal-weight concrete.
 - 1. Compressive Strength (28 Days): 4500 psi for curb and gutters and designated areas and travel lanes in parking and service yards, 3500 psi for all walkways and pedestrian areas.
 - 2. Maximum W/C Ratio at Point of Placement: 0.45.
 - 3. Slump Limit: 4 inches.

2.8 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Furnish batch certificates for each batch discharged and used in the Work.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

- B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.
 - 1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
 - 2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
 - 3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Section 312000 "Earth Moving."
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 INSTALLATION OF STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- C. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- D. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D3963/D3963M.

3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
 2. Provide tie bars at sides of paving strips where indicated.
 3. Butt Joints: Use epoxy-bonding adhesive at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 4. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
1. Locate expansion joints at intervals of 50 feet unless otherwise indicated.
 2. Extend joint fillers full width and depth of joint.
 3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
 4. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 5. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows.
1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
 - a. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.
 2. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.
- B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.
- H. Screed paving surface with a straightedge and strike off.
- I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.
- K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
 - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

3.7 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.

- B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
 - 1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.

3.8 SPECIAL FINISHES

- A. Monolithic Exposed-Aggregate Finish: Expose coarse aggregate in paving surface as follows:
 - 1. Immediately after float finishing, spray-apply chemical surface retarder to paving according to manufacturer's written instructions.
 - 2. Cover paving surface with plastic sheeting, sealing laps with tape, and remove when ready to continue finishing operations.
 - 3. Without dislodging aggregate, remove mortar concealing the aggregate by lightly brushing surface with a stiff, nylon-bristle broom. Do not expose more than one-third of the average diameter of the aggregate and not more than one-half of the diameter of the smallest aggregate.
 - 4. Fine-spray surface with water and brush. Repeat cycle of water flushing and brushing until cement film is removed from aggregate surfaces to depth required.

3.9 INSTALLATION OF DETECTABLE WARNINGS

- A. Blockouts: Form blockouts in concrete for installation of detectable paving units specified in Section 321726 "Tactile Warning Surfacing."
 - 1. Tolerance for Opening Size: Plus 1/4 inch, no minus.

3.10 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture-retaining-cover curing, as follows:

1. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period, using cover material and waterproof tape.

3.11 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 1/8 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot-long; unlevel straightedge not to exceed 1/8 inch.
4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
5. Lateral alignment and Spacing of Dowels: 1 inch.
6. Vertical Alignment of Dowels: 1/4 inch.
7. Joint Spacing: 3 inches.
8. Contraction Joint Depth: Plus 1/4 inch, no minus.
9. Joint Width: Plus 1/8 inch, no minus.

3.12 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C172/C172M will be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 2000 sq. ft. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM C143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C1064; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C31; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C39; test one specimen at seven days and two specimens at 28 days.

- a. All tests shall meet or exceed the specified compressive strengths.
- C. Test results to be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests to 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.
- D. 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.
- E. Additional Tests: Testing and inspecting agency will 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.
- F. Concrete paving will be considered defective if it does not pass tests and inspections.
- G. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- H. Prepare test and inspection reports.

3.13 REPAIR AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint.
- B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as a clean surface. Remove all surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Staining, discoloration, and other aesthetic defects resulting from construction access and traffic is sufficient reason to require replacement. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 321373 - CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cold-applied joint sealants.
2. Hot-applied joint sealants.
3. Joint-sealant backer materials.
4. Primers.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for sealing nontraffic and traffic joints in locations not specified in this Section.

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

A. Product Data:

1. Concrete pavement joint sealants.
2. Joint-sealant backer materials.

- B. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of joint sealant.

- C. Samples for Verification: Actual sample of finished products for each kind and color of joint sealant required.

1. Size: Joint sealants in 1/2-inch wide joints formed between two 6-inch long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Paving-Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Installers: Entity that employs installers and supervisors who are trained and approved by manufacturer.

1.5 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer[or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain joint sealants from single manufacturer for each sealant type.

2.2 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backer materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

2.3 COLD-APPLIED JOINT SEALANTS

- A. Single-Component, Nonsag, Silicone Joint Sealant: ASTM D5893/D5893M, Type NS.
1. Dowsil 888 Silicone Joint Sealant
 2. Craftco Roadsaver Silicone SL.

2.4 JOINT-SEALANT BACKER MATERIALS

- A. Joint-Sealant Backer Materials: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by joint-sealant manufacturer, based on field experience and laboratory testing.

- B. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.

2.5 PRIMERS

- A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Joint Sealants to be used at all expansion joints in concrete paving and at all expansion joints between concrete and walls or other paved surfaces.

3.2 EXAMINATION

- A. Examine joints to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

- A. Surface Cleaning of Joints: Before installing joint sealants, clean out joints immediately to comply with joint-sealant manufacturer's written instructions.
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
- B. Joint Priming: Prime joint substrates where indicated or 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.

3.4 INSTALLATION OF JOINT SEALANTS

- A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
- B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions.

- C. Install joint-sealant backers to support joint 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 joint-sealant backer materials.
 - 2. Do not stretch, twist, puncture, or tear joint-sealant backer materials.
 - 3. Remove absorbent joint-sealant backer materials that have become wet before sealant application and replace them with dry materials.

- D. Install joint sealants immediately following backer material installation, using proven techniques that comply with the following:
 - 1. Place joint sealants so they fully contact 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 Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants in accordance with the following requirements 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 joint sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

- F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

3.5 CLEANING AND PROTECTION

- A. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.

- B. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

END OF SECTION 321373

SECTION 321713 - PARKING BUMPERS

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. Precast concrete wheel stops.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Precast concrete wheel stops.

PART 2 - PRODUCTS

2.1 PARKING BUMPERS

- A. Precast Concrete Wheel Stops: Precast, steel-reinforced, air-entrained concrete; 4000-psi minimum compressive strength; 4-1/2 inches high by 9 inches wide by 72 inches long. Provide chamfered corners, transverse drainage slots on underside, and a minimum of three factory-formed or -drilled vertical holes through wheel stop for anchoring to substrate.
 - 1. Source Limitations: Obtain wheel stops from single source from single manufacturer.
 - 2. Surface Appearance: Smooth, free of pockets, sand streaks, honeycombs, and other obvious defects. Corners shall be uniform, straight, and sharp.
 - 3. Surface Sealer: Manufacturer's standard salt-resistant, clear sealer, applied at precasting location.
 - 4. Mounting Hardware: Galvanized-steel spike or dowel, 1/2-inch diameter, 24-inch minimum length.
 - 5. Color - Blue, matching accessible parking striping paint.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that pavement is in suitable condition to begin installation in accordance with manufacturer's written instructions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wheel stops in accordance with manufacturer's written instructions unless otherwise indicated.
- B. Securely anchor wheel stops to substrate with hardware in each preformed vertical hole in wheel stop as recommended in writing by manufacturer. Recess head of hardware beneath top of wheel stop.

END OF SECTION 321713

SECTION 321723 - PAVEMENT MARKINGS

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. Painted markings applied to asphalt paving.
 - 2. Painted markings applied to concrete surfaces.
- B. Related Requirements:
 - 1. Section 099113 "Exterior Painting" for painting exterior concrete surfaces other than pavement markings.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to marking asphalt paving or concrete surfaces including, but not limited to, the following:
 - a. Asphalt-paving or concrete-surface aging period before application of pavement markings.
 - b. Review requirements for protecting pavement markings, including restriction of traffic during installation period.

1.4 ACTION SUBMITTALS

- A. Product Data: Include technical data and tested physical and performance properties.
- B. Shop Drawings:
 - 1. Indicate pavement markings, colors, lane separations, defined parking spaces, and dimensions to adjacent work.
 - 2. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

- C. Samples: For each exposed product and for each color and texture specified; on rigid backing, 8 inches square.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of City of Midland or Michigan DOT, wherever is the appropriate regulatory agency, for pavement-marking work.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for alkyd materials 55 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain pavement-marking paints from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" jurisdiction and ICC A117.1.

2.3 PAVEMENT-MARKING PAINT

- A. Pavement-Marking Paint water-based / water-borne / zero VOC traffic - rated paint.
 - 1. Color: White, Yellow, or Blue as indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that pavement-marking substrate is dry and in suitable condition to begin pavement marking in accordance with manufacturer's written instructions.
- B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

3.2 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
- B. Allow asphalt paving or concrete surfaces to age for a minimum of 30 days before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.
 - 1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to asphalt paving or concrete surface. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.

3.3 PROTECTING AND CLEANING

- A. Protect pavement markings from damage and wear during remainder of construction period.
- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 321723

SECTION 321726 - TACTILE WARNING SURFACING

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. Surface-applied detectable warning metal tiles.
- B. Related Requirements:
 - 1. Section 321313 "Concrete Paving" for concrete walkways serving as substrates for tactile warning surfacing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each type of tactile warning surface, in manufacturer's standard sizes unless otherwise indicated, showing edge condition, truncated-dome pattern, texture, color, and cross section; with fasteners and anchors.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For tactile warning surfacing, to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 PREINSTALLATION MEETINGS

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

1.7 PROJECT CONDITIONS

- A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.
- B. Weather Limitations for Mortar and Grout:
 - 1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
 - 2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. Provide artificial shade and windbreaks, and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F and higher.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of tactile warning surfaces that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering and wear.
 - b. Separation or delamination of materials and components.
 - 2. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TACTILE WARNING SURFACING, GENERAL

- A. Accessibility 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 for tactile warning surfaces.
 - 1. For tactile warning surfaces composed of multiple units, provide units that when installed provide consistent side-to-side and end-to-end dome spacing that complies with requirements.
- B. Source Limitations: Obtain each type of tactile warning surfacing, joint material, setting material, anchor, and fastener from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

2.2 DETECTABLE WARNING TILES

- A. Cast-in-Place Detectable Warning Metal Tiles: Accessible truncated-dome detectable warning metal tiles configured for setting flush in new concrete walkway surfaces, with slip-resistant surface treatment on domes and field of tile.
 - 1. Material - Duralast Detectable Warning Plate as provided by FJ.
 - a. Cast Iron: Gray iron, ASTM A 48/A 48M, CL 35.
 - 2. Shapes and Sizes:
 - a. Rectangular panel, 18 by 24 inches, 24 by 24 inches, 24 by 36 inches, 24 by 48 inches, 24 by 60 inches as appropriate for each situation.
 - b. Radius panel, nominal 24 inches deep by 6 outside radius indicated on Drawings.
 - 3. Dome Spacing and Configuration: Manufacturer's standard compliant spacing.
 - 4. Mounting:
 - a. Permanently embedded detectable warning tile wet-set into freshly poured concrete.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that pavement is in suitable condition to begin installation according to manufacturer's written instructions. Verify that installation of tactile warning surfacing will comply with accessibility requirements upon completion.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF TACTILE WARNING SURFACING

- A. General: Prepare substrate and install tactile warning surfacing according to manufacturer's written instructions unless otherwise indicated.
- B. Place tactile warning surfacing units in dimensions and orientation indicated. Comply with location requirements of AASHTO MP 12.

3.3 INSTALLATION OF DETECTABLE WARNING TILES

- A. Cast-in-Place Detectable Warning Tiles:
 - 1. Concrete Paving Installation: Comply with installation requirements in Section 321313 "Concrete Paving." Mix, place, and finish concrete to conditions complying with detectable warning tile manufacturer's written requirements for satisfactory embedment of tile.

2. Set each detectable warning tile accurately and firmly in place and completely seat tile back and embedments in wet concrete by tamping or vibrating. If necessary, temporarily apply weight to tiles to ensure full contact with concrete.
3. Set surface of tile flush with surrounding concrete and adjacent tiles, with variations between tiles and between concrete and tiles not exceeding plus or minus 1/8 inch from flush.
4. Protect exposed surfaces of installed tiles from contact with wet concrete. Complete finishing of concrete paving surrounding tiles. Remove concrete from tile surfaces.
5. Clean tiles using methods recommended in writing by manufacturer.

3.4 CLEANING AND PROTECTION

- A. Remove and replace tactile warning surfacing that is broken or damaged or does not comply with requirements in this Section. Remove in complete sections from joint to joint unless otherwise approved by Architect. Replace using tactile warning surfacing installation methods acceptable to Architect.
- B. Protect tactile warning surfacing from damage and maintain free of stains, discoloration, dirt, and other foreign material.

END OF SECTION 321726

SECTION 329113 - SOIL PREPARATION

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 planting soils specified by composition of the mixes.
- B. Related Requirements:
 - 1. Section 311000 "Site Clearing" for topsoil stripping and stockpiling.
 - 2. Section 329200 "Turf and Grasses" for placing planting soil for turf and grasses.
 - 3. Section 329300 "Plants" for placing planting soil for plantings.

1.3 DEFINITIONS

- A. AAPFCO: Association of American Plant Food Control Officials.
- B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.
- C. CEC: Cation exchange capacity.
- D. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.
- E. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.
- F. Imported Soil: Soil that is transported to Project site for use.
- G. Layered Soil Assembly: A designed series of planting soils, layered on each other, that together produce an environment for plant growth.
- H. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.

- I. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.
- J. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."
- K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- L. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.
- M. SSSA: Soil Science Society of America.
- N. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- O. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- P. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.
- Q. USCC: U.S. Composting Council.

1.4 PREINSTALLATION MEETINGS

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

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include recommendations for application and use.
 - 2. Include test data substantiating that products comply with requirements.
 - 3. Include sieve analyses for aggregate materials.
 - 4. Material Certificates: For each type of imported soil and soil amendment and fertilizer before delivery to the site, according to the following:
 - a. Manufacturer's qualified testing agency's certified analysis of standard products.
 - b. Analysis of fertilizers, by a qualified testing agency, made according to AAPFCO methods for testing and labeling and according to AAPFCO's SUIP #25.

- c. Analysis of nonstandard materials, by a qualified testing agency, made according to SSSA methods, where applicable.
 - B. Samples: For each bulk-supplied material, 1-gal. (4-L) volume of each in sealed containers labeled with content, source, and date obtained. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of composition, color, and texture.
- 1.6 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For each testing agency.
 - B. Preconstruction Test Reports: For preconstruction soil analyses specified in "Preconstruction Testing" Article.
 - C. Field quality-control reports.
- 1.7 QUALITY ASSURANCE
- A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.
 - 1. Multiple Laboratories: At Contractor's option, work may be divided among qualified testing laboratories specializing in physical testing, chemical testing, and fertility testing.
- 1.8 PRECONSTRUCTION TESTING
- A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction soil analyses on existing, on-site soil imported soil.
 - 1. Notify Landscape Architect seven days in advance of the dates and times when laboratory samples will be taken.
 - B. Preconstruction Soil Analyses: For each unamended soil type, perform testing on soil samples and furnish soil analysis and a written report containing soil-amendment and fertilizer recommendations by a qualified testing agency performing the testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.
 - 1. Have testing agency identify and label samples and test reports according to sample collection and labeling requirements.
- 1.9 SOIL-SAMPLING REQUIREMENTS
- A. General: Extract soil samples according to requirements in this article.

- B. Sample Collection and Labeling: Have samples taken and labeled by state-certified, -licensed, or -registered soil scientist under the direction of the testing agency.
 - 1. Number and Location of Samples: Representative soil samples where indicated on Drawings and where directed by Landscape Architect for each soil to be used or amended for landscaping purposes.
 - 2. Procedures and Depth of Samples: According to USDA-NRCS's "Field Book for Describing and Sampling Soils."
 - 3. Division of Samples: Split each sample into two, equal parts. Send half to the testing agency and half to Owner for its records.
 - 4. Labeling: Label each sample with the date, location keyed to a site plan or other location system, visible soil condition, and sampling depth.

1.10 TESTING REQUIREMENTS

- A. General: Perform tests on soil samples according to requirements in this article.
- B. Physical Testing:
 - 1. Soil Texture: Soil-particle, size-distribution analysis by one of the following methods according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":
 - a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine, and very fine sand; and fragment-gradation (gravel) percentages for fine, medium, and coarse fragments; according to USDA sand and fragment sizes.
 - b. Hydrometer Method: Report percentages of sand, silt, and clay.
 - 2. Total Porosity: Calculate using particle density and bulk density according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
 - 3. Water Retention: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
 - 4. Saturated Hydraulic Conductivity: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods"; at 85% compaction according to ASTM D 698 (Standard Proctor).
- C. Chemical Testing:
 - 1. CEC: Analysis by sodium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."
 - 2. Clay Mineralogy: Analysis and estimated percentage of expandable clay minerals using CEC by ammonium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 1- Physical and Mineralogical Methods."
 - 3. Metals Hazardous to Human Health: Test for presence and quantities of RCRA metals including aluminum, arsenic, barium, copper, cadmium, chromium, cobalt, lead, lithium, and vanadium. If RCRA metals are present, include recommendations for corrective action.
 - 4. Phytotoxicity: Test for plant-available concentrations of phytotoxic minerals including aluminum, arsenic, barium, cadmium, chlorides, chromium, cobalt,

copper, lead, lithium, mercury, nickel, selenium, silver, sodium, strontium, tin, titanium, vanadium, and zinc.

- D. Fertility Testing: Soil-fertility analysis according to standard laboratory protocol of SSSA NAPT NCR-13, including the following:
1. Percentage of organic matter.
 2. CEC, calcium percent of CEC, and magnesium percent of CEC.
 3. Soil reaction (acidity/alkalinity pH value).
 4. Buffered acidity or alkalinity.
 5. Nitrogen ppm.
 6. Phosphorous ppm.
 7. Potassium ppm.
 8. Manganese ppm.
 9. Manganese-availability ppm.
 10. Zinc ppm.
 11. Zinc availability ppm.
 12. Copper ppm.
 13. Sodium ppm and sodium absorption ratio.
 14. Soluble-salts ppm.
 15. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.
 16. Other deleterious materials, including their characteristics and content of each.
- E. Organic-Matter Content: Analysis using loss-by-ignition method according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."
- F. Recommendations: Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants indicated. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients.
1. Fertilizers and Soil Amendment Rates: State recommendations in weight per 1000 sq. ft. for 6-inch depth of soil.
 2. Soil Reaction: State the recommended liming rates for raising pH or sulfur for lowering pH according to the buffered acidity or buffered alkalinity in weight per 1000 sq. ft. for 6-inch depth of soil.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.
- B. Bulk Materials:
1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.

2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Do not move or handle materials when they are wet or frozen.
4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

PART 2 - PRODUCTS

2.1 PLANTING SOILS SPECIFIED BY COMPOSITION

- A. General: Soil amendments, fertilizers, and rates of application specified in this article are guidelines that may need revision based on testing laboratory's recommendations after preconstruction soil analyses are performed.
- B. Planting-Soil Type: Existing, on-site surface soil, with the duff layer, if any, retained; and stockpiled on-site; modified to produce viable planting soil. Blend existing, on-site surface soil with the following soil amendments and fertilizers in the following quantities to produce planting soil:
 1. Ratio of Loose Compost to Soil: 1:2 by volume.
 2. Ratio of Loose Wood Derivatives Soil: Weight per 1000 sq. ft. as determined by soil test.
 3. Weight of Lime: Weight per 1000 sq. ft. as determined by soil test.
 4. Weight of Sulfur Iron Sulfate: Weight per 1000 sq. ft. as determined by soil test.
 5. Weight of Agricultural Gypsum: Weight per 1000 sq. ft. as determined by soil test.
 6. Weight of Superphosphate: Weight per 1000 sq. ft. as determined by soil test.
 7. Weight of Commercial Fertilizer: Weight per 1000 sq. ft. as determined by soil test.
 8. Weight of Slow-Release Fertilizer: Weight per 1000 sq. ft. as determined by soil test.
- C. Planting-Soil Type: Manufactured soil consisting of manufacturer's basic sandy loam according to USDA textures, blended in a manufacturing facility with sand, stabilized organic soil amendments, and other materials to produce viable planting soil.
 1. Additional Properties of Manufacturer's Basic Soil before Amending: Soil reaction of pH 6 to 7 and minimum of 6 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.
 2. Unacceptable Properties: Manufactured soil shall not contain the following:
 - a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
 - b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 5 percent by dry weight of the manufactured soil.

- c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 1-1/2 inches 2 inches in any dimension.
3. Blend manufacturer's basic soil with the following soil amendments and fertilizers in the following quantities to produce planting soil:
 - a. Ratio of Loose Compost to Soil: 1:2 by volume.
 - b. Volume of Sand: Weight per 1000 sq. ft. as determined by soil test.
 - c. Volume of Perlite: Weight per 1000 sq. ft. as determined by soil test.
 - d. Weight of Lime: Weight per 1000 sq. ft. as determined by soil test.
 - e. Weight of Sulfur Iron Sulfate: Weight per 1000 sq. ft. as determined by soil test.
 - f. Weight of Agricultural Gypsum: Weight per 1000 sq. ft. as determined by soil test.
 - g. Weight of Superphosphate: Weight per 1000 sq. ft. as determined by soil test.
 - h. Weight of Commercial Fertilizer: Weight per 1000 sq. ft. as determined by soil test.
 - i. Weight of Slow-Release Fertilizer: Weight per 1000 sq. ft. as determined by soil test.

2.2 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
 1. Class: T, with a minimum of 99 percent passing through a No. 8 sieve and a minimum of 75 percent passing through a No. 60 sieve.
 2. Form: Provide lime in form of ground dolomitic limestone.
- B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a No. 6 sieve and a maximum of 10 percent passing through a No. 40 sieve.
- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Perlite: Horticultural perlite, soil amendment grade.
- E. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through a No. 50 sieve.
- F. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to ASTM C 33/C 33M.

2.3 ORGANIC SOIL AMENDMENTS

- A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance," and as follows:

1. Feedstock: Limited to leaves May include animal waste.
 2. Reaction: pH of 5.5 to 8.
 3. Soluble-Salt Concentration: Less than 4 dS/m.
 4. Moisture Content: 35 to 55 percent by weight.
 5. Organic-Matter Content: 50 to 60 percent of dry weight.
 6. Particle Size: Minimum of 98 percent passing through a 1/2-inch sieve.
- B. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.4 FERTILIZERS

- A. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 50 percent available phosphoric acid.
- B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.
- C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.
- D. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

PART 3 - EXECUTION

3.1 GENERAL

- A. Place planting soil and fertilizers according to requirements in other Specification Sections.
- B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.
- C. Proceed with placement only after unsatisfactory conditions have been corrected.

3.2 PREPARATION OF UNAMENDED, ON-SITE SOIL BEFORE AMENDING

- A. Excavation: Excavate soil from designated area(s) to a depth of 6 inches and stockpile until amended.
- B. Unacceptable Materials: Clean soil of concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
- C. Unsuitable Materials: Clean soil to contain a maximum of 8 percent by dry weight of stones, roots, plants, sod, clay lumps, and pockets of coarse sand.
- D. Screening: Pass unamended soil through a 2-inch sieve to remove large materials.

3.3 PLACING AND MIXING PLANTING SOIL OVER EXPOSED SUBGRADE

- A. General: Apply and mix unamended soil with amendments on-site to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
- B. Subgrade Preparation: Till subgrade to a minimum depth of 4 inches. Remove stones larger than 2 inches (50 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Apply, add soil amendments, and mix approximately half the thickness of unamended soil over prepared, loosened subgrade according to "Mixing" Paragraph below. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.
- C. Mixing: Spread unamended soil to total depth of 6 inches, but not less than required to meet finish grades after mixing with amendments and natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.
 - 1. Amendments: Apply soil amendments and fertilizer, if required, evenly on surface, and thoroughly blend them with unamended soil to produce planting soil.
 - a. Mix lime and sulfur with dry soil before mixing fertilizer.
 - b. Mix fertilizer with planting soil no more than seven days before planting.
 - 2. Lifts: Apply and mix unamended soil and amendments in lifts not exceeding 8 inches in loose depth for material compacted by compaction equipment, and not more than 6 inches in loose depth for material compacted by hand-operated tampers.
- D. Compaction: Compact each blended lift of planting soil to 85 percent of maximum Standard Proctor density according to ASTM D 698 and tested in-place except where a different compaction value is indicated on Drawings.

- E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.4 PLACING MANUFACTURED PLANTING SOIL OVER EXPOSED SUBGRADE

- A. General: Apply manufactured soil on-site in its final, blended condition. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
- B. Subgrade Preparation: Till subgrade to a minimum depth of 6 inches. Remove stones larger than 2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Apply approximately half the thickness of planting soil over prepared, loosened subgrade. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.
- C. Application: Spread planting soil to total depth of 6 inches, but not less than required to meet finish grades after natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.
 - 1. Lifts: Apply planting soil in lifts not exceeding 8 inches in loose depth for material compacted by compaction equipment, and not more than 6 inches in loose depth for material compacted by hand-operated tampers.
- D. Compaction: Compact each lift of planting soil to 85 percent of maximum Standard Proctor density according to ASTM D 698 except where a different compaction value is indicated on Drawings.
- E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.5 BLENDING PLANTING SOIL IN PLACE

- A. General: Mix amendments with in-place, unamended soil to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
- B. Preparation: Till unamended, existing soil in planting areas to a minimum depth of 6 inches. Remove stones larger than 2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
- C. Mixing: Apply soil amendments and fertilizer, if required, evenly on surface, and thoroughly blend them into full depth of unamended, in-place soil to produce planting soil.
 - 1. Mix lime and sulfur with dry soil before mixing fertilizer.
 - 2. Mix fertilizer with planting soil no more than seven days before planting.

- D. Compaction: Compact blended planting soil to 85 percent of maximum Standard Proctor density according to ASTM D 698 except where a different compaction value is indicated on Drawings.
- E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
 - 1. Test planting soil compaction according to ASTM D698. Space tests at no less than one for each 1000 sq. ft.
- B. Soil will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.
- D. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

3.7 PROTECTION

- A. Protection Zone: Identify protection zones according to Section 015639 "Temporary Tree and Plant Protection."
- B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Parking vehicles or equipment.
 - 3. Vehicle traffic.
 - 4. Foot traffic.
 - 5. Erection of sheds or structures.
 - 6. Impoundment of water.
 - 7. Excavation or other digging unless otherwise indicated.
- C. If planting soil or subgrade is overcompacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by Landscape Architect and replace contaminated planting soil with new planting soil.

3.8 CLEANING

- A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.
- B. Remove waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.

END OF SECTION 329113

SECTION 329200 - TURF AND GRASSES

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. Seeding.
2. Sodding.
3. Turf renovation.

B. Related Requirements:

1. Section 329300 "Plants" for trees, shrubs, ground covers, and other plants as well as border edgings and mow strips.

1.3 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Soil Preparation" and drawing designations for planting soils.
- E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 PREINSTALLATION MEETINGS

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

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For landscape Installer.
- B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
 - 1. Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of supplier.
- C. Product Certificates: For fertilizers, from manufacturer.
- D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.
 - 1. Experience: Five years' experience in turf installation in addition to requirements in Section 014000 "Quality Requirements."
 - 2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 - 3. Pesticide Applicator: State licensed, commercial.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.
- B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.
- C. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.

2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

1.8 FIELD CONDITIONS

- A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of planting completion.
 1. Spring Planting: April 15 - June 1.
 2. Fall Planting: August 15 - October 1.
- B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 SEED

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.
- B. Seed Species:
 1. Quality, Seed of grass species as listed below with not less than 85 percent germination, not less than 95 percent pure seed, and not more than 0.5 percent weed seed:
 2. Sun and Partial Shade: Proportioned by weight as follows:
 - a. 40 percent creeping red fescue - composed of 2 variables.
 - b. 20 percent perennial ryegrass - composed of 2 variables.
 - c. 20 percent hard fescue.
 - d. 20 percent Chewing's fescue.

2.2 TURFGRASS SOD

- A. Turfgrass Sod: Number 1 Quality/Premium, including limitations on thatch, weeds, diseases, nematodes, and insects, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture that is strongly rooted and capable of vigorous growth and development when planted.

- B. Turfgrass Species, Cool-Season Grass: Sod of grass species as follows, with not less than 85 percent germination, not less than 95 percent pure seed, and not more than 0.5 percent weed seed:

- 1. Full Sun: Kentucky bluegrass (*Poa pratensis*), a minimum of three cultivars.

2.3 FERTILIZERS

- A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

- 1. Composition:
 - a. Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.4 MULCHES

- A. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.
- B. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

2.5 HERBICIDES

- A. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- B. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.6 EROSION-CONTROL MATERIALS

- A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches long.
- B. Erosion-Control Fiber Mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb/sq. yd., with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches long.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.
 - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 - 2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 - 3. Uniformly moisten excessively dry soil that is not workable or which is dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

- A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
 - 1. Protect adjacent and adjoining areas from seeding and mulching operations.
 - 2. Protect grade stakes set by others until directed to remove them.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION

- A. General: Prepare planting area for soil placement and mix planting soil according to Section 329113 "Soil Preparation."
- B. Placing Planting Soil: All planting soil and soil preparations shall be in place prior to initiating seeding or sodding operations.
 - 1. Reduce elevation of planting soil to allow for soil thickness of sod.
- C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- D. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 PREPARATION FOR EROSION-CONTROL MATERIALS

- A. For erosion-control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.
- B. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.5 SEEDING

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph.
 - 1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
 - 2. Do not use wet seed or seed that is moldy or otherwise damaged.
 - 3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
- B. Sow seed at a total rate of 5 to 8 lb/1000 sq. ft.
- C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.
- D. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets installed and stapled according to manufacturer's written instructions.
- E. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.
 - 1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.
- F. Alternatively, mulch newly seeded areas with fiber mulch if equipment can access newly seeded areas.

3.6 SODDING

- A. Lay sod within 24 hours of harvesting unless a suitable preservation method is accepted by Architect prior to delivery time. Do not lay sod if dormant or if ground is frozen or muddy.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to soil or sod during installation. Tamp and roll lightly to ensure contact with soil, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

1. Lay sod across slopes exceeding 1:3.
 2. Anchor sod on slopes exceeding 1:6 with wood pegs or steel staples spaced as recommended by sod manufacturer but not less than two anchors per sod strip to prevent slippage.
- C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

3.7 TURF RENOVATION

- A. Renovate turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.
1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
 2. Install new planting soil as required.
- B. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.
- C. Remove topsoil containing foreign materials, such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.
- D. Mow, dethatch, core aerate, and rake existing turf.
- E. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.
- F. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.
- G. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches.
- H. Apply soil amendments and initial fertilizer required for establishing new turf and mix thoroughly into top 4 inches of existing soil. Install new planting soil to fill low spots and meet finish grades.
1. Soil Amendment(s): according to requirements of Section 329113 "Soil Preparation."
 2. Initial Fertilizer: Commercial fertilizer applied according to manufacturer's recommendations.
- I. Apply seed and protect with mulch or sod as required for new turf.
- J. Water newly planted areas and keep moist until new turf is established.

3.8 TURF MAINTENANCE

- A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
 - 1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
 - 2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
 - 3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
- B. Watering: Operate and manage newly installed irrigation systems to keep turf uniformly moist to a depth of 4 inches.
- C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:
 - 1. Mow Kentucky bluegrass, buffalograss, annual ryegrass, chewings red fescue to a height of 1-1/2 to 2 inches.
- D. Turf Postfertilization: Apply commercial fertilizer after initial mowing and when grass is dry.
 - 1. Use fertilizer that provides actual nitrogen of at least 1 lb/1000 sq. ft. to turf area.

3.9 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Architect:
 - 1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.
 - 2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
- B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

3.10 HERBICIDE APPLICATION

- A. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.11 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.
- C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
- D. Remove nondegradable erosion-control measures after grass establishment period.

3.12 MAINTENANCE SERVICE

- A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:
 - 1. Seeded Turf: 60 days from date of Substantial Completion.
 - a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.
 - 2. Sodded Turf: 30 days from date of Substantial Completion.

END OF SECTION 329200

SECTION 32 92 00
TURF ESTABLISHMENT

PART 1 - GENERAL

1.01 Work Included

This work includes soil preparation, seeding, fertilizing, and mulching on those areas designated for turf establishment.

1.02 References

A. Michigan Department of Transportation Qualified Products List

1.03 Related Work

A. Section 31 25 00 – Soil Erosion and Sedimentation Control

1.04 Performance Requirements for Guaranteed Growth and Smooth Ground Surface

The Contractor is responsible to provide turf, substantially free of bare spots and free of weeds. The ground in turf areas shall be smooth, graded to provide positive drainage, and graded to provide a smooth transition to adjacent areas. The Engineer will determine when the requirements of guaranteed growth and smooth ground surface have been met.

Materials, requirements, and methods described in this specification are provided to establish minimum levels. Where the Contractor believes that other materials or methods are appropriate for the specific site conditions or better suited to the Contractor's schedule, the Contractor shall submit details of the alternative materials and/or methods to the Engineer for approval.

The Contractor shall provide re-seeding, watering, and herbicides, as necessary, to achieve the desired results.

There will be no adjustment in project cost for re-seeding, watering, application of herbicides, or using alternative methods of turf establishment.

1.05 Areas Designated for Turf Establishment

All areas disturbed by the Contractor's activities or as a result of the project, which are not to be restored with a pavement or aggregate surface, are to be restored with turf, unless specifically directed otherwise.

Turf shall be established on borrow areas and areas where excess soil is stockpiled.

When shown on the drawings or directed by the Engineer, the Contractor shall establish turf in other areas.

PART 2 - PRODUCTS

2.01 Materials

A. Topsoil

Topsoil shall be a humus-bearing, natural mineral soil of loam, sandy loam, silty loam, or clay loam classification. Topsoil shall neither be excessively acidic or alkaline.

Topsoil shall be screened and free of stones, roots, debris, and other foreign matter. Topsoil which is stripped from the project area shall be removed, transported, and stockpiled in a manner which prevents it from becoming mixed with sub-soils.

B. Fertilizer

Fertilizers shall be standard, commercial packaged or bulk products in granular or liquid form. Each container of packaged fertilizer shall be marked by the manufacturer with the following information: manufacturer name; lot number; date; analysis of contents, including the minimum percentages of total nitrogen, available phosphoric acid, and soluble potash; and the net weight. Bulk fertilizer shall be accompanied with an invoice indicating the manufacturer name; lot number; date; analysis of contents, including the minimum percentages of total nitrogen, available phosphoric acid, and soluble potash; and the net weight or volume.

Fertilizer for seeding and sodding shall be comprised of both a water insoluble component and a water soluble component. The water insoluble nitrogen must be from ureaformaldehydes and/or coarse grade isobutylidene diurea.

Fertilizer shall provide 33 pounds of actual water insoluble nitrogen per acre. The water soluble component of the fertilizer shall provide 65 pounds of actual nitrogen, phosphorus, and potassium nutrient per acre, in equal proportions. The water soluble component of the fertilizer shall include urea, diammonium phosphate, and potassium chloride.

C. Mulch

1. Loose Mulch

Mulch shall be straw or marsh hay, in an air-dried condition. Mulch material must be clean, undamaged, and rot-free. It must be substantially free of weed seed and other objectionable foreign matter.

2. Turf Mulch Blankets

Mulch blankets shall be manufactured by a company currently listed on the Michigan Department of Transportation's Qualified Products List.

Mulch blankets shall have a net covering on both sides of the blanket and shall be manufactured from either excelsior or straw. Excelsior blankets shall be manufactured from a uniform layer of interlocking excelsior fibers cut from sound, green timber, with an average dry weight of 12 ounces per square yard. Straw blankets shall be made of a uniform layer of clean wheat straw, free of weeds and weed seed, with the straw and

net covering securely stitched together to form a uniform mat having an average dry weight of 8 ounces per square yard.

3. Mulch Anchoring

Mulching anchoring shall be manufactured by a company currently listed on the Michigan Department of Transportation's Qualified Products List.

Latex-based anchoring shall have a composition, by weight, of 48 percent styrene, 50 percent butadiene, and 2 percent additive, 42 percent to 46 percent solids, and a pH of 8.5 to 10.

Recycled newsprint mulch shall be comprised of specifically prepared, biodegradable, shredded newspaper particles consisting of recycled newsprint fibers. The recycled newsprint must contain a wetting agent, defoaming agent, and nontoxic dyestuff that will impart a bright green or blue color. The dyestuff must adhere tightly to the fiber. Recycled newsprint shall meet the following minimum requirements:

Moisture content (total weight)	12 percent maximum
Shredded high-grade newsprint (oven dry)	96 percent minimum
Tackifier, by weight	1½ percent to 3 percent
Water holding capacity (water per 3½ ounces of fiber)	32 ounces minimum

Wood fiber shall be specially prepared, biodegradable, air-dried virgin wood fibers manufactured from 100 percent whole wood chips. The wood fiber must be manufactured with a tackifier. Recycled materials are not acceptable. The fibers must be dyed with a green or blue biodegradable dye to aid in visual metering during construction. The process and materials must not contain growth or germination inhibiting materials. The wood fiber must conform to the following specifications:

Moisture content (total weight)	12 percent maximum
Organic wood fiber (oven dry)	95 percent minimum
Tackifier, by weight	3 percent to 5 percent
Water holding capacity (water per 3½ ounces of fiber)	35 ounces minimum

Guar gum tackifiers shall contain a minimum of 95 percent guar gum by weight. The remaining components shall be dispersing and crosslinking additives.

Other tackifiers may include water soluble natural vegetable gums, or guar gums blended with gelling and hardening agents, or a water soluble blend of hydrophilic polymers, viscosifiers, sticking aids, and other gums.

4. Mulch Netting

Netting shall have a mesh size not larger than 1½ inches by 2 inches and not smaller than ½-inch by ½-inch. The netting shall be fabricated from a plastic formulated from or treated with a chemical which will promote the breakdown of the net within the first growing season after its placement. The net shall have sufficient strength to hold the

mulch in place and still deteriorate rapidly upon exposure to sunlight. Steel staples or pins shall not be used for anchoring of netting.

D. Sod

Sod shall be a densely rooted blend of at least 2 bluegrass varieties with 15 percent to 30 percent creeping red fescue content, reasonably free from weeds and grown on soil that is the same or similar to the topsoil at the project site. Sod shall be selected which will adapt well to the topsoil and ambient conditions at the project site and considering future maintenance.

Before sod is cut, the grass shall be mowed to a maximum height of 4 inches above the ground. The sod must be cut at least ¾-inch thick to retain the dense root system of the grass and to allow handling without undue tearing or breaking. When sod is cut in strips, it must be cut in small, uniform units approximately 1½ feet by 6 feet, or in such widths and lengths that can be handled without tearing or breaking. Sod may be cut, transported, and laid in large rolls.

E. Weed Control

Herbicides must be approved for use by the Michigan Department of Agriculture and the U.S. Environmental Protection Agency.

2.02 Seeding Mixtures

Seed shall be furnished in durable bags, each with a tag indicating the seed supplier, lot number, date, mixture proportions, purity, germination, and net weight.

Seed mixtures shall meet the requirements of one or more of the following mixtures, or other mixtures that are approved in advance by the Engineer. Where the Contractor believes that another mixture is appropriate for areas within the limit of the project, the Contractor shall request that the Engineer review and approve the substituted mixture(s). Requests for substitutions shall include the name of the seed supplier, the mixture proportions, the purity, and the germination.

Species	Purity, Minimum (percent)	Germination (percent)	Seed Mixture						
			Mixture Proportions (percent by weight)						
			TDS	THV	TUF	TGM	THM	CR	TSM
Kentucky Blue Grass	98	85	5	15	10	10	30		
Perennial Ryegrass	96	85	25	30	20	20	20		50
Hard Fescue	97	85	25		20	30			
Creeping Red Fescue	97	85	45	45	40	40	50		
Fults Salt Grass	98	85		10	10				
Cereal Rye	85	85						100	
Spring Oats	85	85							50

PART 3 - EXECUTION

3.01 Preparation for Turf Establishment

A. Topsoil Stripping

Prior to performing any excavation, filling, grading, or other earthwork, the Contractor shall strip and stockpile topsoil for later use on the project. Excess topsoil shall not be removed from the project site unless specifically provided elsewhere in the contract documents.

B. Finish Grading

The areas that are to be seeded shall be properly graded, sloped, and shaped with an allowance for the thickness of the topsoil layer. The earth bed upon which topsoil will be placed shall be friable to a depth of at least 4 inches. Earth beds not in a friable condition shall be harrowed with a disk, spring tooth drag, or similar equipment.

C. Placement and Preparation of Topsoil

Topsoil shall be spread on the prepared areas to a depth of 3 inches (in place, after rolling or compaction), unless otherwise shown on the plans or proposal. After spreading, any large clods or lumps shall be broken and all stones larger than 1-inch diameter, rocks, roots, litter, and other foreign debris shall be raked up and disposed of by the Contractor. After spreading and raking, the topsoil surface shall be in a friable condition and the surface shall be reasonably close to the proposed grades and cross section.

The topsoil surface shall be shaped to provide proper drainage. Where proposed grades are not shown on the plans, the topsoil surface shall be graded to provide a smooth transition between the new construction and the existing, adjacent ground.

Excess topsoil shall be stockpiled in a location acceptable to the Owner and neatly trimmed to present a neat appearance.

3.02 Turf Establishment

A. Permanent Seeding and Fertilizing

Disturbed areas shall be seeded upon completion of earthwork and grading operations. Disturbed areas shall be stabilized with temporary seeding if permanent seeding cannot be completed.

Seed mixtures for permanent seeding shall be appropriate for the soil type and location, as indicated in the following table. The Contractor may propose and submit alternative mixtures to the Engineer for review and approval. It is the Contractor's responsibility to provide turf areas which are substantially free of bare spots and generally weed-free.

Mixture Designation	Soil Type	Location
TDS	Dry Sandy to Sand Loam	Rural or Urban
THV	Heavy	Rural
TUF	All Types	City Streets
TGM	Medium to Heavy	All
THM	Loamy to Heavy	Residential / Commercial

Fertilizer and seed shall be applied uniformly on areas prepared for seeding. Seed shall be applied at a rate of 220 pounds per acre. Seed and fertilizer may be applied by drilling, broadcasting, or hydraulically. Seed and fertilizer shall be applied before applying mulch. Seed and fertilizer shall be lightly raked or rolled into the prepared topsoil surface.

Neither broadcast seeding nor hydraulic seeding shall be performed during windy weather.

There shall be provisions for mixing or agitating the seed – fertilizer mixture used for hydraulic seeding to keep it evenly distributed in suspension. Mixtures shall be applied within an hour of mixing the seed with water; unused portions shall be discarded.

B. Sodding

Areas to be sodded shall be prepared by grading the area to the desired elevations and contours, less the depth of the topsoil surface and thickness of the sod. Three inches of screened topsoil shall be provided. The topsoil shall be conditioned by harrowing prior to laying the sod. In sloped areas, the harrowing shall be perpendicular to the slope.

The earth bed shall be thoroughly watered just before laying the sod. Sod shall be laid within 24 hours after cutting and shall be properly protected until it is placed. Sod that has been allowed to dry out will not be accepted. Sod shall not be placed on frozen soil, nor shall sod be frozen.

Sod strips shall be placed parallel with the flow of water on slopes and in ditches. The short ends of strips shall be staggered. Strips shall be placed with tight joints. Sod shall be laid starting at the base of the slope and progress upward. The edges of sodded areas shall transition by turning the edges of the sod into the ground and covering the edge with earth (or aggregate if adjacent to a road or pavement) and compacting the covering so that runoff is directed onto the sod. Sod placed adjacent to paved surfaces shall be firmly butted against and level with them.

Sod shall be firmly compacted by tamping it immediately after its placement to provide a surface even, smooth, and free of bumps and depressions. The Contractor shall thoroughly water sod following its placement, and periodically until it has become established.

C. Temporary Seeding

Temporary seeding shall be completed when the permanent seeding cannot be completed because of seasonal conditions. Temporary seeding shall be applied at a rate of 100 pounds per acre, and shall be of the following designation.

Mixture Designation	Soil Type	Location
CR	All Types	Temporary, less than 6 months
TSM	All Types	Temporary, more than 6 months

Before completion of the contract, the Contractor shall complete permanent seeding of all areas which are temporary seeded.

D. Dormant Seeding

Dormant seeding should be used only when necessary to complete a project when seasonal conditions are not conducive to permanent seeding. Dormant seeding shall not be completed on frozen ground. Dormant seeding shall be completed, as required, for permanent seeding.

The Contractor is responsible to establish turf which is substantially free of bare spots and generally free of weeds.

3.03 Mulching

A. Mulch Placement

Immediately after the seed has been set into the topsoil surface by light raking or rolling, the Contractor shall spread mulch and anchor it as appropriate. Mulching shall not be performed during windy conditions.

Loose mulch shall be placed thick enough to shade the ground, conserve moisture, and resist erosion, but open enough to allow sunlight to penetrate and air to circulate.

The Contractor shall maintain mulched areas and repair any areas where damage from erosion, wind, traffic, fire, or other causes occur.

Mulch shall be applied at a uniform rate of 2 tons per acre, except that a rate of 3 tons per acre is required with dormant seeding.

B. Mulch Anchoring

Mulch anchoring (tackifiers) shall be sprayed immediately after the mulch is placed. Spraying shall not be performed when wind might prevent the proper placement of the adhesive. The Contractor shall provide protection measures, as necessary, to protect traffic, signs, structures, and other objects from being marked or disfigured by tackifier materials.

Latex based adhesive shall be mixed at a rate of at least 15 gallons of adhesive with a minimum of 250 pounds of recycled newsprint and 375 gallons of water.

Recycled newsprint shall be mixed at a minimum rate of 750 pounds of newsprint with 1,500 gallons of water.

Wood fiber shall be mixed at a minimum rate of 750 pounds of wood fiber with 1,500 gallons of water.

Guar gum shall be mixed at a minimum rate of 100 pounds of dry adhesive and a minimum of 250 pounds of recycled newsprint and 1,300 gallons of water.

Other tackifiers shall be mixed at a minimum rate of 100 pounds of dry adhesive with a minimum of 250 pounds of recycled newsprint with 1,300 gallons of water.

C. Mulching Netting

When netting is used to secure mulch, it shall be secured with anchors, staples, or pins. The net shall be spread over the mulch so that a worker can walk between adjacent widths of the net. The edges of adjacent widths of net shall be pulled together and held in place with net anchors. Net anchors shall be spaced not more than 30 inches apart along the edges, joints, and centerline. The net shall not be installed in direct contact with the ground. If the Contractor elects to use mulch netting or blankets, the Contractor will be required to remove the netting fabric once the turf is established.

D. Mulch Blankets

Mulch blankets shall be installed within one day of seeding. The side edges of blankets shall be overlapped by 2 inches. Blanket ends shall be shingle lapped 6 inches. Non-metallic staples or pegs shall be placed along all joint edges and along blanket centerlines at a maximum spacing of 2 feet. Blankets in waterways shall be shingle lapped 12 inches on the downslope edge. If the Contractor elects to use mulch netting or blankets, the Contractor will be required to remove the netting fabric once the turf is established.

High velocity blankets shall be installed on slopes of 1:2, or steeper, on ditch bottoms, on ditch side slopes (to an elevation 1 foot above the ditch bottom), and where specifically shown on the drawings or directed by the Engineer.

3.04 Weed Control

Weed control shall be provided by the Contractor, as necessary, to develop turf areas which are relatively free of weeds. Herbicides shall be applied in accordance with federal, state, and local regulations. Herbicides shall be applied in accordance with manufacturer's instructions. Herbicides shall be applied by commercial applicators, licensed in the State of Michigan and certified by the Michigan Department of Agriculture in the appropriate category(ies).

Target weeds shall be sprayed in the newly seeded turf when the new turf grass is sufficiently established to withstand the application of herbicide. Herbicide application shall be repeated if the first application failed to control target weeds.

The Contractor shall take appropriate measures to preserve and protect adjacent property from damages resulting from the application of herbicides. Herbicides shall not be applied when wind may carry it to adjacent areas.

END OF SECTION

SECTION 329300 - PLANTS

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. Plants.
- 2. Fertilizers
- 3. Mulches.
- 4. Herbicides and pesticides.
- 5. Tree stabilization.
- 6. Tree-watering devices.

- B. Related Requirements:

- 1. Section 015639 "Temporary Tree and Plant Protection" for protecting, trimming, pruning, repairing, and replacing existing trees to remain that interfere with, or are affected by, execution of the Work.
- 2. Section 329200 "Turf and Grasses" for turf (lawn) and meadow planting, hydroseeding, and erosion-control materials.

1.3 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with a ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.
- C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required.
- D. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than the minimum root spread according to ANSI Z60.1 for type and size of plant required.

- E. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.
- F. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of plant.
- G. Finish Grade: Elevation of finished surface of planting soil.
- H. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.
- I. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- J. Planting Area: Areas to be planted.
- K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Soil Preparation" for drawing designations for planting soils.
- L. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.
- M. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.
- N. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.
- O. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 COORDINATION

- A. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.5 PREINSTALLATION MEETINGS

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

1.6 ACTION SUBMITTALS

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

1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
2. Plant Photographs: Include color photographs in digital format of each required species and size of plant material as it will be furnished to Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.
3. Mycorrhizal Fungi: Submit product to be used and application rate.

- B. Samples for Verification: For each of the following:

1. Organic Compost Mulch: 1-quart (1-L) volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
2. Mineral Mulch: 2 lb (1.0 kg) of each mineral mulch required, in sealed plastic bags labeled with source of mulch. Sample shall be typical of the lot of material to be delivered and installed on-site; provide an accurate indication of color, texture, and makeup of the material.
3. Proprietary Root-Ball-Stabilization Device: One unit.
4. Slow-Release, Tree-Watering Device: One unit of each size required.
5. Herbicides and pesticides.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.
- B. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:

1. Manufacturer's certified analysis of standard products.
2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

C. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.

1. Experience: 10 years' experience in landscape installation in addition to requirements in Section 014000 "Quality Requirements."
2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

3. Pesticide Applicator: State licensed, commercial.

B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

C. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.

1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.

2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

D. Plant Material Observation: Landscape Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Landscape Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Landscape Architect of sources of planting materials 30 days in advance of delivery to site.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.

- B. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 - 3. Accompany each delivery of bulk materials with appropriate certificates.
- C. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
- D. Handle planting stock by root ball.
- E. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F until planting.
- F. Apply antidesiccant, if conditions warrant use, to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
 - 1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.
- G. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation. Damage to branches from wrapping and handling can result in rejection of the plant if such damage is determined to be excessive by the Landscape Architect.
- H. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
 - 1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
 - 2. Do not remove container-grown stock from containers before time of planting.
 - 3. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

1.10 FIELD CONDITIONS

- A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

- B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.
 - 1. Spring Planting: March 15 - June 1.
 - 2. Fall Planting: September 1 - October 15.

- C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

1.11 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
 - b. Structural failures including plantings falling or blowing over.
 - c. Faulty performance of tree stabilization.

 - 2. Warranty Periods: From date of Substantial Completion.
 - a. Trees and Shrubs; 24 months.
 - b. Ground Covers, Vines, Ornamental Grasses, Biennials, Perennials, and Other Plants: 12 months.

 - 3. Include the following remedial actions as a minimum:
 - a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
 - b. Replace plants that are more than 10 percent dead or in an unhealthy condition at end of warranty period.
 - c. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease,

pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots are unacceptable.
 2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.
- B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of roots or balls.
- C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting. If root flare is more than 2 inches below the top of the root ball, the tree or shrub can be rejected for this reason alone.
- D. Labeling: Label each plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant.
- E. If formal arrangements or consecutive order of plants is indicated on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

2.2 FERTILIZERS

- A. Amend soil into which trees, shrubs, grasses, and perennials are planted per Soil Preparation Plans and associated details.
- B. Planting Tablets: Planting Tablets shall be used in addition to soil amendments and shall be tightly compressed chip-type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.
1. Size: 10-gram tablets.
 2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.
- C. Mycorrhizal Fungi: Dry, granular inoculant containing at least 5,300 spores per lb. of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb. of ectomycorrhizal fungi, 33% hydrogel, and maximum of 5% inert material.

2.3 MULCHES

- A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
 - 1. Type: Double - Shredded bark.
 - 2. Size Range: 2 inches maximum, 1/2 inch minimum.
 - 3. Color: Natural.

- B. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through a 1-inch sieve; soluble-salt content of 2 to 5 dS/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
 - 1. Organic Matter Content: 50 to 60 percent of dry weight.
 - 2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

- C. Mineral Mulch: Hard, durable stone, washed free of loam, sand, clay, and other foreign substances, of the following type, size range, and color:
 - 1. Type: Rounded riverbed gravel or smooth-faced stone as acceptable to Landscape Architect.
 - 2. Size Range: 1-1/2 inches (38 mm) maximum, 3/4 inch (19 mm) minimum.
 - 3. Color: Uniform tan-beige color range acceptable to Landscape Architect.

2.4 HERBICIDES

- A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

- B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

- C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.5 TREE-STABILIZATION MATERIALS

- A. Trunk-Stabilization Materials:
 - 1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal (38-by-38-mm actual) by length indicated, pointed at one end.
 - 2. Tree-Tie Webbing: UV-resistant polypropylene or nylon webbing with brass grommets.
 - 3. Flags: Standard surveyor's plastic flagging tape, white, 6 inches (150 mm) long.

4. Proprietary Staking-and-Guying Devices: Proprietary stake or anchor and adjustable tie systems to secure each new planting by plant stem; sized as indicated and according to manufacturer's written recommendations.

2.6 TREE-WATERING DEVICES

- A. Slow-Release Watering Device: Standard product manufactured for drip irrigation of plants and emptying its water contents over an extended time period; manufactured from UV-light-stabilized nylon-reinforced polyethylene sheet, PVC, or HDPE plastic.

2.7 MISCELLANEOUS PRODUCTS

- A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.
- B. Burlap: Non-synthetic, biodegradable.
- C. Mycorrhizal Fungi: Dry, granular inoculant containing at least 5300 spores per lb (0.45 kg) of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb (0.45 kg) of ectomycorrhizal fungi, 33 percent hydrogel, and a maximum of 5 percent inert material.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.
 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
 3. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 4. Uniformly moisten excessively dry soil that is not workable or which is dusty.
- B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Phillips Environmental Consulting Services, Inc. and the Landscape Architect and replace with new planting soil.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Landscape Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.
- D. Lay out plants at locations directed by Landscape Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

3.3 PLANTING AREA ESTABLISHMENT

- A. General: Prepare planting area for soil placement and mix planting soil according to Section 329113 "Soil Preparation" and according to Soil Preparation Plans.
- B. Before planting, obtain Landscape Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.
- C. Application of Mycorrhizal Fungi: Broadcast dry product uniformly over prepared soil at application rate according to manufacturer's written recommendations.

3.4 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits and Trenches: Excavate circular planting pits.
 - 1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
 - 2. Excavate approximately three times as wide as ball diameter for balled and burlapped, balled and potted, container-grown and fabric bag-grown stock.
 - 3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
 - 4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
 - 5. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
 - 6. Maintain supervision of excavations during working hours.
 - 7. Keep excavations covered or otherwise protected overnight and after working hours.

8. If drain tile is indicated on Drawings or required under planting areas, excavate to top of porous backfill over tile.
- B. Backfill Soil: Subsoil and topsoil removed from excavations may be used as backfill soil unless otherwise indicated.
- C. Obstructions: Notify Landscape Architect if unexpected rock, demolition debris, pipes, or other obstructions detrimental to trees or shrubs are encountered in excavations.
- D. Drainage: Notify Landscape Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.
- E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.5 TREE, SHRUB, AND VINE PLANTING

- A. Inspection: At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements. If it does not, tree or shrub will be rejected.
- B. Roots: Remove stem girdling roots and kinked roots as directed by the Landscape Architect. Girdling roots, if judged to be too excessive by the Landscape Architect, shall result in rejection of the tree or shrub. Remove injured roots by cutting cleanly; do not break.
- C. Balled and Burlapped Stock: Set each plant plumb and in center of planting pit or trench with root flare 2 inches above adjacent finish grades.
 1. Backfill: Planting soil. For trees, use excavated soil for backfill.
 2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
 - a. Quantity: Three for each caliper inch of plant; minimum of three for each shrub.
 5. Continue backfilling process. Water again after placing and tamping final layer of soil.

- D. Balled and Potted and Container-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 2 inches above adjacent finish grades.
 - 1. Backfill: Planting soil. For trees, use excavated soil for backfill.
 - 2. Carefully remove root ball from container without damaging root ball or plant.
 - 3. Thoroughly loosen circling roots or root-bound plants. Extremely root-bound plants will be rejected by the Landscape Architect if the root mass cannot be spread within the planting excavation.
 - 4. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 - 5. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
 - a. Quantity: Three for each caliper inch of plant; minimum of three for each shrub.
 - 6. Continue backfilling process. Water again after placing and tamping final layer of soil.
- E. Slopes: When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.6 MECHANIZED TREE-SPADE PLANTING

- A. Trees may be planted with an approved mechanized tree spade at the designated locations. Do not use tree spade to move trees larger than the maximum size allowed for a similar field-grown, balled-and-burlapped root-ball diameter according to ANSI Z60.1, or larger than manufacturer's maximum size recommendation for the tree spade being used, whichever is smaller.
- B. Use the same tree spade to excavate the planting hole as will be used to extract and transport the tree.
- C. When extracting the tree, center the trunk within the tree spade and move tree with a solid ball of earth.
- D. Cut exposed roots cleanly during transplanting operations.
- E. Plant trees following procedures in "Tree, Shrub, and Vine Planting" Article.
- F. Where possible, orient the tree in the same direction as in its original location.

3.7 TREE, SHRUB, AND VINE PRUNING

- A. Remove only dead, dying, or broken branches after inspection by Landscape Architect. Do not prune for shape.
- B. Prune, thin, and shape trees, shrubs, and vines as directed by Landscape Architect.
- C. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Landscape Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.
- D. Do not apply pruning paint to wounds.

3.8 TREE STABILIZATION

- A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated:
 - 1. Upright Staking and Tying: Stake trees with two stakes for trees up to 12 feet high and 2-1/2 inches or less in caliper; three stakes for trees less than 14 feet high and up to 4 inches in caliper. Space stakes equally around trees.
 - 2. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree; or
 - 3. Support trees with two strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
 - 4. Proprietary Staking and Guying Device: If used, install staking and guying system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions.
- B. Root-Ball Stabilization: If used, install at- or below-grade stabilization system to secure each new planting by the root ball unless otherwise indicated.
 - 1. Proprietary Root-Ball Stabilization Device: Install root-ball stabilization system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions.

3.9 GROUND COVER AND PLANT PLANTING

- A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on Drawings in even rows with triangular spacing.
- B. Use planting soil for backfill.
- C. Dig holes large enough to allow spreading of roots.
- D. For rooted cutting plants supplied in flats, plant each in a manner that minimally disturbs the root system but to a depth not less than two nodes.

- E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.
- H. Set plants firmly in soil so that soil does not settle after watering and expose root ball.

3.10 PLANTING AREA MULCHING

- A. Mulch backfilled surfaces of planting areas and other areas indicated.
 - 1. Trees and Treelike Shrubs in Turf Areas: Apply organic mineral mulch ring of 3-inch average thickness, with 36-inch radius around trunks or stems. Do not place mulch within 3 inches of trunks or stems.
 - 2. Mineral Mulch in Planting Areas: Apply 2-inch average thickness of mineral mulch extending over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.

3.11 INSTALLING SLOW-RELEASE WATERING DEVICE

- A. Provide two devices for each tree.
- B. Place devices on top of the mulch at base of tree stem and fill with water according to manufacturer's written instructions.

3.12 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.
- B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.13 HERBICIDE APPLICATION

- A. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas according to manufacturer's written recommendations. Do not apply to seeded areas.
- B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.14 REPAIR AND REPLACEMENT

- A. General: Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by Landscape Architect.
 - 1. Submit details of proposed pruning and repairs.
 - 2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
 - 3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Landscape Architect.
- B. Remove and replace trees that are more than 10 percent dead or in an unhealthy condition, or are damaged during construction operations that Landscape Architect determines are incapable of restoring to normal growth pattern.
 - 1. Provide new trees of same size as those being replaced for each tree of 6 inches or smaller in caliper size.
 - 2. Species of Replacement Trees: Species selected by Landscape Architect.

3.15 CLEANING AND PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.
- C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- D. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.
- E. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

3.16 MAINTENANCE SERVICE

- A. Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Coordinate with Dow Gardens horticulturists. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:
 - 1. Maintenance Period: 12 months from date of Substantial Completion.

- B. Maintenance Service for Ground Cover and Other Plants: Provide maintenance by skilled employees of landscape Installer. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:
 - 1. Maintenance Period: 12 months from date of Substantial Completion.

END OF SECTION 329300

SECTION 33 11 00
WATER MAIN

PART 1 - GENERAL

1.01 Work Included

The Contractor shall install water main and appurtenances in accordance with this specification. This work includes excavation, pipelaying, backfilling, and testing.

The Contractor shall protect existing utilities during construction, whether the existing utilities are shown on the plans or not. Utilities damaged by construction shall be repaired in a manner satisfactory to the Engineer and at the Contractor's expense. The Contractor shall call MISS DIG (800-482-7171) for staking and locating the existing utilities.

The Contractor shall contact the water department to schedule work that may interfere with existing water service.

The Contractor shall develop a construction sequencing plan and submit to the Engineer and Owner for approval. The construction sequence shall minimize interruption of service.

1.02 References

Where materials or methods of construction are listed as being in conformance with a standard specification, it shall refer to the latest edition of the standard specification or any interim revision.

- A. ANSI A21.4/AWWA C104 – American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
- B. ANSI A21.5/AWWA C105 – American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems
- C. ANSI A21.11/AWWA C111 – American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
- D. ANSI A21.50/AWWA C150 – American National Standard for Thickness Design for Ductile-Iron Pipe
- E. ANSI A21.51/AWWA C151 – American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water
- F. ANSI A21.53/AWWA C153 – American National Standard for Ductile-Iron Compact Fittings for Water Service
- G. AWWA C110 – Ductile-Iron and Gray-Iron Fittings
- H. AWWA C115 – Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
- I. AWWA C500 – Metal-Seated Gate Valves for Water Supply Service

- J. AWWA C502 – Dry-Barrel Fire Hydrants
- K. AWWA C504 – Rubber-Seated Butterfly Valves
- L. AWWA C509 – Resilient-Seated Gate Valves for Water Supply Service
- M. AWWA C512 – Air Release, Air/Vacuum, and Combination Air Valves for Water and Wastewater Service
- N. AWWA C515 – Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
- O. AWWA C600 – Installation of Ductile Iron Water Mains and Their Appurtenances
- P. AWWA C605 – Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
- Q. AWWA C651 – Disinfecting Water Mains
- R. AWWA C800 – Underground Service Line Valves & Fittings
- S. AWWA C900 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm), for Water Transmission and Distribution
- T. AWWA C904 – Crosslinked Polyethylene (PEX) Pressure Tubing, 1/2 In. (13 mm) Through 3 in. (76 mm) for Water Service
- U. AWWA C906 – Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 65 In. (100 mm Through 1,650 mm), for Waterworks
- V. AWWA C908 – Standard for PVC Self-Tapping Saddle Tees for Use on PVC Pipe
- W. AWWA C909 – Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 In. (100 mm) and Larger
- X. ASTM B88 – Standard Specification for Seamless Copper Water Tube
- Y. ASTM B251 – Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube
- Z. ASTM C443 – Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
- AA. ASTM C478 – Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
- BB. ASTM D1248 – Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
- CC. ASTM D2657 – Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings
- DD. ASTM D3035 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
- EE. ASTM D3139 – Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

- FF. ASTM D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
- GG. ASTM F714 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
- HH. ASTM F876 – Standard Specification for Crosslinked Polyethylene (PEX) Tubing
- II. ASTM F2080 – Standard Specification for Cold-Expansion Fittings with Metal Compression Sleeves for Crosslinked Polyethylene (PEX) Pipe and SDR9 Polyethylene of Raised Temperature (PE-RT) Pipe
- JJ. ASTM F2657 – Standard Test Method for Outdoor Weathering Exposure of Crosslinked Polyethylene (PEX) Tubing
- KK. ISO 9002 – Model for Quality Assurance in Production, Installation and Servicing
- LL. CSA B137.5 - Crosslinked Polyethylene Tubing Systems for Pressure Applications
- MM. DIPRA – Polyethylene Encasement Installation Guide
- NN. DIPRA – Thrust Restraint Design for Ductile Iron Pipe
- OO. NSF/ANSI Standard 14 – Plastics Piping System Components and Related Materials
- PP. NSF/ANSI Standard 61 – Drinking Water System Components-Health Affects
- QQ. Plastic Pipe Institute TR-3/2021/HDB/HDS/PDB/SDB/MRS/CRS Policies

1.03 Related Work

- A. Section 01 45 16.02 – Density and Aggregate Testing
- B. Section 02 41 13.13 – Pavement Removal
- C. Section 31 10 01 – Clearing and Removal of Miscellaneous Structures
- D. Section 31 23 01 – Excavating, Filling, and Grading
- E. Section 31 25 00 – Soil Erosion and Sedimentation Control
- F. Section 32 11 23 – Aggregate Base
- G. Section 32 12 16 – HMA Paving
- H. Section 32 92 00 – Turf Establishment

1.04 Submittals

Submit shop drawings or manufacturer's data to the Engineer for review and approval prior to ordering for the following:

- A. Hydrants
- B. Valves
- C. Pipe, including fittings and joints

- D. Restraints
- E. Curb stops, corporation taps, and curb stop boxes
- F. Tracer wire and splice connections
- G. Manholes, manhole adjusting rings, and castings

1.05 Quality Assurance and Quality Control

A. Leakage

The completed pipeline shall be subjected to a hydrostatic pressure test in accordance with Section 3.18.

B. Bacteriological

Following disinfection, a bacteriological test shall be completed in accordance with Section 3.18.

1.06 Local Standards

The Owner's standards for materials are shown on the plans. Where there is a conflict between the Owner's standards and the specifications, the Owner's standards prevail.

PART 2 - PRODUCTS

2.01 Materials

A. Pipe

Pipe may be any of the following materials, except where a specific material is indicated on the plans or in the proposal.

1. Ductile Iron Pipe (Thickness Class)

Ductile iron pipe shall meet ANSI A21.51/AWWA C151. Pipe shall be cement lined and shall meet ANSI A21.4/AWWA C104. Pipe wall thickness shall conform to ANSI A21.50/AWWA C150 and shall be of the following thicknesses, unless specifically noted otherwise on the plans or in the proposal:

Pipe Diameter (inches)	Pipe Class (psi)
4	50
6	50
8	50
10	50
12	50

The pipe manufacturer and class shall be marked on each length of pipe.

Joints for buried pipe shall be either mechanical type or push-on type, in accordance with ANSI A21.11/AWWA C111. Working pressure shall be 350 psi. Provide electrical conductivity at each joint.

Joints for piping in structures shall be flanged.

B. Fittings

Fittings shall be mechanical joint or push-on type, either cast iron or ductile iron as follows: Cast iron fittings shall meet the requirements of AWWA C110 and shall be rated for 350 psi working pressure. Ductile iron fitting shall meet the ANSI A21.53/AWWA C153 and shall be Class 350. Fittings shall be cement lined in accordance with ANSI A21.4/AWWA C104. Rubber gasket joints shall meet ANSI A21.11/AWWA C111. Electrical conductivity shall be provided at each joint.

C. Gate Valves

Gate valves shall meet the Owner's standards for manufacturer, style, and opening direction.

Gate valves shall be iron body, non-rising stem, resilient wedge type meeting the requirements of AWWA C509. Gate valves shall be designed for direct bury application.

Resilient seated valves shall meet the requirements of AWWA C509, thick wall valves shall meet AWWA C515.

D. Hydrants

Hydrants shall meet or exceed AWWA C502. Unless otherwise noted, hydrants shall have two 2½-inch hose nozzles and one 4-inch pumper nozzle, National Standard Threads, with all nozzles located 18 inches above ground level.

Nozzle caps shall be securely chained to the barrel. Hydrants shall be of the breakable flange type, such that neither barrel nor stem are damaged upon impact and that no water is lost. Hydrants shall be designed so that the direction of the nozzles can be changed by rotating the above-ground section.

Hydrant color shall be approved by Owner.

Hydrants shall be provided with a drain, which is plugged at the time of delivery. Hydrants are to be of the "dry top" design to prevent freezing.

If removal of the seat valve requires a special wrench, one shall be provided. The wrench shall operate the valve stem at the point of removal of the above-ground section.

Operating nut size, shape, opening direction and model shall be in accordance with the Owner's standards.

E. Copper Pipe

Copper pipe shall be constructed of Type K, soft temper copper tubing for underground use, in accordance with ASTM B88 and B251. The manufacturer and pipe type shall be marked on

the outside of the pipe. The weight per foot of copper tubing shall meet or exceed that specified by ASTM B251, Table II.

F. Stops and Fittings

Corporation stops, curb stops, and fittings shall be fabricated of brass and shall be lead free.

For PVC pipe, any taps 2 inches or less shall be Style 202B saddle with stainless steel bands, as manufactured by Ford Brass or approved equal.

G. Service Boxes

Water services boxes shall be of a style conforming to the Owner's standard. Boxes shall be adjustable, a minimum of 6 inches above and below finish grade.

H. Valve Boxes

Valve boxes shall be made of good quality cast iron and shall be of the sectional type. The lower section shall be a minimum of 5 inches in diameter, enlarged at the base to fit around the bonnet of the valve. The upper section shall be arranged to slide or screw down over the adjoining lower section and shall be full diameter throughout. Valve boxes shall be provided with cast iron lids or covers. Lids or covers shall be marked "WATER". The over-all length of valve boxes shall be sufficient to permit the top to be set flush with the final ground surface grade. Valve boxes shall be as manufactured by Traverse City Iron Works, Clow Corporation, or equal.

I. Materials for Gate Wells

The manhole base, sections, and reducer shall be manufactured in accordance with ASTM C478, with rubber gasket conforming to ASTM C443. The manhole sections shall be provided with an 8-inch pre-cast base slab. Integrally cast wall and slab sections are required.

Precast riser rings shall be manufactured in accordance with Michigan Department of Transportation Standard Plan R-1-Series.

Adjusting rings shall be manufactured in accordance with ASTM C478.

Manhole steps shall be copolymer polypropylene plastic steps with a steel reinforcement bar, with a minimum diameter of ½-inch, a minimum width of 10 inches center to center of wall anchor, and complete with anti-skid side plates conforming to ASTM D4101. Steps shall be manufactured with the manhole wall and spaced at a maximum of 16 inches on center. Gray iron castings shall be heavy duty classification and shall conform to ASTM A48 Class 35B coated with asphalt coating.

Manhole frames and covers shall be EJ No. 104014 with 1040 AGS cover and covers shall be stamped "WATER" with 2-inch raised letters, or approved equal.

J. Tracer Wire

Tracer wire shall be designed and manufactured for the purpose of detecting buried utilities. Tracer wire shall be 12 AWG (minimum) copper wire coated with a 30 mil (minimum) polyethylene jacket. The Contractor shall use larger wire, when necessary, for installation without damage during bored installations.

K. Polyethylene Encasement

Polyethylene encasement shall be in tube and sheet form, fabricated from either linear low-density polyethylene film having a thickness of at least 8 mils or high-density, cross-laminated polyethylene film with a thickness of at least 4 mils.

PART 3 - EXECUTION

3.01 Alignment and Grade

The water mains shall be constructed at the alignment and grades indicated in the plans and specifications, except where changes are directed or approved by the Engineer. Fittings, valves, hydrants, and service connections shall be installed at the locations indicated on the drawings or in the specifications, except where field conditions warrant changes which are directed and approved by the Engineer.

Valves and hydrants shall be installed plumb. Valve operating stems shall be installed in a manner to allow for their proper operation.

3.02 Investigation

Prior to excavation, the Contractor shall call MISS DIG and shall contact utility agencies which are not part of the MISS DIG system to make arrangements for identifying the location of existing utilities in the project area. Where potential conflicts are suggested by the plans and/or the utilities' locations, the Contractor shall excavate and expose the existing utilities at least 100 feet in advance of pipelaying operations. Where the existing utilities may conflict with the proposed alignment and construction, the Contractor shall make such appropriate modifications to the alignment and grade, as necessary, to prevent a conflict. Changes to the alignment and grade shall be as directed and approved by the Engineer. Changes to the alignment and grade shall be completed by the Contractor at no additional cost to the project.

3.03 Excavation

The Contractor shall excavate all materials to the depths necessary to construct the water main as shown on the plans. Excavation shall include the removal of rock, dirt, abandoned pipelines, old foundations, stumps and roots, and similar materials encountered. Excavation of whatever material encountered shall be included in the contract unit prices for water main installation and will not be paid for separately.

Excavation shall be in accordance with Section 31 23 01 – Excavating, Filling, and Grading.

3.04 Pipe Handling

Pipe shall be handled in such a manner as to prevent the ends from splitting, damages to the protective coatings, and other undesirable conditions. Pipe shall not be dropped, skidded, or rolled into other pipe. Repairs to damaged pipe must be approved by the Engineer.

3.05 Pipe Cutting

Pipe cutting shall be done in a neat and workmanlike manner, without damage to the pipe or lining, and as to leave a smooth end at right angles to the axis of the pipe. Cutting shall be done by an approved mechanical saw or cutter. Hydraulic squeeze cutters are not acceptable.

3.06 Pipelaying

Pipe located inside structures shall be rigidly supported.

Pipe laid underground shall be uniformly supported through its entire length on a 4-inch cushion of sand. A depression shall be carved out of the sand cushion to accommodate the pipe bells.

Pipe shall be inspected for defects, debris, or dirt while suspended in a sling prior to lowering it into the trench. Defective pipe shall be removed from the project site immediately. Lumps, blisters, and excess coal tar coating shall be removed from inside the bell and outside the spigot. These areas shall be wire-brushed and wiped clean with a dry oil-free rag. No debris, tools, clothing, or other materials shall be allowed in the pipe.

Pipe shall be laid in a dry trench, with bell ends facing in the direction of laying. After placing a length of pipe in the trench, and after installing the gasket and applying the gasket lubricant, the spigot end shall be centered in the bell, and the pipe pushed home and brought to the correct line and grade. The pipe shall be secured in place by tamping sand around it. Precautions shall be taken to prevent soil from entering the joint space.

A watertight plug shall be inserted in the open end(s) of the pipe to prevent water, soil, animals, or other foreign matter from entering the pipe during the construction phase.

When it is necessary to deflect pipe from a straight line, either horizontally or vertically, the deflection shall not exceed the following values:

Nominal Pipe Size (inches)	PVC & PVCO "Push on" Joint Maximum Deflection (inches/18-foot length)	Ductile Iron "Push on" Joint Maximum Deflection (inches/18-foot length)	Ductile Iron Mechanical Joint Maximum Deflection (inches/18-foot length)
4	4	19	27
6	4	19	27
8	4	19	20
10	4	19	20
12	4	19	20
14	0	11	13
16	0	11	13
18	0	11	13
20	0	11	11
24	0	11	9

3.07 Jointing

A. Fittings

Mechanical and "push on" joints shall be installed in accordance with the joint manufacturer's recommendations. Copies of such recommendations shall be furnished to the Engineer prior to the start of construction.

Flange faces of flanged joints shall be thoroughly cleaned with a wire brush and the pipe carefully aligned. The gasket shall then be inserted between the flanges and the bolts and nuts installed. Tightening of the bolts shall be done evenly around the flange so as to uniformly distribute the stress carried by the bolts.

B. Butt Fusion

Joints for pipe shall be by thermal butt fusion per ASTM D2657. All joints shall be performed in accordance with the procedures recommended by the manufacturer.

3.08 Tracer Wire

A tracer wire shall be laid along the crown of any plastic pipes. The wire shall be attached to the top of the pipe in such a manner that it will not become displaced during construction and backfilling. Tracer wire shall be continuous (without splices) over each separate run. If wire is damaged or broken during installation, a new wire shall be installed by the Contractor. The wire shall be terminated in valve wells or boxes as approved by the Engineer.

3.09 Backfilling

Backfilling shall be in accordance with Section 31 23 01 – Excavating, Filling, and Grading.

3.10 Separation and Cover

Where the proposed water main crosses under an existing utility, the proposed water main shall be deflected above or below the existing utility in accordance with the following:

- A. Maintain a minimum depth of cover over top of proposed water main as shown on the drawings.
- B. Maintain at least 18 inches of vertical separation and 10 feet of horizontal separation between the outside of the proposed water main and the outside of a sewer, drain pipe, or catch basin lead.
- C. Maintain at least 1 foot of vertical separation between the outside of the proposed water main and the outside of an existing utility other than a sewer, drain or catch basin lead.
- D. When crossing an existing sewer, drain pipe, or catch basin lead, construct the proposed water main so that its joints are equidistant from the utility being crossed.

3.11 Hydrants and Valves

A. General

Hydrants and valves shall be located as shown on the plans or as otherwise directed by the Engineer. Failure by the Contractor to locate said hydrants or valves, as called for, may result in Contractor correcting the error at their own expense.

B. Setting Hydrants

Hydrant bowls shall be set on stone or concrete slab and braced to resist thrust. Hydrants shall be set perfectly plumb. Hydrant valves shall be located 2 feet from the hydrant, unless otherwise directed by the plans or Engineer.

Excavations for the construction of hydrants and hydrant leads shall be backfilled with sand and compacted. That portion of the excavation outside the 1:1 influence of an existing or proposed roadway, sidewalk, driveway, parking lot, structure, or railroad, and at least 12 inches above the pipe, may be backfilled with suitable excavated material, and compacted.

Hydrants shall be supplied with the correct bury height needed at each location. If the water main is deeper than the minimum bury depth for constructability purposes and the hydrant lead pipe elevation cannot be adjusted, the hydrant bury height will need to be increased or the hydrant shall have an extension installed accordingly.

C. Removal of Hydrants

Where shown on the plans or otherwise directed by the Engineer, the Contractor shall remove existing hydrants. The ground shall be excavated to the depth of the hydrant lead. The water main shall be "shut down" by the water department. The Contractor shall remove the hydrant, lead, valve, and box. The fitting on the main shall be plugged and blocked. The excavation shall be backfilled with sand and compacted. The hydrant, valve, and box shall be delivered to the water department service yard. That portion of the excavation that is outside the 1:1 influence of the existing or proposed roadway, and at least 12 inches above the pipe, may be backfilled with suitable excavated material and compacted.

D. Setting Valves

Valves shall be examined by the Contractor prior to lowering in the trench. All nuts and bolts shall be checked to assure tightness.

Valves shall be installed with the valve closed, supported on two 2-inch by 6-inch by 18-inch hardwood blocks and vertically plumb. The valve box shall be set plumb and its axis shall be in line with the stem. Valve boxes shall have the ability for future adjustments of up to 6 inches, above or below grade.

E. Cutting-in Valves

Where shown on the plans or directed by the Engineer, the Contractor shall install a new valve on an existing line. The existing main shall be uncovered by the Contractor. A section of the existing main shall then be cut out. The length will vary depending on the valve and sleeve dimensions. A suitable mechanical joint cutting-in sleeve shall be slid over one end of the pipe, and a gate valve installed over the other end. After the gate valve is in the "home" position, the sleeve shall be slid into the gate valve. The gaskets shall be positioned and the mechanical

joints shall be tightened to the manufacturer's specifications. The valve shall be plumb. Provide support under the valve by placing two 2-inch by 6-inch by 18-inch hardwood boards. The completed installation shall be visually inspected for leaks before the pipe is covered. The valve box shall be installed over gate valve and adjusted to the proposed grade. The excavation shall be backfilled with sand and compacted. That part of the excavation that is not within the 1:1 influence of an existing or proposed roadway or railway, and at least 6 inches above the water main, may be backfilled with suitable excavated material and compacted.

F. Reconnection of Existing Hydrants

Where the plans call for reconnection of an existing hydrant to a new main, the Contractor shall excavate, as necessary, to locate the existing hydrant lead. The lead shall be cut in a location, directed by the Engineer. The Contractor shall then connect the hydrant to the new main by the use of sleeves, tees, elbows, 6-inch ductile iron pipe, and a 6-inch gate valve and box, as conditions require. The excavation shall be backfilled with sand and compacted. That portion of the excavation outside of the 1:1 influence of an existing or proposed roadway or railroad may be backfilled using suitable excavated material and compacted.

3.12 Polyethylene Encasement

All ductile iron fittings and hydrants below grade shall be wrapped with polyethylene encasement. Installation shall be as set forth in ANSI A21.5/AWWA C105 and DIPRA's "Polyethylene Encasement" brochure.

3.13 Thrust Restraint

All tees, plugs, bends, hydrants, offsets, and similar fittings shall be mechanically restrained or braced to undisturbed ground by use of concrete thrust blocks.

Concrete for use as thrust blocks shall have a 28-day compressive strength of not less than 3,000 psi. The thrust block shall be placed so that the pipe, valve, hydrant, or fitting joints are accessible for repair. Details of placement of thrust blocks are shown on the plans. Vertical bends will require blocking and strapping as shown on the plans.

Restrained joints shall be designed in accordance with DIPRA *Thrust Restraint Design for Ductile Iron Pipe*. The following restraint joint systems are approved for ductile iron pipe, when observed by the Engineer.

Pipe Size	Restrained Joint Type
12 inch or less	Field Lok, Fast Grip
16 inches or larger	FlexRing, TR Flex

Restrained joints for PVC and PVCO pipe shall be as follows:

- A. MEGALUG by EBAA Iron, Series 19MJ00 or approved equal for mechanical joint restraints.
- B. MEGALUG by EBAA Iron, Series 1900 or approved equal for push joint/bell restraints.

Restrain all mechanical joints with retainer glands. Restraint all joints within length(s) according to restraint schedule, as determined using EBAA Iron Restraint Length Calculator.

Restrained joints are considered included in work of water main construction and will not be paid for separately.

3.14 Connection of Polyethylene to Fixed Appurtenances for Fittings

All connections where PE water main is transitioned to a different type of piping material or fitting, the pipe shall be anchored in concrete at the connection of the PE to the existing or proposed line or fitting. Concrete for use as anchor blocks shall have a 28-day compressive strength of not less than 3,000 psi. A flanged HDPE fitting shall be butt fused at the location of the transition of differing materials and encased in concrete.

3.15 Conflicts with Existing Utilities

Excavation shall be made sufficiently in advance of pipelaying operations so that water main alignment can be adjusted to go above, below, or around existing pipes, structures, cables, or other obstacles that are encountered. Where such minor adjustments are made to the water main alignment, no additional compensation will be due to the Contractor.

Where existing electric cables, telephone cables, gas mains, or services are damaged, repairs shall be at the Contractor's expense. The repairs shall be made by the appropriate utility.

Where sewer leads are damaged, they shall be repaired by the Contractor at no charge to the Owner. Sewer leads shall be repaired with a section of schedule 40 PVC pipe of the size encountered. Pipe of the same material as that encountered can also be used. The damaged pipe shall be cut square and the "connection" area shall be thoroughly cleaned. Rubber gasketed sleeve couplings, suitable for connecting the pipe sizes and materials encountered, shall be furnished and installed by the Contractor for each reconnection or repair joint.

3.16 Conflicts with Proposed Utilities

This work consists of relocating a portion of existing water main or water service to avoid a conflict with a proposed utility. This work includes furnishing all labor, equipment, and materials required for excavation, installation, disinfection, and backfilling as shown on the plans and specified within this specification.

3.17 Restoration

Areas disturbed by construction activities shall be restored by the Contractor.

3.18 Testing and Disinfection

A. Hydrostatic Pressure Testing for Water Main

Water main shall be hydrostatically tested immediately after the section to be tested is installed. The Contractor shall coordinate with the City of Midland Water Distribution Department and pay all fees. The Contractor shall provide all labor, equipment, and materials

to perform the test, including pumps, gauges, plugs, corporations, water, miscellaneous pipes and fittings, and a means of measuring lost water. The testing equipment shall be approved by the Engineer. Testing to be performed by the City of Midland Water Distribution Department.

The Contractor shall fill the main through hydrants or corporations. After completion of the tests, corporations made for the purpose of testing shall be plugged. Water shall be added to the line and air expelled to provide a pressure of 150 psig. When the Contractor has verified that all air is expelled and that the test pressure is maintained, the Contractor shall notify the Engineer to witness the test. The City of Midland shall be given at least a 48-hour notice. The test duration shall be two hours. Water shall be added during the test period, as required, to maintain the required pressure to the highest point in the system throughout the test period. The amount of water required to maintain the test pressure is the actual leakage.

The actual leakage shall not exceed the allowable leakage as tabulated below:

Pipe Size (inch)	Allowable Leakage per 1,000 feet of Water Main (gallons/2 hours)
6	1.00
8	1.32
10	1.66
12	1.98
16	2.64
20	3.32
24	3.98

If unsatisfactory results are obtained, the Contractor shall locate and repair the leak and the system shall be retested.

B. Tracer Wire Continuity

The Contractor shall demonstrate continuity of the installed tracer wire to the Engineer.

C. Disinfection

The Contractor shall flush the water main with potable water until discharge from the main runs clear. The Contractor shall coordinate with the City of Midland Water Distribution Department and pay all fees. The main shall be chlorinated in accordance with AWWA C651. After the chlorination procedure is completed, the water main shall be flushed again until the chlorine content is equal to that of the water being supplied. Sixteen hours or longer after the flushing, the Contractor may begin collecting samples for bacteriological analysis. Samples shall be collected at 24-hour intervals until two consecutive satisfactory results are obtained. Samples shall be collected at the end opposite the chlorine injection, except that in long lines or where contamination is suspected, the Engineer may require other sampling points. Sampling shall be performed under the observation of the City of Midland. Testing to be performed by the City of Midland Water Distribution Department.

Where satisfactory results are not obtained, the main shall be reflushed, disinfected, and retested. Heavily chlorinated water shall be disposed of properly.

3.19 Abandoning Water Mains

Existing water main shall be abandoned where shown on the drawings or directed by the Engineer.

Water main that is to be abandoned shall be disconnected from the existing main which is to remain in service. A suitable sized plug or cap shall be installed on the existing main to remain in service, together with suitable thrust restraint.

Where directed, the existing water main, together with any fittings and appurtenances, shall be removed in their entirety. The Contractor shall fill the excavation resulting from the excavation and removal of the pipe. Backfill within the 1:1 influence of pavements, roads, driveways, or structures shall be sand and compacted according to Section 01 45 16.02 – Density and Aggregate Testing. Backfill in other areas shall be suitable soil, free of rocks, debris, and frozen material and compacted according to Section 01 45 16.02 – Density and Aggregate Testing.

If the abandoned water main is to remain in place, the open ends of the pipe (or fittings) shall be bulkheaded. When designated on the plans or by the Engineer, the existing pipe shall also be filled with a lean grout mixture (flowable fill). The Contractor shall provide suitable openings in the pipe to fill the pipe and prevent the trapping of air. Fill shall be placed evenly to avoid displacing pipes or structures. Pipes and conduits within the fill area shall be secured to resist any movement resulting from buoyant forces.

END OF SECTION

SECTION 33 31 00
SANITARY SEWER

PART 1 - GENERAL

1.01 Work Included

The Contractor shall supply all labor, material, and equipment required for the installation and testing of gravity sanitary sewers and appurtenances in compliance with these general specifications, project specifications, and the contract drawings.

1.02 References

Where materials or methods of construction are listed as being in conformance with a standard specification, it shall refer to the latest edition of the standard specification or any interim revision.

- A. ASTM A48 – Standard Specification for Gray Iron Castings
- B. ASTM C76 – Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
- C. ASTM C443 – Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
- D. ASTM C478 – Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
- E. ASTM C923 – Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
- F. ASTM C1479 – Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations
- G. ASTM D1785 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
- H. ASTM D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
- I. ASTM D2665 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
- J. ASTM D2680 – Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
- K. ASTM D3034 – Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
- L. ASTM D3139 – Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

- M. ASTM D3212 – Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
- N. ASTM D4101 – Standard Specification for Polypropylene Injection and Extrusion Materials
- O. ASTM F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- P. ASTM F679 – Standard Specifications for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
- Q. ASTM F1417 – Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air
- R. ASTM F1668 – Standard Guide for Construction Procedures for Buried Plastic Pipe
- S. ANSI A21.4/AWWA C104 – Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
- T. ANSI A21.5/AWWA C105 – Polyethylene Encasement for Ductile-Iron Pipe Systems
- U. ANSI A21.10/AWWA C110 – Ductile-Iron and Gray-Iron Fittings
- V. ANSI A21.11/AWWA C111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
- W. ANSI A21.51/AWWA C151 – Ductile-Iron Pipe, Centrifugally Cast
- X. ANSI A21.53/AWWA C153 – Ductile-Iron Compact Fittings
- Y. Michigan Department of Transportation 2020 Standard Specifications for Construction

1.03 Related Work

- A. Section 01 45 16.02 – Density and Aggregate Testing
- B. Section 31 10 01 – Clearing and Removal of Miscellaneous Structures
- C. Section 31 23 01 – Excavating, Filling, and Grading
- D. Section 31 25 00 – Soil Erosion and Sedimentation Control
- E. Section 32 92 00 – Turf Establishment

1.04 Submittals

The Contractor shall submit shop drawings or certificates of compliance to the Owner and Engineer for the following items.

- A. Pipe, fittings, and joint material
- B. Manholes and manhole adjusting rings and castings
- C. Pipe bedding and backfill material

1.05 Quality Assurance and Quality Control

A. Grade and Alignment

Grade and alignment shall be maintained using a laser. The Contractor shall verify that the sewer is constructed at the proper alignment by checking grades and offsets at each manhole, at 50 feet upstream from manholes, and at 100-foot intervals. The Contractor shall report as-constructed measurements to the Engineer.

B. Acceptance Tests

The completed sewer(s) shall be subjected to the following tests, prior to acceptance by the Owner. Acceptance tests shall be completed by the Contractor, in the presence of the Engineer (or Owner's representative).

1. Internal Video Inspection

The video inspection shall be completed in accordance with Section 3.10.A.

2. Infiltration Tests

The infiltration test shall be completed in accordance with Section 3.10.B.

3. Air Test

Air testing shall be completed in accordance with section 3.10.C.

4. Deflection Testing

All plastic sewers shall be subjected to a deflection test in accordance with Section 3.10.D.

5. Physical Inspection

The physical inspection shall be completed in accordance with Section 3.10.E.

PART 2 - PRODUCTS

2.01 Materials

All material supplied shall be new and shall be designed and guaranteed to perform the service required.

A. Pipe

Pipe shall be of the material, class and/or thickness indicated on the plans or on the proposal. If no specific materials or classes are provided on the plans or on the proposal, any of the following pipe materials are permissible.

1. PVC Pipe

All 3-inch diameter thru 15-inch diameter PVC pipe shall be ASTM D3034 gasketed sewer pipe with an SDR of 26 or lower. All PVC pipe with a diameter larger than 15-inch shall meet ASTM F679 with a pipe stiffness (PS) of 115. Pipe joints shall conform to ASTM D3212. Gaskets shall conform to ASTM F477 . PVC pipe conforming to ASTM D1785 Schedule 40 and ASTM D2665 is acceptable for 6-inch service leads.

B. Materials for Manholes

The manhole base, sections, and reducer shall be manufactured in accordance with ASTM C478 with rubber gaskets conforming to ASTM C443. The manhole sections shall be provided with an 8-inch pre-cast base slab for depths up to 20 feet and a 12-inch pre-cast base slab for greater depths. Integrally cast wall and slab sections are required. Manhole lifting holes shall not be permitted in the manhole sections. Lifting lugs shall be cast into the manhole for lifting.

Precast risers ring shall be manufactured in accordance with Michigan Department of Transportation Standard Plan R-1-Series.

Adjusting rings shall be manufactured in accordance with ASTM C478.

Manhole connection shall be cored openings with watertight, flexible rubber connectors meeting ASTM C923.

Manhole steps shall be copolymer polypropylene plastic steps with a steel reinforcement bar, with a minimum diameter of ½ inches, a minimum width of 10 inches center to center of wall anchor, and complete with anti-skid side plates conforming to ASTM D4101. Steps shall be manufactured with the manhole wall and spaced at a maximum of 16 inches on center. Gray iron castings shall be heavy duty classification and shall conform to ASTM A48 Class 35B coated with asphalt coating.

Manhole frames and covers shall be EJ No. 1040ZPT Type A solid cover, or Neenah Foundry Company No. R-1916-F, or approved alternate.

Manhole frames shall have anchor base flange holes furnished for bolting the frames to the cone section. Covers shall be equipped with four stainless steel cap screws countersunk flush with the cover. The frame and cover shall be connected to the cone section by use of 4 chromite coated ⁵/₈-inch thread studs with washers and nuts, field cut bolts to proper length. All covers shall be stamped "SANITARY SEWER" with 2-inch raised letters.

2.02 Material Testing

All materials to be incorporated in the construction of gravity sewers and appurtenances shall be subject to inspection and tests, as specified by ASTM or AWWA references. The Owner reserves the right to subject any material supplied for a particular project to an independent testing laboratory. Such tests, if scheduled, shall be paid for by the Owner. The results of such tests shall be the basis of material acceptance.

The Contractor shall supply the Owner with shop drawings, a certificate of compliance, or actual test results stating that the material to be used is in conformance with the specifications prior to using material for construction.

PART 3 - EXECUTION

3.01 General

Sewers shall be constructed in accordance with the following standards, except as modified in this specification:

- A. Concrete Pipe: ASTM C1479
- B. Plastic Pipe: ASTM D2321 and ASTM F1668

3.02 Excavation

Excavation shall be completed in accordance with Section 31 23 01 – Excavating, Filling, and Grading.

3.03 Pipe Alignment

It shall be the Contractor's responsibility to transfer the line and grade to the bottom of the excavation for pipe laying. Lasers shall be used for pipe laying.

It shall be the Contractor's responsibility to protect the original survey control and benchmarks, as set by the Engineer.

3.04 Pipe Laying

Each pipe shall be laid on an even, firm bed, so that no uneven strain will come to any part of the pipe. Particular care shall be exercised to prevent the pipes bearing on the sockets. Bell holes for bell and spigot pipe shall be dug at each point as specified before. Each pipe shall be laid in the presence of the inspector. The bell-end of the pipe shall be laid up-grade. Pipe laying shall proceed in the upstream direction, except where otherwise approved by the Engineer.

The interior of the sewer shall be cleaned of all dirt, debris, jointing material, and other material.

All pipe shall be completely pushed to the "home" position.

Pipes laid in tunnel or casing pipe shall be supported on suitable blocks, cut or grouted into position to place the invert of the sewer or drain at the slope, and to the elevations indicated on the contract drawings.

3.05 Connections to Existing Sewers

When replacing an existing sewer or manhole or constructing a new manhole over an existing sewer, the original sewer shall be reconnected to the new sewer or manhole. Existing sewer pipe shall be removed, salvaged, and reused to make connection to the new manhole, if possible. If existing pipe is not salvageable, a new sewer pipe shall be installed, as required, and connected to the existing sewer. When a new sewer is connected to an existing sewer, the existing sewer

shall be removed to an existing joint, if existing joint is compatible with new sewer. If existing sewer joint is not compatible with new sewer, a watertight coupler shall be installed.

3.06 Pipe Joints

In all jointing operations, the trench must be dewatered when joints are made. Bell and spigot or tongue and groove ends of the pipe shall first be wiped clean before actual jointing operations are started.

Joints between consecutive bell and spigot or tongue and groove pipe shall be made with a rubber gasket. The gasket shall be fitted over the tongue or spigot of each pipe, as recommended by the manufacturer, and the pipe entered into the bell or groove and shoved home.

A. PVC Joints

All PVC pipe shall be joined with rubber compression gaskets that are factory installed. The joint shall be lubricated and joined so the "home" mark on the pipe is flush with the bell end.

3.07 Connections for Service Pipes

Service connections for house sewers shall be provided in the main sewers, as shown on the contract drawings or as designated in the specifications. The exact location shall be as directed by the Engineer during construction.

Either tee or wye branches are acceptable for service connections, where the main line sanitary sewer is 12 inches or greater. Wye fittings are required on 8-inch and 10-inch sewers. Service leads shall be installed at a sufficient depth to service house basements if the main line sewer is sufficiently deep, but shall be left above the water table at their terminus.

The Contractor shall place a hardwood stake on the property line directly opposite each opening left in the sewer. The hardwood stake shall be 8 feet long and a minimum size of 2 inches by 2 inches. The Contractor shall locate and keep a record, in tabular form, of all manhole and sewer opening locations by measurement to the nearest downstream opening. All manhole locations shall be witnessed by at least two ties to existing topographic features. This record shall be delivered to the Engineer during the progress of the work. When constructing sanitary sewer connections in wet ground, place a 45-degree bend at the property end of the connection and install enough house lead to bring the connection above the natural ground water level.

For service connections where the main line is less than 10 feet deep, the Contractor need not supply a riser connection for the service lead. The service connection shall be left at a depth of 8 feet to 10 feet below the ground at the property line. The Contractor has the option of installing the house lead at an incline or using a riser section for sewers less than 10 feet deep.

When the invert of the sanitary sewer is in excess of 10 feet, a riser section shall be used to raise the service connection to a point approximately 10 feet below the surface of the ground. All service connections shall be installed in accordance with the standard details.

All openings shall be plugged with air tight stoppers.

Service leads on easements or adjacent to property lines shall extend one pipe length from the main line sewer, but not beyond the easement limit.

3.08 Manholes

All manholes shall be constructed at the locations shown and in accordance with the contract drawings. Manholes shall be constructed of precast wall sections with a rubber gasket in the joint. The precast top section shall be an eccentric cone. Precast bases shall be installed on the subbase in such a way as to provide a uniform bearing under the manhole. Manholes shall have either a precast integral bottom and channel or a field constructed channel. The steps and castings shall be constructed in accordance with the standard details on the construction drawings.

Holes shall be cored through the manhole for necessary pipe connections. Each pipe opening shall be provided with a resilient connector.

Openings into existing manholes (sewer tap), shall be made by a concrete drilling or coring machine. The opening shall be no larger than necessary for the new sanitary sewer. A watertight resilient connector shall be installed in the cored hole for the tapped sewer connection. The new tap shall be supported at the external side of the manhole with 6AA aggregate or concrete. The end of the tapped pipe shall be flush with the interior surface of the manhole. The existing flow channel shall be adjusted in accordance with the plan details.

Flow channels and/or drop connections shall be constructed as detailed on the construction drawings.

3.09 Backfill

Backfill shall meet the requirements of Section 31 23 01 – Excavating, Filling, and Grading.

3.10 Acceptance Tests - Sanitary Sewers

The methods of testing shall be approved by the Engineer. The Contractor shall provide the necessary equipment and labor for making the tests, and the cost of testing and repair shall be included in the unit price bid for completed sanitary sewer. The Engineer shall determine when grouting or relaying of faulty pipe is required.

A. Alignment, Grade, and Wyes

Each section of the sanitary sewer shall be checked for alignment and grade by using a closed circuit television inspection. The report and video shall indicate the measurements from manhole center to manhole center and shall tabulate all service leads. The Contractor shall supply the Engineer with a digital file of the video inspection and a listing of service connections prior to requesting final inspection.

B. Infiltration Testing

Sewers 24 inches and larger shall be subjected to an infiltration test. Infiltration into the sanitary sewer shall be measured by use of an infiltration manhole where called for on the

plans or by a V-notched sharp crested weir. The weir shall be furnished and installed by the Contractor, as directed by the Engineer. The joint shall be tight and visible leakage in the joints or excess of the specified amount shall be repaired at the Contractor's expense.

There shall be no allowable infiltration for PVC sanitary sewer pipe. The maximum amount of allowable leakage for other sanitary sewer pipe materials shall be limited to 100 gallons per inch diameter, per mile, per 24-hour day. The maximum allowable leakage shall be limited to 1,200 feet test length. The Contractor may elect to test longer sections of pipe, but the maximum allowable leakage shall be calculated based on a 1,200-foot test length. All testing shall be monitored by the Engineer.

C. Air Testing

Sewers less than 24 inches in diameter shall be subjected to an air test. The Contractor shall furnish all necessary labor, equipment, and supervision to perform the required air testing. The testing of PVC pipe sewer shall conform to ASTM F1417.

The Contractor shall be required to furnish the Owner with acceptable air test results for each segment of sanitary sewer. All testing shall be monitored by the Engineer.

The procedure for air testing of sewers shall be as follows:

The sewer line shall be tested in increments between manholes. The line shall be cleaned and plugged at each manhole. Such plugs shall be designed to hold against the test pressure and shall provide an air-tight seal. One of the plugs shall have an orifice through which air can be introduced into the sewer. An air supply line shall be connected to the orifice. The air supply line shall be fitted with suitable control valves and a pressure gauge for continually measuring the air pressure in the sewer. The pressure gauge shall have a minimum diameter of 3½ inches and a range of 0-10 psig. The gauge shall have minimum divisions of 0.10 psig and an accuracy of plus or minus 0.04 psig.

The sewer shall be pressurized to 4 psig, plus sufficient pressure to equal the force exerted by ground water over the pipeline. At least 2 minutes shall be allowed for the air pressure to stabilize between 3.5 and 4 psig. If necessary, air shall be added to the sewer to maintain a pressure of 3.5 psig or greater.

After the stabilization period, the air supply control valve shall be closed so that no more air will enter the sewer. The sewer air pressure shall be noted and timing for the test begun. The test shall not begin if the air pressure is less than 3.5 psig, or such other pressure as is necessary to compensate for ground water level.

The time required for the air pressure to decrease 1 psig during the test shall not be less than the time shown in the following table:

Pipe Diameter (inches)	Minimum Test Time (minutes)	Pipe Length for Minimum Time (feet)	Time for Longer Pipe Length (seconds)
4	3:46	597	0.380 L
6	5:40	398	0.854 L
8	7:34	298	1.520 L
10	9:26	239	2.374 L
12	11:20	199	3.418 L
15	14:10	159	5.342 L
18	17:00	133	7.692 L
21	19:50	114	10.470 L

Length is based on the length of the sewer main only. If laterals or other leads are connected, their lengths are not to be included in the testing length.

If a sewer fails to pass any of the previously described tests, the Contractor shall determine the location of the leaks, repair them, and retest the sewer. The tests shall be repeated until satisfactory results are obtained.

D. Deflection Testing

All sanitary sewers constructed using plastic pipe shall be subjected to a deflection test. The Contractor shall furnish all labor, materials, and equipment necessary to perform deflection testing. The testing shall be completed after the pipeline has been backfilled for a period of at least 30 days. The pipeline shall be tested with a rigid ball or mandrel having at least 7 points, and having a diameter of not less than 95 percent of the average inside diameter of the pipe being tested. The average diameter for the pipe will be as specified by the ASTM specification for the pipe material, class, and size. Where testing indicates that the pipe deflection exceeds 5 percent of the pipe diameter, the pipe shall be removed and replaced. Pipe that is replaced shall be re-tested at least 30 days following its replacement.

Deflection testing shall be performed in the presence of the Engineer. The Contractor shall provide the Engineer with a least two working days' notice of conducting deflection testing.

E. Physical Inspection

Upon completion of all work, the Contractor shall open all manholes in the presence of the Engineer to demonstrate that the manholes are complete and free of debris.

3.11 Bypass Pumping

Bypassing of the existing sewage shall be provided, as required, to maintain uninterrupted sanitary sewer service. The line shall be plugged at an upstream manhole and the flow shall be pumped to a downstream point or adjacent system. The pump and bypass lines provided shall be of sufficient size to handle the normal and peak flow conditions for the system. Internal combustion engines shall have adequate exhaust silencers to muffle engine noise to an acceptable level for the area where located.

The bypass plan for each segment of pipe shall be submitted to the Owner and Engineer for review and approval prior to the start of the project, along with a list of equipment. All property owners affected by the bypass shall be notified by the Contractor a minimum of 48 hours in advance.

3.12 Removal of Sanitary Sewer

Existing sanitary sewer shall be removed where shown on the drawings or directed by the Engineer.

Existing sanitary sewer structures shall be removed where shown on the drawings or directed by the Engineer.

Where directed, the existing sanitary sewer and sanitary sewer structures, shall be removed in their entirety. The Contractor shall fill the excavation resulting from the excavation and removal of the pipe and structures. Backfill within the 1:1 influence of pavements, roads, driveways, or structures shall be sand and compacted according to Section 01 45 16.02 – Density and Aggregate Testing. Backfill in other areas shall be suitable soil, free of rocks, debris, and frozen material and compacted according to Section 01 45 16.02 – Density and Aggregate Testing.

3.13 Abandoning Sanitary Sewer

Existing sanitary sewer shall be abandoned where shown on the drawings or directed by the Engineer.

If the abandoned sanitary sewer pipe is to remain in place, the open ends of the pipe shall be bulkheaded.

If the abandoned sanitary sewer structure is to remain in place, remove the cover and break down portions of existing structures, not interfering with new construction, to 3 feet below the finished grade within the influence of pavements, roads, driveways, or structures and to 1 foot below finished grade in other areas.

Break or perforate the bottom of the structure to provide drainage, and fill the remaining structure sections with sand and compacted according to Section 01 45 16.02 - Density and Aggregate Testing.

The Contractor shall fill the excavation resulting from the excavation and removal of the structure sections. Backfill within the 1:1 influence of pavements, roads, driveways, or structures shall be sand and compacted according to Section 01 45 16.02 – Density and Aggregate Testing. Backfill in other areas shall be suitable soil, free of rocks, debris, and frozen material and compacted according to Section 01 45 16.02 – Density and Aggregate Testing.

END OF SECTION

SECTION 33 44 00
STORM SEWERS

PART 1 - GENERAL

1.01 Work Included

This work includes construction of storm sewers, drainage structures, and appurtenances. Drainage structures include catch basins, inlets, manholes, and manhole tees.

1.02 References

Where materials or methods of construction are listed as being in conformance with a standard specification, it shall refer to the latest edition of the standard specification or any interim revision.

- A. AASHTO M36 – Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains
- B. AASHTO M170 – Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
- C. AASHTO M294 – Standard Specification for Corrugated Polyethylene Pipe, 300-mm to 1,500-mm (12-in. to 60-in.) Diameter
- D. ASTM A48 – Standard Specification for Gray Iron Castings
- E. ASTM C76 – Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
- F. ASTM C443 – Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
- G. ASTM C478 – Standard Specifications for Circular Precast Reinforced Concrete Manhole Sections
- H. ASTM C923 – Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
- I. ASTM D1056 – Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber
- J. ASTM D3212 – Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
- K. ASTM D4101 – Standard Specifications for Polypropylene Injection and Extrusion Materials
- L. ASTM F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- M. Michigan Department of Transportation 2020 Standard Specifications for Construction
- N. Michigan Department of Transportation Standard Plans

1.03 Related Work

- A. Section 01 45 16.02 – Density and Aggregate Testing
- B. Section 31 23 01 – Excavating, Filling, and Grading
- C. Section 31 25 00 – Soil Erosion and Sedimentation Control
- D. Section 32 92 00 – Turf Establishment

1.04 Submittals

The Contractor shall submit shop drawings or certificates of compliance to the Owner and Engineer for the following items.

- A. Pipe, fittings, and joint material
- B. Manholes and manhole adjusting rings and castings
- C. Pipe bedding and backfill material

1.05 Quality Assurance and Quality Control

A. Grade and Alignment

Grade and alignment shall be maintained using a laser. The Contractor shall verify that the sewer is constructed at the proper alignment by checking grades and offsets at each manhole, at 50 feet upstream from manholes, and at 100-foot intervals. The Contractor shall report as-constructed measurements to the Engineer.

B. Acceptance Tests

The completed sewer(s) shall be subjected to the following tests, prior to acceptance by the Owner. Acceptance tests shall be completed by the Contractor, in the presence of the Engineer (or Owner's representative).

1. Internal Video Inspection

The video inspection shall be completed in accordance with Section 3.06.A.

2. Physical Inspection

The physical inspection shall be completed in accordance with Section 3.06.B.

3. Deflection Testing

The deflection testing shall be completed in accordance with Section 3.06.C.

PART 2 - PRODUCTS

2.01 Materials

A. Pipe

Unless a specific type, class or thickness is called for on the plans or in the proposal, material class shall meet the requirements of Pipe Alternates for Storm Sewer Classes, as described in

Section 402 of the Michigan Department of Transportation 2020 Standard Specifications for Construction.

1. Smooth-Lined Corrugated Plastic Pipe

Where storm sewers from 12-inch to 24-inch diameter are called for on the plans, with at least 2 feet of cover over the pipe, and when a particular kind of sewer pipe is not specified, the Contractor may furnish smooth-lined corrugated plastic pipe (SLCPP).

SLCPP shall be corrugated polyethylene pipe meeting the requirements of AASHTO M294, Type S. Any fittings required shall also meet the requirements of AASHTO M294. The joint shall be watertight according to the requirements of ASTM D3213. Gaskets shall meet the requirements of ASTM F477. Only fittings supplied or recommended by the pipe manufacturer shall be used. All materials shall be installed per the manufacturer's recommendations.

2. PVC Pipe

PVC pipe conforming to ASTM D1785 Schedule 40 and ASTM D2665 is acceptable for 6-inch service leads.

B. End Sections

End sections shall be flared and beveled to conform with ditch slopes.

Metal end sections shall conform with AASHTO M36, where applicable. The metallic coating on the end sections shall be the same as on the pipe. End sections shall be furnished complete with coupling bands or hardware necessary for connecting them to the end of the pipe culvert.

Concrete end sections shall be constructed of precast concrete and reinforcement conforming to the requirements of AASHTO M170 (ASTM C76) Class III or as shown on the drawings. Connection of end section to concrete pipe shall be made by tongue and groove joints.

C. Drainage Structures

Drainage structures shall be precast concrete units meeting the requirements of ASTM C478 with rubber gaskets conforming to ASTM C443. Drainage structures shall be 4 feet in diameter, unless shown otherwise on the plans or in the proposal. Precast concrete grade rings meeting ASTM C478 shall be used to adjust the top of the structure to the final grade. At least 6 inches, but not more than 18 inches, of vertical adjustment shall be provided with grade rings. Manhole lifting holes shall not be permitted in the manhole sections. Lifting lugs shall be cast into the manhole for lifting.

Manhole connection shall be cored openings with watertight, flexible rubber connectors meeting ASTM C923.

Manhole steps shall be copolymer polypropylene plastic steps with a steel reinforcement bar, with a minimum diameter of ½-inch, a minimum width of 10 inches center to center of wall anchor, and complete with anti-skid side plates conforming to ASTM D4101. Steps shall be manufactured with the manhole wall and spaced at a maximum of 16 inches on center. Gray

iron castings shall be heavy duty classification and shall conform to ASTM A48 Class 35B coated with asphalt coating.

D. Castings

Castings shall meet the requirements of the Michigan Department of Transportation 2020 Standard Specifications for Construction, and the Michigan Department of Transportation Standard Plans.

PART 3 - EXECUTION

3.01 Excavation

Excavation shall be completed in accordance with Section 31 23 01 – Excavating, Filling, and Grading.

3.02 Pipelaying

Sections of sewer pipe shall be carefully laid in the prepared trench, bell ends upgrade, with the spigot end fully entered in the adjacent bell. Each section shall have firm bearing throughout its length and shall be substantially true to the line and grade required. The use of blocks to bring sections to grade will not be permitted.

Circular concrete pipe with lift holes shall be installed with the lift holes on top of the pipe. Holes shall be plugged with suitable concrete plugs before backfilling.

Existing live sewers that are to remain shall be carefully protected during construction of the new sewers. If they are damaged in any way, they shall be immediately repaired or replaced, as directed by the Engineer.

All junctions with house or building leads shall be made in a manner acceptable to the Engineer.

Flexible watertight joints shall be installed in accordance with the manufacturer's recommendations.

Connections to sewers owned by other agencies shall be done in accordance with their requirements.

Connections to existing sewers having a plug or bulkhead shall be made with a watertight joint. The plug or bulkhead shall be removed without damage to the sewer, and the plug material shall be removed from the sewer and properly disposed of.

If there are no openings in the existing pipe or structures at the point of connection, an opening shall be cut in the pipe or the structure sufficiently large enough to permit 3 inches of mortar to be packed around the entering pipe and the mortar pointed up smooth and flush with the inner wall. Pipe passing through pipe or structure walls shall be cut at the end to conform with the shape of the inside of the wall and to be flush therewith. On the outside of the pipe or structure, the entering pipe shall be encased with sufficient mortar to provide bearing under the pipe. Any

existing pipe broken or cracked while making the connection shall be replaced at the Contractor's expense.

When replacing an existing sewer, connections to the original sewer or drain that are encountered shall be reconnected to the new sewer.

Sewers and drainage structures shall be reasonably free of accumulation of silt debris and other foreign matter at the time of final acceptance.

3.03 Backfill

Backfill shall meet the requirements of Section 31 23 01 – Excavating, Filling, and Grading.

3.04 Additional Requirements of Construction for SLCPP Sewers

SLCPP shall be installed in accordance with Section 3.01. and the additional requirements provided here.

Joints in SLCPP shall be wrapped with a 2-foot wide strip of non-woven geotextile filter fabric with a 1-foot lap at the fabric joint.

The installed pipe shall not be deformed such that any diameter is reduced by 5 percent or more. Deformed pipe shall be removed and replaced at the Contractor's expense. The completed pipeline shall be tested for deformation by the Contractor under the Engineer's supervision. The Contractor shall furnish a 9-point mandrel having a diameter equal to at least 95 percent of the original uninstalled inside diameter of the pipe. The mandrel shall meet the Engineer's approval. Mandrel testing shall be performed no less than thirty calendar days after installation.

3.05 Drainage Structures

Precast concrete units shall be placed on a 6-inch sand base, leveled, and thoroughly compacted. Joints shall be sealed with mortar. Joints shall be thoroughly wetted prior to sealing. The joints inside the structure shall be flush with the walls. Joints shall be completely filled with mortar.

Pipe or tile connections to concrete drainage structures shall extend through the structure wall and be cut flush with the inside surface. The opening around the pipe shall be neatly filled with mortar to prevent leakage.

Drainage structure covers shall be new and adjusted to the finish elevation using precast concrete grade rings. Covers shall be of the type called for on the plans. Covers and grade rings shall be set in full mortar beds.

Cover elevations given on the plans are for information only. The final elevation will be determined in the field, based on as-constructed conditions.

Drainage structures shall be maintained reasonably free of accumulations of silt, debris, and other foreign matter at the time of final acceptance.

3.06 Acceptance Tests - Storm Sewers

The methods of testing shall be approved by the Engineer. The Contractor shall provide the necessary equipment and labor for making the tests, and the cost of testing and repair shall be included in the unit price bid for completed storm sewer. The Engineer shall determine when grouting or relaying of faulty pipe is required.

A. Alignment, Grade, and Connections

Each section of the storm sewer shall be checked for alignment and grade by using a closed circuit television inspection. The report and video shall indicate the measurements from manhole center to manhole center and shall tabulate all connections. The Contractor shall supply the Engineer with a digital recording of the video inspection and a listing of service connections prior to requesting final inspection.

B. Physical Inspection

Upon completion of all work, the Contractor shall open all manholes in the presence of the Engineer to demonstrate that the manholes are complete and free of debris.

C. Deflection Testing

All sewers constructed using plastic pipe shall be subjected to a deflection test. The Contractor shall furnish all labor, materials, and equipment necessary to perform deflection testing. The testing shall be completed after the pipeline has been backfilled for a period of at least 30 days. The pipeline shall be tested with a rigid ball or mandrel having at least 7 points, and having a diameter of not less than 95 percent of the average inside diameter of the pipe being tested. The average diameter for the pipe will be as specified by the ASTM specification for the pipe material, class, and size. Where testing indicates that the pipe deflection exceeds 5 percent of the pipe diameter, the pipe shall be removed and replaced. Pipe that is replaced shall be re-tested at least 30 days following its replacement.

Deflection testing shall be performed in the presence of the Engineer. The Contractor shall provide the Engineer with a least two working days' notice of conducting deflection testing.

3.07 Removal of Storm Sewer

Existing storm sewer shall be removed where shown on the drawings or directed by the Engineer.

Existing storm sewer structures shall be removed where shown on the drawings or directed by the Engineer.

Where directed, the existing storm sewer and storm sewer structures, shall be removed in their entirety. The Contractor shall fill the excavation resulting from the excavation and removal of the pipe and structures. Backfill within the 1:1 influence of pavements, roads, driveways, or structures shall be sand and compacted according to Section 01 45 16.02 – Density and Aggregate Testing. Backfill in other areas shall be suitable soil, free of rocks, debris, and frozen material and compacted according to Section 01 45 16.02 – Density and Aggregate Testing.

END OF SECTION

SECTION 33 46 16
UNDERDRAINS

PART 1 - GENERAL

1.01 Work Included

This work includes constructing a subsurface drainage system.

1.02 References

Where materials or methods of construction are listed as being in conformance with a standard specification, it shall refer to the latest edition of the standard specification or any interim revision.

- A. AASHTO M36 – Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains
- B. AASHTO M218 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized), for Corrugated Steel Pipe
- C. AASHTO M252 – Standard Specification for Corrugated Polyethylene Drainage Pipe
- D. AASHTO M274 – Standard Specification for Steel Sheet, Aluminum-Coated (Type 2), for Corrugated Steel Pipe
- E. AASHTO M278 – Standard Specification for Class PS46 Poly(Vinyl Chloride) (PVC) Pipe
- F. ASTM D1785 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
- G. ASTM D3034 – Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
- H. ASTM D3786 – Standard Test Method for Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method
- I. ASTM D4491 – Standard Test Methods for Water Permeability of Geotextiles by Permittivity
- J. ASTM D4533 – Standard Test Method for Trapezoid Tearing Strength of Geotextiles
- K. ASTM D4632 – Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
- L. ASTM D4751 – Standard Test Methods for Determining Apparent Opening Size of a Geotextile
- M. ASTM D4833 – Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
- N. ASTM F949 – Standard Specification for Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings

- O. ASTM F2806 – Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe (Metric SDR-PR)
- P. Michigan Department of Transportation 2020 Standard Specifications for Construction

1.03 Related Work

- A. Section 01 45 16.02 – Density and Aggregate Testing

PART 2 - PRODUCTS

2.01 Materials

A. Pipe for Underdrains

1. Corrugated Plastic Tubing

Corrugated plastic tubing shall conform to AASHTO M252 for polyethylene (PE) tubing or ASTM F949 for polyvinyl chloride (PVC) tubing. Perforations shall meet the requirements of AASHTO M252.

Corrugated plastic tubing shall be wrapped with a non-woven geotextile filter fabric meeting the requirements of Section 2.01.E.

B. Pipe for Outlets

Underdrain outlets into storm sewer drainage structures shall be fabricated from either PVC pipe meeting ASTM D1785, Schedule 40 or ASTM D 3034, Type SDR 23.5.

C. Aggregate

Aggregate shall be open graded aggregate meeting gradation and requirements of Series 34R, as described in the Michigan Department of Transportation 2020 Standard Specifications for Construction.

D. Sand

Sand shall meet the gradation and requirements of Granular Material Class II, as described in the Michigan Department of Transportation 2020 Standard Specifications for Construction.

E. Geosynthetic Fabric

Geosynthetic fabric for trench lining and pipe wrap shall be a non-woven geotextile meeting the following requirements:

Physical Property	Test Method	Physical Requirements
Grab Tensile Strength (minimum)	ASTM D4632	90 pounds
Trapezoid Tear Strength (minimum)	ASTM D4533	45 pounds
Puncture Strength (minimum)	ASTM D4833	45 pounds
Mullen Burst Strength (minimum)	ASTM D3786	140 pounds
Permittivity	ASTM D4491	0.5 per second
Apparent Opening Size (maximum)	ASTM D4751	0.21 mm

PART 3 - EXECUTION

3.01 Construction

Underdrains shall be constructed where shown on the plans or where directed by the Engineer. Underdrain outlets shall be provided where shown on the plans or as necessary to provide positive drainage.

A. Trench Excavation

Trenches for underdrain installation shall be excavated using a wheel or chain type trencher, or other method which can excavate to the required depth and grade. The trench width shall be wide enough to accommodate installation of the drain pipe, or as necessary to prevent the trench walls from collapsing.

B. Laying Underdrains

Underdrains shall be laid to the line and grade shown on the plans or as directed by the Engineer. The trench bottom shall be uniform and provide uniform bearing for the pipe. Two inches of aggregate shall be laid in the bottom of the trench before the pipe is installed.

The underdrain pipe shall be fitted with the appropriate fittings (end caps, tees, bends, etc.) before the pipe is placed.

C. Connections

Joints for fittings and pipe shall be made using mechanical methods, which will prevent separation and not cause an obstruction in the pipe. Joints shall be wrapped with geotextile fabric. The fabric shall be sealed to the pipe with waterproof tape.

D. Backfill

Trenches shall not be backfilled until the Engineer has observed the installation.

Trenches shall be backfilled with sand. Sand shall be placed around the pipe and to a depth of 6 inches below the top of the curb or pavement. The remaining portion of the trench shall be backfilled with other material according to the plans. Trenches shall be compacted in accordance with Section 01 45 16.02 – Density and Aggregate Testing.

E. Underdrain Outlets

Underdrain outlets shall be installed immediately after installation of the underdrains.

Where storm sewers are present, underdrain outlets shall be connected to storm manholes, inlets, and catch basins. The underdrain shall be connected at each storm sewer structure which is available along the length of the underdrain.

Outlets shall be connected to drainage structures by coring a hole through the wall of the drainage structure, at least 4 inches above the invert elevation of the storm sewer pipe outlet. The hole shall be large enough to accommodate the underdrain pipe. The underdrain pipe shall be installed in the cored opening using either a flexible connection or by grouting the void between the pipe and structure wall.

END OF SECTION

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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 "Hydronic Piping."
 - 4. Division 23 Section "Snow Melting and Floor Heating."

1.2 DEFINITIONS

- A. HDPE: High density polyethylene plastic.
- B. PE: Polyethylene plastic.
- C. PEX: Crosslinked polyethylene plastic.
- D. PVC: Polyvinyl chloride plastic.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing hydronic piping systems with the following minimum working-pressure ratings:
 - 1. Hot-Water Piping: 100 psig
 - 2. Chilled-Water Piping: 100 psig
 - 3. Domestic water piping: 100 psig

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Conduit piping.
 - 2. Cased piping.
 - 3. Flexible cased piping.
 - 4. Loose-fill insulation.

1.5 INFORMATIONAL SUBMITTALS

- A. Shop Drawings:
 - 1. Perform stress calculations in accordance with ANSI B31.1.
 - 2. Calculate requirements for expansion compensation for underground piping.
 - 3. Show expansion compensators, offsets, and loops with appropriate materials to allow piping movement in the required locations. Show anchors and guides that restrain piping movement with calculated loads, and show concrete thrust block dimensions.
 - 4. Show pipe sizes, locations, and elevations. Show piping in trench, conduit, and cased pipe with details showing clearances between piping, and show insulation thickness.
- B. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from hydronic distribution piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures. Show expansion loops and 90 degree fittings.
- C. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and at vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing hydronic distribution piping.

1.6 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.

1.7 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

1.8 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Architect no fewer than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Architect's written permission.

1.9 COORDINATION

- A. Coordinate pipe-fitting pressure classes with products specified in related Sections.

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. Refer to Part 3 "Piping Application" Article for applications of pipes, tubes, fittings, and joining methods.
- B. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for commonly used joining materials.

2.3 CONDUIT PIPING

- A. Manufacturers:
 - 1. Rovanco Piping Systems, Inc.
- B. Description: Factory-fabricated and -assembled, airtight and watertight, drainable, pressure-tested piping with conduit, inner pipe supports, and insulated carrier piping. Fabricate so insulation can be dried in place by forcing dry air through conduit.
- C. Carrier Pipe: Schedule 40 steel pipe complying with ASTM A 106/A 106M, Type E or S, Grade B with beveled ends for welded joints.
- D. Carrier Pipe Insulation:
 - 1. Mineral-Wool Pipe Insulation: ASTM C 547, Type I, molded.
 - a. Apparent Thermal Conductivity (k-Value): 0.31 at 200 deg F mean temperature.

- b. Density: Maximum 10 lb/cu. ft. average.
 - c. Compressive Strength: 10 psig minimum at 5 percent deformation.
 - d. Bands: ASTM A 666, Type 304, stainless steel, 3/4 inch wide, 0.020 inch thick.
 2. Polyisocyanurate Foam Pipe Insulation: ASTM C 591, preformed, rigid, cellular.
 - a. Thermal Conductivity (k-Value): 0.14 at 75 deg F.
 - b. Service Temperature: Minus 250 to plus 400 deg F.
 - c. Moisture Absorption: ASTM D 2842, maximum 0.054 percent by volume.
 - d. Minimum 90 percent closed cell.
 - e. Dry Density: 2 lb/cu. ft. maximum.
 - f. Compressive Strength: 35 psig minimum at 5 percent deformation.
 - g. Water-Vapor Transmission: 1.26 perm inches according to ASTM E 96.
 3. Polyurethane Foam Pipe Insulation: ASTM C 591, preformed, rigid, cellular.
 - a. Thermal Conductivity (k-Value): 0.13 at 75 deg F.
 - b. Service Temperature: Minus 250 to plus 200 deg F.
 - c. Moisture Absorption: ASTM D 2842, maximum 0.054 percent by volume.
 - d. Minimum 90 percent closed cell.
 - e. Dry Density: 2 lb/cu. ft. maximum.
 - f. Compressive Strength: 35 psig minimum at 5 percent deformation.
 - g. Water-Vapor Transmission: 1.26 perm inches according to ASTM E 96.
- E. Minimum Clearance:
 1. Between Carrier Pipe Insulation and Conduit: 3/4 inch.
 2. Between Insulation of Multiple Carrier Pipes: 1/8 inch.
 3. Between Bottom of Carrier Pipe Insulation and Conduit: 3/4 inch.
 4. Between Bottom of Bare, Carrier Pipe and Casing: 1-3/8 inches.
- F. Conduit: Steel, 10 gage for conduits up to 24 inches in diameter, 6 gage for conduits 26 inches and greater in diameter. Finish conduit with 2 coats of fusion-bonded epoxy, minimum 20 mils thick. The fusion bonded epoxy shall conform to the following ASTM Standards:

ASTM D1763	Disclosure of properties of the epoxy sub-components.
ASTM G17	Penetration Tests
ASTM D1044	Abrasion Resistance
ASTM D1474	Hardness
ASTM D2370	Tensile Strength and Elongation
ASTM G14	Impact Testing
ASTM G8	Salt Crock
ASTM D968	Abrasion Tests
ASTM D1002	Shear Strength and Adhesion
ASTM D659	Compressive Strength
ASTM D257	Volume Resistivity
ASTM D1000	Electric Strength
ASTM G53	Weathering
ASTM B117	Salt Fog
- G. Carrier Piping Supports within Conduit: Calcium silicate insulation supported by corrugated galvanized steel with a maximum spacing of 10 feet.
- H. Fittings: Factory-fabricated and -insulated elbows and tees. Tees shall be factory fabricated and insulated, and shall be compatible with the carrier pipe.

- I. Expansion Offsets and Loops: Size casing to contain piping expansion.
- J. Conduit accessories include the following:
 - 1. Water Shed: Terminal end protector for carrier pipes entering building through floor, 3 inches deep and 2 inches larger than casing; terminate casing 20 inches above the floor level.
 - 2. Guides and Anchors: Steel plate welded to carrier pipes and to casing, complete with vent and drainage openings inside casing.
 - 3. End Seals: Steel plate welded to carrier pipes and to casing, complete with drain and vent openings on vertical centerline.
 - 4. Gland Seals: Packed stuffing box and gland follower mounted on steel plate, welded to end of casing, permitting axial movement of carrier piping, with drain and vent connections on vertical centerline.
 - 5. Joint Kit: Half-shell, pourable or split insulation and shrink-wrap sleeve.
- K. Source Quality Control: Factory test the conduit to 15 psig for a minimum of 2 minutes with no change in pressure. Factory test the carrier pipe to 150 percent of the operating pressure of system. Furnish test certificates. Test conduit coating with electric holiday detector. Repair defects in coating and retest.

2.4 INSULATED CONDUIT PIPING

- A. Manufacturers:
 - 1. Rovanco Piping Systems, Inc.
- B. Description: Factory-fabricated and -assembled, airtight and watertight, drainable, pressure-tested piping with conduit, inner pipe supports, and insulated carrier piping. Fabricate so insulation can be dried in place by forcing dry air through conduit.
- C. Carrier Pipe: Schedule 40 steel pipe complying with ASTM A 53/A 53M, Type E, Grade B with beveled ends for welded joints.
- D. Carrier Pipe Insulation:
 - 1. Mineral-Wool Pipe Insulation: ASTM C 547, Type I, molded.
 - a. Apparent Thermal Conductivity (k-Value): 0.31 at 200 deg F mean temperature.
 - b. Density: Maximum 10 lb/cu. ft. average.
 - c. Compressive Strength: 10 psig minimum at 5 percent deformation.
 - d. Bands: ASTM A 666, Type 304, stainless steel, 3/4 inch wide, 0.020 inch thick.
 - 2. Polyisocyanurate Foam Pipe Insulation: ASTM C 591, preformed, rigid, cellular.
 - a. Thermal Conductivity (k-Value): 0.14 at 75 deg F.
 - b. Service Temperature: Minus 250 to plus 400 deg F.
 - c. Moisture Absorption: ASTM D 2842, maximum 0.054 percent by volume.
 - d. Minimum 90 percent closed cell.
 - e. Dry Density: 2 lb/cu. ft. maximum.
 - f. Compressive Strength: 35 psig minimum at 5 percent deformation.
 - g. Water-Vapor Transmission: 1.26 perm inches according to ASTM E 96.
 - 3. Polyurethane Foam Pipe Insulation: ASTM C 591, preformed, rigid, cellular.

- a. Thermal Conductivity (k-Value): 0.13 at 75 deg F.
 - b. Service Temperature: Minus 250 to plus 200 deg F.
 - c. Moisture Absorption: ASTM D 2842, maximum 0.054 percent by volume.
 - d. Minimum 90 percent closed cell.
 - e. Dry Density: 2 lb/cu. ft. maximum.
 - f. Compressive Strength: 35 psig minimum at 5 percent deformation.
 - g. Water-Vapor Transmission: 1.26 perm inches according to ASTM E 96.
- E. Minimum Clearance:
1. Between Carrier Pipe Insulation and Conduit: 3/4 inch.
 2. Between Insulation of Multiple Carrier Pipes: 1/8 inch.
 3. Between Bottom of Carrier Pipe Insulation and Conduit: 3/4 inch.
 4. Between Bottom of Bare, Carrier Pipe and Casing: 1-3/8 inches.
- F. Conduit: Spiral wound, steel. Cover with nominal 2-inch (50-mm) thick polyurethane foam insulation with a high-density polyethylene jacket.
- G. Carrier Piping Supports within Conduit: Calcium silicate insulation supported by corrugated galvanized steel with a maximum spacing of 10 feet.
- H. Fittings: Factory-fabricated and -insulated elbows and tees. Elbows may be bent pipe equal to carrier pipe. Tees shall be factory fabricated and insulated, and shall be compatible with the carrier pipe.
- I. Expansion Offsets and Loops: Size casing to contain piping expansion.
- J. Conduit accessories include the following:
1. Water Shed: Terminal end protector for carrier pipes entering building through floor, 3 inches deep and 2 inches larger than casing; terminate casing 20 inches above the floor level.
 2. Guides and Anchors: Steel plate welded to carrier pipes and to casing, complete with vent and drainage openings inside casing.
 3. End Seals: Steel plate welded to carrier pipes and to casing, complete with drain and vent openings on vertical centerline.
 4. Gland Seals: Packed stuffing box and gland follower mounted on steel plate, welded to end of casing, permitting axial movement of carrier piping, with drain and vent connections on vertical centerline.
 5. Joint Kit: Half-shell, pourable or split insulation and shrink-wrap sleeve.
- K. Source Quality Control: Factory test the conduit to 15 psig for a minimum of 2 minutes with no change in pressure. Factory test the carrier pipe to 150 percent of the operating pressure of system. Furnish test certificates.
- 2.5 RIGID HDPE CASSED PIPING
- A. Manufacturers:
1. Rovanco Piping Systems, Inc.
- B. Description: Factory-fabricated piping with carrier pipe, insulation, and casing.
- C. Carrier Pipe: Steel pipe complying with ASTM A 53/A 53M, Type E, Grade B with beveled ends for welded joints.

- D. Carrier Pipe Insulation:
 - 1. Polyurethane Foam Pipe Insulation: ASTM C 591, preformed, rigid, cellular.
 - a. Thermal Conductivity (k-Value): 0.13 at 75 deg F.
 - b. Service Temperature: Minus 250 to plus 200 deg F.
 - c. Moisture Absorption: ASTM D 2842, maximum 0.054 percent by volume.
 - d. Minimum 90 percent closed cell.
 - e. Dry Density: 2 lb/cu. ft. maximum.
 - f. Compressive Strength: 35 psig minimum at 5 percent deformation.
 - g. Water-Vapor Transmission: 1.26 perm inches according to ASTM E 96.
- E. Casing: High-density polyethylene.
- F. Casing accessories include the following:
 - 1. Joint Kit: Half-shell, pourable or split insulation, casing sleeve, and shrink-wrap sleeve.
 - 2. Expansion Blanket: Elastomeric foam, formed to fit over piping.
 - 3. End Seals: Shrink wrap the casing material to seal watertight around casing and carrier pipe.
- G. Source Quality Control: Factory test the carrier pipe to 150 percent of the operating pressure of system. Furnish test certificates.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Refer to Division 31 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATION

- A. Hot-Water Piping: Conduit piping with polyisocyanurate carrier-pipe insulation and with coated and insulated conduit.
- B. Snow Melt Supply and Return Piping:
 - 1. Rigid HDPE cased piping with polyurethane carrier-pipe insulation.
 - 2. Flexible cased piping with polyurethane carrier-pipe insulation.

3.3 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawings indicate general location and arrangement of piping. 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. Remove any standing water in the bottom of trench.
- C. Bed the pipe on a minimum 6-inch layer of granular fill material with a minimum 6-inch clearance between the pipes.

- D. Do not insulate piping or backfill piping trench until field quality-control testing has been completed and results approved.
- E. Install piping at uniform grade of 0.2 percent upward in direction of flow or as indicated.
- F. Install components with pressure rating equal to or greater than system operating pressure.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for sleeves and mechanical sleeve seals through exterior building walls.
- J. Secure anchors, where necessary, with concrete thrust blocks. Concrete is specified in Division 03 "Cast-in-Place Concrete."
- K. Connect to hydronic piping where it passes through the building wall or floor. Hydronic piping inside the building is specified in Division 23 Section "Hydronic Piping."

3.4 JOINT CONSTRUCTION

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.
- B. Conduit and Cased Piping Joints: Assemble sections and finish joints with pourable or split insulation, exterior jacket sleeve, and apply shrink-wrap seals as required by manufacturer's written installation instructions.

3.5 IDENTIFICATION

- A. Install continuous plastic underground warning tapes during back filling of trenches for underground hydronic distribution piping. Locate 6 to 8 inches below finished grade, directly over piping. Refer to Division 20 Section "Mechanical Identification" for warning-tape materials and devices and their installation.

3.6 FIELD QUALITY CONTROL

- A. Prepare hydronic piping for testing according to ASME B31.9 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Isolate equipment. Do not subject equipment to test pressure.
 - 3. Install relief valve set at pressure no more than one-third higher than test pressure.
 - 4. Fill system with water. Where there is risk of freezing, air or a safe, compatible liquid may be used.
 - 5. Use vents installed at high points to release trapped air while filling system.

- B. Test hydronic piping as follows:
 - 1. Subject hydronic piping to hydrostatic test pressure that is not less than 1.5 times the design pressure, but not less than 90 psig.
 - 2. After hydrostatic test pressure has been applied for 10 minutes, examine joints for leakage. Remake leaking joints using new materials and repeat hydrostatic test until no leaks exist.

- C. Test conduit as follows:
 - 1. Seal vents and drains and subject conduit to 15 psig for 4 hours with no loss of pressure. Repair leaks and retest as required.
 - 2. Before backfilling, test the corrosion protective system with an electric holiday detector. Repair breaks in the coating system and repeat test.

- D. Prepare a written report of testing.

END OF SECTION 336113