

SECTION 26 05 00
COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.1 SCOPE

- A. This section includes administrative items related to submittals, permits, substitutions, owner training, project closeout, and general requirements for performance of work by the Division 26 contractor. Reference Division 1 for other requirements.

1.2 SUBMITTAL REQUIREMENTS – DIVISION 26

- A. Engineer will commence review only when all Division 26 submittals have been received, due to interrelations between different sections. Review may be delayed if certain other related divisions have not been received, for example elevators or HVAC equipment.
- B. Organize submittals by section and name files with section number and title.
- C. All data required for review must be contained in the files provided to the Engineer. Links to manufacturer's websites will not be accepted.
- D. Re-submittals must contain markups that clearly delineate the changed items. Engineer will not re-review the entire submittal package in order to find the changes.
- E. Electronic submittals (pdf format) are preferred and can be reviewed faster. Paper submittals will also be accepted, but mixed format submittals are not acceptable.
- F. No fabrication or work which requires submittals shall begin until submittals are returned with the Engineer's approval.
- G. The Contractor shall coordinate each submittal with the requirements of the Work and of the Contract Documents. In the event that significant deviations are necessary between the submittals and the Contract Documents, he shall notify the Engineer in writing at the time of submission.
- H. The Contractor shall visit the project site, verify dimensions and existing conditions as far as possible without beginning work, and coordinate submittals accordingly. In the event that significant deviations are found between the existing conditions and the Contract Documents, he shall notify the Engineer in writing at the time of submission.
- I. Engineer's review does not constitute acceptance or responsibility for accuracy of dimensions, and will not relieve the Contractor from responsibility for errors or omissions in the Shop Drawings.
- J. Engineer's review does not relieve the Contractor of any requirements in the Contract Documents, nor shall it constitute approval of any deviation from the Contract Documents, unless such deviations are specifically stated by the Engineer in the submittal review.

1.3 PERMITS

- A. Permits necessary for the performance of the work under this contract shall be secured and paid for by the Contractor. Final inspection by the Engineer will not be made or certificate of final payment issued until certificates of satisfactory inspection from the inspection authorities are delivered. Reference Division 1 for permit requirements.

1.4 TRAINING

- A. The electrical contractor shall conduct a 4 hour minimum training session with owner's designated staff to review all electrical equipment installed under this contract. At a minimum, the session will include operation and maintenance, programming, and basic operation of the systems.
- B. Contractor shall physically demonstrate the operation of each piece of equipment.
- C. A sign in sheet and agenda indicating a list of all equipment reviewed shall be included in the close out documents.

PART 2 DIVISION 26 SCOPE

2.1 ELECTRICAL WIRING AND CONTROL EQUIPMENT

- A. All line voltage wiring and conduit systems required by any Division shall be the responsibility of the Division 26 contractor. Every attempt will be made to reflect these requirements on the electrical sheets, but it is the Division 26 contractor's responsibility to obtain a complete drawing set, familiarize himself with the complete project scope, and coordinate with other Divisions.
- B. Responsibilities of the Division 26 contractor include but are not limited to:
 - 1. Installation and wiring of variable frequency drives (VFDs furnished by Division 23, startup and programming of VFDs shall be by VFD manufacturer's representative)
 - 2. Wiring to duct smoke detectors, including signal wiring to fire alarm system
 - 3. Wiring to fire/smoke dampers, including signal wiring and provision of disconnecting means at dampers
 - 4. Raceways for control circuits in all Divisions
 - 5. Field wiring of motor overload protection and starters (where required by equipment manufacturer)
 - 6. Field wiring of integral transformers in equipment (where required by equipment manufacturer)
- C. The Division 26 Contractor must coordinate with the Division 23 Contractor regarding the requirements of electrical control components. Any changes or additions required due to the specific nature of equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment.
- D. The Division 26 Contractor must coordinate with the Division 23 Contractor to ensure that all required components of control systems are included and fully understood. The Owner shall not incur any additional cost as a result of lack of such coordination.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

- A. The Contractor shall carefully examine the drawings and specifications, visit the site of the work, fully inform himself as to all existing conditions, dimensions and limitations before starting work.
- B. If discrepancies are found between existing conditions and Contract Documents, Contractor shall notify Engineer for direction before proceeding. No claim for additional cost or time extension will be allowed without proper notice plus prior determination of time

and cost to the owner.

- C. If existing active or non-active services (which are not shown on plans) are encountered that require relocation or disconnection, the Contractor shall notify the Engineer for a decision on proper handling of these services. The Contractor shall not proceed with the work until so authorized.
- D. Damage to existing improvements caused by the contractor or a party to the contractor during the demolition or construction phase shall be repaired prior to contract date of substantial completion at no additional expense to the owner.

3.2 DEMOLITION AND MODIFICATION OF EXISTING SYSTEMS

- A. The demolition plan shall be used as a schematic guide. Additional demolition may be required to complete the work indicated on the Contract Documents. If additional demolition scope is required, notify Engineer for direction before proceeding.
- B. If concealed conditions are found that are of an unusual nature not ordinarily encountered in work of this kind, and these conditions will impact the cost, schedule, or design of the project, notify Engineer for direction before proceeding. No claim for additional cost or time extension will be allowed without proper notice plus prior determination of time and cost to the owner.
- C. Division 26 contractor is responsible for disconnection of all electrical systems in walls, floors, and ceilings scheduled for removal in the Contract Documents.
- D. Division 26 contractor is responsible for provision of temporary wiring and connections when required to maintain existing systems in service during construction.
- E. Verify that all electrical equipment to be relocated or reused is in working order prior to removal. If the existing material is found to be deficient, contractor shall notify Engineer for direction before proceeding.
- F. When performing work on energized equipment or circuits, use personnel experienced and trained in similar operations.
- G. Coordinate with general contractor for repair of adjacent construction and finishes damaged or exposed during demolition work. Repairs shall match existing finishes, and include paint on entire wall where required to match color.
- H. Unless otherwise noted in drawings, all existing removed equipment shall be stockpiled at the site at a location approved by Owner until an inspection by the Owner's representative determines what will be salvaged. All equipment not salvaged shall be properly disposed of off-site by Contractor.
- I. Division 26 contractor is responsible for properly disposing of existing hazardous materials removed under Division 26, including but not limited to:
 - 1. Fluorescent Lamps: remove from the site and properly disposing of them with a fluorescent lamp recycling company. Any used bulbs should be removed and placed in a new fluorescent lamp cardboard container. The cardboard container should be properly labeled. Boxes shall be stored and handled so that the used fluorescent lamps will not be crushed.
 - 2. Lighting Ballasts: Inspect ballasts to be removed. Ballasts with a "No PCB" label may be disposed of as normal construction debris. Ballasts without a "No PCB" label shall be assumed to contain PCBs:
 - a. Non-leaking ballasts with PCBs shall be disposed of at a landfill that will accept them. If no such landfill is available, treat as leaking below.

- b. Leaking ballasts shall be transported off-site by a PCB transporter to an EPA-approved chemical processing site.

3.3 PERFORMANCE OF NEW WORK

- A. Provide, install, and coordinate all Division 26 work indicated by Contract Documents. This consists of furnishing all labor, equipment, supplies and materials in addition to performing all operations including cutting, channeling and underground trenching, back fill and tamping necessary for the installation of complete power, lighting, or other systems as shown.
- B. Perform all electrical work in a neat and workmanlike manner in full compliance with all applicable, adopted codes; including, but not limited to: the national electrical code (NEC), UBC, IBC, NFPA, and ADA. all local and state requirements will be observed during the performance of this work.
- C. If any if discrepancies are found between Contract Documents and any associated legal or safety requirements, Contractor shall notify Engineer in writing. The Engineer will modify the Contract Documents as required. If the Contractor proceeds with any work he knows to be in variance of legal or safety requirements, the Contractor will assume all responsibility for this work. He will promptly correct the work when notified, without additional cost to the Owner.
- D. Coordinate all phases of the electrical work with the Architect and General Contractor. Schedule work to minimize disruption and inconvenience to the Owner.
- E. Obtain from system suppliers all wiring diagrams for all equipment and ensure that manufacturer's electrical requirements are met. Any incorrect wiring or devices installed by Contractor without the wiring diagram shall be corrected at Contractor's expense.
- F. Obtain permission from Structural Engineer before drilling or cutting structural members.
- G. Contact utility companies (power, gas, water, sewer, telephone, cable tv, etc.) prior to trenching in order to identify underground utilities. Contractor shall locate secondary service feeders, underground electrical branch circuits, sprinkler lines, etc., prior to trenching. Any cut or damaged underground utilities shall be repaired or replaced at Contractor's expense.
- H. When installing service equipment or metering equipment, coordinate with utility company to ensure that their standards are being met. If any discrepancy is found between utility standards and Contract Documents, notify Engineer for direction.
- I. Coordinate exact locations of electrical components and connections:
 - 1. Where devices are shown in casework, coordinate exact locations with architectural casework details prior to rough-in.
 - 2. Verify final locations of all sinks with the plumbing contractor prior to rough-in of nearby electrical devices. Any above counter electrical devices found within 8" of a sink, and any disposal receptacles found outside the under-sink space, shall be relocated at electrical contractor's expense.
 - 3. The owner reserves the right to relocate any electrical device up to a distance of 12", prior to installation, without additional charge.
 - 4. Coordinate the exact location of equipment requiring electrical connections with other trades prior to rough in. Where there is a question of adequate clearance or coordination between trades, Contractor will submit dimensioned drawings for Engineer's review prior to rough in.

3.4 ELECTRICAL PROJECT CLOSE OUT REQUIREMENTS

- A. Before substantial completion can be granted, the following items must be completed:

1. AHJ inspection shall be completed and work approved
 2. All Division 26 equipment shall be installed and connected
 3. All Division 26 systems shall be online, tested, adjusted and calibrated
 4. Engineer's substantial completion inspection shall be performed
- B. Prior to consideration of Final Payment, the Contractor shall:
1. Provide typed panel directories installed in each panelboard. Directories shall not be printed from drawings unless all circuiting is identical to that shown in drawings.
 2. Have all electrical equipment labeled per requirements in 26 05 53
 3. Provide Record As-Built Drawings to Engineer. As-Built Drawings shall consist of clear, legible markups of the Contract Documents indicating the following:
 - a. Any installed circuiting that deviates from circuiting on plan
 - b. Any equipment size or locations that deviate from plan
 - c. Any other significant deviations from design
 4. Provide copies of permits and/or inspection certificates.
 5. Provide Operating and Maintenance Manual(s).
 6. Return keys to the Owner.
 7. Deliver all spare parts.
 8. Touch up any damaged finishes.
 9. Clean all affected electrical equipment and systems as needed to remove construction debris such as paint, dust, grease, etc.
 10. Remove all existing equipment labels that are no longer accurate.

END OF SECTION

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes building wire and cable, conduit and tubing, surface raceway, boxes, wiring devices, wiring connectors, and connections.

1.2 SYSTEM DESCRIPTION

- A. Wiring Products:
1. Solid conductor for feeders and branch circuits 10 AWG and smaller.
 2. Stranded conductors for control circuits.
 3. Conductor not smaller than 12 AWG for power and lighting circuits.
 4. Conductor not smaller than 16 AWG and stranded conductors for control circuits.
 5. Increase wire size in branch circuits to limit voltage drop to a maximum of 2 percent.
- B. Wiring Methods:
1. Concealed Dry Interior Locations: Use only building wire, Type THHN/THWN insulation.
 2. Exposed Dry Interior Locations: Use only building wire, Type THHN/THWN insulation.
 3. Above Accessible Ceilings: Use only building wire, Type THHN/THWN insulation.
 4. Wet or Damp Interior Locations: Use only building wire, Type THWN insulation in raceway, or PVC jacketed armored cable as allowed below under raceway products.
 5. Exterior Locations: Use only building wire, Type THWN XHHW insulation in raceway, or direct burial cable service- entrance cable, armored cable, or metal clad cable.
 6. Underground Locations: Use only building wire, Type THWN insulation, in raceway.
- C. Conductor sizes are based on copper. Aluminum conductors as indicated by "AL". Conductors shall not be substituted without written approval from the Engineer.
- D. Raceway and boxes shall be located as indicated on Drawings, and at other locations where required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements.
- E. Minimum Raceway Size shall be: 3/4" unless granted written approval from FLC.
- F. Use hinged enclosures for large pull boxes.
- G. 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.
- H. Raceway Products:
1. Concealed Dry Locations - Home Runs over 20 Amps:
Use rigid steel and aluminum conduit, or electrical metallic tubing. Use sheet-metal boxes.

2. Concealed Dry Locations - Branch Wiring and Home Runs 20 Amps or Less:
Use rigid steel and aluminum conduit, electrical metallic tubing, or metal clad cable. Use sheet-metal boxes.
 3. Exposed Dry Locations (all ampacities):
Use rigid steel and aluminum conduit, electrical metallic tubing. Use sheet-metal boxes. Use flush mounting outlet boxes in finished areas.
 4. Wet Interior Locations (ie, crawl spaces) - Home Runs over 20 Amps:
Use rigid steel conduit, or nonmetallic conduit rated for the environmental conditions. Use nonmetallic boxes.
 5. Wet Interior Locations - Branch Wiring and Home Runs 20 Amps or Less:
Use rigid steel conduit, nonmetallic conduit rated for the environmental conditions, or PVC jacketed armored cable. Use nonmetallic boxes.
 6. Underground More than 5 Feet outside Foundation Wall:
Use rigid steel conduit, or nonmetallic conduit rated for the environmental conditions. Use cast metal boxes or nonmetallic handhole.
 7. Underground Within 5 Feet outside Foundation Wall:
Use rigid steel conduit, or nonmetallic conduit rated for the environmental conditions. Use cast metal boxes.
 8. Exposed Outdoor Locations:
Use rigid steel conduit. Use cast metal outlet, pull, and junction boxes.
 9. Raceways in locations subject to mechanical damage: Rigid Steel galvanized conduit or intermediate metal conduit. Locations subject to mechanical damage include but are not limited to, the following:
 - a. Exposed conduits outdoors up to 8' A.F.G.;
 - b. Exposed conduits in dock areas and high/medium bay locations up to 25' above finished floor;
 - c. Exposed service entrance feeders
- I. Minimum Raceway Size: 3/4 inch unless otherwise specified.
- J. Multiple Circuits: Where multiple branch circuits, control wiring or communications/signal conductors are terminated or spliced in a box or enclosure, label each conductor or cable with circuit number. For control and communications/signal wiring, use wire/cable marking tape at terminations in wiring boxes, troughs and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tapes.

PART 2 PRODUCTS

2.1 SURFACE METAL RACEWAY

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 1. Wiremold
 2. Equal
- B. Product Description: Sheet metal channel with fitted cover, suitable for use as surface metal raceway, with manufacturer's standard Ivory enamel finish. Furnish manufacturer's standard accessories; match finish on raceway.

2.2 SURFACE NONMETALLIC RACEWAY

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Wiremold
 2. Equal
- B. Description: Plastic channel with fitted cover, suitable for use as surface raceway, with manufacturer's standard finish. Furnish manufacturer's standard accessories, finish to match raceway.

2.3 WIREWAY

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Square D
 2. Equal
- B. Product Description: General purpose or Raintight type wireway with screw cover and manufacturer's standard enamel finish.

2.4 WALL SWITCHES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
- B. Single Pole Switch:
1. Hubbell, Model 1221.
 2. Leviton, Model 1221.2.
 3. Eagle, Model 1221.
- C. Double Pole Switch:
1. Hubbell, Model 1222.
 2. Leviton, Model 1222I.
 3. Eagle, Model 1222.
- D. Three-way Switch:
1. Hubbell, Model 1223.
 2. Leviton, Model 1223.2.
 3. Eagle, Model 1223.
- E. Four-way Switch:
1. Hubbell, Model 1224.
 2. Leviton, Model 1224.2.
 3. Eagle, Model 1224.
- F. Description: NEMA WD 1, heavy duty, AC quiet wall switch.
- I. Color: per architect
- J. Current Rating: 20 amperes.
- K. Ratings: Match branch circuit voltage and load characteristics.

2.5 WALL DIMMERS-NA (see Section 26 09 23)

2.6 RECEPTACLES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
- B. Duplex Convenience Receptacle:
 - 1. Hubbell, Model 5362.
 - 2. Leviton, Model 5362.
 - 3. Eagle, Model 5362.
- C. GFCI Receptacle:
 - 1. Hubbell, Model GF 5362
 - 2. Leviton, Model 6899
 - 3. Eagle, Model GF 5362
- D. TR (Tamper Resistant) Receptacle:
 - 1. Hubbell : DRS 15GRYTR
 - 2. Hubbell : GF 82 GYTR (GFCI)
 - 3. Equal
- E. Color: per architect.

2.7 WALL PLATES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
- B. Decorative Cover Plate:
 - 1. Hubbell.
 - 2. Leviton.
 - 3. Approved equal.
- C. Jumbo Cover Plate:
 - 1. Hubbell.
 - 2. Leviton.
 - 3. Approved equal.
- D. Weatherproof Cover Plate: Gasketed cast metal plate with hinged and gasketed device cover.

2.8 FLOOR MOUNTED SERVICE FITTINGS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following
- B. Flush Cover Outlet:
 - 1. Walker, Model 853, 860CP carpet plate.
 - 2. Hubbell, Model B-2537, Box S-3425 cover, S-3082 carpet plate.
 - 3. Steel City, Model 664 or 665 Box, 669 or 665-CST color, cover.
 - 4. Material: Brass.
 - 5. Configuration: Concealed service with carpet flange.

- C. Flush Cover Combination Outlet:
 - 1. Walker RFB4 Box, RAKM III Cover.
Approved equal
 - 2. Material: Brass.
 - 3. Configuration: Concealed service with carpet flange.

2.9 TWIST TIMER SWITCHES- NA

2.10 MULTIOUTLET ASSEMBLY

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Walker
- B. Multi-outlet Assembly: Sheet metal channel with fitted cover, with pre-wired receptacles, suitable for use as multi-outlet assembly. Furnish manufacturer's standard enamel finish.
- C. Receptacles: NEMA WD 6, type 5-15R, single receptacle. Tamper Resistant
- D. Receptacle Spacing: 12 inches on center.
- E. Fittings: Furnish manufacturer's standard couplings, elbows, outlet and device boxes, and connectors.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Remove exposed abandoned raceway, boxes, wire, and cable, including abandoned raceway and cable above accessible ceiling finishes.
- B. Disconnect abandoned circuits and remove raceway, wire, and cable. Remove abandoned boxes when associated wire and cable is removed.
- C. Maintain access to existing boxes and wiring connections remaining active and requiring access.
- D. Extend existing circuits using materials and methods compatible with existing electrical installations, or as specified.

3.2 INSTALLATION

- A. Provide 10% attic stock of wiring devices; e.g. receptacles, switches, cover plates, relays, light fixture drivers, light fixture lenses, emergency lighting drivers, occupancy sensors, power packs, etc.
- B. Route raceway and cable to meet Project conditions.
- C. Use 10AWG conductors for 20 ampere branch circuits longer than 100 feet, unless otherwise specified on drawings.
- D. Pull all conductors into raceway at same time.

- E. Do not rest cable on ceiling grid panels.
- F. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape un-insulated conductors and connector with electrical tape to 150% of insulation rating of Conductor.
- G. Verify continuity of each branch circuit conductor.
- H. Arrange supports to prevent misalignment during wiring installation
- I. Group related conduits and support using conduit rack. Construct using steel channel and provide space on each for 25% additional conduits.
- J. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers and split hangers
- K. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports. Do not attach conduit to ceiling support wires.
- L. Route all conduits parallel and perpendicular to structure.
- M. Route conduit in and under slab from point-to-point. Do not cross conduits in slab.
- N. Maintain 12 inches between conduit and surfaces with temperatures exceeding 104°F.
- O. Install no more than equivalent of three 90-degree bends between boxes.
- P. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
- Q. Provide #200 nylon pull string in each empty conduit except sleeves and nipples.
- R. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
- S. Mount raceway channel plumb and level.
- T. Set wall mounted boxes at elevations to accommodate mounting heights indicated
- U. Adjust box location up to 10 feet prior to rough-in when required to accommodate intended purpose.
- V. Do not install flush mounting box back-to-back in walls; install boxes with minimum 24 inches separation.
- W. Verify outlet and switch boxes are installed at proper heights meeting ADA requirements.
- X. Do not install switches behind door swings.
- Y. Install switches with OFF position down.
- Z. Do not share neutral conductors between circuits unless specifically allowed in design drawings.
- AA. Install receptacles with grounding pole on bottom.
- BB. Install decorative plates on switch, receptacle, and blank outlets in finished areas.

- CC. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, and above accessible ceilings.
- DD. Operate each wall switch with circuit energized and verify proper operation.
- EE. Verify that each receptacle device is energized and Test each receptacle device for proper polarity.
- FF. Test each GFCI receptacle device for proper operation.
- GG. Do not install flush mounting box back-to-back in walls. Provide a minimum of six inches of separation. Provide a minimum of 24 inches of separation in acoustic rated walls.
- HH. Coordinate mounting heights and locations of outlets mounted above counters, benches and back splashes.
- II. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- JJ. Use tamper resistant receptacle types in all school spaces where children are present (classrooms, media centers, restrooms, corridors, etc).

END OF SECTION 260519

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Color and legend requirements for raceways, conductors, and warning labels and signs.
2. Labels and Signs.
3. Bands and tubes.
4. Tapes and stencils.
5. Tags.
6. Paint for identification.
7. Cable Ties and fasteners for labels and signs.

1.2 IDENTIFICATION REQUIRED

A. EQUIPMENT:

1. Apply equipment identification labels of engraved plastic-laminate on each major unit of electrical equipment in building, including central or master unit of each electrical system. This includes communication/signal/alarm systems, unless unit is specified with its own self-explanatory identification. Text shall match terminology and numbering of the Contract Documents and shop drawings. Apply labels for each unit of the following categories of electrical equipment.
 - a. Panelboards, electrical cabinets and enclosures.
 - b. Access doors and panels for concealed electrical items.
 - c. Electrical switchgear and switchboards.
 - d. Motor starters.
 - e. Pushbutton stations.
 - f. Contactors.
 - g. Remote-controlled switches.
 - h. Dimmers.
 - i. Control devices.
 - j. Transformers.
 - k. Inverters.
 - l. Telephone switching equipment.
 - m. Clock/program master equipment.
 - n. TV/audio monitoring master station.
 - o. Fire alarm master station or control panel.
 - p. Security monitoring master station or control panel
2. Voltage designation for each piece of electrical distribution equipment.
3. Nameplate for each piece of electrical distribution equipment, using name as shown on Construction Drawings.
4. Nameplate for each piece of control equipment, indicating system and function.
5. Emergency instructions or warning labels as specified in Construction Drawings, or required by Authority Having Jurisdiction.

B. RECEPTACLES, SWITCH DEVICES, AND WALLPLATES:

1. All receptacles and switch devices shall be labeled on the cover plate in black lettering on a clear background with panel designation and circuit number.
2. Adhesive marking tape for cover plates shall be 3/8 inch Kroy tape or Brother labels with 3/16 inch minimum height letters.
3. Tape shall have black letters on clear background for normal power and red letters on clear background for emergency power.
4. Embossed Dymo-tape labels are not acceptable.

C. RACEWAYS:

1. Identify all conduit runs longer than 6 feet.
2. Install bands at changes in direction, at penetrations of walls and floors (each side), at junction boxes and terminations, and straight runs.
3. Identification spacing: at 50-foot (15-m) maximum intervals in straight runs, and at 20-foot (7.6-m) maximum intervals in congested areas.
4. Identify System Raceways with Painted Couplings & Connectors: Apply the following colors:
 - a. 208v/120v Power: Black
 - b. 480v/277v Power: Yellow
 - c. Emergency or Life Safety: Orange
 - d. Fire Alarm: Red
 - e. BMS/Temperature Control: Green
 - f. Data and Telephone System: Blue
 - g. Security: White
 - h. Paging and Sound: Grey
- 5.

D. UNDERGROUND:

1. Install underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

E. BOXES:

1. Painted Junction Box Covers: Label Junction Box Covers with painted cover plates in exposed unfinished or utility areas such as Mechanical, Electrical, Telecom, Elevator, etc., rooms and above suspended ceilings. Use same color scheme as referenced above. Also label cover plate with electrical panel name circuit numbers and voltage.

F. CONDUCTORS:

1. Identify each power conductor at panelboard gutters, pull boxes, and outlet and junction boxes.
2. Identify each control-circuit conductor in pull and junction boxes, manholes, handholes, and terminations, with the conductor or cable designation, origin, and destination.

G. WORKING SPACE: In unfinished and utility spaces only, apply floor marking tape or tape and stencil to finished surfaces showing working clearances, labeled "KEEP CLEAR". Workspace shall comply with NFPA 70.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 PRODUCT PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 70 and NFPA 70E.
- B. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- C. Comply with ANSI Z535.4 for safety signs and labels.
- D. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes. Temperature Change: 100 deg F (67 deg C), ambient; 150 deg F (100 deg C), material surfaces.

2.2 PRODUCT COLOR AND LEGEND REQUIREMENTS

- A. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
 - 1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - 4. Color for Neutral: White or gray.
 - 5. Color for Equipment Grounds: Bare copper, Green, Green with a yellow stripe.
 - 6. Colors for Isolated Grounds: Green with white stripe.
- B. Warning Label Colors:
 - 1. Identify system voltage with black letters on an orange background.
- C. Equipment Identification Labels:
 - 1. Black letters on a white field, or vice versa.

2.3 LABELING PRODUCTS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
- B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameter and that stay in place by gripping action.
- C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- (0.08-mm-) thick, flexible label with acrylic pressure-sensitive adhesive.
 - 1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
- D. Self-Adhesive Labels: Polyester, Vinyl, thermal, transfer-printed, 3-mil- (0.08-mm-) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
 - 1. Minimum Nominal Size:
 - a. 1-1/2 by 6 inches (37 by 150 mm) for raceway and conductors.
 - b. 3-1/2 by 5 inches (76 by 127 mm) for equipment.
 - c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBE PRODUCTS

- A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameters sized to suit diameter and that stay in place by gripping action.
- B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameters of and shrunk to fit firmly around item being identified. Full shrink recovery occurs at a maximum of 200 deg F (93 deg C). Comply with UL 224.

2.5 TAPE AND STENCIL PRODUCTS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide; compounded for outdoor use.
- C. Tape and Stencil: 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers placed diagonally over orange background and is 12 inches (300 mm) wide. Stop stripes at legends.
- D. Floor Marking Tape: 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white or yellow and black stripes and clear vinyl overlay.
- E. Underground-Line Warning Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
4. Color and Printing:
 - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
 - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
 - c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".
5. Tape Product :
 - a. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright colored, continuous-printed on one side with the inscription of the utility where required, compounded for direct-burial service.
 - b. Width: 4 inches (75 mm).
 - c. Overall Thickness: 5 mils (0.125 mm).
 - d. Foil Core Thickness: 0.35 mil (0.00889 mm).
 - e. Weight: 28 lb/1000 sq. ft. (13.7 kg/100 sq. m).
 - f. Tensile according to ASTM D 882: 70 lbf (311.3 N) and 4600 psi (31.7 MPa).

- F. Stenciled Legend: In nonfading, waterproof, high contrast ink or paint. Minimum letter height shall be 1 inch (25 mm).

2.6 TAG PRODUCTS

A. Write-on Tags:

1. Polyester Tags: 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment.
2. Marker for Tags:
 - a. Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - b. Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.7 SIGN PRODUCTS

A. Baked-Enamel Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Minimum Nominal Size: 7 by 10 inches (180 by 250 mm).

B. Metal-Backed Butyrate Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch (1-mm) galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal Size: 10 by 14 inches (250 by 360 mm).

C. Laminated Acrylic or Melamine Plastic Signs:

1. Engraved legend.
2. Thickness:
 - a. For signs up to 20 sq. in. (129 sq. cm), minimum 1/16 inch (1.6 mm) thick.
 - b. For signs larger than 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) thick.
 - c. Engraved legend with black letters on white face or white letters on a dark gray background.
 - d. Punched or drilled for mechanical fasteners with 1/4-inch (6.4-mm) grommets in corners for mounting, or self-adhesive where suitable for environment.
 - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 CABLE TIE PRODUCTS

A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black, except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black.

C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 7000 psi (48.2 MPa).
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
5. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.
- H. System Identification for Raceways and Cables: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side. Secure tight to surface of conductor, cable, or raceway.
- I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- J. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions.
- K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- L. Vinyl Wraparound Labels:
 - 1. Secure tight to surface at a location with high visibility and accessibility.
 - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- M. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.
- N. Self-Adhesive Wraparound Labels: Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
- O. Self-Adhesive Labels:

1. On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
- P. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
- Q. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.
- R. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- S. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- T. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- U. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.
- V. Underground Line Warning Tape:
1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 12 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.
 2. Install underground-line warning tape for direct-buried cables and cables in raceways.
- W. Write-on Tags:
1. Place in a location with high visibility and accessibility.
 2. Secure using cable ties (UV-stabilized if outdoor, or plenum-rated if in plenum).
- X. Baked-Enamel Signs:
1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.
- Y. Metal-Backed Butyrate Signs:
1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.

Z. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.

AA. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.2 IDENTIFICATION METHODS

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 20 A: Identify with self-adhesive raceway labels or vinyl tape applied in bands.
- D. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use write-on tags or self-adhesive wraparound labels.
- E. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes or self-adhesive wraparound labels.
- F. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive equipment labels, Baked-enamel warning signs or Metal-backed butyrate warning signs.
1. Apply to exterior of door, cover, or other access.
 2. For equipment with multiple power or control sources, apply to door or cover of equipment.
 3. Install labels straight and level.
- G. Arc Flash Warning Labeling: Self-adhesive labels.
- H. Emergency Operating Instruction Signs: Self-adhesive labels, Baked-enamel warning signs, Metal-backed butyrate warning signs, Laminated acrylic or melamine plastic signs. White legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer load shedding Insert emergency operations.
- I. Equipment Identification Labels:
1. Indoor Equipment: Self-adhesive label, Baked-enamel signs, Metal-backed butyrate signs, Laminated acrylic, or melamine plastic sign.
 2. Outdoor Equipment: Laminated acrylic or melamine sign or Stenciled legend 2 inches (50 mm) high or more.

3. Install labels straight and level.

END OF SECTION 26 05 53

SECTION 26 08 00
COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. The purpose of this section is to specify the Contractor's responsibilities relative to Division 26 and participation in the commissioning process.
 - 1. Organization of the commissioning program is primarily the responsibility of the Commissioning Authority. Execution of the program is primarily the responsibility of the Contractor with support from the Division 26 for:
 - a. Testing and start-up of the automatic lighting control system.
 - b. Providing qualified personnel to assist the Commissioning Authority with functional testing to verify equipment/system performance.
 - c. Providing equipment, materials, and labor necessary to correct deficiencies found during the commissioning process which fulfill contract and warranty requirements.
 - d. Providing training for the systems specified in Division 26 with coordination of Owner by the Commissioning Authority.
- B. Division 26 shall cooperate with the Commissioning Authority in the following manner:
 - 1. Allow sufficient time before final completion dates so that electrical testing, lighting control checkout, and functional testing can be accomplished.
 - 2. Provide labor and material to make corrections when required without undue delay.
 - 3. Put all electrical systems and equipment into full operation and continue the operation of the same during each working day of commissioning.
- C. Related Sections
 - 1. Division 23 - Mechanical
 - 2. Division 26 - Electrical

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. Standard certified test equipment for commissioning will be provided by the Commissioning Authority.
- B. Proprietary test equipment required by the manufacturer shall be provided by the manufacturer of the equipment. The manufacturer shall provide the test equipment, demonstrate its use, and assist the Commissioning Authority in the commissioning process.

PART 3 - EXECUTION

3.1 WORK PRIOR TO COMMISSIONING

- A. Specific pre-commissioning responsibilities of Division 26 are as follows:
 - 1. Normal start-up services are required to bring each system into a fully operational state.
 - 2. Complete pre-functional test checklists for all equipment and systems to be commissioned.
 - 3. Portions of mechanical equipment start-up requiring electrical connections and metering.
 - 4. Factory start-up services for key equipment and systems specified in Division 26. The Division 26 Contractor shall coordinate this work with the manufacturer and the Commissioning Authority.
 - 5. Demonstrate system readings as requested by the Commissioning Authority and adjust units to achieve specified operation.

3.2 PARTICIPATION IN COMMISSIONING

- A. The Division 26 Contractor shall provide skilled technicians to start-up and debug all systems within Division 26 work (particularly with lighting controls). These same technicians shall be made available to assist the Commissioning Authority in completing the commissioning program as it relates to each system and their technical specialty. Work schedules, time required for testing, etc., will be requested by the Commissioning Authority and coordinated by the Contractor. The contractor will ensure the qualified technician(s) are available and present during the agreed upon schedules, and of sufficient duration to complete the necessary tests, adjustments, and/or problem resolutions.
- B. The Commissioning Authority reserves the right to judge the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians include expert knowledge relative to the specific equipment involved, adequate documentation and tools to service/commission the equipment, and an attitude/willingness to work with the Commissioning Authority to get the job done. A liaison or intermediary between the Commissioning Authority and qualified factory representatives does not constitute the availability of a qualified technician for the purposes of this work.
- C. Provide skilled technicians to manipulate the following equipment and systems to be commissioned for functional testing:
 - 1. Lighting control systems

3.3 WORK TO RESOLVE DEFICIENCIES

- A. Maladjustments, misapplied equipment, and/or deficient performance under varying loads will result in a system that does not meet Acceptable Performance. Correction of work will be completed under the direction of the Owner/Architect, with input from the Contractor, Equipment Supplier, and Commissioning Authority. Whereas all members will have input and the opportunity to discuss, debate, and work out problems, the Architect/Engineer-of-Record will have final jurisdiction on the necessary work to be done to achieve performance and/or design intent.

3.4 ELECTRICAL SYSTEM TESTING

- A. Electrical system testing as required in other sections of this specification shall be coordinated with the Commissioning Authority. The Commissioning Authority may witness testing performed by the Division 26 Contractor.
- B. All testing documentation related to Division 26 equipment and systems, as specified in other sections of this specification, will be provided to the Commissioning Authority for use and review.

3.5 TRAINING

- A. The Division 26 Contractor will be required to participate in the training of the Owner's engineering and maintenance staff for each electrical system and the related components. Training may be conducted in a classroom setting, with system and component documentation, and suitable classroom training aids, or in the field with specific equipment. The type of training will be per the Owner's option.

END OF SECTION

SECTION 26 09 26

LIGHTING CONTROL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.2 SUMMARY

- A. The products specified in this section shall constitute a complete lighting control system as described on the Drawings.
- B. The intent of these specifications is to provide a complete, functional, lighting control system for the control of lighting fixtures specified on the Drawings, including any dimming technologies needed for those fixtures.
- C. Where shown on the drawings, the contractor shall furnish and install a lighting control system consisting of, but not limited to, panels with relays, graphic user interfaces, controllers, enclosures, switch stations, photo sensors, occupancy sensors, low voltage Class 2 wiring for input devices and data wiring between master and secondary panels as required for a complete, operable lighting control system.

1.3 SUBMITTALS

- A. Manufacturer shall provide submittal drawings and data for approval prior to beginning manufacture of equipment in electronic pdf format.
- B. Submittal package shall include, but not be limited to, the following. Submittals that do not contain all the information listed below will not be considered for approval.
 - 1. Bill of Materials: Provide as part of the submittal package a detailed itemized listing of all proposed equipment, including quantities and capacities for all major system components.
 - 2. Product Data Sheets: Provide as part of the submittal package detailed product data sheets for all major system components.
 - 3. Shop Drawings: Submittal shall include shop drawings that accurately represent the system or systems specified herein. Shop drawings shall include the name of the project, quantity and physical dimensions of all major system components, locations of all devices on a building floorplan with legend, wire sizes and counts for all required connections between system components.
 - 4. Contractor/Commissioning Worksheet – must be completed prior to factory start-up.

1.4 QUALITY ASSURANCE

- A. Factory Assembly: All devices shall be factory assembled and tested. All system components shall arrive at the job site completely pre-wired and ready for installation, requiring only the connection of lighting circuits and control terminations. All connections shall be made to clearly and permanently labeled termination points.

- B. Component Testing: All system components and assemblies shall be individually tested prior to assembly. Once assembled, all finished products shall be tested for proper operation of all control functions per specifications prior to shipment.
- C. NEC Compliance: All system components shall comply with all applicable sections of the National Electrical Code (NEC) as required.
- D. NEMA Compliance: All system components shall comply with all applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.
- E. FCC Emissions: All applicable equipment shall comply with FCC emissions standards specified in Part 15, sub-part j for commercial and residential applications and shall bear labels indicating compliance testing. Equipment that does not meet these standards shall not be acceptable.
- F. All applicable products must be ETL or UL Listed or other acceptable national testing organization.
- G. Title 24: Not applicable.

1.5 PROJECT CONDITIONS

- A. Do not install equipment until the following conditions can be maintained in the spaces where equipment is to be placed:
 1. Ambient temperature: 0° to 40° C (32° to 104° F).
 2. Relative humidity: Maximum 95 percent, non-condensing
 3. Lighting control system must be protected from dust during installation.

1.6 WARRANTY

- A. All devices in lighting control system shall have a 5 year manufacturer's warranty.
- B. Warranty period shall begin after the completion of the installation and the system's start-up and training, the point at which the system owner receives beneficial use of the control system or 1 year after shipment from the manufacturer, whichever occurs first.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. All components of the lighting system shall be from the same manufacturer, unless pre-approved by the Engineer. Pre-approval requests shall include an explanation of why the proposed component could not be sourced from the same manufacturer, and how compatibility will be assured.
- B. Complete systems from the following manufacturers may be provided without prior approval. Other manufacturers must be pre-approved.
 1. Wattstopper
 2. Leviton
 3. Greengate
 4. Lutron
 5. Acuity Brands Inc
 6. Douglas Lighting Controls

7. Hubbell Building Automation

2.2 SYSTEM REQUIREMENTS

- A. Low voltage input devices including occupancy/vacancy sensors, daylight sensors and switch stations shall be connected to the panel (or room controller, per drawings) and software assignable to any type. Power and control for LED indication at switch stations shall be provided.
- B. Panel shall be capable of automatic recognition of relay types when relays are mixed or changed in the panel. Systems requiring programming of relay types shall not be acceptable.
- C. User interface shall be LCD display. Home Screen display shall include real time clock display including Hours/Minutes/Seconds, Time Zone, Date with Day of the week.
- D. System shall have an intuitive and easy to use Graphical User Interface (GUI) to control, monitor and schedule individual devices or groups of devices.
- E. System shall remain fully functional during the programming process. Lighting control systems that must be taken "OFF LINE" for programming are not acceptable. All programming changes shall take effect immediately as they are programmed.

2.3 PANELS

- A. Panels shall be factory assembled fully populated with a single relay type or with no relays installed for field installation of relays in less than a full panel or combinations of relay types. Panels shall be capable of having mixed types of relays installed in any slot or combination without any programming to assign relay type.
- B. Panels shall provide input power leads to accommodate voltage indicated on Drawings.
- C. Panel housing shall be NEMA 1 surface or recessed mounting, as shown on Drawings. The cabinet shall have a hinged door and be provided with a locking mechanism. The user interface is integral with the door for access with the cabinet locked.
- D. Panel firmware and programming shall be stored in non-volatile memory and shall be unaffected by loss of power events. The system clock shall be provided with battery back-up that will remain accurate for a minimum of 5 years. Panel system diagnostics shall be provided to check battery performance.
- E. Each lighting control relay shall include a manual override means of turning the relay ON or OFF without the panel controller connected or operational. Each lighting control relay shall include an LED visual indicator showing the current status of the relay itself.
- F. Interface with BAS (Building Automation System) for HVAC: Provide hardware and software to enable the BAS for HVAC to monitor, control, display, and record data for use in processing reports.
 - 1. Hardwired Points:
 - a. Monitoring: On-off status, <Insert monitoring point>.
 - b. Control: On-off operation, <Insert control point>.

2.4 TIMING UNIT:

- A. 365-day calendar, astronomical clock, and automatic adjustments for daylight savings and leap year.
- B. Clock configurable for 12-hour (a.m./p.m.) or 24-hour format.
- C. 16 independent schedules, each having 24 time periods.
- D. Schedule periods settable to the minute.
- E. Day of week, day of month, day of year with one-time or repeating capability.
- F. 32 special date periods

2.5 PANEL PROGRAMMING CAPABILITIES

- A. The Panel shall have the following System Settings capabilities:
 - 1. Date/Time Settings: System shall allow time setting of hours/minutes/seconds. Date and Time shall display continuously on the panel home screen.
 - 2. Daylight Savings Time: Automatically adjusts the clock at the appropriate calendar dates standard, with manual date adjustment.
 - 3. System shall provide for naming of Panels, Relays, Groups, Schedules, Holidays, Inputs, Outputs.
 - 4. Panel shall have after hours sweep function that allows for relays to be swept off based on a designated start time (Clock Time or Open/Close Time) with up to four sweeps with intervals of 1-120 minutes.
 - 5. Panels shall provide blink/alert capabilities before the schedule OFF event. Override duration may be selected from 1-120 minutes. Blink/warn recur if lights are still on at the end of the override duration.
 - 6. Panels shall be capable of setting relays to be ON, OFF or return to the LAST state upon return of power after a loss of power event.
- B. Inputs: Inputs shall be software assigned to any device input including motion sensors, switches, and photocells.
- C. If called for on Drawings, dry contact low voltage inputs and outputs shall be provided on panels for use in initiating signals to and from the control panels to outside building systems.
- D. The Panel shall provide System Tools as follows:
 - 1. System Status: View ON/OFF states of all relays, groups, inputs and outputs. View actual sunrise/sunset time for the current date.
 - 2. Save/Restore Programming: The system shall allow for programming to be saved to portable memory device. The system shall also allow for saving 2 back-up programs to non-volatile memory without the use of removable memory.
 - 3. Diagnostics: On-board diagnostics for battery, panel and relay communications
 - 4. Firmware update, controller version information, and system reboot functions
 - 5. System event logging to SD Card

2.6 OCCUPANCY SENSORS

- A. For each space indicated on the Drawings to have occupancy sensing, provide sensors of the mounting type described. Based on coverage pattern of proposed sensor, provide quantity of sensors necessary for complete coverage of space.

- B. Sensor locations and quantities shown on Drawings are approximate only. In shop drawings, show locations for all proposed sensors. Locations shall consider possible obstructions, and minimize the probability of being tripped by passers-by in adjacent spaces such as corridors.

2.7 SWITCH STATIONS

- A. Switches shall be injection molded and designed to mount in a standard single gang junction box with standard decorator-style plate opening.
- B. Networked Switches shall have removable buttons for field replacement. Button replacement may be completed without removing the switch from the wall.
- C. Switches with LED indication shall have an LED that is illuminated when the switch is in the ON state.
- D. Networked Switches shall be programmable from the Panel user interface.
- E. Networked Switches may be programmed for active and inactive times using the Panel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All equipment shall be installed in accordance with manufacturer requirements and in compliance with all applicable local and national codes and requirements.

3.2 SITE VERIFICATION

- A. Verify all wiring conditions installed under separate sections at the time of Panel installation as acceptable to and in accordance to the manufacturer's installation instructions supplied with the products.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."
- C. Create a directory to indicate loads served by each circuit; incorporate Owner's final room designations. Obtain approval before installing. Use a computer to create directory; handwritten directories are unacceptable.
- D. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD MEASUREMENTS

- A. The electrical contractor shall be responsible for field measurements and coordination of physical size as appropriate for the product location. The electrical contractor shall coordinate with all architectural requirements for the space that the panel is located.

3.5 INSPECTION

- A. The electrical contractor shall inspect all materials prior to installation and notify the manufacturer of any unacceptable materials prior to installation.

3.6 SITE PROTECTION

- A. Contractor shall protect installed product and finished surfaces from damage during all phases of construction including storage, preparation, testing, and cleanup

3.7 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within [two] <Insert number> years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
- C. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.8 FACTORY COMMISSIONING

- A. Upon completion of the installation, the system shall be programmed and commissioned by the manufacturer's factory authorized representative who will verify a complete fully functional system.
- B. The electrical contractor shall provide both the manufacturer and the electrical engineer with ten working days written notice of the system startup and adjustment date.
- C. Upon completion of the system commissioning, the factory-authorized technician shall provide the proper training to the owner's personnel on the adjustment and maintenance of the system.

END OF SECTION 260926

SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.2 DEFINITIONS

- A. MCCB: Molded-case circuit breaker.
- B. SPD: Surge protective device.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
- B. Shop Drawings: For each panelboard and related equipment.
 1. Include dimensioned plans, elevations, sections, and details.
 2. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
 3. Detail bus configuration, current, and voltage ratings.
 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 5. Include evidence of NRTL listing for series rating of installed devices.
 6. Include evidence of NRTL listing for SPD as installed in panelboard.
 7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 8. Include wiring diagrams for power, signal, and control wiring.
 9. Key interlock scheme drawing and sequence of operations.
 10. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

1.4 INFORMATIONAL SUBMITTALS

- A. Panelboard schedules for installation in panelboards.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.6 FIELD CONDITIONS

A. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."

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

C. Comply with NEMA PB 1.

D. Comply with NFPA 70.

E. Enclosures: Surface-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.

- a. Indoor Dry and Clean Locations: NEMA 250.

2. Height: 84 inches (2.13 m) maximum.

3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.

4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.

F. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.

G. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.

2. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.

3. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.

4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

- 5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- H. NRTL Label: Panelboards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
- I. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- J. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include label or manual with size and type of allowable upstream and branch devices listed and labeled by an NRTL for series-connected short-circuit rating.
- K. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. 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."
- B. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1.

2.3 POWER PANELBOARDS

- A. Manufacturers:
 - 1. Square D, basis-of-design, owner preference
 - 2. Siemens
 - 3. Eaton
 - 4. ABB
- B. Panelboards: NEMA PB 1, distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 - 1. For doors more than 36 inches high, provide two latches, keyed alike.
- D. Branch Overcurrent Protective Devices: All overcurrent protective devices (circuit breakers) shall be bolt-in type. Plug-in type are not accepted.
- E. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- B. Branch Overcurrent Protective Devices: All overcurrent protective devices (circuit breakers) shall be bolt-in type. Plug-in type are not accepted.
- C. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
- D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- E. Column-Type Panelboards: Single row of overcurrent devices with narrow gutter extension and overhead junction box equipped with ground and neutral terminal buses.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. MCCB: Comply with UL 489, with series-connected rating to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.
 - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic Trip Circuit Breakers:
 - a. RMS sensing.
 - b. Field-replaceable rating plug or electronic trip.
 - c. Digital display of settings, trip targets, and indicated metering displays.
 - d. Multi-button keypad to access programmable functions and monitored data.
 - e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
 - f. Integral test jack for connection to portable test set or laptop computer.
 - g. Field-Adjustable Settings:
 - 1) Instantaneous trip.
 - 2) Long- and short-time pickup levels.
 - 3) Long and short time adjustments.
 - 4) Ground-fault pickup level, time delay, and I squared T response.
 - 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 - 5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
 - 6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
 - 7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
 - 8. Subfeed Circuit Breakers: Vertically mounted.
 - 9. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.

- b. Breaker handle indicates tripped status.
 - c. UL listed for reverse connection without restrictive line or load ratings.
 - d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
 - f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - g. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- B. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
1. Fuses and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."

2.6 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder.

2.7 ACCESSORY COMPONENTS AND FEATURES

- A. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- C. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.
- D. Mount panelboard cabinet plumb and rigid without distortion of box.
- E. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- F. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.

- G. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- H. Install filler plates in unused spaces.
- I. All new panels that are installed recessed shall stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- J. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.

- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 262416

SECTION 26 51 19

LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following types of LED luminaires:

1. Cylinder.
2. Downlight.
3. Lowbay.
4. Recessed linear.
5. Strip light.
6. Surface mount, linear.
7. Surface mount, nonlinear.
8. Suspended, linear.
9. Suspended, nonlinear.
10. Materials.
11. Finishes.
12. Luminaire support.

B. Related Requirements:

1. Section 260926 "Lighting Control Panelboards" for panelboards used for lighting control.

1.2 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product, arranged by designation.
- 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. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale and coordinated with each other, using input from installers of the items involved:
- B. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.
- C. Product Certificates: For each type of luminaire.
- D. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.6 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) 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 7.
- B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified."

2.2 LUMINAIRE REQUIREMENTS

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

1. ENERGY STAR certified.
 2. California Title 24 compliant.
 3. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
 4. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
 5. UL Listing: Listed for damp location.
 6. Recessed luminaires shall comply with NEMA LE 4.
- C. Rated lamp life of 35,000 hours to L70.
- D. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- E. Internal driver.

2.3 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: 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 (3.175 mm) minimum unless otherwise indicated.

2.4 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.

2.5 LUMINAIRE SUPPORT

- 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: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm)
- D. Rod Hangers: 3/16-inch (5-mm) 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 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports: Sized and rated for luminaire weight.
- E. Flush-Mounted Luminaire Support: Secured to outlet box.
- F. Wall-Mounted Luminaire Support:
 - 1. Do not attach luminaires directly to gypsum board.
- G. Suspended Luminaire Support:
 - 1. Pendants and Rods: Where longer than 48 inches (1200 mm), 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.
- H. Ceiling-Grid-Mounted Luminaires:
 - 1. Secure to any required outlet box.
 - 2. Secure luminaire using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
- I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.
- J. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.2 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.

END OF SECTION 265119