

## **DIVISION 26: ELECTRICAL**

### **26 0500 COMMON WORK RESULTS FOR ELECTRICAL**

- 26 0501 COMMON ELECTRICAL REQUIREMENTS
- 26 0519 LINE-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
- 26 0523 CONTROL-VOLTAGE ELECTRICAL CABLES
- 26 0526 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
- 26 0533 RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS
- 26 0613 ELECTRICAL EQUIPMENT MOUNTING HEIGHT SCHEDULE
- 26 0924 LIGHTING CONTROL SYSTEM

### **26 5000 LIGHTING**

- 26 5600 EXTERIOR LIGHTING

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**SECTION 26 0501****COMMON ELECTRICAL REQUIREMENTS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
  - 1. General electrical system requirements and procedures.
  - 2. Perform excavating and backfilling work required by work of this Division as described in Contract Documents.
  - 3. Make electrical connections to equipment provided under other Sections.
  - 4. Furnish and install Penetration Firestop Systems at electrical system penetrations as described in Contract Documents.
  
- B. Products Furnished But Not Installed Under This Section:
  - 1. Anchor bolts and templates for exterior lighting equipment bases.
  
- C. Related Requirements:
  - 1. Section 07 8400: 'Firestopping' for quality of Penetration Firestop Systems to be used on Project and submittal requirements.
  - 2. Section 31 2316: 'Excavation' for criteria for performance of excavating.
  - 3. Section 31 2323: 'Fill' for criteria for performance of backfilling.

**1.2 REFERENCES**

- A. Reference Standards:
  - 1. National Fire Protection Association / American National Standards Institute:
    - a. NFPA 70, National Electric Code (NEC).
  - 2. National Electrical Manufacturing Association Standards (NEMA):
    - a. NEMA 250, 'Enclosure for Electrical Equipment (1000 Volts Maximum)'.

**1.3 SUBMITTALS**

- A. Action Submittals:
  - 1. Product Data:
    - a. Provide following information for each item of equipment:
      - 1) Catalog Sheets.
      - 2) Assembly details or dimension drawings.
      - 3) Installation instructions.
      - 4) Manufacturer's name and catalog number.
      - 5) Name of local supplier.
    - b. Furnish such information for following equipment:
      - 1) Section 26 2816: 'Enclosed Switches And Circuit Breakers'.
      - 2) Section 26 2913: 'Enclosed Controllers'.
      - 3) Section 26 5600: 'Exterior Lighting' for fixtures, poles, and associated control equipment.
    - c. Do not purchase equipment before approval of product data.
  - 2. Shop Drawings:
    - a. Submit on Panelboards:
    - b. Indicate precise equipment to be used, including all options specified. Indicate wording and format of nameplates where applicable. Submit in three-ring binder with hard cover.

- B. Informational Submittals:
  - 1. Test And Evaluation Reports:
    - a. Report of site tests, before Substantial Completion.
  - 2. Qualification Statement:
    - a. Electrical Subcontractor:
      - 1) Provide Qualification documentation if requested by Architect or Owner.
    - b. Installer:
      - 1) Provide Qualification documentation if requested by Architect or Owner.
- C. Closeout Submittals:
  - 1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
    - a. Operations and Maintenance Data:
      - 1) Provide operating and maintenance instructions for each item of equipment submitted under Product Data.
    - b. Record Documentation:
      - 1) Manufacturers documentation:
        - a) Manufacturer's literature.
        - b) Include copy of approved shop drawings.

## 1.4 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
  - 1. NEC and local ordinances and regulations shall govern unless more stringent requirements are specified.
  - 2. Material and equipment provided shall meet standards of NEMA or UL and bear their label wherever standards have been established and label service is available.
- B. Qualifications: Requirements of Section 01 4301 applies, but not limited to following:
  - 1. Electrical Subcontractor:
    - a. Company specializing in performing work of this section.
      - 1) Minimum five (5) years experience in electrical installations.
      - 2) Minimum five (5) satisfactorily completed installations in past three (3) years of projects similar in size, scope, and complexity required for this project before bidding.
    - b. Upon request, submit documentation.
  - 2. Installer:
    - a. Licensed for area of Project.
    - b. Designate one (1) individual as project foremen who shall be on site at all times during installation and experienced with installation procedures required for this project.
    - c. Upon request, submit documentation.

## PART 2 - PRODUCTS

### 2.1 SYSTEMS

- A. Performance:
  - 1. Design Criteria:
    - a. Materials and equipment provided under following Sections shall be by same Manufacturer:
      - 1) Section 26 2417: Panelboards.
      - 2) Section 26 2816: Enclosed Switches And Circuit Breakers.
      - 3) Section 26 2913: Enclosed Controllers.

**PART 3 - EXECUTION****3.1 INSTALLERS**

- A. Acceptable Installers:
1. Meet Quality Assurance Installer Qualifications as specified in Part 1 of this specification.

**3.2 EXAMINATION**

- A. Verification Of Conditions:
1. Confirm dimensions, ratings, and specifications of equipment to be installed and coordinate these with site dimensions and with other Sections.

**3.3 INSTALLATION**

- A. General:
1. Locations of electrical equipment shown on Drawings are approximate only. Field verify actual locations for proper installation.
  2. Coordinate electrical equipment locations and conduit runs with those providing equipment to be served before installation or rough in.
    - a. Notify Architect of conflicts before beginning work.
    - b. Coordinate locations of power and lighting outlets in mechanical rooms and other areas with mechanical equipment, piping, ductwork, cabinets, etc, so they will be readily accessible and functional.
  3. Work related to other trades which is required under this Division, such as cutting and patching, trenching, and backfilling, shall be performed according to standards specified in applicable Sections.
- B. Install Penetration Firestop System appropriate for penetration at electrical system penetrations through walls, ceilings, and top plates of walls.

**3.4 FIELD QUALITY CONTROL**

- A. Field Tests:
1. Test systems and demonstrate equipment as working and operating properly. Notify Architect before test. Rectify defects at no additional cost to Owner.
  2. Measure current for each phase of each motor under actual final load operation, i.e. after air balance is completed for fan units, etc. Record this information along with full-load nameplate current rating and size of thermal overload unit installed for each motor.

**3.5 CLOSEOUT ACTIVITIES**

- A. Training:
1. Provide competent instructor for three (3) days to train Owner's maintenance personnel in operation and maintenance of electrical equipment and systems. Factory representatives shall assist this instruction as necessary. Schedule instruction period at time of final inspection.

**END OF SECTION**

**SECTION 26 0519****LINE-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
  - 1. Quality of conductors used on Project except as excluded below.
- B. Related Requirements:
  - 1. Section 23 0933: 'Electric and Electronic Control System for HVAC' for conductors and cables for temperature control system.
  - 2. Section 26 0501: 'Common Electrical Requirements'.

**1.2 REFERENCES**

- A. Definitions:
  - 1. Line Voltage: Over 70 Volts.
- B. Reference Standards:
  - 1. National Fire Protection Association:
    - a. NFPA (Fire) 70, 'National Electric Code (NEC)' (2014 Edition or most recent edition adopted by AHJ including all applicable amendments and supplements).
      - 1) Article 334, "Nonmetallic-Sheathed Cable, Types NM, NMC And NMS".

**PART 2 - PRODUCTS****2.1 SYSTEMS**

- A. Line Voltage Conductors:
  - 1. Copper with AWG sizes as shown:
    - a. Minimum size shall be No. 12 except where specified otherwise.
    - b. Conductor size No. 8 and larger shall be stranded.
  - 2. Insulation:
    - a. Standard Conductor Size No. 10 And Smaller: 600V type THWN or XHHW (75 deg F (24 deg C)).
    - b. Standard Conductor Size No. 8 And Larger: 600V Type THW, THWN, or XHHW (75 deg F (24 deg C)).
    - c. Higher temperature insulation as required by NFPA 70 or local codes.
  - 3. Colors:
    - a. 208Y / 120 V System:
      - 1) Black: Phase A.
      - 2) Red: Phase B.
      - 3) Blue: Phase C.
      - 4) Green: Ground.
      - 5) White: Neutral.
      - 6) Green: Ground.
    - b. Conductors size No. 10 and smaller shall be colored full length. Tagging or other methods for coding of conductors size No. 10 and smaller not allowed.
    - c. For feeder conductors larger than No. 10 at pull boxes, gutters, and panels, use painted or taped band or color tag color-coded as specified above.

- B. Line Voltage Cables:
1. Non-Metallic Sheathed Cable (NM) and Metal Clad Cable (MC) may be used as restricted below:
    - a. Copper conductors.
    - b. Sizes #12 through #8.
    - c. Use only in indoor dry locations where:
      - 1) Not subject to damage.
      - 2) Not in contact with earth.
    - d. Not in concrete.
    - e. Not where exposed or not concealed.
    - f. Not over suspended ceilings.
    - g. As restricted by NFPA 70 Article 334.
- C. Cord Sets For Ranges: Three pole, 4 wire grounding, 125/250V, NEMA 14-50P plug, 48 inch (1 200 mm) cord length minimum.
- D. Standard Connectors:
1. Conductors No. 8 And Smaller: Steel spring wire connectors.
  2. Conductors Larger Than No. 8: Pressure type terminal lugs.
  3. Connections Outside Building: Watertight steel spring wire connections with waterproof, non-hardening sealant.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. General:
1. Conductors and cables shall be continuous from outlet to outlet.
  2. Do not use direct burial cable.
- B. Line Voltage Conductors:
1. Install conductors in raceway where indicated on Contract Drawings. Run conductors of different voltage systems in separate conduits.
  2. Route circuits at own discretion, however, circuiting shall be as shown in Panel Schedules. Group circuit homeruns to panels as shown on Contract Drawings.
  3. Neutrals:
    - a. On three-phase, 4-wire systems, do not use common neutral for more than three circuits.
    - b. On single-phase, 3-wire systems, do not use common neutral for more than two circuits.
    - c. Run separate neutrals for each circuit where specifically noted on Contract Drawings.
    - d. Where common neutral is run for two or three home run circuits, connect phase conductors to breakers in panel which are attached to separate phase legs:
      - 1) Provide breaker tie so that all circuits that share common neutral are simultaneously disconnected.
      - 2) Neutral conductors shall be of same size as phase conductors unless specifically noted otherwise.
  4. Pulling Conductors:
    - a. Do not pull conductors into conduit until raceway system is complete and cabinets and outlet boxes are free of foreign matter and moisture.
    - b. Do not use heavy mechanical means for pulling conductors.
    - c. Use only listed wire pulling lubricants.
- C. Line Voltage Cables:
1. Route circuits at own discretion, however, circuiting and numbering shall be as shown in Panel Schedules.
  2. Support cables using approved staples, cable ties, straps, hangers, or similar fittings, spaced as required.

3. Where installing in framing, do not bore holes in joists or beams outside center 1/3 of member depth or within 24 inches (600 mm) of bearing points. Do not bore holes in vertical framing members outside center 1/3 of member width. Holes shall be one inch diameter maximum.
4. Conceal cables within ceilings and walls of finished areas. Cables may be exposed in unfinished areas but not run on floors of mechanical equipment spaces or in such a way that they obstruct access to, operation of, or servicing of equipment.
5. Install exposed cables parallel to or at right angles to building structure lines.
6. Keep cables 6 inches (150 mm) minimum from hot water pipes.
7. Do not support cables from mechanical ducts or duct supports without Architect's written approval.
8. Prohibited procedures:
  - a. Boring holes for installation of cables in vertical truss members.
  - b. Notching of structural members for installation of cables.

**END OF SECTION**

**SECTION 26 0523****CONTROL-VOLTAGE ELECTRICAL CABLES****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
  - 1. Furnish and install control-voltage electrical cables as described in Contract Documents.
- B. Related Requirements:
  - 1. Section 23 0933: 'Electric And Electronic Control System For HVAC' for cables for Temperature Control System cables.
  - 2. Section 26 0501: 'Common Electrical Requirements'.
  - 3. Section 26 0924: 'Lighting Control System'.

**1.2 REFERENCES**

- A. Definitions:
  - 1. Control Voltage: 70 Volts and under.

**PART 2 - PRODUCTS****2.1 SYSTEM**

- A. Manufacturers:
  - 1. Category Four Approved Cable Manufacturers. See Section 01 6200 for definitions of Categories:
    - a. Alpha Wire Co, Elizabeth, NJ [www.alphawire.com](http://www.alphawire.com).
    - b. Belden Wire & Cable Co, Richmond, IN [www.belden.com](http://www.belden.com).
    - c. Liberty Wire & Cable, Colorado Springs, CO [www.libertycable.com](http://www.libertycable.com).
    - d. West Penn Wire Corp, Washington, PA [www.westpenn-cdt.com](http://www.westpenn-cdt.com).
- B. Components:
  - 1. Building Control System Cables.
    - a. CAT 5E, 24 AWG, solid bare copper, four pair, UTP, white cable jacket.
    - b. Sheath Colors:
      - 1) Lighting Control: Yellow.
    - c. Meet requirements of EIA / TIA 568 Standard.
  - 2. Lighting Control Cables and Conductors:
    - a. Provide cable per Lighting Control Panel Manufacturer's recommendations and requirements.
    - b. Lighting Control Cables ran in same raceway as line voltage cables shall have same insulation voltage rating as line voltage conductors.
    - c. Cable Jacket shall be yellow.

**PART 3 - EXECUTION****3.1 INSTALLATION****A. General:**

1. Cables shall be continuous and without splices from source to outlet.
2. Conceal cables within ceilings and walls of finished areas. Cables may be exposed in unfinished areas but not run on floors of mechanical equipment spaces or in such a way that they obstruct access to, operation of, or servicing of equipment.
3. Run exposed cables parallel to or at right angles to building structure lines.
4. Keep cables 6 inch (150 mm) minimum from hot water pipes.
5. Support cables using approved staples, cable ties, straps, hangers, or similar fittings spaced every 3 feet (900 mm).
6. Where installing in framing, do not bore holes in joists or beams outside center 1/3 of member depth or within 24 inches (600 mm) of bearing points. Do not bore holes in vertical framing members outside center 1/3 of member width. Holes shall be 1/2 inch (13 mm) diameter maximum.
7. Bundle only cables of same systems together.
8. Do not run cables within 10 inches (255 mm) of line voltage conductors/raceways.
9. Extend cables 18 inches (450 mm) from wall or ceiling at all outlet locations. Extend cables to twice vertical length of cabinet at each cabinet location.
10. Pulling cables into conduit:
  - a. Do not pull cables until raceway system is complete and cabinets and outlet boxes are free of foreign matter and moisture.
  - b. Do not use heavy mechanical means for pulling cables.
  - c. Use only listed wire pulling lubricants.
11. Prohibited procedures:
  - a. Boring holes for installation of cables in vertical truss members.
  - b. Notching of structural members for installation of cables.

**B. Control Cables:**

1. For cables not installed in raceway, do not run cables within 10 inches (255 mm) of line voltage conductors / raceways. Also, maintain 10 inches (255 mm) minimum between following exposed cable groups:
  - a. Microphone cables.
  - b. CAT-6, sound system control, telephone, video, or ATC cables.
  - c. Loudspeaker cables.

**END OF SECTION**

**SECTION 26 0526****GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
  - 1. Furnish and install grounding for electrical installation as described in Contract Documents except as excluded below.
- B. Related Requirements:
  - 1. Section 03 3111: 'Cast-In-Place Structural Concrete'.
    - a. Pre-installation conference held jointly with other concrete related sections.
  - 2. Section 26 0501: 'Common Electrical Requirements'.
  - 3. Section 26 4301: 'Surge Protection Devices'.

**1.2 REFERENCES**

- A. Reference Standards:
  - 1. Institute of Electrical and Electronics Engineers (IEEE):
    - a. IEEE 837-2014, 'Standard for Qualifying Permanent Connections Used in Substation Grounding'.
  - 2. National Fire Protection Association:
    - a. NFPA (Fire) 70, 'National Electric Code (NEC)' (2014 Edition or most recent edition adopted by AHJ including all applicable amendments and supplements).
    - b. NFPA (Fire) 780, 'Standard for the Installation of Lightning Protection Systems' (2014 Edition or most recent edition adopted by AHJ including all applicable amendments and supplements).
  - 3. Telecommunications Industry Association:
    - a. TIA-942, 'Telecommunications Infrastructure Standard for Data Centers' (Revision A, 2014).
  - 4. Section 27 1116: 'Communications Cabinets, Racks, Frames, and Enclosures'.
  - 5. Section 27 1501: 'Communications Horizontal Cabling' for cables for Telephone and Data Systems.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- A. Pre-Installation Conference:
  - 1. Participate in pre-installation conference as specified in Section 03 3111.
  - 2. In addition to agenda items specified in Section 01 3100 and 31 3111, review following:
    - a. Review Architect's inspection of grounding conductor installation before placement of concrete.

**1.4 QUALITY ASSURANCE**

- A. Regulatory Agency Sustainability Approvals:
  - 1. Requirements of Section 27 1501 applies, but is not limited to following:
    - a. Cable assemblies shall be UL / CE Listed and CSA Certified. Cables shall be a distinctive green or green/yellow in color, and all jackets shall be UL, VW-1 flame rated.
    - b. Grounding shall conform to all required Commercial Building Grounding and Bonding Requirements for Telecommunications, Electrical Codes, and Manufacturer's grounding requirements.

2. Systems shall be installed per NFPA 780 and NFPA 70.
  3. All Bonds shall comply with most current version of IEEE 837 Standard.
- B. Qualifications: Requirements of Section 01 4301 applies, but is not limited to following:
1. Installers Qualifications:
    - a. Grounding and Bonding:
      - 1) Licensed electrical contractor shall perform installation and termination of main bonding conductor to building service entrance ground.
      - 2) Licensed in State that Work is to be performed.

## PART 2 - PRODUCTS

### 2.1 SYSTEM

- A. Manufacturers:
1. Type One Acceptable Products:
    - a. 'Cadweld' by Erico International, Solon, OH [www.erico.com](http://www.erico.com).
    - b. 'ThermOweld' by Continental Industries, Tulsa, NE [www.conind.com](http://www.conind.com).
    - c. Equal as approved by Architect before bidding. See Section 01 6200.
- B. Performance:
1. Design Criteria:
    - a. Size materials as shown on Drawings and in accordance with applicable codes.
    - b. Bonding System Workmanship:
      - 1) The ground/earthing system shall be designed for high reliability and shall meet following criteria:
        - a) Local electrical codes shall be adhered to.
        - b) All grounding/earthing conductors shall be copper.
        - c) Regulatory Agency Sustainability Approvals requirements are required.
    - c. Rack and Cabinet Grounding/Earthing:
      - 1) Equipment and racks shall be bonded in accordance with methods prescribed in TIA-942.
      - 2) All grounding backbone should be #6 AWG copper cable.
      - 3) In telecommunications spaces with small number of racks or cabinets, rack/cabinet grounding/earthing jumper cable directly to telecommunications ground bus is permitted. Large spaces shall utilize mesh Common Bonding network, or overhead grounding backbone.
      - 4) Equipment racks, housings, messenger cables, and raceways:
        - a) Connect cabinets, racks, frames and terminal boards to single-point ground which is connected to building ground system proper sized, bonded and tested green insulated copper grounding conductor.
- C. Materials:
1. Grounding And Bonding Jumper Conductors: Bare copper or with green insulation.
  2. Make grounding conductor connections to ground rods and foundation ground loop using approved bolted clamps listed for such use.
  3. Service Grounding Connections And Cable Splices: Make by exothermic process.
  4. Telecommunications ground bus bar (TGB): copper.
    - a. Grounding bus bar:
      - 1) Technology Room shall be provided with telecommunications ground bus bar (TGB).
      - 2) Ground loop current potential is minimized between telecommunications equipment and electrical system to which it is attached.
    - b. All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. entering or residing in Technology Room shall be grounded to respective TGB using minimum #6 AWG stranded copper bonding conductor and compression connectors.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Interface With Other Work: Coordinate with Section 03 3111 in installing grounding conductor and placing concrete. Do not allow placement of concrete before Architect's inspection of grounding conductor installation.
- B. Grounding conductors and bonding jumper conductors shall be continuous from terminal to terminal without splice. Provide grounding for following.
  - 1. Conduits and other conductor enclosures.
  - 2. Neutral or identified conductor of interior wiring system.
  - 3. Non-current-carrying metal parts of fixed equipment such as motors, starter and controller cabinets, instrument cases, and lighting fixtures.
- C. Pull grounding conductors in non-metallic raceways, in flexible steel conduit exceeding 72 inches (1 800 mm) in length, and in flexible conduit connecting to mechanical equipment.
- D. Provide grounding bushings on all feeder conduit entrances into panelboards and equipment enclosures.
- E. Bond conduit grounding bushings to enclosures with minimum #10 AWG conductor.
- F. Connect equipment grounds to building system ground.
  - 1. Use same size equipment grounding conductors as Phased conductors up through #10 AWG.
  - 2. Use NEC Table 250-95 for others unless noted otherwise in Drawings.
- G. Run separate insulated grounding cable from each equipment cabinet to electrical panel. Do not use intermediate connections or splices. Affix directly to cabinet.
- H. On motors, connect ground conductors to conduit with approved grounding bushing and to metal frame with bolted solderless lug.
- I. Ground cabinet of transformers to conduit and ground wires, if installed. Bond transformer secondary neutral conductor to cabinet.
- J. TGB shall be 1/4 inch (6.4 mm) thick x 2 inches (50 mm) high x 12 inches (305 mm) long installed with insulated standoffs at location directed.
- K. Ground rack to TGB using #6 copper conductor and compression connector.

### **3.2 FIELD QUALITY CONTROL**

- A. Field Inspections:
  - 1. Notify Architect for inspection two (2) days minimum before placing concrete over grounding conductor.
  - 2. Grounding Well integrity shall be tested separately and together with Lightning Protection System integrity.

**END OF SECTION**

**SECTION 26 0533****RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
1. Quality of material and installation procedures for raceway, boxes, and fittings used on Project but furnished under other Divisions.
  2. Furnish and install raceway, conduit, and boxes used on Project not specified to be installed under other Divisions.
  3. Furnish and install air-vapor barrier boxes as described in Contract Documents.
  4. Furnish and install main electrical service raceway as described in Contract Documents and comply with electrical utility company requirements.
  5. Furnish and install main telephone service raceway as described in Contract Documents and comply with telephone company requirements.
  6. Furnish and install internet service raceway as described in Contract Documents and comply with internet service company requirements.
- B. Related Requirements:
1. See Section 07 8400: 'Firestopping' for raceways penetrating fire rated walls, ceilings, and barriers'.
  2. Section 23 0933: 'Electric and Electronic Control System for HVAC' for concealed raceway and extensions for temperature control system.
  3. Section 26 0501: 'Common Electrical Requirements' for general electrical requirements'.
  4. Section 26 0503: 'Electrical Utility Services' for electrical primary underground service requirements.
  5. Section 27 1501: 'Communications Horizontal Cabling' for raceway for telephone and data systems.
  6. Section 27 4117: 'Video Systems' for system wiring.
  7. Section 27 5117: 'Audio Systems' for sound system wiring.
  8. Section 28 3101: 'Fire Detection And Alarm System' for clarification of raceway and conduit requirements for detection and alarm system.

**1.2 REFERENCES**

- A. Reference Standards:
1. National Fire Protection Association:
    - a. NFPA (Fire) 70, 'National Electric Code (NEC)' (2014 Edition or most recent edition adopted by AHJ including all applicable amendments and supplements).

**PART 2 - PRODUCTS****2.1 SYSTEM**

- A. Manufacturers:
1. Manufacturer Contact List:
    - a. Cooper B-Line, Highland, IL [www.b-line.com](http://www.b-line.com).
    - b. Hubbell Incorporated, Milford, CT [www.hubbell-wiring.com](http://www.hubbell-wiring.com) or Hubbell Canada Inc, Pickering, ON (905) 839-4332.
    - c. Square D, Palatine, IL [www.squared.com](http://www.squared.com).

- d. Thomas & Betts, Memphis, TN www.tnb.com or Thomas & Betts Ltd, Iberville, PQ (450) 347-5318.
- e. Walker Systems Inc, Williamstown, WV (800) 240-2601 or Walker Systems Inc / Wiremold Canada Inc, Fergus, ON (519) 843-4332.
- f. Wiremold Co, West Hartford, CT www.wiremold.com.

**B. Materials:**

**1. Raceway And Conduit:**

- a. Sizes:
  - 1) 1" inch (19 mm) for exterior use, unless indicated otherwise.
  - 2) 1/2 inch (13 mm) for interior use, unless indicated otherwise.
- b. Types: Usage of each type is restricted as specified below by product.
  - 1) Galvanized rigid steel or galvanized intermediate metal conduit (IMC) is allowed for use in all areas. Where in contact with earth or concrete, wrap buried galvanized rigid steel and galvanized IMC conduit and fittings completely with vinyl tape.
  - 2) Galvanized Electrical Metallic Tubing (EMT), Flexible Steel Conduit, and Electrical Non-Metallic Tubing (ENT):
    - a) Allowed for use only in indoor dry locations where it is:
      - (1) Not subject to damage.
      - (2) Not in contact with earth.
      - (3) Not in concrete.
    - b) For metal conduit systems, flexible steel conduit is required for final connections to indoor mechanical equipment.
  - 3) Schedule 40 Polyvinyl Chloride (PVC) Conduit:
    - a) Allowed for use only underground or below concrete with galvanized rigid steel or IMC elbows and risers.
  - 4) Listed, Liquid-Tight Flexible Metal Conduit:
    - a) Use in outdoor final connections to mechanical equipment, length not to exceed 36 inches (900 mm).
  - 5) Pre-wired 3/8 Inch (9.5 mm) Flexible Fixture Whips: Allowed only for connection to recessed lighting fixtures, lengths not to exceed 72 inches (1 800 mm).
- c. Prohibited Raceway Materials:
  - 1) Aluminum conduit.
  - 2) Armored cable type AC (BX) cable.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

**A. Verification Of Conditions:**

- 1. Confirm dimensions, ratings, and specifications of materials to be installed and coordinate these with site dimensions and with other Sections.

**3.2 INSTALLATION**

**A. Interface With Other Work:**

- 1. Coordinate with Divisions 22 and 23 for installation of raceway for control of plumbing and HVAC equipment.
- 2. Coordinate with Division 27 for installation of raceway for sound system.
- 3. Before rough-in, verify locations of boxes with work of other trades to insure that they are properly located for purpose intended.
  - a. Coordinate location of outlet for water coolers with Division 22.
  - b. Coordinate location of outlets adjacent to or in millwork with Division 06 before rough-in. Refer conflicts to Architect and locate outlets under his direction.

4. Coordinate installation of floor boxes in carpeted areas with carpet installer to obtain carpet for box covers.
  5. Install pull wires in raceways installed under this Section where conductors or cables are to be installed under other Divisions.
- B. General:
1. Sound system electrical components furnished by Division 27 and installed under this Section include following items:
    - a. Speaker mounting rings.
    - b. Speaker enclosures.
- C. Conduit And Raceway:
1. Conceal raceways within ceilings, walls, and floors, except at Contractor's option, conduit may be exposed on walls or ceilings of mechanical equipment areas and above acoustical panel suspension ceiling systems. Install exposed raceway runs parallel to or at right angles to building structure lines.
  2. Seal all raceways penetrating fire rated walls, ceilings and barriers. See Section 07 8400.
  3. Keep raceway runs 6 inches (150 mm) minimum from hot water pipes.
  4. Make no more than four quarter bends, 360 degrees total, in any conduit run between outlet and outlet, fitting and fitting, or outlet and fitting.
    - a. Make bends and offsets so conduit is not injured and internal diameter of conduit is not effectively reduced.
    - b. Radius of curve shall be at least minimum indicated by NFPA 70.
  5. Cut conduit smooth and square with run and ream to remove rough edges. Cap raceway ends during construction. Clean or replace raceway in which water or foreign matter have accumulated.
  6. Install insulated bushings on each end of raceway 1-1/4 inches (32 mm) in diameter and larger, and on all raceways where cables emerge. Install expansion fittings where raceways cross building expansion joints.
  7. Run two spare conduits from each new panelboard to ceiling access area or other acceptable accessible area and cap for future use.
  8. Bend PVC conduit by hot box bender and, for PVC 2 inches (50 mm) in diameter and larger, expanding plugs. Apply PVC adhesive only by brush.
  9. Installation In Framing:
    - a. Do not bore holes in joists or beams outside center 1/3 of member depth or within 24 inches (600 mm) of bearing points. Do not bore holes in vertical framing members outside center 1/3 of member width.
    - b. Holes shall be one inch (25 mm) diameter maximum.
  10. Underground Raceway And Conduit:
    - a. Bury underground raceway installed outside building 24 inches (600 mm) deep minimum.
    - b. Bury underground conduit in planting areas 24 inches (600 mm) deep minimum. It is permissible to install conduit 6 inch (150 mm) below concrete sidewalks, however, conduit must be buried 24 inches (600 mm) deep at point of exit from planting areas.
  11. Conduit And Raceway Support:
    - a. Securely support raceway with approved straps, clamps, or hangers, spaced as required.
    - b. Do not support from mechanical ducts or duct supports without Architect's written approval. Securely mount raceway supports, boxes, and cabinets in an approved manner by:
      - 1) Expansion shields in concrete or solid masonry.
      - 2) Toggle bolts on hollow masonry units.
      - 3) Wood screws on wood.
      - 4) Metal screws on metal.
  12. Prohibited Procedures:
    - a. Use of wooden plugs inserted in concrete or masonry units for mounting raceway, supports, boxes, cabinets, or other equipment.
    - b. Installation of raceway that has been crushed or deformed.
    - c. Use of torches for bending PVC.
    - d. Spray applied PVC cement.
    - e. Boring holes in truss members.
    - f. Notching of structural members.

- g. Supporting raceway from ceiling system support wires.
  - h. Nail drive straps or tie wire for supporting raceway.
- D. Boxes:
- 1. Boxes shall be accessible and installed with approved cover.
  - 2. Do not locate device boxes that are on opposite sides of framed walls in the same stud space. In other wall construction, do not install boxes back to back.
  - 3. Locate boxes so pipes, ducts, or other items do not obstruct outlets.
  - 4. Install outlets flush with finished surface and level and plumb.
  - 5. Support switch boxes larger than two-gang with side brackets and steel bar hangers in framed walls.
  - 6. At time of substantial completion, install blank plates on uncovered outlet boxes that are for future use.
  - 7. Install air-vapor barrier boxes.
    - a. Follow Manufacturer's installation instructions.
    - b. Care should be taken to cut above grade vapor barrier and seal around recessed outlet boxes to minimize air infiltration.
  - 8. Location:
    - a. Install boxes at door locations on latch side of door, unless explicitly shown otherwise on Contract Drawings. Verify door swings shown on electrical drawings with architectural drawings, and report discrepancies to Architect before rough-in. Distance of box from jamb shall be 6 inches (150 mm) from door jamb.
    - b. Properly center boxes located in walls with respect to doors, panels, furring, trim and consistent with architectural details. Where two or more outlets occur, space them uniformly and in straight lines with each other, if possible.
    - c. Center ceramic tile boxes in tile.
- E. Support speaker enclosures and mounting rings from structure or ceiling suspension system.

**END OF SECTION**

**SECTION 26 0613****ELECTRICAL EQUIPMENT MOUNTING HEIGHT SCHEDULE****PART 1 - GENERAL: Not Used****PART 2 - PRODUCTS: Not Used****PART 3 - EXECUTION****3.1 INSTALLATION**

- A. Unless otherwise indicated, mount center of outlets or boxes at following heights above finish floor. Refer special conditions to Architect before rough-in and locate outlet under his direction.
- B. Mounting Heights:
1. HVAC:
    - a. Temperature Control Junction Boxes: As indicated on Drawings.
    - b. Thermostats not mounted in occupied space: As indicated on Drawings.
    - c. Remote Temperature Sensors and thermostats mounted in occupied space:
      - 1) Wall-Mounted 50 inches (1 270 mm) to top.
    - d. Indoor Motor Disconnects: 60 inches (1 525 mm).
    - e. Outdoor Motor Disconnects: As indicated on Drawings.
    - f. Motor Controls: 60 inches (1 525 mm).
  2. Plumbing:
    - a. Electric Water Cooler Outlets: Mount so outlet and cord are hidden by water cooler and outlet is accessible for resetting for GFCI trip.
  3. Electrical:
    - a. Wall Switches: 42 inches (1 065 mm).

**END OF SECTION**

**SECTION 26 0924****LIGHTING CONTROL SYSTEM****PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
  - 1. Furnish and install complete lighting control system as described in Contract Documents consisting of the following:
    - a. Lighting Control Panel.
    - b. Programmable Digital Control Switches.
    - c. Photocells.
- B. Related Requirements:
  - 1. Section 26 0501: 'Common Electrical Requirements'.
  - 2. Section 26 0523: 'Control-Voltage Electrical Cables'.

**1.2 REFERENCES**

- A. Definitions:
  - 1. Class A: Equipment has been tested and found to comply with limits for Class A digital device, pursuant to part 15 of FCC Rules. These limits provide reasonable protection against harmful interference when equipment is operated in commercial environment.
- B. Reference Standards:
  - 1. Federal Communications Commission (FCC):
    - a. Emission requirements for Class A applications.
  - 2. Underwriters Laboratories:
    - a. UL 916, 'Energy Management Equipment' (2007).

**1.3 SUBMITTALS**

- A. Informational Submittals:
  - 1. Certifications:
    - a. Technician Certification that equipment has been installed, adjusted and tested in accordance with Manufacturer's recommendations.
- B. Closeout Submittals:
  - 1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
    - a. Operations and Maintenance Data:
      - 1) Equipment operation and maintenance manual(s).

**1.4 QUALITY ASSURANCE**

- A. Regulatory Agency Sustainability Approvals:
  - 1. All control equipment shall be in compliance with FCC emissions' standards in Part 15 Subpart J for Class A application.
  - 2. Programmable panelboards shall be UL listed under UL 916 Energy Management Equipment.
- B. Qualifications:
  - 1. Manufacturer Qualifications:

- a. Manufacturer of assembly shall be manufacturer of major components with assembly.
- b. Manufacturer of this equipment shall have minimum of five (5) years manufacturing experience.
- 2. Technician Qualifications:
  - a. Authorized by Manufacturer and trained.
  - b. Have thorough knowledge of software, hardware and system programming.
- C. Certifications:
  - 1. Provide Technician Certification that equipment has been installed, adjusted and tested in accordance with Manufacturer's recommendations.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery And Acceptance Requirements:
  - 1. Equipment shall be delivered, handled and stored in accordance with manufacturer's instructions.

## PART 2 - PRODUCTS

### 2.1 ASSEMBLIES

- A. Manufacturers:
  - 1. Type One Acceptable Manufacturer:
    - a. Acuity Brands Inc., Atlanta, GA [www.acuitybrands.com](http://www.acuitybrands.com).
    - b. Leviton Manufacturing Co, Little Neck, NY [www.leviton.com](http://www.leviton.com) or Leviton Manufacturing of Canada Ltd, Pointe-Claire, QB (800) 461-2002 or (514) 954-1840.
    - c. Lutron Electronics Co Inc, Coopersburg, PA [www.lutron.com](http://www.lutron.com).
    - d. Watt Stopper Inc., Santa Clara, CA [www.wattstopper.com](http://www.wattstopper.com).
    - e. Equal as approved by Architect before bidding. See Section 01 6200.
- B. Design Criteria:
  - 1. Lighting Control System shall meet or exceed following capabilities:
    - a. Capable of switching for specific lighting zone for following:
      - 1) Time-of-day scheduling
      - 2) Daylight savings time adjustments.
      - 3) Light level sensors.
- C. Components:
  - 1. Light Control Panel:
    - a. Enclosure/tub shall be NEMA 1 unless indicated otherwise on Drawings, sized to accommodate required components.
    - b. Cover shall have hinged and lockable door and be configured for flush mounting of panel.
    - c. Panel shall include power supply and interior assembly with motherboard and control electronics.
      - 1) Interior construction shall provide isolation between line voltage and low voltage (class 2) wiring.
    - d. Panel shall be factory assembled and designed for disassembly for mounting enclosure first and reassembly after conduit installation.
    - e. Panel shall utilize mechanically held latching relays rated for 30A ballast load at 120/277VAC with 10,000A short circuit current rating and shall include contactor for exterior lighting control.
      - 1) Visual LED status and manual override for each relay shall be included.
    - f. Panel shall contain network clock/programmer and photocell control module for interface with interior and exterior photocell controls.
      - 1) Network clock shall provide menu driven control for seven (7) day repeating schedules and holiday provisions.

- 2) Clock shall provide user selectable pre-programmed scenarios for: Scheduled on/off, Manual on/off, Scheduled off, and on/off when used with photocell control module.
- g. Panel shall contain automation intelligence card for program, monitor, and control functions and group cards as required for control of groups of relays.
2. Programmable Digital Control Switches:
  - a. Programmable digital control switches shall be provided with number of control buttons as indicated on Contract Drawings.
    - 1) Each button shall be capable of individual programming without use of computer or other programming device.
    - 2) Each button shall be able to control individual relay or group of relays.
    - 3) Individual buttons shall allow for permanent labeling.
  - b. Switches shall be illuminated for ease of location in dark.
3. Photocells:
  - a. Weatherproof Class 2 photocell shall be provided for exterior light levels.
  - b. Adjustable interior photo cell shall be provided for day-lighting control.
    - 1) Photocell shall provide output suitable for controlling continuously dimming loads.
    - 2) Refer to Contract Drawings for fixtures to be controlled.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. General:
  1. Install switches flush with wall, straight and level.
  2. Permanently label switches as shown on drawing schedule in Contract Drawings.
- B. Interface With Other Work:
  1. Coordinate with appropriate Sections of Divisions 26.
  2. Program system to meet the local energy code.

#### **3.2 FIELD QUALITY CONTROL**

- A. Field Testing:
  1. Manufacturer shall provide Manufacturer's authorized Technician to adequately test supplied equipment and software to ensure system performs as intended including the following:
    - a. Test start-up system and confirm proper installation, operation, and adjustment of all system components.
  2. Submit Certification in writing that equipment has been installed, adjusted and tested in accordance with Manufacturer's recommendations.
- B. Non-Conforming Work: Non-conforming work as covered in the General Conditions applies, but is not limited to following:
  1. Correct any work found defective or not complying with Contract Document requirements at no additional cost to the Owner.

#### **3.3 CLOSE-OUT ACTIVITIES**

- A. Instruction of Owner:
  1. Provide Manufacturer's authorized Technician training session for Owner's Representative(s) for demonstrating operation and programming of completed system.
    - a. Training program shall include instructions on control system, programming, and other major components. Provide Manufacturer Manual(s) to be submitted to Owner to assist training.
    - b. Training program shall include:
      - 1) System review of all system components and their function.

- 2) System review of all management software and its function.
- 3) Operator training to develop experience with control applications.

**END OF SECTION**

**SECTION 26 5600**  
**EXTERIOR LIGHTING**

**PART 1 - GENERAL****1.1 SUMMARY**

- A. Includes But Not Limited To:
  - 1. Furnish and install exterior lighting system as described in Contract Documents.
- B. Products Furnished But Not Installed Under This Section:
  - 1. Anchor bolts.
- C. Related Requirements:
  - 1. Section 03 3111: 'Cast-In-Place Structural Concrete' for bases for light poles and installation of anchor bolts.
  - 2. Section 26 0501: 'Common Electrical Requirements'.

**PART 2 - PRODUCTS****2.1 SYSTEM**

- A. Manufacturers:
  - 1. Manufacturer Contact List:
    - a. Cutler-Hammer Inc, Milwaukee, WI [www.cutler-hammer.eaton.com](http://www.cutler-hammer.eaton.com) or Cutler-Hammer/Eaton Yale Ltd, Burlington, ON (905) 333-6442.
    - b. General Electric Industrial Systems, Charlotte, NC or G E Lighting Canada Inc, Mississauga, ON [www.geindustrial.com](http://www.geindustrial.com).
    - c. Intermatic Inc, Spring Grove, IL [www.intermatic.com](http://www.intermatic.com).
    - d. Paragon Electric Co Inc, Carol Stream, IL [www.icca.invensys.com/paragon](http://www.icca.invensys.com/paragon) or Paragon Electric / Maple Chase, Mississauga, ON (800) 951-5526 or (905) 890-5956.
    - e. Siemens Energy & Automation, Alphrata, GA [www.sea.siemens.com](http://www.sea.siemens.com) or Siemens Canada, Mississauga, ON (905) 819-8000.
    - f. Square D Co, Palatine, IL or Square D / Schneider Electric, Toronto, ON [www.squared.com](http://www.squared.com).
    - g. Tork Inc, Mount Vernon, NY [www.tork.com](http://www.tork.com).
- B. Materials:
  - 1. Exterior Fixtures:
    - a. Finish shall be high quality polyester powder coating:
      - 1) Finish process shall consist of cleaning, electrostatically applying power coat, and thermal curing.
      - 2) Weather, scratch, UV, and fade resistant.
    - b. Color shall be Manufacturer's standard white, natural aluminum, or medium bronze as selected by Architect before bidding.
    - c. Type One Acceptable Products:
      - 1) As indicated on Fixture Schedule. Do not mix fixtures from different manufacturers for one use.
      - 2) Equals as approved by Architect before bidding. See Section 01 6200.
  - 2. Parking Area Poles:
    - a. Designed for wind loading required for Project location as determined by Architect.
    - b. Aluminum hinged base type with matching aluminum anchor bolt cover secured to base.
    - c. Include hand hole with cover at pole base.
    - d. Finish And Color: Match parking area fixtures.

3. Exterior Lighting Control:
  - a. Photo Cell:
    - 1) 120 volts.
    - 2) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
      - a) Paragon: CW201-00.
      - b) Tork: 2101.
  - b. Lighting Contactor:
    - 1) 120 volt coil, 20 amps, 2 pole, NEMA 1 enclosure.
    - 2) By same manufacturer as main panelboard.
    - 3) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
      - a) Cutler Hammer: CN35.
      - b) General Electric: CR260L-21CA22.
      - c) Siemens: LEN01B200120A.
      - d) Square D: Class 8903, Type LG-20.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Interface With Other Work:
  1. Coordinate location of anchor bolts and conduit in concrete bases so pole will be properly mounted and centered on base.
  2. Install hinged light pole bases so poles can be completely lowered to ground without obstruction out into parking area.
- B. Lighting Control:
  1. Install time switches, manual bypass switches, and contactor inside building to control parking area and building exterior lighting. Label each component to identify lighting controlled, I.E. 'PARKING LIGHTING' or 'BUILDING LIGHTING.' Label with 1/16 inch (1.5 mm) thick laminated plastic composition material with contrasting color core. Engraved letters shall be 1/4 inch (6 mm) high.
  2. Locate photocell(s) outside building under soffit and away from any light source and direct sunlight.
  3. Wire photocell and time switch in series for photo cell ON, time switch OFF operation.

**END OF SECTION**