

## SECTION 26 05 00

### ELECTRICAL METHODS AND MATERIALS

#### PART 1 - GENERAL

##### 1.1 NOTE

- A. The requirements of Section 26 00 00 apply to work performed under this Section.
- B. The requirements of this Section of the Specifications apply to and form a part of the individual Electrical Sections of the Specifications.

##### 1.2 SCOPE

- A. The Work under this Section of the Specification includes the furnishing of labor, materials and equipment for the installation of a complete electrical system as shown and as specified herein.

#### PART 2 - PRODUCTS

##### 2.1 SAFETY SWITCHES

- A. Subject to compliance with requirements, provide products by one of the following:
  - 1. Square D
  - 2. Eaton Cutler Hammer
- B. General
  - 1. Horsepower rated switches, of the appropriate size, where applicable.
  - 2. 240 Volt
    - a. Heavy duty type
  - 3. 480 Volt
    - a. Heavy duty type
  - 4. Fused
    - a. Heavy duty switches - rated 200,000 RMS symmetrical amperes at 480 volts.
  - 5. Cover interlock to prevent operation with cover open.
  - 6. Visible blade
  - 7. Externally handle operated with current carrying parts silver or tin plated.
  - 8. Provisions for two or more external padlocks
  - 9. Capable of accepting copper or aluminum cables.
  - 10. Ground kit and neutral kit as required.
  - 11. Labeled for use as service equipment.
  - 12. Pull out switch type disconnects are not acceptable.
- C. Enclosures
  - 1. Provide enclosure at installed locations with the following environmental ratings:
    - a. Indoor, dry and clean locations: NEMA 250 Type 1
    - b. Indoor damp and wet locations: NEMA 250 Type 3R
    - c. Outdoor Locations: NEMA 250, Type 3R

## 2.2 FUSES

- A. Subject to compliance with requirements, provide products by one of the following:
  - 1. Bussman (basis of design)
  - 2. Mersen (Ferraz-Shawmut)
  - 3. Littlefuse
- B. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
  - 1. Type RK-1: 250V and 600V, zero to 600A rating, 200 kAIC time delay.
- C. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

## 2.3 MOTOR STARTERS

- A. Motors shall be provided with starters under this Division or other Divisions of the Specifications as hereinafter designated in this Division of the Specifications.
- B. Manual Motor Starting Switches
  - 1. Subject to compliance with requirements, provide products by one of the following:
    - a. Square D Class 2510 (basis of design)
    - b. Allen Bradley
    - c. Eaton Cutler Hammer
  - 2. General Requirements:
    - a. Built-in thermal overload protection properly sized for the motor protected.
    - b. Handle guards which permit padlocking in the "Off" position.
    - c. Red 'on' pilot light.
    - d. Enclosures:
      - i. Unfinished dry locations, surface mounted: NEMA Type 1.
      - ii. Finished dry locations, flush mounted: NEMA Type 1.
      - iii. Damp and wet locations, surface mounted: NEMA Type 4

## 2.4 OCCUPANCY/VACANCY SENSOR SWITCHES

- A. Subject to compliance with requirements, provide products by one of the following:
  - 1. Sensor Switch (basis of design, model as noted)
  - 2. Leviton
  - 3. Watt Stopper
  - 4. Hubbell
- B. Unless otherwise noted, all sensors for interior applications (excluding corridors, stairways, restrooms, primary building entrance areas, lobbies, and parking garages) shall be wired as vacancy sensors (manual on, automatic off).
  - 1. Ceiling-mount sensors shall achieve manual-on via low-voltage wall station.
- C. All sensors shall utilize dual technology (infrared and ultrasonic).

- D. Sensor layout indicated on drawings is for reference only. Submit a sensor layout by sensor manufacturer indicating exact placement of devices and coverage area of each sensor.
- E. Wall-mount
  - 1. Wall switch sensors shall be rated for 120/277V operation, compatible with load to be controlled and with capacity exceeding load connected.
  - 2. Sensors shall be factory set to manual-on operation.
  - 3. Sensors shall be equipped with the following: manual override switch for on/off operation; adjustable timer settings; minimum on time to maximize lamp life; optional ambient light sensing override.
  - 4. Basis-of-design product is Sensor Switch WSX PDT SA.
- F. Ceiling-mount
  - 1. Ceiling sensors shall be rated for 120/277V operation, up to 2000 square feet coverage area, surface-mountable to suspended ceiling.
  - 2. Provide low voltage power packs as required. Each power pack shall be capable of accepting at least six sensors.
  - 3. Sensors shall be equipped with the following: adjustable timer settings; self-adjusting technology to minimize nuisance switching; low voltage auxiliary relay/contacts; optional ambient light sensing override.
  - 4. Basis-of-design product is Sensor Switch nCM 10 series.
  - 5. Where indicated on Drawings, provide sensors with automatic dimming control photocell, and associated 0-10V dimming power pack, Cat5e cable, and related accessories. Basis-of-design product is Sensor Switch nCM 10 ADC series.
- G. Low Voltage Wall Station
  - 1. Low voltage wall stations shall be configured for manual on operation to comply with energy code requirements. Stations shall include soft-click buttons and LED indicator lights, and shall be designed for use with low voltage ceiling sensors and related power packs.
  - 2. Provide 0-10V dimming control where indicated on Drawings.
  - 3. Basis-of-design product is Sensor Switch nPODM series.

## 2.5 WIRING DEVICES

- A. Subject to compliance with requirements, provide products by one of the following:
  - 1. Hubbell
  - 2. Leviton
  - 3. Pass & Seymour
- B. Lighting switches:
  - 1. Single pole, Three-way and Four-way
  - 2. Pilot light (where noted): illuminated when switch is on
  - 3. Toggle type
  - 4. Back and side wired
  - 5. Commercial specification grade
    - a. 120/277V
    - b. 20A

6. Color: Ivory
- C. Receptacle outlets:
  1. Duplex or simplex as noted.
  2. Polarized grounding
  3. Back and side wired
  4. Commercial specification grade
    - a. 120V
    - b. 20A
  5. Color: Ivory
- D. GFI outlets:
  1. Duplex
  2. Commercial specification grade
    - a. 120V
    - b. 20A
  3. Tamper resistant where required
  4. Weather-resistant type in wet or damp locations
  5. Self-testing with red LED for lost capability to provide protection.
  6. Color: Ivory
- E. Wiring Device Coverplates:
  1. Interior use
    - a. standard sized
    - b. satin finished stainless steel
  2. Exterior use or in damp or wet locations:
    - a. Specification grade
    - b. Weatherproof cast aluminum construction
    - c. Gasketed plate & device covers
    - d. U.L Listed for its intended use as follows:
      - i. Type 1: U.L. Listed & suitable for wet locations while in use (plug inserted at all times).
- F. Provide appropriate DS covers on exposed FS boxes. Plates on narrow partitions or in locations too narrow for standard width plates shall be 1-11/16 inches wide, single or two gang tandem.

## 2.6 BOXES AND FITTINGS

- A. Provide metal boxes manufactured by one of the following:
  1. ABB/Steel City
  2. ABB/Thomas & Betts
  3. Racor
  4. Crouse-Hinds
  5. Walker
- B. Provide pressed steel galvanized boxes, #14 gauge minimum, for boxes less than 50 cubic inches installed:
  1. flush in walls and concrete slabs
  2. above removable ceilings and similar spaces
  3. exposed at ceilings of unfinished spaces

- C. Provide O-Z/Gedney type "FS" or "FD" cast aluminum device boxes, equipped with matching covers for boxes less than 50 cubic inches accommodating wiring devices installed:
  - 1. flush in exterior locations
  - 2. exposed on walls of unfinished interior spaces
- D. Provide boxes 50 cubic inches and larger and wire troughs as follows:
  - 1. Constructed of sheet steel
  - 2. Equipped with flat sheet steel covers held in place with round headed machine screws
  - 3. Weld and grind joints to remove burrs.
  - 4. Provide hot dip galvanized boxes and covers.
  - 5. Provide covers to flush boxes which overlap box approximately 3/4 inch on sides.
- E. Provide pull boxes, junction boxes and wire troughs indicated in the construction documents, or required by field conditions or the National Electrical Code to facilitate wiring installation. Obtain approval prior to installing boxes in finished areas.
- F. Provide a 4 inches square, 1-1/2 inches deep or larger box with appropriate raised covers or plaster rings for flush mounted switches and receptacles.
- G. Locate boxes in face block, brick or tile walls at the course line and fit with square tile covers similar to Raco Series 782 or 792, or ABB/Steel City Series GW where walls are 6 inches or more in thickness.
- H. Provide 4 inch octagonal boxes for ceiling and wall recessed outlets for lighting fixtures, except where required by fixture design.
- I. Where switches and receptacles are indicated in close proximity to each other provide one multi-gang box with single plate. Install one device in each gang. Use solid gang boxes or sectional boxes for three or more devices.
- J. Provide gang boxes containing both low voltage or communications system wiring and branch circuit conductors or containing normal and emergency system wiring equipped with internal barriers to separate the two systems as required by the National Electrical Code.
- K. Do not use, unless specifically indicated, through-wall boxes or boxes mounted back-to-back.
- L. In fire-rated assemblies, install boxes in a manner listed for such purpose.
- M. Mount flush boxes in or exposed on walls plumb. Install flush boxes such that the distance between the lip of the box and the wall is less than 1/8 inch. Mount receptacles vertically, unless noted otherwise.
- N. Provide gasketed covers for boxes in exterior, damp, or wet locations.
- O. Provide blank stainless steel device plates as covers for pressed steel pull and junction boxes installed flush in walls of finished areas. Provide flat galvanized steel covers for pressed steel pull and junction boxes in other locations.
- P. Provide device-specific cover plates for boxes used to accommodate wiring devices.

- Q. Provide two-point support for wall and ceiling mounted boxes whose largest surface is less than 200 square inches in area. Provide additional support where the conduit system in conjunction with these supports does not provide a rigid installation. Provide a minimum of four-point support for boxes whose largest surface exceeds 200 square inches in area.
- R. Provide 3/8 inch threaded steel rod studs, securely anchored to the building, which pass through the center knockout in the back of boxes for connection and support of lighting fixtures weighing 50 pounds or more.
- S. Provide sheet steel pull and junction boxes and wire troughs with metal gauges as follows, the dimensions being those of the largest surface:

Maximum Dim. Inches	Maximum Square Inches	Box Gauge	Cover Gauge
26	600	16	14
40	1000	14	12
60	1500	12	12
over 60	over 1500	10	10

- T. Provide wire troughs as follows:
  - 1. Steel enclosed wireway
  - 2. UL listed and labeled for use and application
  - 3. 16 gauge steel for size 6" x 6" and smaller
  - 4. 14 gauge steel for larger sizes.
  - 5. Raintight when installed in wet or damp locations
  - 6. Manufactured by Square D, General Electric, Siemens, Cutler-Hammer, Hoffman, Rittal Corp, or Keystone.

## 2.7 CONDUCTORS

- A. Subject to compliance with requirements provide products by one of the following:
  - 1. Southwire
  - 2. General Cable
  - 3. Encore Wire
- B. Provide soft drawn, 98 percent conductivity, copper conductors with 600 volt insulation, and manufactured in accordance with the requirements of the National Electrical Code, the Board of Fire Underwriters, A.S.A., N.E.M.A. and I.C.E.A.
- C. Unless specifically noted otherwise on Drawings, feeders and conduits are sized for copper.
- D. Aluminum conductors are not permitted.
- E. Provide conductors with 90 °C "THHN-THWN" insulation.

## 2.8 CABLE

- A. Metal clad cable

1. Subject to compliance with requirements provide products by one of the following:
  - a. Southwire
  - b. General Cable
  - c. Encore Wire
2. Provide type "MC" cable with galvanized steel armor, "THHN/THWN" 90° C, 600 volt, insulated copper conductors and insulated green grounding conductor.
3. Comply with Federal Specification A-A-59544 and bears the UL label.

## 2.9 RACEWAYS AND WIRING METHODS

- A. Rigid metal conduit (RMC)
  1. Galvanized threaded heavy-wall steel conduit and threaded couplings
  2. Comply with UL 6 and ANSI Standard C80.1.
- B. Electrical Metallic Tubing (EMT)
  1. Galvanized steel conduit
  2. Comply with UL797 and ANSI C80.3.
  3. Couplings and box connectors for all other locations:
    - a. steel
    - b. compression ring type
- C. Flexible metal conduit
  1. Zinc coated steel.
  2. Comply with UL 1.
- D. Liquid tight flexible metal conduit
  1. Flexible steel conduit with PVC jacket.
  2. Comply with UL 360.

## PART 3 - EXECUTION

### 3.1 EQUIPMENT CONNECTIONS

- A. Conduit, outlets, wiring and other necessary fittings or accessories for power connections for heating equipment, fans and special furnishings shall be provided under this Section. Motor and equipment of different ratings shall be furnished, and circuit components shall be adjusted accordingly.
- B. Make final connections to electrical equipment, whether equipment is specified under this Section or other Sections of the Specifications.

### 3.2 WIRING DEVICES

- A. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for device boxes with routers that are guided by riding against outside of boxes.
- B. Clean boxes prior to installation of devices.
- C. When conductors larger than what is recommended for termination by the manufacturer are installed, splice #12AWG pigtails for device connection. Do not exceed box fill requirements.

- D. Install ground pin of vertically mounted receptacles up and on horizontally mounted receptacles to the right.

### 3.3 SAFETY SWITCHES

- A. Coordinate layout of switches to maintain required workspace clearances and clearances/access for equipment access doors and panels.
- B. Install fuses in fusible switches.

### 3.4 FUSES

- A. Feeders
  - 1. Class RK1, time delay
- B. Motor Circuits Protection
  - 1. Class RK1, time delay.
- C. General Branch Circuit Devices
  - 1. Class RK1, time delay.
- D. Fuses shall not be installed until installation is complete. Fuses shall be installed on the job site; they shall not be installed in equipment at the factory and shipped in place in the equipment.
- E. Fuses shall be of the same manufacturer and shall be of the sizes indicated. Where not indicated, fuses shall be of the proper size for the equipment protected.
- F. Provide one (1) set of fuses in fuse spaces and leave one (1) replacement set with owner.
- G. Requests for change in manufacturer or fuse types from that specified below shall be accompanied by a complete coordination study indicating the suitability of the proposed changes.

### 3.5 MOTORS, EQUIPMENT, CONTROLS AND CONTROL WIRING

- A. Motors, air handling units, compressors, etc., and built-in control devices will be provided under other Sections unless noted otherwise.
- B. Provide power connections for equipment furnished under other Sections.
- C. The installation, connections and operation of controls not noted will be done under other Sections, including provisions for conduits, wiring, outlet boxes, control components and connections.
- D. Control wires shall be marked with "E-Z" tape markers at terminal points. Terminal blocks shall be marked to correspond to wire terminated.
- E. Provide conduit and wires, install and connect control equipment (starters, push buttons, etc.) and connect motors, air handling units, air conditioning equipment, and built-in control devices, in accordance with wiring diagrams furnished under other Sections.

### 3.6 CONDUCTOR AND CABLE APPLICATIONS

- A. Exposed Feeders: Type THHN/THWN, single conductors in raceway



- B. Feeders concealed in ceilings, wall, partitions and crawl spaces: Type THHN/THWN, single conductors in raceway.
- C. Exposed branch circuits: Type THHN/THWN, single conductors in raceway.
- D. Branch circuits concealed in ceilings, new walls/partitions and crawl spaces:
  - a. Type THHN/THWN, single conductors in raceway.
- E. Branch circuit concealed in existing walls and partitions: MC cable.
- F. Connections to light fixtures: MC cable 5'-0" maximum length.

### 3.7 CONDUCTOR AND CABLE INSTALLATION

- A. Sizes are AWG or kcmil. Minimum size for power and lighting circuits is #12. Minimum size for 120 volt control circuits is #14. Minimum insulation rating of conductors is 600 volts.
- B. Provide stranded wire for No. 10 and larger. Make conductors continuous from outlet with no splices made except within outlet or junction boxes.
- C. Conceal cables in finished walls, ceiling and floors unless otherwise indicated.
- D. Use manufacturer approved pulling compound or lubricant where necessary. Compound used must not deteriorate conductor or insulations. Do not exceed manufacturer's recommended maximum pulling tensions.
- E. Install concealed and exposed cables parallel and perpendicular to structural members.
- F. A color coding system shall be as follows throughout the building's network of feeders and circuits and used as a basis of balancing the load. The color code shall be continuous from fixture to fixture or other outlet.

Color System	Phase A	Phase B	Phase C	Neutral
480Y/277V	Brown	Orange	Yellow	Gray
208Y/120V	Black	Red	Blue	White

- G. Wire and cable shall be delivered to the job site in full coils or reels, each bearing a tag containing the UL approval stamp, name of manufacturer, trade name, code, type of wire, and month and year manufactured.

### 3.8 RACEWAY APPLICATIONS

- A. Outdoors:
  - 1. Exposed Conduit: RMC
- B. Indoors:
  - 1. Exposed: EMT
  - 2. Concealed in ceilings, interior walls and partitions:
    - i. EMT
  - 3. Connection to vibrating equipment:
    - a. Interior dry locations: FMC
    - b. Interior/Exterior damp and wet locations: LFMC
    - c. The use of LFNC is not permitted.

4. Damp or wet locations: RMC

3.9 RACEWAY INSTALLATION

- A. Minimum Raceway Size: 3/4" trade size. 1/2" may be used for control cabling.
- B. Raceway Fittings: compatible with raceways and suitable for use and location.
- C. Do not fasten conduits onto the bottom side of a metal roof deck.
- D. Run conduits and cabling parallel and perpendicular to structural members.
- E. Install no more than the equivalent of three 90 degree bends in any conduit run.
- F. Provide bushings on the ends of all conduits.
- G. Install pull wires in empty raceways. Utilize polypropylene or monofilament plastic line with not less than 200 lb tensile strength.
- H. Install devices to seal raceway interiors at accessible locations in the following locations:
  - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Heated to unheated spaces.
  - 3. Where otherwise required by the NEC.
- I. Provide expansion joint fittings in the following locations:
  - 1. Where conduits cross building or structure expansion joints
  - 2. Exposed above ground runs of PVC that has a straight run length that exceeds 50 feet.
- J. Use a maximum of 6'-0" of flexible conduit or MC cable for connection to recessed/semi-recessed light fixtures, transformers and equipment subject to vibration.
- K. Bends in conduits for high voltage, telephone, data, television and similar cables shall be made with wide-sweep field bends. Radius of wide sweep bends shall be as required by the National Electrical Code for conduits containing cables with lead sheath. No manufactured elbows permitted.
- L. Conduits in close proximity to one another in concrete slabs (at panelboards, etc.) shall be located and wrapped with wire mesh to prevent cracking of slab.
- M. Conduits shall be installed concealed in walls, floors and above ceilings throughout, except as follows:
  - a. Where suspended ceilings are not provided, and the restrictions below prohibit conduit installation in concrete slab.
  - b. In vertical shafts, electrical closets, mechanical and electrical equipment spaces, etc. where concealment is not practical.
  - c. At surface-mounted panelboards in otherwise finished spaces, limited to vertical runs above and below panel.
  - d. Where required for equipment connections.

### 3.10 WIRING METHODS

- A. Cable methods shall conform to the National Electrical Code requirements and these Specifications and shall produce a complete, safe, well-built electrical system.
- B. Conduit nipples connecting outlets in adjoining rooms shall be packed with Johns-Manville "Duxseal" after wires are in place to prevent transmission of noise between rooms unless nipples are 12 inches or more in length.
- C. Provide blank cover plates for unused data outlet assemblies.
- D. Provide wallplate blanks for unused data termination ports.
- E. Provide a grounded ("neutral") conductor at each light switch location.
- F. Where electrical equipment or material is installed in or through fire-rated building elements, provide appropriate UL-listed firestop material to maintain the rated integrity of the affected surface.
- G. Provide cable supports for all cables installed in vertical raceways, with maximum spacing as required by NEC. In conduit risers, provide type "S" cable supports manufactured by O-Z/Gedney. Provide pullboxes and any additional appurtenances required to accomplish support requirement. For fire-rated cable assembly, provide support per manufacturer's listing in addition to NEC requirements.

### 3.11 SPLICES AND TERMINATIONS

- A. Splices in branch circuits and control wiring shall be made with "Wirenuts". Splices shall be insulation rated for 90°C at 600 volts. Push in wire connectors or scotchloks are not permitted.
- B. Splices, taps and terminations for feeder and motor wiring shall be made with approved set screw mechanical taps, sleeves or lugs. Provide terminations with a minimum 75°C rating at 600 volts.
- C. Vinyl electrical tape shall be 90°C, 600 volt insulation rated for use whenever added insulation is required. Rubber and friction tape shall not be used.

### 3.12 TESTING

- 1. Perform tests and inspections:
  - a. Visual and Mechanical Inspection:
    - i. Inspect physical and mechanical condition.
    - ii. Inspect anchorage, alignment, grounding, and clearances.
    - iii. Verify unit is clean.
    - iv. Verify blade alignment and mechanical operation.
    - v. Verify fuse sizes and types match the specifications and drawings.
    - vi. Verify tightness of bolted electrical connections.
  - b. Prepare and submit test and inspection report.
- B. Wiring Devices
  - 1. Perform the following tests and inspections
    - a. Test Instruments: Use instruments that comply with UL 1436.

- b. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- c. Test for Receptacles:
  - i. Line Voltage: Acceptable range is 114 to 126 V.
  - ii. GFCI Trip: Test using integral test/reset buttons.
  - iii. Using the test plug, verify that the device and its outlet box are securely mounted.
- 2. Wiring device will be considered defective if it does not pass tests and inspections.
- 3. Prepare and submit test and inspection reports.

END OF SECTION 260500