

**SECTION 26 24 11**  
**DISTRIBUTION SWITCHBOARDS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies the furnishing, installation, and connection of the distribution switchboards.

**1.2 RELATED WORK**

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.
- C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for Personnel Safety and to provide a low impedance path for possible fault currents.
- D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit and outlet boxes.

**1.3 QUALITY ASSURANCE**

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 FACTORY TESTS**

- A. Distribution switchboards shall be thoroughly tested at the factory to assure that there are no electrical or mechanical defects. Tests shall be conducted as per NEMA PB 2 and UL 891. Factory tests shall be certified.
- B. The following additional tests shall be performed:
  - 1. Verify that circuit breaker sizes and types correspond to drawings.
  - 2. Verify tightness of bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.
  - 3. Exercise all active components.
  - 4. Perform a dielectric withstand voltage test on each bus section, each phase-to-ground with phases not under test grounded, in accordance with manufacturer's published data.
  - 5. Perform insulation-resistance tests on control wiring with respect to ground. Applied potential shall be 500 volts dc for 300-volt rated cable and 1000 volts dc for 600-volt rated cable, or as required if

solid-state components or control devices cannot tolerate the applied voltage.

- C. Furnish four (4) copies of certified manufacturer's factory test reports to the Resident Engineer prior to shipment of the switchboards to ensure that the switchboards have been successfully tested as specified.

#### **1.5 SUBMITTALS**

Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS:

A. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, temperature rise, wiring and connection diagrams, plan, front, side, and rear elevations, sectional views, bus work, circuit breaker frame sizes, trip and short-circuit rating, long-time, short-time, instantaneous and ground fault settings, coordinated breaker and fuse curves, accessories, and device nameplate data.
3. Show the size, ampere-rating, number of bars per phase and neutral in each bus run (horizontal and vertical), bus spacing, equipment ground bus, and bus material.

B. Manuals:

1. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering replacement parts.
  - a. Wiring diagrams shall have their terminals identified to facilitate installation, maintenance, and operation.
  - b. Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnection between the items of equipment.
  - c. Provide a clear and concise description of operation, which gives, in detail, the information required to properly operate the equipment.
  - d. Approvals will be based on complete submissions of manuals together with shop drawings.
2. Two weeks prior to final inspection, deliver four copies of the final updated maintenance and operating manuals to the Resident Engineer.
  - a. The manuals shall be updated to include any information necessitated by shop drawing approval.

- b. Complete "As Installed" wiring and schematic diagrams shall be included which show all items of equipment and their interconnecting wiring.
  - c. Show all terminal identification.
  - d. Include information for testing, repair, trouble shooting, assembly, disassembly, and recommended maintenance intervals.
  - e. Provide a replacement parts list with current prices. Include a list of recommended spare parts, tools, and instruments for testing and maintenance purposes.
  - f. Furnish manuals in loose-leaf binder or manufacturer's standard binder.
- C. Certifications:
- 1. Two weeks prior to final inspection, submit four copies of the following to the Resident Engineer:
    - a. Certification by the Contractor that the assemblies have been properly installed, adjusted and tested, including circuit breakers settings.
    - b. Certified copies of all of the factory design and production tests, field test data sheets and reports for the assemblies.

#### **1.6 APPLICABLE PUBLICATIONS**

Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.

- A. Institute of Engineering and Electronic Engineers (IEEE):
- C37.13.....Low Voltage AC Power Circuit Breakers Used in Enclosures
  - C57.13.....Instrument Transformers
  - C62.41.....Surge Voltage in Low Voltage AC Power Circuits
  - C62.45.....Surge Testing for Equipment connected to Low-Voltage AC Power Circuits
- B. National Electrical Manufacturer's Association (NEMA):
- PB-2.....Dead-Front Distribution Switchboards.
  - PB-2.1.....Instructions for Proper Handling, Installation, Operation, and Maintenance of Switchboards
  - AB-1.....Molded Case Circuit Breakers, Molded Case Switches and Circuit Breaker Enclosures
- C. National Fire Protection Association (NFPA):
- 70.....National Electrical Code (NEC)

D. Underwriters Laboratories, Inc. (UL):

- 67.....Panelboards
- 489.....Molded Case Circuit Breakers and Circuit  
Breakers Enclosures
- 891.....Dead-Front Switchboards
- 1283.....Electromagnetic Interference Filters
- 1449.....Transient Voltage Surge Suppressors

**PART 2 - PRODUCTS**

**2.1 GENERAL**

- A. Switchboards shall be in accordance with UL, NEMA, NEC, IEEE, and as shown on the drawings.
- B. Switchboards shall be provided complete, ready for operation including, but not limited to housing, buses, circuit breakers, instruments and related transformers, fuses, and wiring.
- C. Switchboard dimensions shall not exceed the existing space limitations to allow the equipment to be installed as indicated on the drawings.
- D. Manufacturer's nameplate shall include complete ratings of switchboard in addition to the date of manufacture.

**2.2 BASIC ARRANGEMENT**

- A. Type I: Switchboard shall be front accessible with the following features:
  - 1. Device mounting:
    - a. Main breaker: Individually mounted and compartmented or group mounted with feeder breakers.
    - b. Feeder breakers: Group mounted.
  - 2. Section alignment: As shown on the drawings.
  - 3. Accessibility:
    - a. Main section line and load terminals: Front and side.
    - b. Distribution section line and load terminals: Front.
    - c. Through bus connections: Front and end.
  - 4. Bolted line and load connections.
  - 5. Full height wiring gutter covers for access to wiring terminals.
  - 6. Short Circuit Current Rating: 50,000 amperes rms symmetrical, minimum, or as shown on the drawings, whichever is higher.

**2.3 HOUSING**

- A. Provide a completely enclosed, free standing, steel enclosure not less than the gage required by the ANSI and UL standards. The enclosure is to

consist of the required number of vertical sections bolted together to form one metal enclosed rigid switchboard. The sides, top and rear shall be covered with removable screw on sheet steel plates.

- B. Provide ventilating louvers where required to limit the temperature rise of current carrying parts. All openings shall be protected against entrance of falling dirt, water, or foreign matter.
- C. Enclosure shall be thoroughly cleaned, phosphate treated, and primed with rust-inhibiting paint. Final finish coat to be the manufacturers standard gray. Provide a quart of finish paint for touch-up purposes.

#### **2.4 BUSES**

- A. General: Buses shall be arranged for 3 phase, 4 wire distribution. Main phase buses (through bus), full size neutral bus, and ground bus shall be full capacity the entire length of the switchboard. Provide for future extensions by means of bolt holes or other approved method. Brace the bus to withstand the available short circuit current at the particular location and as shown on the drawings. No magnetic material shall be used between buses to form a magnetic loop.
- B. Material and Size: Buses and connections shall be hard drawn copper of 98 percent conductivity. Bus temperature rise shall not exceed 65 degrees C (149 degrees F). Section busing shall be sized based on UL and NEMA Switchboard Standards.
- C. Bus Connections: All contact surfaces shall be copper. Provide a minimum of two plated bolts per splice. Where physical bus size permits only one bolt, provide a means other than friction to prevent turning, twisting or bending. Torque bolts to the manufacturer's recommended values.
- D. Neutral Bus: Provide bare or plated bus and mount on insulated bus supports. Provide neutral disconnect link to permit isolation of neutral bus from the common ground bus and service entrance conductors.
- E. Ground Bus: Provide an uninsulated 6 mm by 50 mm (1/4 inch by 2 inch) copper equipment ground bus bar sized per UL 891 the length of the switchboard and secure at each section.

#### **2.5 NAMEPLATES AND MIMIC BUS**

- A. Nameplates: For Normal Power system, provide laminated black phenolic resin with white core with 1/2 inch [12mm] engraved lettered nameplates next to each circuit breaker. For Essential Electrical System, provide laminated red phenolic resin with white core with 1/2 inch [12mm] engraved lettered nameplates next to each circuit breaker. Nameplates shall indicate equipment served, spaces, or spares in accordance with one line diagram shown on drawings. Nameplates shall be mounted with

plated screws on front of breakers or on equipment enclosure next to breakers. Mounting nameplates only with adhesive is not acceptable.

- B. Mimic Bus: Provide an approved mimic bus on front of each switchboard assembly. Color shall be black for the Normal Power system and red for the Essential Electrical System, either factory-painted plastic or metal strips. Plastic tape shall not be used. Use symbols similar to one line diagram shown on drawings. Plastic or metal strips shall be mounted with plated screws.

## **2.6 PROVISION FOR FUTURE**

Where "provision for", "future", or "space" is noted on drawings, the space shall be equipped with bus connections to the future overcurrent device with suitable insulation and bracing to maintain proper short circuit rating and physical clearance. Provide buses for the ampere rating as shown for the future device.

## **2.7 BREAKER REMOVAL EQUIPMENT**

Where draw out circuit breakers are provided, furnish a portable elevating carriage or switchboard permanent top mounted device for installation and removal of the breakers.

## **2.8 CONTROL WIRING**

Control wiring shall be 600 volt class B stranded SIS. Install all control wiring complete at the factory adequately bundled and protected. Wiring across hinges and between shipping units shall be Class C stranded. Size in accordance with NEC. Provide control circuit fuses.

## **2.9 MAIN CIRCUIT BREAKERS**

- A. Type I Switchboard: Provide UL listed and labeled molded case circuit breakers in accordance with NEC and as shown on the drawings. Circuit breakers shall be the solid state adjustable trip type.
1. Trip units shall have field adjustable tripping characteristics as follows:
    - a. Ampere setting (continuous).
    - b. Long time band.
    - c. Short time trip point.
    - d. Short time delay.
    - e. Instantaneous trip point.
    - f. Ground fault trip point.
    - g. Ground fault trip delay.
  2. Breakers, which have same rating, shall be interchangeable with each other.

## **2.10 FEEDER CIRCUIT BREAKERS**

- A. Provide UL listed and labeled molded case circuit breakers, in accordance with the NEC, as shown on the drawings, and as herein specified.
- B. Adjustable Trip Molded Case Circuit Breakers:
  - 1. Provide molded case, solid state adjustable trip type circuit breakers.
  - 2. Trip units shall have field adjustable tripping characteristics as follows:
    - a. Ampere setting (continuous).
    - b. Long time band.
    - c. Short time trip point.
    - d. Short time delay.
  - 3. Breakers, which have same rating, shall be interchangeable with each other.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install the switchboard in accordance with the NEC, as shown on the drawings, and as recommended by the manufacturer.
- B. Anchor switchboard to the slab with plated 1/2 inch [12.5mm] minimum anchor bolts, or as recommended by the manufacturer.
- D. Interior Location. Mount switchboard on concrete slab. Unless otherwise indicated, the slab shall be at least 4 inches [100mm] thick. The top of the concrete slab shall be approximately 4 inches [100mm] above finished floor. Edges above floor shall have 1/2 inch [12.5mm] chamfer. The slab shall be of adequate size to project at least 8 inches [200mm] beyond the equipment. Provide conduit turnups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant. Cut off and bush conduits 3 inches [75mm] above slab surface. Install concrete pads for electrical equipment in accordance with the drawing details using 3000 psi concrete minimum.

### **3.2 ACCEPTANCE CHECKS AND TESTS**

- A. Perform in accordance with the manufacturer's recommendations. Include the following visual and mechanical inspections and electrical tests:
  - 1. Visual and Mechanical Inspection
    - a. Compare equipment nameplate data with specifications and approved shop drawings.
    - b. Inspect physical, electrical, and mechanical condition.

- c. Confirm correct application of manufacturer's recommended lubricants.
  - d. Verify appropriate anchorage, required area clearances, and correct alignment.
  - e. Verify that circuit breaker sizes and types correspond to approved shop drawings.
  - f. Verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey after energization.
  - g. Confirm correct operation and sequencing of electrical and mechanical interlock systems.
  - h. Clean switchboard.
  - i. Inspect insulators for evidence of physical damage or contaminated surfaces.
  - j. Verify correct shutter installation and operation.
  - k. Exercise all active components.
  - l. Verify the correct operation of all sensing devices, alarms, and indicating devices.
  - m. If applicable, verify that vents are clear.
  - n. If applicable, inspect control power transformers.
2. Electrical Tests
- a. Perform insulation-resistance tests on each bus section.
  - b. Perform overpotential tests.
  - c. Perform insulation-resistance test on control wiring; do not perform this test on wiring connected to solid-state components.
  - d. Perform phasing check on double-ended switchboard to ensure correct bus phasing from each source.

### **3.3 FOLLOW-UP VERIFICATION**

- A. Upon completion of acceptance checks, settings, and tests, the Contractor shall show by demonstration in service that the switchboard is in good operating condition and properly performing the intended function. Circuit breakers shall be tripped by operation of each protective device.

### **3.4 INSTRUCTION**

- A. Furnish the services of a factory certified instructor for one 4 hour period for instructing personnel in the operation and maintenance of the switchboard and related equipment on the date requested by the Resident Engineer.

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