

## **SECTION 262300 - LOW-VOLTAGE SWITCHGEAR**

Latest Update 5-6-2017 See underlined text for Edits.

(Engineer shall edit specifications and blue text in header to meet project requirements. This includes but is not limited to updating Equipment and/or Material Model Numbers indicated in the specifications and adding any additional specifications that may be required by the project. Also turn off all "Underlines".)

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and all other sections of Division 26.

#### **1.2 SUMMARY**

- A. This Section includes metal-enclosed, low-voltage power circuit-breaker switchgear rated 1000 V and less for use in ac systems.
- B. Related Sections include the following:
  - 1. Division 26 Section "Electrical Power Monitoring and Control" for interfacing communication and metering requirements.

#### **1.3 DEFINITIONS**

- A. ATS: Acceptance Testing Service.
- B. GFCI: Ground-fault circuit interrupter.

#### **1.4 SUBMITTALS**

- A. Product Data: For each type of switchgear, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each type of switchgear and related equipment.
  - 1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Include the following:
    - a. Tabulation of installed devices with features and ratings.

- b. Enclosure types and details.
  - c. Outline and general arrangement drawing showing dimensions, shipping sections, and weights of each assembled section.
  - d. Bus configuration with size and number of conductors in each bus run, including phase, neutral, and ground conductors of main and branch buses.
  - e. Current rating of buses.
  - f. Short-time and short-circuit current rating of switchgear assembly.
  - g. Nameplate legends.
  - h. Mimic-bus diagram.
  - i. Utility company's metering provisions with indication of approval by utility company.
  - j. UL listing for series rating of installed devices.
  - k. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
2. Wiring Diagrams: Power, signal, and control wiring.
- C. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around switchgear where pipe and ducts are prohibited. Show switchgear layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.
- D. Samples: Representative portion of mimic bus with specified finish. Manufacturer's color charts showing colors available for mimic bus.
- E. Qualification Data: For testing and inspection agencies.
- F. Field quality-control test reports.
- G. Updated mimic-bus diagram reflecting field changes after final switchgear load connections have been made, for record.
- H. Operation and Maintenance Data: For switchgear and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
- 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
  - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device.
- 1.5 QUALITY ASSURANCE
- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the International

Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. Source Limitations: Obtain switchgear through one source from a single manufacturer.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of switchgear and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Comply with NFPA 70.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver switchgear in sections of lengths that can be moved past obstructions in delivery path.
- B. Store switchgear indoors in clean dry space with uniform temperature to prevent condensation. Protect switchgear from exposure to dirt, fumes, water, corrosive substances, and physical damage.

#### 1.7 PROJECT CONDITIONS

- A. Installation Pathway: Remove and replace building components and structures to provide pathway for moving switchgear into place.
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by UM or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
  1. Notify UM in writing no fewer than 10 days in advance of proposed interruption of electric service.
  2. Do not proceed with interruption of electric service without UM's written permission.

- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchgear, including clearances between switchgear, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
  - 1. Ambient Temperature: Not exceeding 40°C.
  - 2. Altitude: Not exceeding 6600 feet.
  - 3. <Insert unusual service conditions.>

## 1.8 COORDINATION

- A. Coordinate layout and installation of switchgear and components with other construction that penetrates ceilings or is supported by them, including conduit, piping, equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels.
- B. Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

## 1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fuses: [Six] <Insert number> of each type and rating used. Include spares for potential transformer fuses, control power fuses, and fuses and fusible devices for fused circuit breakers.
  - 2. Indicating Lights: [Six] <Insert number> of each type installed.
  - 3. Touchup Paint: [3] <Insert number> containers of paint matching enclosure finish, each 0.5 pint.

## 1.10 WARRANTY/GUARANTEE

- A. See Division 26 Specification Section “Basic Electrical Requirements” for warranty and guarantee requirements.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
1. Square D; Schneider Electric.
  2. Cutler-Hammer, Inc.; Eaton Corporation.

### 2.2 RATINGS

- A. Nominal System Voltage: 480/277 V, 4 wire, 60 Hz.
- B. Main-Bus Continuous: [4000] [3200] [2000] [1600] <Insert other> A.
- C. Short-Time and Short-Circuit Current: Match rating of highest-rated circuit breaker in switchgear assembly.

### 2.3 FABRICATION

- A. Factory assembled and tested and complying with IEEE C37.20.1.
- B. Indoor Enclosure Material: Steel.
- C. Outdoor Enclosure Material: Galvanized steel.
- D. Outdoor Enclosure Fabrication Requirements: Weatherproof; integral structural-steel base frame with factory-applied asphaltic undercoating; and each compartment equipped with the following features:
1. Structural design and anchorage adequate to resist loads imposed by [125-mph] <Insert wind speed> wind.
  2. Space heater operating at one-half or less of rated voltage, sized to prevent condensation.
  3. Louvers equipped with insect and rodent screen and filter; arranged to permit air circulation while excluding insects, rodents, and exterior dust.
  4. Hinged front door with padlocking provisions.
  5. Interior light with switch.
  6. Weatherproof duplex receptacle.
  7. Common internal aisle of sufficient width to permit protective-device withdrawal, disassembly, and servicing in aisle.
  8. Aisle access doors with outside padlocking provisions and interior panic latches.

9. Aisle space heaters operating at one-half or less of rated voltage, thermostatically controlled.
  10. Vapor proof fluorescent aisle lights with low-temperature ballasts, controlled by wall switch at each entrance.
  11. GFCI duplex receptacles, a minimum of two (2), located in aisle.
  12. Aisle ventilation louvers equipped with insect and rodent screen and filter and arranged to permit air circulation while excluding insects, rodents, and exterior dust.
- E. Finish: IEEE C37.20.1, manufacturer's standard gray finish over a rust-inhibiting primer on phosphatizing-treated metal surfaces.
- F. Section barriers between main and tie circuit-breaker compartments shall be extended to rear of section.
- G. Bus isolation barriers shall be arranged to isolate line bus from load bus at each main and tie circuit breaker.
- H. Circuit-breaker compartments shall be equipped to house drawout-type circuit breakers and shall be fitted with hinged outer doors.
- I. Fabricate enclosure with removable, hinged, rear cover panels to allow access to rear interior of switchgear.
- J. Auxiliary Compartments: Match and align with basic switchgear assembly. Include the following:
1. Utility metering compartment that complies with utility company requirements.
  2. Bus transition sections.
  3. Incoming-line pull sections.
  4. Hinged front panels for access to metering, accessory, and blank compartments.
  5. Pull box on top of switchgear for extra room for pulling cable, with removable top, front, and side covers and ventilation provisions adequate to maintain air temperature in pull box within same limits as switchgear.
    - a. Set pull box back from front to clear circuit-breaker lifting mechanism.
    - b. Bottom: Insulating, fire-resistant material with separate holes for cable drops into switchgear.
    - c. Cable Supports: Arranged to ease cabling and adequate to support cables indicated, including those for future installation.
- K. Bus bars connect between vertical sections and between compartments. Cable connections are not permitted.
1. Main Phase Bus: Uniform capacity the entire length of assembly.

2. Neutral Bus: 100% of phase-bus ampacity, except as indicated. Equip bus with pressure-connector terminations for outgoing circuit neutral conductors. Include braces for neutral-bus extensions for busway feeders.
3. Vertical Section Bus Size: Comply with IEEE C37.20.1, including allowance for spare circuit breakers and spaces for future circuit breakers.
4. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent minimum conductivity, with copper feeder circuit-breaker line connections.
5. Use copper for connecting circuit-breaker line to copper bus.  
Revise subparagraph below to select Copper-plated bus when not in a corrosive environment.
6. Contact Surfaces of Buses: Silver [Copper] plated.
7. Feeder Circuit-Breaker Load Terminals: Silver-plated copper bus extensions equipped with pressure connectors for outgoing circuit conductors.
8. Ground Bus: Hard-drawn copper of 98 percent minimum conductivity, with pressure connector for feeder and branch-circuit ground conductors, minimum size one quarter (1/4) inch by two (2) inches.
9. Supports and Bracing for Buses: Adequate strength for indicated short-circuit currents.
10. Neutral bus equipped with pressure-connector terminations for outgoing circuit neutral conductors. Neutral-bus extensions for busway feeders are braced.
11. Neutral Disconnect Link: Bolted, uninsulated, one quarter (1/4) inch by two (2) inch copper bus, arranged to connect neutral bus to ground bus.
12. Provide for future extensions from either end of main phase, neutral, and ground bus by means of predrilled bolt-holes and connecting links.
13. Bus-Bar Insulation: Individual bus bars wrapped with factory-applied, flame-retardant tape or spray-applied, flame-retardant insulation.
  - a. Sprayed Insulation Thickness: 3 mils, minimum.
  - b. Bolted Bus Joints: Insulate with secure joint covers that can easily be removed and reinstalled.

## 2.4 COMPONENTS

- A. Instrument Transformers: Comply with IEEE C57.13.
  1. Potential Transformers: Secondary-voltage rating of 120 V and NEMA accuracy class of 0.3 with burdens of W, X, and Y
  2. Current Transformers: Ratios as indicated; 0-5 amp secondary with 0.3% accuracy, burden suitable for connected relays, meters, and instruments.
- B. Multifunction Digital-Metering Monitor: See Division 26 Section "Electrical Monitoring and Control":
- C. Relays: Comply with IEEE C37.90, types and settings as indicated; with test blocks and plugs.

- D. Surge Arresters: Distribution class, metal-oxide-varistor type. Comply with IEEE C62.11 and NEMA LA 1.
  - 1. Install in cable termination compartments and connect in each phase of circuit.
  - 2. Coordinate rating with circuit voltage.
- E. Provision for Future Devices: Equip compartments with rails, mounting brackets, supports, necessary appurtenances, and bus connections.
- F. Control Power Supply: Constant-voltage control power transformer supplying 120-V control circuits through secondary disconnect devices. Include the following features:
  - 1. Dry-type transformers, in separate compartments for units larger than 3 kVA, including primary and secondary fuses.
  - 2. Two control power transformers in separate compartments with necessary interlocking relays; each transformer connected to line side of associated main circuit breaker.
    - a. Secondary windings connected through a relay or relays to control bus to effect an automatic transfer scheme.
    - b. Secondary windings connected through an internal automatic transfer switch to switchgear control power bus.
  - 3. Control Power Fuses: Primary and secondary fuses with current-limiting and overload protection.
  - 4. Fuses are specified in Division 26 Section "Fuses."
- G. Control Wiring: Factory installed, complete with bundling, lacing, and protection; and complying with the following:
  - 1. Flexible conductors for No. 8 AWG and smaller, for conductors across hinges and for conductors for interconnections between shipping units.
  - 2. Conductors sized according to NFPA 70 for duty required.

## 2.5 CIRCUIT BREAKERS

- A. Description: Comply with IEEE C37.13.
- B. Ratings: As indicated for continuous, interrupting, and short-time current ratings for each circuit breaker; voltage and frequency ratings same as switchgear.
- C. Operating Mechanism: Mechanically and electrically trip-free, stored-energy operating mechanism with the following features:
  - 1. Normal Closing Speed: Independent of both control and operator.
  - 2. Slow Closing Speed: Optional with operator for inspection and adjustment.



3. Stored-Energy Mechanism: Electrically charged, with optional manual charging.
  4. Operation counter.
- D. Trip Devices: Solid-state, overcurrent trip-device system consisting of one or two current transformers or sensors per phase, a release mechanism, and the following features:
1. Functions: Long-time-delay, short-time-delay, and instantaneous-trip functions, independent of each other in both action and adjustment.
  2. Temperature Compensation: Ensures accuracy and calibration stability from minus 5<sup>o</sup>C to plus 40<sup>o</sup>C.
  3. Field-adjustable, time-current characteristics.
  4. Current Adjustability: Dial settings and rating plugs on trip units or sensors on circuit breakers, or a combination of these methods.
  5. Three bands, minimum, for long-time- and short-time-delay functions; marked "minimum," "intermediate," and "maximum."
  6. Pickup Points: Five minimum, for long-time- and short-time-trip functions. Equip short-time-trip function for switchable I<sup>2</sup>t operation.
  7. Pickup Points: Five minimum, for instantaneous-trip functions.
  8. Ground-fault alarming with at least three short-time-delay settings and three trip-time-delay bands; adjustable current pickup. Arrange to provide protection for the following:
    - a. Three-wire circuit or system.
    - b. Four-wire circuit or system.
    - c. Four-wire, double-ended substation.
  9. Trip Indication: Labeled, battery-powered lights or mechanical targets on trip device to indicate type of fault.
- E. Auxiliary Contacts: For interlocking or remote indication of circuit-breaker position, with spare auxiliary switches and other auxiliary switches required for normal circuit-breaker operation, quantity as indicated. Each consists of two Type "a" and two Type "b" stages (contacts) wired through secondary disconnect devices to a terminal block in stationary housing.
- F. Drawout Features: Circuit-breaker mounting assembly equipped with a racking mechanism to position circuit breaker and hold it rigidly in connected, test, and disconnected positions. Include the following features:
1. Interlocks: Prevent movement of circuit breaker to or from connected position when it is closed, and prevent closure of circuit breaker unless it is in connected, test, or disconnected position.
  2. Circuit-Breaker Positioning: An open circuit breaker shall be racked to or from connected, test, and disconnected positions only with the associated compartment door closed unless live parts are covered by a full dead-front shield. An open circuit breaker may be manually withdrawn to a position for removal from the

structure with the door open. Status for connection devices for different positions includes the following:

- a. Test Position: Primary disconnect devices disengaged, and secondary disconnect devices and ground contact engaged.
  - b. Disconnected Position: Primary and secondary devices and ground contact disengaged.
- G. Arc Chutes: Readily removable from associated circuit breaker when it is in disconnected position, and arranged to permit inspection of contacts without removing circuit breaker from switchgear.
- H. Padlocking Provisions: For installing at least three padlocks on each circuit breaker to secure its enclosure and prevent movement of drawout mechanism.
- I. Operating Handle: One for each circuit breaker capable of manual operation.
- J. Electric Close Button: One for each electrically operated circuit breaker.
- K. Mechanical Interlocking of Circuit Breakers: Uses a mechanical tripping lever or equivalent design and electrical interlocks.
- L. Key Interlocks: Arranged so keys are attached at devices indicated. Mountings and hardware are included where future installation of key-interlock devices is indicated.
- M. Undervoltage Trip Devices: Instantaneous, with adjustable pickup voltage.
- N. Undervoltage Trip Devices: Adjustable time-delay and pickup voltage.
- O. Shunt-Trip Devices: Where indicated.
- P. Indicating Lights: Separate indicating lights for circuit breaker is open or closed, for feeder, main and bus tie circuit breakers.

## 2.6 ACCESSORIES

- A. Accessory Set: Furnish tools and miscellaneous items required for circuit-breaker and switchgear test, inspection, maintenance, and operation.
1. Racking handle to manually move circuit breaker between connected and disconnected positions.
  2. Portable test set for testing all functions of circuit-breaker, solid-state trip devices without removal from switchgear.
  3. Relay and meter test plugs suitable for testing switchgear meters and switchgear class relays.

- B. Circuit-Breaker Removal Apparatus: Portable, floor-supported, roller-base, elevating carriage arranged for moving circuit breakers in and out of compartments.
- C. Circuit-Breaker Removal Apparatus: Overhead-circuit-breaker lifting device, track mounted at top front of switchgear and complete with hoist and lifting yokes matching each size of drawout circuit breaker installed.
- D. Spare-Fuse Cabinet: Identified and compartmented steel box or cabinet with lockable door.
- E. Storage for Manual: Include a rack or holder, near the operating instructions, for a copy of maintenance manual.

## 2.7 IDENTIFICATION

- A. Mimic Bus: Continuous mimic bus, arranged in single-line diagram format, using symbols and lettered designations consistent with approved mimic-bus diagram.
  - 1. Mimic-bus segments coordinated with devices in switchgear sections to which applied, to produce a concise visual presentation of principal switchgear components and connections.
  - 2. Medium: Painted graphics, as selected by Architect.
  - 3. Color: Contrasting with factory-finish background; as selected by Architect from manufacturer's full range.
- B. System Power Riser Diagrams: Depict power sources, feeders, distribution components, and major loads. Include as-built data for low-voltage power switchgear and connections as follows:
  - 1. Frame size of each circuit breaker.
  - 2. Trip rating for each circuit breaker.
  - 3. Conduit and wire size for each feeder.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine elements and surfaces where switchgear will be installed for compliance with installation tolerances, required clearances, and other conditions affecting performance.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with applicable portions of NECA 400.
- B. Anchor switchgear assembly to 6-inch, channel-iron floor sill embedded in concrete base and attach by bolting.
  - 1. Sills: Select to suit switchgear; level and grout flush into concrete base.
  - 2. Concrete Bases: 6 inches high, reinforced, with chamfered edges. Extend base no more than three (3) inches in all directions beyond the maximum dimensions of switchgear unless otherwise indicated or unless required for seismic anchor support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, brackets, and temporary blocking of moving parts from switchgear units and components.

### 3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."
- B. Diagram and Instructions:
  - 1. Frame and mount under clear acrylic plastic on the front of switchgear.
    - a. Operating Instructions: Printed basic instructions for switchgear, including control and key-interlock sequences and emergency procedures.
    - b. System Power Riser Diagrams: Depict power sources, feeders, distribution components, and major loads.
  - 2. Storage for Maintenance: Include a rack or holder, near the operating instructions, for a copy of maintenance manual.

### 3.4 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:
1. Inspect switchgear installation, including wiring, components, connections, and equipment. Test and adjust components and equipment.
  2. Verify that electrical control wiring installation complies with manufacturer's submittal by means of point-to-point continuity testing. Verify that wiring installation complies with requirements in Division 26 Sections.
  3. Complete installation and startup checks according to manufacturer's written instructions.
  4. Assist in field testing of equipment including pretesting and adjusting of equipment and components.
  5. Report results in writing.
- B. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters. Perform NETA tests and inspections for each of the following NETA categories:
    - a. Switchgear.
    - b. Circuit breakers.
    - c. Protective relays.
    - d. Instrument transformers.
    - e. Metering and instrumentation.
    - f. Ground-fault systems.
    - g. Battery systems.
    - h. Surge arresters.
    - i. Capacitors.
  2. Remove and replace malfunctioning units and retest as specified above.
- C. Infrared Scanning: After Substantial Completion, but not more than sixty (60) days after Final Acceptance, perform an infrared scan of each switchgear. Remove front and rear panels so joints and connections are accessible to portable scanner.
1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchgear eleven (11) months after date of Substantial Completion.
  2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

3. Record of Infrared Scanning: Prepare a certified report that identifies switchgear checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.6 ADJUSTING

- A. Set field-adjustable, protective-relay trip characteristics according to results in Division 26 Section "Overcurrent Protective Device Coordination Study."
- B. Set field-adjustable, protective-relay trip characteristics.

### 3.7 CLEANING

- A. On completion of installation, inspect interior and exterior of switchgear. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

### 3.8 PROTECTION

- A. Temporary Heating: Apply temporary heat to switchgear, according to manufacturer's written instructions, throughout periods when switchgear environment is not controlled for temperature and humidity within manufacturer's stipulated service conditions.

### 3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchgear. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 262300