

SECTION 26 24 16 – PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes panelboards, overcurrent protective devices, and associated auxiliary equipment rated 600 V and less for the following types:
 - 1. Lighting and appliance branch circuit panelboards.
 - 2. Distribution panelboards.
 - 3. TVSS Devices.

1.2 DEFINITIONS

- A. GFCI: Ground fault circuit interrupter.

1.3 SUBMITTALS

- A. Product Data: For each type of panelboard, overcurrent protective device, accessory, and component indicated. Include dimensions and Manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Bus configuration, current, and voltage ratings.
 - c. Short circuit current rating of panelboards and overcurrent protective devices.
 - d. UL listing for series rating of installed devices.
 - e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 2. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between Manufacturer installed and field installed wiring.
- C. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- D. Maintenance Data: For panelboards and components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Contract Closeout," 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.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Division 01 "Operation and Maintenance Data," include the following:
 - a. Routine maintenance requirements for switchboards and all installed components.
 - b. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - c. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

- A. 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.
- B. Comply with NEMA PB 1.
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Provide coordination study to provide proper settings for all breaker settings throughout the switchboard(s). Refer to Division 26 "Coordination Studies" for additional information and requirements.
- B. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Square D Company. – Base Bid
- B. GE by ABB. – Alternate Bid
- C. No Other Manufacturers Will Be Considered.

2.2 FABRICATION AND FEATURES

- A. Enclosures: Flush and surface mounted cabinets. Refer to panel Schedules on Drawings to determine flush or surface. NEMA PB 1, Type 1 for interior locations and Type 3R for exterior locations, unless noted otherwise in the documents.
- B. Front: See panelboard, Hinged Trim Covers.
- C. Finish: Manufacturer's standard enamel finish over corrosion resistant treatment or primer coat.

- D. Directory Card: With transparent protective cover, mounted inside metal frame, inside panelboard door.
- E. Bus Material (Main, Neutral & Ground): Aluminum.
- F. Main and Neutral Lugs: Mechanical type suitable for use with conductor material.
- G. Equipment Ground Bus: Adequate for feeder and branch circuit equipment ground conductors; bonded to box.
- H. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches. Provide when indicated on the panel Schedules.
- I. Skirt for Surface Mounted Panelboards: Provide skirts with same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor. Skirts shall be provided for all surface mounted panels in all rooms with exception of rooms labeled on plans "Electric or Mechanical."
- J. Feed through Lugs: Mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
- K. Provide a TVSS Unit when indicated on the panelboard schedule. Refer to Division 26 "Transient Voltage Surge Suppression" for TVSS information.

2.3 PANELBOARD SHORT CIRCUIT RATING

- A. Panelboards shall be fully rated to interrupt symmetrical short circuit current as indicated on the schedules. All breakers within panelboards shall be fully rated to the panel AIC rating. Series ratings of branch breakers or bus shall not be acceptable.

2.4 ARC ENERGY REDUCTION

- A. For any circuit breaker rated for 1200A, or can be adjusted to 1200A or higher, an electronic circuit breaker must be used, and the following shall be provided:
 - 1. Documentation shall be made available, at the switchboard, regarding the Arc Energy Reduction methodology.
 - 2. The applicable breaker shall be provided with an energy-reducing maintenance switch setting with local status indicator.

2.5 LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARDS

- A. Branch Overcurrent Protective Devices: Bolt on circuit breakers, replaceable without disturbing adjacent units.
- B. Doors: See Panelboard Hinged Trim Covers.

2.6 DISTRIBUTION PANELBOARDS

- A. Doors: Front mounted secured with latch and lock; keyed alike.
- B. Main Overcurrent Protective Devices: Circuit breaker or Main Lugs Only. Refer to panel Schedule.

- C. Branch Overcurrent Protective Devices: Bolt on circuit breakers.

2.7 OVERCURRENT PROTECTIVE DEVICES

A. Lighting and Appliance Branch Circuit Panelboards:

1. Molded Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
 - a. Thermal Magnetic Circuit Breakers: Inverse time current element for low level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit breaker frame sizes 250 A and larger.
 - b. GFCI Circuit Breakers: Single pole configurations with 5mA trip sensitivity.
2. Molded Case Circuit Breaker Features and Accessories. Standard frame sizes, trip ratings, and number of poles.
 - a. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.
 - b. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air conditioning, and refrigerating equipment.
 - c. Ground Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time delay settings, push to test feature, and ground fault indicator.
 - d. Shunt Trip: 120 V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.

B. Distribution Panelboards, 600A main lug and larger

1. 100A and larger, provide electronic trip units with LSI (Long time, Short time and Instantaneous) protection, size as specified on the drawings. Interrupting rating shall be available up to 200 kAIR RMS without fuses. Under 100A, provide thermal magnetic trip units, size as specified on the drawings.
 - a. Circuit Breakers
 - 1) Circuit breakers shall have voltage and interrupting ratings that meet the application requirements.
 - 2) Circuit breakers shall be constructed using glass reinforced insulating material.
 - 3) Current carrying components shall be completely isolated from the handle, and the accessory mounting area.
 - 4) Circuit breakers shall have an over center, trip-free, toggle-operating mechanism which shall provide quick-make, quick-break contact action. The circuit breaker shall have common tripping of all poles.
 - 5) Up to 600 A rating frame, MCCBs breaking unit shall be made with a double rotary contact to limit let-through energy on the installation.
 - 6) MCCBs shall be designed to trip the circuit breaker in the event of high-level short-circuit currents. This design shall be independent of the trip unit.
 - 7) The circuit breaker handle shall reside in a tripped position between ON and OFF to provide local trip indication. Circuit breaker escutcheon shall be clearly marked ON and OFF in addition to providing international I/O markings.
 - 8) The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on the face of the circuit breaker.

- 9) Each circuit breaker shall be equipped with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit breaker tripping mechanism for maintenance and testing purposes.
- 10) Circuit breakers shall be factory-sealed with a hologram quality mark or a tamper evident label and shall have a date code.
- 11) MCCB's shall be able to receive a device for locking in the isolated position.
- 12) Electronic components shall withstand temperatures up to 221 °F (105 °C).
- 13) Circuit breakers shall be UL-listed to accept field installable/removable mechanical type lugs. Lugs shall be UL-listed to accept solid and/or stranded copper and aluminum conductors. Lugs shall be suitable for 194 °F (90 °C) rated wire, sized according to the 167 °F (75 °C) temperature rating in the NEC.
- 14) Circuit breakers shall be capable of accepting bus connections.
- 15) For frame ratings, higher than 250 amperes, MCCBs shall be fitted with metallic filters to reduce effects perceptible from the outside during current interruption.
- 16) For a given MCCB rated frame, MCCBs dimensions shall be the same whatever the AIR.
- 17) 1200 amperes frame shall be provided in electrically operated version. The operation shall use stored-energy type only and will be equipped with anti-pumping function.
- 18) Circuit breakers, 600A and larger, shall be equipped with a safety interlock which keeps the circuit breaker open if the trip unit is not installed.

b. Trip Units

- 1) MCCB's, 100A and larger shall be equipped with electronic trip units. MCCB's less than 100A shall be equipped with thermal magnetic trip units.
- 2) Circuit breakers with permanent trip units shall be UL-listed for reverse connection without restrictive line and load markings and be suitable for mounting in any position.
- 3) MCCBs with field interchangeable trip units (600A and larger) shall have trip units that are easily interchangeable and easily secured to the MCCB.
- 4) The trip units shall not augment overall circuit breaker volume.
- 5) Thermal Magnetic (less than 100A):
 - a) Thermal trip elements shall be factory preset and sealed. Circuit breakers shall be true RMS sensing and thermally responsive to protect circuit conductor(s) in a 104 °F (40 °C) ambient temperature.
 - b) Where indicated on drawings, circuit breakers shall be equipped with a ground fault module (GFM) with 20 to 200 amperes sensitivity level or earth leakage module (ELM) with sensitivity ranges between 30 mA and 3 amperes, or approved equivalent.
- 6) Electronic Trip Circuit Breakers (100A and larger):
 - a) Trip unit shall be true RMS sensing.
 - b) Air core current transformers shall be used to ensure accurate measurements from low currents up to high currents.
 - c) Electronic trip unit shall be fitted with thermal imaging to protect intermittent short circuits or ground-faults.
 - d) The following monitoring functions shall be integral parts of electronic trip units:
 - i) A test connector shall be installed for checks on electronic and tripping mechanism operation using an external device.
 - ii) LED for load indication at 105 percent.
 - iii) LED for load indication at 90 percent of load for applications 600 amperes and smaller.

PANELBOARDS

- iv) LED for visual verification of protection circuit functionality for applications 600 amperes or smaller.
- v) LED for trip indication for applications above 600 amperes.
- vi) Trip unit functions shall consist of adjustable protection settings with the capability to be set and read locally by rotating a switch.
- vii) Long-time pickup shall allow for adjustment to nine long-time pickup settings. This adjustment must be at least from 0.4 to 1 times the sensor plug (I_n), with finer adjustments available for more precise settings to match the application.
- viii) Adjustable long-time delay shall be in nine bands. At six times I_r , from 0.5 to 24 seconds above 600 amperes, and 0.5 to 16 seconds for 600 amperes and below.
- ix) Short-time pickup shall allow for nine settings from 1.5 to 10 times I_r .
- x) Short-time delay shall be in nine bands from 0.1-0.4 I^2t ON and 0-0.4 I^2t OFF.
- xi) Instantaneous settings on the trip units with LSI protection shall be available in nine bands.
 - 1. Above 600 amperes, from 2 to 15 times I_n
 - 2. 600 amperes, from 1.5 to 11 times I_n
 - 3. 400 amperes from 1.5 to 12 times I_n
 - 4. 250 amperes and below, from 1.5 to 15 times I_n
- xii) Four-pole devices shall be equipped for neutral protection with a three-position setting; neutral not protected, neutral tripping threshold equal to half the phase value, and neutral threshold equal to the phase value.
- xiii) Ground fault settings for circuit breaker sensor sizes 1200 amperes or below shall be in nine bands from 0.2 to 1.0 times I_n . The ground fault settings for circuit breakers above 1200 amperes shall be nine bands from 500 to 1200 amperes.
- e) It shall be possible to fit the trip unit with a seal to prevent unauthorized access to the settings in accordance with NEC Section 240-6(b).
- f) Trip unit shall provide local trip indication and capability to locally and remotely indicate reason for trip, i.e., overload, short circuit, or ground fault.
- g) Measurement chain shall be independent from the protection chain.
- h) The measurements shall be displayed on the breaker itself.

2.8 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: To test functions of solid-state trip devices without removal from panelboard.
- C. Provide top and bottom panel skirts for all surface mounted lighting and power panels.

2.9 HINGED TRIM COVERS

- A. Provide Hinged Trim Panelboard covers for lighting and power panelboards. Entire Trim Hinged to one side of the box with a piano type hinge to access panel gutter space. Front door of panel shall be keyed to lock.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Mounting Heights: Top of trim 74 inches above finished floor, unless otherwise indicated.
- C. Mounting: Plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
- D. Circuit Directory: Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable. Refer to Section 260553 for more information.
- E. Install filler plates in unused spaces.
- F. Provision for Future Circuits at Flush Panelboards: Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub two 1-inch empty conduits below slab not on grade into suspended ceiling cavity.
- G. Wiring in Panelboard Gutters: Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

- A. Provide panel and circuit identification as outlined in Division 26 "Electrical Identification".

3.3 CONNECTIONS

- A. Install equipment grounding connections for panelboards with ground continuity to main electrical ground bus.
- B. Tighten electrical connectors and terminals according to Manufacturers' published torque tightening values. If Manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

- A. Test continuity of each circuit.
- B. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded case circuit breakers. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

- C. Balancing Loads: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes as follows:
1. Measure as directed during period of normal system loading.
 2. Perform load balancing circuit changes outside normal occupancy/working Schedule of the facility and at time directed. Avoid disrupting critical 24 hour services such as on line data processing, computing, transmitting, and receiving equipment.
 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 4. Tolerance: Difference exceeding 10 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.5 PROTECTIVE SHIELDS

- A. Provide metal protective shield(s) under all piping located within 3'-0" of the panelboard to deflect a pipe leak away from the electrical equipment. Shield(s) shall be sized as required to cover the required pipe to prevent water from reaching the panelboard.

3.6 ADJUSTING

- A. Set field adjustable switches and circuit breaker trip ranges.

3.7 CLEANING

- A. On completion of installation, inspect interior and exterior of panelboards. 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 DEMONSTRATION AND START-UP

- A. Adjust all adjustable settings. When a coordination study is performed, adjust breakers and ground fault circuit interrupters as required per the study.

END OF SECTION 26 24 16