CONSTRUCTION STANDARD SPECIFICATION

SECTION 16442

ELECTRICAL POWER PANELBOARDS

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ELECTRICAL POWER PANELBOARDS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes power panelboards, and associated auxiliary equipment rated 600 volts or less.

1. Furnish labor, materials, services, equipment, supplies, and perform operations necessary to install electrical panelboards in accordance with this specification and Drawings.

2. Contractor shall engage services of independent testing organization that meets requirements specified in “Quality Assurance” article.

a. Testing organization shall provide material, equipment, labor, and technical supervision to perform special testing specified in Part 3, “Field Tests and Inspections” article.

3. Panelboards located in hazardous (classified) locations are not included.

1.02 REFERENCES

A. Related Sections: Refer to the following sections for related work.

1. Division 1, Section 01300 “Descriptive Submittals”.

2. Division 9, Section 09900 “Painting”.

3. Division 16, Section 16001 "Electrical Work".

4. Division 16, Section 16441 “Electrical Lighting and Appliance Panelboards” for panelboards rated 225 A or less.

B. Related Drawings: Refer to Standard Drawing E-0006STD, “Standard Symbols List and General Notes” for panelboard identification requirements.

C. InterNational Electrical Testing Association (NETA)

ATS Acceptance Testing Specifications

D. National Electrical Manufacturers Association (NEMA)

AB 1 Molded Case Circuit Breakers

PB 1 Panelboards

PB 1.1 General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less

250 Enclosures for Electrical Equipment (1000 Volts Maximum)

289 Application Guide for Ground Fault Circuit Interrupters

E. National Fire Protection Association (NFPA)

70 National Electrical Code

F. Underwriters Laboratories, Inc. (UL)

50 Cabinets and Boxes

67 Panelboards

486 A Wire Connectors and Soldering Lugs for Use With Copper Conductors

489 Circuit Breakers, Molded-Case, and Circuit-Breaker Enclosures

943 Ground Fault Circuit Interrupters

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1, Section 01300, "Descriptive Submittals."

B. Product data for each type of panelboard, accessory item, and component specified.

C. Shop Drawings: For panelboards, include dimensioned plans, sections, and elevations. Show tabulations of installed devices, major features, and voltage rating. Include the following:

1. Enclosure type with details for types other than NEMA 250, Type 1.

2. Bus configuration and current ratings.

3. Short-circuit current rating of panelboard.

4. Characteristics, that include time-current curves; ratings, that include interrupting ratings; and factory settings of individual circuit breakers and auxiliary components. Provide Ip and I^2t let-through curves for current limiting circuit breakers.

5. Number and size of conductor terminals available on equipment ground bus, and if applicable, neutral bus.

D. Testing Organization Qualifications: Submit written certification that testing organization complies with requirements specified in “Quality Assurance” article.

E. Maintenance Data: Include manufacturer’s written instructions for testing circuit breakers.

F. Where manufacturers other than those designated in schedules of circuit breakers with adjustable settings are proposed for use, submit full coordination study.

1. Study shall be commissioned and paid for by Contractor.

2. Coordination study shall be performed by registered professional engineer in accordance with ANSI/IEEE Standard 242 "Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems."

3. Study shall graphically show that substitute circuit breakers coordinate selectively with both upstream and downstream components.

4. Include single line diagram, coordinated time-current characteristics, device performance curves, and fault current calculations adequate to demonstrate satisfactory component protection and selective coordination of protective devices.

1.04 QUALITY ASSURANCE

A. Provide panelboards designed and assembled in accordance with the referenced standards.

B. Listing and Labeling: Provide new panelboards listed and labeled by Underwriter’s Laboratories, Inc., or other nationally recognized testing laboratory.

C. Single-source Responsibility: Provide panelboards products that are new, and from the same manufacturer.

a. Panelboard components shall be from the same manufacturer, or listed as an assembly thereof.

D. Testing Organization Qualifications: Independent testing organization shall function as unbiased authority, professionally independent of manufacturers, suppliers, and installers of equipment or systems evaluated by testing organization.

1. Testing organization shall have regularly engaged in testing of electrical equipment devices, installations, and systems for minimum of five years.

2. Testing organization shall be Full Member company of NETA.

3. On-site, lead technical person shall be currently certified by NETA or National Institute for Certification in Engineering Technologies (NICET) in electrical power distribution system testing.

4. Testing organization shall utilize engineers and technicians who are regularly employed by organization for testing services.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

Subject to compliance with requirements, provide products by the following:

Manufacturer	***Panelboard Type	Voltage (volts)	*Minimum Cabinet Width (inches)	Branch Breaker Type
Cutler-Hammer /Westinghouse	PRL3a (600 A max.)	600,480Y/277, 240,208Y/120	28 (710 mm)	**
	PRL4a (1200 A max.)	600,480Y/273, 240,208Y/120	36 (914 mm)	**
Square D	I-Line (800 A max.)	600	29 (737 mm)	**
Siemens	S4 (600 A max.)	600	32 (813 mm)	**
	S5 (1200 A max.)	600	38 (965 mm)	**
GE	AD (800 A max.)	600	31.5 (800 mm)	**

* As specified on Drawings (depends on breaker frame size).

** As specified on Panel Schedules (depends on voltage, frame size, whether breaker has thermal magnetic or solid-state trip unit, and interrupting capacity.

*** When maximum amperage is exceeded, switchboard will be required.

2.02 GENERAL

A. Install UL-listed and labeled panelboards as required by NEC.

B. Three-phase, four-wire deadfront, circuit breaker type distribution panelboard rated greater than 225 A.

C. Voltage and current rating, as indicated on Drawings or Panel Schedules.

D. Main circuit breaker or Main Lug Only (MLO) as indicated on Drawings or Panel Schedules.

E. Provide panelboards with size and number of single, double, or triple pole circuit breaker as indicated on Panel Schedules.

F. Arrange and number circuit breakers exactly as shown on Panel Schedules. Single-branch mounted or subfeed breakers are not acceptable.

G. Where the word "space" occurs in Panel Schedules, it is intended as space for future branch circuit breaker. Includes connection straps rated for future breaker indicated on Panel Schedules, but not less than 100 A, holding brackets, and identifying numbering unit so that conversion to active circuit only requires actual installation of circuit breaker.

H. Panel Schedule Holders: C-Line Products self-adhesive clear heavy vinyl shop ticket holder, size 9" x 12" (Stock No. 70912) or 5" x 8" (Stock No. 70058).

2.03 CABINETS AND TRIM

A. General: Provide NEMA 250, Type 1 cabinets, unless otherwise indicated on Panel Schedules.

1. Comply with UL 50 requirements for specified cabinet type.

2. Provide NEMA 250, Type 3R or Type 4 for exterior-mounted panelboards, as indicated on Drawings or Panel Schedules.

3. Flush- or surface-mount cabinets, as indicated on Panel Schedules.

B. NEMA 250, Type 1 Cabinets: Galvanized steel; zinc-coated galvannealed steel is not acceptable.

C. NEMA 250, Type 1 Trim Front: Provide one-piece, hinged "door-in-door", and one-piece, removable, inner deadfront cover plate. Secure deadfront cover plate by maximum of six removable screws.

1. Provide interior hinged door with lock and latch to cover access to circuit breaker operating handles, but without access to energized parts.

2. Provide outer door with either piano hinge along one vertical edge of trim, or outer door with piano hinge on one side of door.

a. Provide captive screws, screw driver operated latches, or 25% each of spare screws and screw clips.

b. Outer door shall provide minimum 4-1/2 inches (114 mm) between deadfront cover and inside edge of hinged cover.

3. Provide cabinet with extra gutter space as required to meet requirement listed in Item 2 above.

4. Prepare, prime, and paint front trim cover with light gray enamel electro-deposited over phosphatized steel, or baked-on polyester coating.

D. NEMA 250, Type 3R or Type 4 Cabinets

1. Type 3R: Provide outer door hinged at top or on right side of cabinet, and latch at opposite side.

2. Type 4: Provide outer door hinged on right side, and latch at other three sides.

3. Bolt interior cover on all four sides.

4. Weld and seal end walls, and provide door gaskets.

E. Provide phenolic buttons, small window-frame, or permanent strip type identification labels on interior trim to identify circuit number. Do not use adhesive-backed fabric, or paper labels alone.

2.04 BUS

A. Phase Bus: Hard-drawn copper of 98 percent conductivity.

B. Neutral Bus: Hard-drawn copper of 98 percent conductivity.

1. Electrically isolated from enclosure.

2. Current rating not less than phase bus.

3. Screw terminal for each breaker position.

C. Grounding Bus: Hard-drawn copper of 98 percent conductivity.

1. Ground bus shall be factory-installed to enclosure by brazing, or bolting to unpainted structural framing members.

2. Screw terminal for each breaker position.

D. Provide subfeed lugs or through-feed lubs if required, or indicated on Drawings.

2.05 CIRCUIT BREAKERS

A. General: Provide industrial rated (breakers that can be used or installed in 600 volts panelboard) circuit breakers as integral components of panelboard with indicated features, ratings, characteristics, and settings. Adjustable breakers shall have adjustments that are accessible without removal of deadfront cover.

B. Mounting: Provide circuit breakers connected to phase bus by either of the following:

1. Direct-bolted connection between source terminal of circuit breaker and phase bus.

2. Spring-tension connection between source terminal of circuit breaker and phase bus with circuit breaker held in position by bolted connection.

C. Molded-Case Circuit Breakers: Comply with UL 489, and NEMA AB 1.

1. Characteristics: Frame size, trip rating, number of poles, and short-circuit interrupting capacity rating as shown on Drawings or Panel Schedules.

2. Tripping Device: Quick-make, quick-break toggle mechanism with inverse-time delay, and instantaneous overcurrent trip protection for each pole.

3. Adjustable Instantaneous Trip Devices: Front-adjustable on units where available. Where available, factory adjusted to low-trip-setting.

4. Where indicated, provide combination circuit breakers and ground fault circuit interrupters (GFCI) in accordance with UL 943, arranged for sensing and tripping for ground fault current in addition to overcurrent and short-circuit current. Provide features as follows:

   a. Match features and module size of panelboard breakers, and provide clear identification of ground fault trip function.

   b. When ground fault protection of personnel is indicated, provide trip setting of 4 to 6 mA. Provide GFCI circuit breaker listed and labeled as Class A, Type 1 device.

   c. When ground fault protection of equipment is indicated, provide trip seating of 30 mA, unless noted otherwise.

5. Circuit Breakers With Solid-State Trip Devices: When circuit breakers with solid-state trip devices are indicated on Drawings or Panel Schedules, provide devices that are standard (80%) rated, unless otherwise indicated on Drawings, and incorporate the following features:

   a. Provide test equipment to test breakers, unless otherwise specified on Drawings.

   b. Ambient Compensation: Trip device insensitive to temperature changes between minus 20 degrees C and plus 55 degrees C.

   c. Adjustability: Provide equipment permitting breaker ratings and trip settings to be changeable by operation of controls on front panel of breaker, by changing of plug-in element without removing breakers from mounting, or by combination of two methods.

   d. Ground-Fault Tripping: If shown on Drawings or Panel Schedules, provide devices suitable for incorporation in zone.

6. Terminal Lugs: Furnish load side of circuit breaker with front-connected UL-listed lugs for copper cable at full frame terminals rated for minimum 75 degrees C.

7. Provide circuit breakers with provision for locking in “OFF” position, with padlocking device that complies with OSHA, Lockout-Tagout device requirements.

   a. If circuit breaker is lockable with removable device on operating handle that can be transferred between breakers without access to energized parts, provide 10 percent of circuit breakers, but not less than two, with these devices.

   b. If circuit breaker is lockable only with factory-installed device, or with device that is not field-changeable without access to energized parts, provide all circuit breakers with locking devices.

8. If the circuit breaker design rather than its position in the panelboard determines the phase a circuit breaker is connected to, provide circuit breakers with factory markings clearly indicating phase connection. Provide markings visible without removal of any panelboard trim or covers.

9. Install three-pole circuit breakers designed to achieve A-B-C phase sequence from top terminal to bottom terminal.

PART 3 - EXECUTION

3.01 INSTALLATION - GENERAL

A. Install panelboards and accessory items in accordance with NEMA PB 1.1.

B. Install panelboard ground fault circuit interrupter devices in accordance with installation guidelines of NEMA 289.

C. Wiring in panel gutters shall be trained neatly in groups, bundled and wrapped with wire ties after completion of load-balancing. Form wiring to right angles at circuit breaker connections.

D. Grind smooth corners, and file or grind smooth edges of metal angles, channels, straps, and other similar items to be used to support electrical panelboards. Paint to match panelboards prior to installation, per requirements of Division 9, “Painting”.

E. Panelboard Identification: Refer to Standard Drawing E-0006STD.

F. Conductor Identification: Install tag on all panel conductors, including neutral and ground conductors.

1. Tags shall indicate circuit number, and list all equipment that conductors may serve.

2. Provide tags of polyester material (Panduit #MP-350C) and tie-wrap to conductor.

G. Provide conduit terminations in enclosures in a manner to maintain integrity of enclosure. Example: Terminate at NEMA 250, Type 3R panelboard with rain-tight hubs, when entering panelboard from top.

3.02 MOUNTING

A. Mount panelboards plumb and rigid without distortion of box.

B. Arrange flush panels so that enclosure front surface is uniformly flush with wall, and exterior door covers wall to enclosure mating surfaces. Provide for future circuits as shown on Drawings.

1. If not shown on Drawings, stub minimum of four two-inch (50-mm) empty conduits from panel into accessible ceiling space or space designated to be ceiling space in future.

2. If not shown on Drawings, stub minimum of four two-inch (50-mm) empty conduits into raised floor space, or below slab other than slabs-on-grade.

C. Surface-mounted panelboards located on finished walls within office and light laboratory areas, and other areas as shown on Drawings, shall be furred from floor to ceiling to provide conduit chase.

1. Provide 20-gage sheet metal furring panels, and install with sheet metal screws to permit removal.

2. Install spare conduit or other types of penetrations within chase area at floor and ceiling, as detailed on Drawings.

D. Mount panelboards so that distance from floor to center of top panel does not exceed 6'-6" (2 m), unless otherwise noted on Drawings.

E. Permanently mount self-adhesive heavy vinyl shop ticket holder, appropriately sized for door size, to inside of each panelboard door. Place copy of up-to-date Panel Schedules inside holder.

3.03 CONNECTIONS

After installation, but before panelboard is energized, tighten electrical connectors and terminals, including grounding connections, in accordance with manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A.

3.04 GROUNDING AND BONDING

A. Run separate equipment grounding conductor with panelboard incoming feeder circuit and all branch circuits. Size equipment grounding conductors as shown on Drawings, and run in same raceway as associated ungrounded and neutral circuit conductors.

B. Bond neutral bus to enclosure grounding bus after any separately derived system, if neutral and ground are not bonded at transformer (refer to grounding one-line diagram when furnished).

3.05 FIELD QUALITY CONTROL

A. Verify neutral ground connections and phase connections.

B. Perform field tests and inspections, and prepare panelboard for satisfactory operation in accordance with manufacturer's recommendations and requirements of this Section.

C. Circuit Breaker Ratings and Settings: Verify indicated ratings and settings to be appropriate for final system configuration and parameters.

1. Where discrepancies are found, provide Sandia Construction Observer (SCO) with recommended final breaker ratings and settings.

2. Use accepted ratings or settings as directed by SCO to make final system adjustments.

D. Visual and Mechanical Inspection: Include the following inspections and related work:

1. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and Panelboard Schedules.

2. Exercise and perform operational tests of mechanical components and other operable devices in accordance with manufacturer's instruction manual.

3. Check panelboard mounting, area clearances, and alignment and fit of components.

4. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.

E. Special Testing Requirements: Panelboard main breakers and circuit breakers feeding branch circuits rated 200 A and above, shall be tested prior to initial energization of system.

1. Independent testing organization shall perform tests to ensure that electrical equipment is operational and within industry and manufacturer’s tolerances, and is installed in accordance with design specifications.

2. Perform testing in accordance with circuit breaker testing requirements of NETA ATS.

3. Tests and inspections shall determine suitability for energization.

4. Other circuit breakers require this special testing when indicated on Drawings.

3.06 CLEANING

Upon completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish, or color as indicated on the Drawings.

END OF SECTION 16442