

SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. The Conditions of the Contract and applicable requirements of Divisions 0 and 1 and Section 26 00 01, "Electrical General Provisions", govern this Section.

1.2 DESCRIPTION OF WORK:

- A. Work Included: Provide panelboard and enclosure work, including cabinets, as shown, scheduled, indicated, and as specified.
- B. Types: The types of panelboards and enclosures required for the project include, but are not limited to, the following:
 - 1. Power distribution panelboards.
 - 2. Lighting and appliance panelboards.
 - 3. **[Circuit breakers for existing building panelboards.]**

1.3 STANDARDS:

- A. Products shall be designed, manufactured, tested, and installed in compliance with the following standards:
 - 1. NEMA AB 1 Molded Case Circuit Breakers.
 - 2. NEMA KS 1 Enclosed Switches.
 - 3. NEMA PB 1 Panelboards.
 - 4. NEMA PB 1.1 Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

1.4 QUALITY ASSURANCE:

- A. Manufacturers: Provide products complying with these specifications and produced by one of the following:
 - 1. Cutler-Hammer, Inc.
 - 2. General Electric Company.
 - 3. Square D Company.
 - 4. Siemens.
- B. UL Standards: Panelboards and enclosures shall conform to all applicable UL standards and shall be UL-labeled.

1.5 SUBMITTALS:

- A. Shop Drawing submittals shall include, but not be limited to, the following:
 - 1. Cut sheets of the circuit breaker and fusible switch distribution panels and panelboards with construction, fuse and circuit breaker amperage and poles, interrupting ratings, and quantities clearly listed, and with bus amperage, voltage, phase and wires, integrated equipment ratings and all associated accessories clearly indicated.

2. Include dimensioned drawings of panelboards and enclosures. Submit, if requested, transparencies of circuit breaker characteristics with unlatch times and fuse characteristics with melting/clearing times.
3. The Short Circuit Analysis, Protective Device Coordination Study, **Emergency Power System Selective Coordination Study** and Arc Flash and Electrical Hazard Studies specified in Section 26 05 73, "Short Circuit Analysis/Coordination Study" shall be completed and submitted prior to submitting submittals for this section.
4. Additional information as required in Section 26 00 01, "Electrical General Provisions".

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver distribution panels and panelboards in factory-fabricated water-resistant wrapping.
- B. Handle panelboards carefully to avoid damage to material component, enclosure and finish.
- C. Store distribution panels and panelboards in a clean, dry space and protect from the weather.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS:

- A. General: Lighting and appliance panelboards shall be dead front safety type equipped with molded case circuit breakers as shown and scheduled. Power distribution panelboards shall be dead front type equipped with fusible switches or circuit breakers as shown and scheduled. All panelboards 400a and under shall be with door or with hinged trim. All panel boards that are above 400 amps shall have a multi paneled cover.

[SELECT BUS MATERIAL]

- B. Busing Assembly: Panelboard and power distribution panel board busing shall be **[tin or silver-plated copper]** Bus structure and mains shall have ratings as shown and scheduled and shall be phase sequence construction. Such ratings shall be established by heat rise tests with maximum hot spot temperature on any connector or busbar not to exceed 65°C rise above 40°C ambient. Heat rise test shall be conducted in accordance with UL 67. The use of conductor dimensions will not be accepted instead of actual heat tests. All bus joints shall be bolted with medium carbon steel, zinc or cadmium plated hardware equipped with lock washers and torqued to the manufacturer's recommended settings (usually ASTM standards). All bolted connections shall have Belleville washers. All torques must be witnessed by AHJ (UH Fire Marshal). Furnish a bare uninsulated or an isolated, where noted, ground bus inside each 208Y/120 volt panelboard enclosure and elsewhere where noted on the Drawings. Furnish an isolated full size neutral bus, insulated where noted, in all panels where the neutral is present. All multi-section panelboards shall be connected with copper cable, with an ampacity meeting or exceeding the main bus ampacity. All distribution and 120/208 volt panels shall have a ground bus. All 277/480 volt panels shall have a ground bus where a ground wire is shown in the panel feeder or branch circuits.
- C. Neutrals: All panels serve by K-rated or phase cancellation transformers shall have 200% rated neutral.
- D. Molded Case Circuit Breakers:

[VERIFY BREAKER TYPE]

1. Circuit breakers shall be of the molded case, thermal magnetic type equipped with individually insulated, braced and protected connectors. The front faces of all circuit breakers shall be flush with each other. Tripped indication shall be clearly shown by the breaker handle taking a position between "ON" and "OFF". Provisions for additional

breakers shall be such that no additional connectors will be required to add breakers. Circuit breakers shall bolt in to the main bus for 480/277 volt panels (except Square D I-line panels which shall have plug-in breakers) and **bolt** on to the main bus for 208/120 volt panels. All 2 and 3-pole breakers shall have common trips. Where "series rated" breakers are shown, scheduled or specified and the manufacturer does not have a series rated breaker combination for the application shown, fully rated breakers with the required minimum interrupting capacity shall be provided.

[VERIFY THE FOLLOWING]

2. **[Circuit breakers installed in existing building panelboards shall be from the same manufacturer as and compatible with the existing panelboard and shall have an interrupting rating equal to or greater than the interrupting rating of the existing breakers installed in the panelboard.]**
3. All single-pole circuit breakers shall be either ambient or case-compensated (calibrated 40°C) thermal-magnetic type breakers, with inverse time delay on overloads and instantaneous magnetic trip on short circuits. (Twin, tandem and half-size single-pole breakers and breaker tie handles are not acceptable.) All multiple breakers shall be common trip, thermal-magnetic type, calibrated 40°C.
4. The breakers shall employ quick-make, toggle mechanism for manual operation, as well as automatic operation. The breakers shall have provisions for manually testing the tripping mechanism with the breaker removed from the panel. Automatic tripping shall be indicated by the breaker handle assuming a clearly distinctive position from the manual "on" and "off" positions.
5. Circuit breakers used as switches in 120 volt and 277 volt fluorescent lighting circuits, the circuit breakers shall be approved for such switching duty and shall be marked "SWD".
6. Provide panelboard circuit breakers with conventional interrupting capacity unless scheduled shown or noted otherwise, but in no case less than the following symmetrical amperes RMS:

<u>Voltage (volts)</u>	<u>Interrupting Capacity</u>
120/208	10,000 AIC
277/480	14,000 AIC

7. Provide distribution panel circuit breakers with conventional interrupting capacity unless scheduled shown or noted otherwise, but in no case less than the following symmetrical amperes RMS:

<u>Frame Size/Voltage (volts)</u>	<u>Interrupting Capacity</u>
100AF to 225AF/240V	10,000 AIC
400AF to 1000AF/240V	42,000 AIC
1200AF/240V	100,000 AIC-
100AF/480V	18,000 AIC
225AF/480V	25,000 AIC
400AF to 1000AF/480V	30,000 AIC
1200AF/480V	50,000 AIC

8. Current limiting thermal-magnetic circuit breakers suitable for interrupting currents up to 200,000 amperes shall be provided where scheduled or specified. Current limiting breakers shall have a non-fusible type independently operating limiter section in series

with each pole which shall automatically reset after circuit interruption. Current limiting circuit breakers shall be equal to Square D Company "I-LIMITER".

9. Ground fault interrupter (GFI) circuit breakers, where shown, shall be 5 ma ground fault trip and shall include a TEST button.

[VERIFY THE FOLLOWING, DELETE OPTION IF ALL DP BREAKERS TO BE ELECTRONIC TRIP]

10. Distribution panel circuit breakers **[400 ampere frame and above and all emergency power system distribution panel circuit breakers]** shall be equipped with solid-state programmable trip complete with built-in current transformers, solid-state trip unit and flux transfer shunt trip. The solid-state electronic programmable trip device shall have the following features and tripping functions.
 - a. Adjustable current setting.
 - b. Adjustable long-time delay.
 - c. Adjustable instantaneous pick-up.
 - d. Adjustable short time delay.
 - e. Adjustable short time pick-up.
 - f. **[Adjustable ground fault delay]**
 - g. **[Adjustable ground fault pick-up]**
- E. Fusible Switches: Fusible switches shall be quick-make quick-break type. Each switch shall be enclosed in a separate steel enclosure. The enclosure shall employ a hinged cover for access to the fuses. Cover shall be interlocked with the operating handle to prevent opening the cover when the switch is in the "ON" position. This interlock shall be constructed so that it can be over-ridden for testing fuses without interrupting service. The switches shall have padlocking provisions in the "OFF" position. Switches shall include positive pressure rejection type fuse clips for use with UL Class R fuses and be UL-labeled for 200,000 AIC.
- F. Lugs: Panelboards and distribution panels shall be provided with main lugs, main overcurrent devices, and feed-thru lugs as noted on the Drawings. Lugs shall be suitable for use with the cable size and material installed. Panel wireways shall provide adequate space for wiring to all lugs.
- G. Spaces: Where space for future breakers is shown, panelboard enclosure shall include removable blank panels or knockouts to allow installation of future breakers and panelboard busing shall be complete, including all required connectors.
- H. Integrated Equipment Rating: Each panelboard, as a complete unit, shall have short circuit bracing and a short-circuit rating equal to the interrupting rating of the weakest overcurrent device installed in the panelboard. This rating shall equal or exceed the rating shown, scheduled or noted on the Drawings. Such ratings shall have been established by tests on similar panelboards with the circuit breakers installed.
- I. Short Circuit Bracing: Distribution panel bussing shall have short circuit bracing as shown, scheduled or noted on the drawings and this rating shall be clearly indicated on the distribution panel nameplate.

[VERIFY ENCLOSURE REQUIREMENTS]

- J. Panelboard Enclosures: Panelboard enclosures shall be code gauge galvanized steel with wire bending space per the NEC. Panelboard enclosures shall be NEMA Type 1 surface or flush mounted as shown, scheduled or noted for indoor locations and NEMA 3R for outdoor

locations, minimum 16 gauge thickness, minimum 20" width, without knockouts, unless shown, scheduled or noted otherwise. Panelboard fronts shall be full-height hinged door-in-door front covers with an interior access door hinged to the main front cover providing dead-front access to the panelboard overcurrent devices (interior) and the dead front main cover over the interior and wireway full-height hinged to the panelboard back box with fastening, concealed on flush mounted panelboards, on the non-hinged side. Provide flush spring latch and keyed lock for all panelboard access doors with all distribution panel and panelboard locks keyed alike. Provide an interior circuit directory frame, card and clear plastic covering inside the interior access door for panelboards. Door and cover trim shall be painted with manufacturer's standard gray enamel finish over a rust inhibitor. Trim on flush mounted panels shall have concealed fasteners. **[Covers for panelboards installed in any areas subject to moisture shall be stainless steel.]** Enclosures shall be fabricated by the same manufacturer as panelboards to be enclosed. Multi-section panelboards shall have separate covers and trims. Multi-section panel cans shall be installed side by side with minimum 1" gap.

[VERIFY ENCLOSURE REQUIREMENTS]

- K. **Distribution Panel Enclosures:** Distribution panel enclosures shall be code gauge galvanized steel with wire bending space per the NEC. Distribution panel enclosures shall be NEMA 1 surface or flush mounted as shown, scheduled or noted for indoor locations and NEMA 3R for outdoor locations. The distribution panel interior assembly shall be dead front with panel front removed. Main lugs or main circuit breakers shall have barriers on five sides. The barrier in front of the main lugs shall be hinged to a fixed part of the interior. The end of the bus structure opposite the mains shall have barriers. Interior surface distribution panels shall have full height front covers full height hinged to the distribution panel back box with fastening on the non-hinged side. Interior flush and exterior distribution panel fronts shall be full-height hinged door-in-door front covers with an interior access door hinged to the main front cover providing dead-front access to the panelboard overcurrent devices (interior) and the dead front main cover over the interior and wireway full-height hinged to the panelboard back box with concealed fastening on the non-hinged side. Cabinet interior doors shall be equipped with a latch and tumbler type lock. Doors over 48" long shall be equipped with a three point latch and vault lock with all distribution panel and panelboard locks keyed alike. Cabinets shall be of sufficient size to allow a width of gutter to conform with Underwriters' Laboratories, Inc. Standards. Panel trim shall be full finish sheet steel finished with two coats of paint, the first being a prime coat and the second a finish coat of light gray lacquer. **[Covers for panelboards installed in any areas subject to moisture shall be stainless steel.]**

PART 3 - EXECUTION

3.1 INSTALLATION OF PANELBOARDS AND ENCLOSURES:

- A. **General:** Install panelboards and enclosures as shown, including electrical connections, in accordance with the manufacturer's written instructions, the applicable requirements of NEC, the NECA's "Standard of Installation", and recognized industry practices to ensure that products serve the intended function. All surface mount panels shall be mounted on 1-5/8" unistrut. No panels shall be mounted to floor.
- B. **Coordination:** Coordinate installation of panelboards and enclosures with cable and raceways installation work. Verify that wall thickness is adequate where recessed panels are shown. Prefabricated knock-outs are only allowed on flush-mount panels.

- C. Anchoring: Anchor enclosures firmly to walls and structural surfaces ensuring that they are permanently and mechanically secured. All panels shall mount to 1-5/8" unistrut. Minimum Hardware: 15/16".
 - D. Concrete Pads: Install each floor-mounted power distribution panelboard on a reinforced concrete housekeeping pad. The housekeeping pad shall extend 3" beyond the housing of the distribution panel, unless otherwise shown. Furnish the exact position of any block outs, dimensions, and location of the housekeeping pads in time to prevent delay of the concrete work. Refer to Section 26 05 01, "Electrical Basic Materials and Methods", for additional requirements.
 - E. Directory Card: Type the enclosure's circuit directory card upon completion of work. Refer to Section 26 05 53, "Identification for Electrical Systems", for additional requirements.
 - F. Fuses: Install fuses, of the rating and class shown, in each power distribution and motor control panelboards. For panelboards over 200 amps, provide three (3) spare fuses.
 - G. Circuit Arrangement: Branch circuit connections to 3-phase lighting and appliance panelboards shall be arranged such that when two or three circuits are run with a common neutral, each circuit shall be connected to a different phase unless otherwise shown. At the completion of the electrical system this Contractor shall check each phase of all panels under full load and arrange so that all phases shall carry the same load as near as possible.
 - H. Spare Conduits: Stub three empty one inch (1") conduits to accessible location above ceiling out of each recessed panelboard. Provide pullstrings and cap conduit ends.
 - I. Terminations: All terminations that do not have slotted head screws shall only be snug-tight prior to energizing torque and witnessing by AHJ (UH Fire Marshal).
- 3.2 TESTING:
- A. General: Prior to energization, check for continuity of circuits and for short circuits.
 - B. Thermographic Testing: Refer to Section 26 01 25, "Electrical Testing", for thermographic testing.
- 3.3 IDENTIFICATION:
- A. Identification: Refer to Section 26 05 53, "Identification for Electrical Systems", for applicable painting, nameplates, and labeling requirements.

END OF SECTION 26 24 16