

SECTION 26 2416 - PANELBOARDS

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.

1.2 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Electronic-grade panelboards.

B. Related Sections include the following:

1. Division 26 Section "Surge Protective Devices for Low-Voltage Electrical Power Circuits" for transient voltage surge suppressors for low-voltage power, control, and communication equipment located in Panelboards.

1.3 DEFINITIONS

- A. SVR: Suppressed voltage rating.

- B. SPD: Surge Protective Device.

1.4 *(future use)*

- 1.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, surge suppression 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. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.

5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
6. Include wiring diagrams for power, signal, and control wiring.
7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.6 INFORMATIONAL SUBMITTALS

A. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards 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 that allows adjustments.
3. Circuit directories with load descriptions prepared in electronic format. Submit to Electric Shop.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock. Keys shall be received and signed for by the University's Chief Electrician. Failure to do so will result in Contractor re-keying all equipment at no cost to NU.

1.9 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.
- F. Series rated equipment shall not be used.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.11 PROJECT CONDITIONS

A. Environmental Limitations:

- 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding minus 22 deg F (minus 30 deg C) to plus 104 deg F (plus 40 deg C).

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

- 1. Ambient temperatures within limits specified.
- 2. Altitude not exceeding 6600 feet (2000 m).

C. ***(Delete This Paragraph If Not Required)*** [Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Northwestern University or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

- 1. **Notify Northwestern University Electric Shop no fewer than [two] calendar weeks in advance of proposed interruption of electric service.**
- 2. **Indicate method of providing temporary utilities.**
- 3. **Do not proceed with interruption of electrical service without the University's Chief Electrician's written permission.**
- 4. **Northwestern University Lock-out/Tag-out procedures shall be used with Contractor controlled locks and tags.**
- 5. **Comply with NFPA 70E.]**

1.12 COORDINATION

- A. 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, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.13 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: **Five** years from date of Beneficial Occupancy.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Subject to compliance with requirements, provide products by Gus Berthold Electric with components by one of the following:
 - 1. Siemens Industry Inc.
 - 2. Eaton Corp. Electrical Group.
- B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.
- C. Enclosures: Flush and surface-mounted cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Kitchen, Food Service and Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
 - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
 - 2. Hinged Front Cover: "Door-in-Door" construction. Entire front trim hinged to box and with standard door within hinged trim cover.
 - 3. Flush type latch and lock assembly shall be provided.
 - 4. All keying and locks for cabinets shall be alike and comply with University Standards.
 - 5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 - 6. Finishes:
 - a. Panels and Trim: 12 gauge hot rolled steel formed and welded steel, factory finished immediately after cleaning and pre-treating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: 12 gauge steel.
 - c. Panelboard boxes shall be supplied without knock-outs (blank end walls).

7. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.
- D. Incoming Mains Location: Top.
- E. Phase, Neutral, and Ground Buses:
 1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Minimum rating: 200 Amps.
 3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
 4. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
 5. Fully rated Neutral bus.
 6. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
- F. Conductor Connectors: Suitable for use with conductor material and sizes.
 1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Main and Neutral Lugs: Mechanical type.
 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
(Edit for project requirements)
 4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 5. Sub-feed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 6. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 7. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
- G. Service Equipment Label: NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.
- H. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- I. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals, minimum 22 kAIC.

2.2 DISTRIBUTION PANELBOARDS

- A. Panelboards: NEMA PB 1, power and feeder distribution type.
- B. Doors: Secured with vault-type latch with tumbler lock; keyed alike per University's Master key protocol, use Corbin #4T3142 unless directed in writing otherwise.
 1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.
- C. Mains: Circuit breaker or Lugs as shown on One Line Diagram.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- B. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- C. **[Contactors in Main Bus: NEMA ICS 2, Class A, electrically held, general-purpose controller, with same short-circuits interrupting rating as panelboard.**
 - 1. **Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.]**
- D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike per University's Master Key protocol, use Corbin #4T3142 unless directed in writing otherwise.

2.4 ELECTRONIC-GRADE PANELBOARDS

- A. Panelboards: NEMA PB 1; with factory-installed, integral TVSS; labeled by an NRTL for compliance with UL 67 after installing TVSS.
- B. Doors: Secured with vault-type latch with tumbler lock; keyed alike per University's Master key protocol, use Corbin #4T3142 unless directed in writing otherwise.
- C. Main Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.
- D. Branch Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.
- E. Buses:
 - 1. Copper phase and neutral buses; 200 percent capacity neutral bus and lugs.
 - 2. Copper equipment and isolated ground buses.
- F. Surge Protection Device: IEEE C62.41-compliant, externally mounted, complying with UL 1449, 3rd edition and Specification 264313.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Subject to compliance with requirements, provide products by one of the following:
 - 1. Siemens Industry Inc.
 - 2. Eaton Corp. Electrical Group.
- B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.
- C. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, fully rated, with interrupting capacity to meet available fault currents. Series rated equipment is not acceptable.
 - 1. Circuit-breaker frame sizes 250 A and larger shall be 100% rated to continuously carry their full ampere capacity.

2. 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 up to 250 A.
3. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
4. Electronic trip circuit breakers with RMS sensing; field-replaceable rating plug or field-replicable electronic trip for circuit-breaker frame sizes 250 A and larger; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Single- and two-pole configurations with Class B ground-fault protection (30-mA trip).
7. Arc-Flash Circuit Interrupters (AFCI): Single (15 – 20A) or two pole (15 – 20A) configuration. LED trip indicator. UL 1669 listed.
8. Multi-pole circuit breakers shall have common trip, use of handle ties is not permitted.
9. Standard frame sizes, trip ratings, and number of poles.
10. Application Listing: Appropriate for application. (e.g. HACR, SWD)
11. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
12. Molded-Case Circuit-Breaker (MCCB) Features and Accessories: (**Edit For Project Requirements**)
 - a. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - b. Communication Capability: Communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
 - c. Shunt Trip: 120 -V trip coil energized from separate circuit.
 - d. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
 - e. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
 - f. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
 - g. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 - h. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
 - i. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handles in on or off position.
 - j. Handle Clamp: Loose attachment, for holding circuit-breaker handles in on position.

2.6 PANELBOARD SUPPRESSORS

- A. Subject to compliance with requirements, Surge Protection Devices shall be IEEE C62.41-compliant, externally mounted, and complying with UL 1449, 3rd edition and Specification 26 4313.

2.7 RETRO-FIT PANELBOARD KITS

- A. The panelboard kit shall be specifically designed for retrofit applications in existing panelboard boxes. Trims for retrofit panelboards shall be designed specifically for retrofit applications. Trim mounting shall not be dependent nor attached to the existing enclosure. The trim and door shall attach directly to the panelboard dead-front assembly so that no external trim-fastening hardware shall be required. Panelboards shall be fully rated.
- B. Interiors shall have field adjustable height and depth.
- C. Factory installed copper neutral and ground bars, field bondable for Service Entrance applications.
- D. Bolt-on type, heavy-duty, quick-make, quick-break, single- and multi-pole circuit breakers of the types specified herein, shall be provided for each circuit.
- E. Existing enclosures shall be identified for retrofit suitability in advance. Enclosure size calculations shall be submitted to NU Electric Shop. The structural integrity of all existing enclosures shall be verified. Any enclosure that is damaged shall be replaced with a new enclosure and panelboard.

2.8 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been exposed to water.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Wall Mounted Panelboards: Do not attach directly to walls or structural surfaces. Attach panelboard to the vertical finished or structural surface behind the panelboard on channels such as "Unistrut".

- C. Floor Mounted Panelboards: Install panelboards on 4 inch high (Evanston: 6 inch high east of Sheridan Rd.) concrete bases. Comply with requirements for concrete base specified in Division 03 Sections.
 - 1. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 2. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 3. Install anchor bolts to elevations required for proper attachment to panelboards with not more than 1" exposed.
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- E. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.
- F. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- G. Install overcurrent protective devices and controllers not already factory installed.
- H. Provide GFI circuit breakers with 30 mA sensitivity trip for all freeze protection, temperature maintenance, and heat tracing circuits.
- I. Install filler plates in unused spaces.
- J. Punch out openings only in those areas perforated by the manufacturer in the top and bottom end panels, field punched openings not permitted.
- K. Circuit breaker handle locks shall be provided for all circuits that supply exit signs, emergency lights, energy management and control system panels and fire alarm panels.
- L. Flush mounted panelboards: Stub four (4) 3/4-inch empty conduits from panelboard into an 18" x 18" pull box located in accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- M. Arrange conductors in gutters into groups and bundle and wrap in order of H-N-G with wire ties after completing load balancing.
- N. Comply with NECA 1.
- O. New circuit breakers installed in existing panelboards shall be of standard manufacture, shall match existing, and shall have an interrupting rating of not less than the lowest rated circuit breaker in the panelboard.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Circuit breakers serving Fire Alarm panels shall have a factory or field applied Red finish, the circuit shall be highlighted on the circuit directory.

- C. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Northwestern University's final room designations. Obtain approval before installing. Use a computer to create directory; handwritten directories are not acceptable.
- D. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- E. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- F. Arc Flash Labels: provide as specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
 - 3. Comply with NETS.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. 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. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, an infrared scan of each panelboard shall be performed by a third party. Remove front so joints and connections are accessible to portable scanner.
 - 1. Instrument: Use an infrared-scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 2. Record of Infrared Scanning: Prepare a certified report that identifies panelboards checked and that describes infrared-scanning results. Include notation of deficiencies detected, remedial actions taken, and observations after remedial action.
 - 3. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.
- F. No panelboard shall be energized unless test reports have been reviewed and accepted by NU Electric Shop.

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3.5 CLEANING

- A. Vacuum dirt and debris from panelboard tubs; do not use compressed air to assist in cleaning.

3.6 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in the "Overcurrent Protective Device Coordination Study." Provide list of "as left" settings and submit to Electric Shop.
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
 - 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 fax machines and 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 to NU Electric Shop.
 - 4. Tolerance: Difference exceeding 15 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.7 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 26 2416

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