# SECTION 26 24 13 SWITCHBOARDS

**PART 1 - GENERAL**

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| 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. Service and distribution switchboards rated 600 V and less. 2. Surge protection devices. 3. Disconnecting and overcurrent protective devices. 4. Instrumentation. 5. Control power. 6. Accessory components and features. 7. Identification. |

## ACTION SUBMITTALS

* + 1. Product Data: For each switchboard, overcurrent protective device, surge protection device, ground-fault protector, accessory, and component.
       1. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
    2. Shop Drawings: For each switchboard and related equipment.
       1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
       2. Detail enclosure types for types other than NEMA 250, Type 1.
       3. Detail bus configuration, current, and voltage ratings.
       4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
       5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
       6. Detail utility company's metering provisions with indication of approval by utility company.
       7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
       8. Include 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.
       9. Include schematic and wiring diagrams for power, signal, and control wiring.

## INFORMATIONAL SUBMITTALS

* + 1. Qualification Data: For Installer and testing agency.
    2. 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.

## CLOSEOUT SUBMITTALS

* + 1. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals.
       1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
          1. Routine maintenance requirements for switchboards and all installed components.
          2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
          3. 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.

## MAINTENANCE MATERIAL SUBMITTALS

* + 1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
       1. Potential Transformer Fuses: Equal to two of each size and type.
       2. Control-Power Fuses: Equal to two of each size and type.
       3. Fuses and Fusible Devices for Fused Circuit Breakers: Equal to three of each size and type.
       4. Fuses for Fused Switches: Equal to three of each size and type.
       5. Fuses for Fused Power-Circuit Devices: Equal to three of each size and type.
       6. Indicating Lights: Equal to one of each size and type.

## QUALITY ASSURANCE

* + 1. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

## DELIVERY, STORAGE, AND HANDLING

* + 1. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.
    2. Handle and prepare switchboards for installation according to NEMA PB 2.1.

## FIELD CONDITIONS

* + 1. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.
    2. Environmental Limitations:
       1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and 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:
          1. Ambient Temperature: Not exceeding 104oF.
          2. Altitude: Not exceeding 6600-feet.
    3. Unusual Service Conditions: NEMA PB 2, as follows:
       1. Ambient temperatures within limits specified.
       2. Altitude not exceeding 6600-feet.

## COORDINATION

* + 1. Coordinate layout and installation of switchboards 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.
    2. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor- bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

## WARRANTY

* + 1. Manufacturer's Warranty: Manufacturer agrees to repair or replace switchboard enclosures, buswork, overcurrent protective devices, accessories, and factory installed interconnection wiring that fail in materials or workmanship within specified warranty period.
       1. Warranty Period: Three years from date of Substantial Completion.
    2. Manufacturer's Warranty: Manufacturer's agrees to repair or replace surge protection devices that fail in materials or workmanship within specified warranty period.
       1. Warranty Period: Five years from date of Substantial Completion.

# PART 2 - PRODUCTS

## SWITCHBOARDS

* + 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
       1. Eaton Electrical Inc/Cutler-Hammer Products.
       2. Square D/Schneider Electric.
    2. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
    3. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
    4. 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.
    5. Comply with NEMA PB 2.
    6. Comply with NFPA 70.
    7. Comply with UL 891.
    8. Front-Connected, Front-Accessible Switchboards:
       1. Main Devices: Fixed, individually mounted.
       2. Branch Devices: Panel mounted.
       3. Sections front and rear aligned.
    9. Nominal System Voltage: **{480Y/277 V}**.
    10. Main-Bus Continuous: **{2500 ,1600 A}.**
    11. Indoor Enclosures: Steel, NEMA 250, Type 2.
    12. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
    13. Barriers: Between adjacent switchboard sections.
    14. Insulation and isolation for main bus of main section and main and vertical buses of feeder sections.
    15. Service Entrance Rating: Switchboards intended for use as service entrance equipment shall contain from one to six service disconnecting means with overcurrent protection, a neutral bus with disconnecting link, a grounding electrode conductor terminal, and a main bonding jumper.
    16. Customer Metering Compartment: A separate customer metering compartment and section with front hinged door, and section with front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks. Include potential transformers having primary and secondary fuses with disconnecting means and secondary wiring terminated on terminal blocks.
    17. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
    18. Removable, Rear Compartment Covers: Secured by standard bolts, for access to rear interior of switchboard.
    19. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
    20. Pull Box on Top of Switchboard:
        1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
        2. Set back from front to clear circuit-breaker removal mechanism.
        3. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
        4. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
        5. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.
    21. Buses and Connections: Three phase, four wire unless otherwise indicated.
        1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from the front of the switchboard.
        2. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity.
        3. Copper feeder circuit-breaker line connections.
        4. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit- breaker position.
        5. Ground Bus: Minimum-size required by UL 891, hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors.
        6. Main-Phase Buses and Equipment-Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
        7. Disconnect Links:
           1. Isolate neutral bus from incoming neutral conductors.
           2. Bond neutral bus to equipment-ground bus for switchboards utilized as service equipment or separately derived systems.
        8. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
        9. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.
    22. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.
    23. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105oC.

## SURGE PROTECTION DEVICES

* + 1. SPDs: Comply with UL 1449, Type 2.
    2. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 2.
    3. Features and Accessories:
       1. Integral disconnect switch.
       2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
       3. Indicator light display for protection status.
       4. Form-C contacts rated at 2 A and 24-V ac, one normally open and one normally closed, for remote monitoring of protection status.
       5. Surge counter.
    4. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than [200 kA] [250kA] [300 kA]. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
    5. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, three-phase, four-wire circuits shall not exceed the following:
       1. Line to Neutral: 1200 V for 480Y/277 V.
       2. Line to Ground: 1200 V for 480Y/277 V.
       3. Line to Line: 2000 V for 480Y/277 V.
    6. SCCR: Equal or exceed. Refer to drawings.
    7. Nominal Rating: 20 kA.

## DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

* + 1. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
       1. 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.
       2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front- mounted, field-adjustable trip setting.
       3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field- replicable electronic trip; and the following field-adjustable settings:
          1. Instantaneous trip.
          2. Long- and short-time pickup levels.
          3. Long- and short-time adjustments.
          4. Ground-fault pickup level, time delay, and I2t response.
       4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
       5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
       6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
       7. MCCB Features and Accessories:
          1. Standard frame sizes, trip ratings, and number of poles.
          2. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
          3. Application Listing: Appropriate for application.
          4. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
          5. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system specified in Section 26 09 13 "Electrical Power Monitoring and Control."
          6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
          7. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
          8. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

## INSTRUMENTATION

* + 1. Instrument Transformers: NEMA EI 21.1, and the following:
       1. Potential Transformers: NEMA EI 21.1; 120 V, 60 Hz, [**single**] [**tapped**] [**double**] secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
       2. Current Transformers: NEMA EI 21.1; 5 A, 60 Hz, secondary; [**wound**] [**bushing**] [**bar or window**] type; [**single**] [**double**] secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
       3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
       4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.
    2. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three or four-wire systems and with the following features: (Must also comply with Section 26 09 12)
       1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
          1. Phase Currents, Each Phase: Plus, or minus 0.5 percent.
          2. Phase-to-Phase Voltages, Three Phase: Plus, or minus 0.5 percent.
          3. Phase-to-Neutral Voltages, Three Phase: Plus, or minus 0.5 percent.
          4. Megawatts: Plus, or minus 1 percent.
          5. Megavars: Plus, or minus 1 percent.
          6. Power Factor: Plus, or minus 1 percent.
          7. Frequency: Plus, or minus 0.1 percent.
          8. Accumulated Energy, Megawatt Hours: Plus, or minus 1 percent; accumulated values unaffected by power outages up to 72 hours.
          9. Contact devices to operate remote impulse-totalizing demand meter.
       2. Mounting: Display and control unit flush or semi-flush mounted in instrument compartment door.
    3. Voltmeters: Cover an expanded-scale range of nominal voltage plus 10 percent.
    4. Instrument Switches: Rotary type with off position.
       1. Voltmeter Switches: Permit reading of all phase-to-phase voltages and, where a neutral is indicated, phase-to-neutral voltages.
       2. Ammeter Switches: Permit reading of current in each phase and maintain current- transformer secondaries in a closed-circuit condition at all times.
    5. Ammeters: 2-1/2-inch (64-mm) minimum size with 90- or 120-degree scale. Meter and transfer device with off position, located on overcurrent device door for indicated feeder circuits only.
    6. Watt-Hour Meters and Wattmeters:
       1. Comply with ANSI C12.1.
       2. Three-phase induction type with two stators, each with current and potential coil, rated 5 A, 120 V, 60 Hz.
       3. Suitable for connection to three- and four-wire circuits.
       4. Potential indicating lamps.
       5. Adjustments for light and full load, phase balance, and power factor.
       6. Four-dial clock register.
       7. Integral demand indicator.
       8. Contact devices to operate remote impulse-totalizing demand meter.
       9. Ratchets to prevent reverse rotation.
       10. Removable meter with drawout test plug.
       11. Semiflush mounted case with matching cover.
       12. Appropriate multiplier tag.
    7. Impulse-Totalizing Demand Meter:
       1. Comply with ANSI C12.1.
       2. Suitable for use with switchboard watt-hour meter, including two-circuit totalizing relay.
       3. Cyclometer.
       4. Four-dial, totalizing kilowatt-hour register.
       5. Positive chart drive mechanism.
       6. Capillary pen holding a minimum of one month's ink supply.
       7. Roll chart with minimum 31-day capacity; appropriate multiplier tag.
       8. Capable of indicating and recording [**five**] [**15**] [**30**] <**Insert time period**>-minute integrated demand of totalized system.

## CONTROL POWER

* + 1. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control- power transformer.
    2. Electrically Interlocked Main and Tie Circuit Breakers: Two control-power transformers in separate compartments, with interlocking relays, connected to the primary side of each control- power transformer at the line side of the associated main circuit breaker. 120-V secondaries connected through automatic transfer relays to ensure a fail-safe automatic transfer scheme.
    3. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
    4. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

## ACCESSORY COMPONENTS AND FEATURES

* + 1. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

## IDENTIFICATION

* + 1. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

# PART 3 - EXECUTION

## EXAMINATION

* + 1. Receive, inspect, handle, and store switchboards according to NEMA PB 2.1.
       1. Lift or move panelboards with spreader bars and manufacturer-supplied lifting straps following manufacturer's instructions.
       2. Use rollers, slings, or other manufacturer-approved methods if lifting straps are not furnished.
       3. Protect from moisture, dust, dirt, and debris during storage and installation.
       4. Install temporary heating during storage per manufacturer's instructions.
    2. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.
    3. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work or that affect the performance of the equipment.
    4. Proceed with installation only after unsatisfactory conditions have been corrected.

## INSTALLATION

* + 1. Install switchboards and accessories according to NEMA PB 2.1.
    2. Equipment Mounting: Install switchboards on concrete base, 4-inch nominal thickness. Comply with requirements for concrete base specified in Section 03 30 00 "Cast-in-Place Concrete."
       1. Install conduits entering underneath the switchboard, entering under the vertical section where the conductors will terminate. Install with couplings flush with the concrete base. Extend 2-inches above concrete base after switchboard is anchored in place.
       2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
       3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
       4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
       5. Install anchor bolts to elevations required for proper attachment to switchboards.
       6. Anchor switchboard to building structure at the top of the switchboard if required or recommended by the manufacturer.
    3. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.
    4. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
    5. Install filler plates in unused spaces of panel-mounted sections.
    6. Install overcurrent protective devices, surge protection devices, and instrumentation.
       1. Set field-adjustable switches and circuit-breaker trip ranges.
    7. Comply with NECA 1.

## CONNECTIONS

* + 1. Bond conduits entering underneath the switchboard to the equipment ground bus with a bonding conductor sized per NFPA 70.
    2. Support and secure conductors within the switchboard according to NFPA 70.
    3. Extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

## IDENTIFICATION

* + 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
    2. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
    3. Device Nameplates: Label each disconnecting, and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

## FIELD QUALITY CONTROL

* + 1. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
    2. Tests and inspections:
       1. Acceptance Testing:
          1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within the switchboard and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
          2. Test continuity of each circuit.
       2. Test ground-fault protection of equipment for service equipment per NFPA 70.
       3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
       4. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
       5. Perform the following infrared scan tests and inspections, and prepare reports:
          1. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
          2. Instruments and Equipment:

Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

* + - 1. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
    1. Switchboard will be considered defective if it does not pass tests and inspections.
    2. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

## ADJUSTING

* + 1. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.
    2. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 05 73 "Overcurrent Protective Device Coordination Study".

## PROTECTION

* + 1. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

## DEMONSTRATION

* + 1. Train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories, and to use and reprogram microprocessor-based trip, monitoring, and communication units.

**END OF SECTION 26 24 13**

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