

SECTION 26 05 04
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
 - a. A1011/A1011M, Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low Alloy and High-Strength Low Alloy Formability.
 - b. E814, Method of Fire Tests of Through-Penetration Fire Stops.
2. Canadian Standards Association (CSA).
3. Institute of Electrical and Electronics Engineers, Inc. (IEEE): 18, Standard for Shunt Power Capacitors.
4. International Society of Automation (ISA): RP12.06.01, Wiring Practices for Hazardous (Classified) Locations Instrumentation–Part 1: Intrinsic Safety.
5. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - b. C12.1, Code for Electricity Metering.
 - c. C12.6, Phase-Shifting Devices Used in Metering, Marking and Arrangement of Terminals.
 - d. ICS 2, Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.
 - e. ICS 5, Industrial Control and Systems: Control Circuit and Pilot Devices.
 - f. KS 1, Enclosed and Miscellaneous Distribution Switches (600 Volts Maximum).
6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
7. UL:
 - a. 98, Standard for Enclosed and Dead-Front Switches.
 - b. 248, Standard for Low Voltage Fuses.
 - c. 486E, Standard for Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors.
 - d. 489, Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
 - e. 508, Standard for Industrial Control Equipment.
 - f. 810, Standard for Capacitors.

- g. 943, Standard for Ground-Fault Circuit-Interruption.
- h. 1059, Standard for Terminal Blocks.
- i. 1479, Fire Tests of Through-Penetration Fire Stops.

1.02 SUBMITTALS

A. Action Submittals:

1. Provide manufacturers' data for the following:
 - a. Control devices.
 - b. Control relays.
 - c. Circuit breakers.
 - d. Fused switches.
 - e. Nonfused switches.
 - f. Timers.
 - g. Fuses.
 - h. Elapsed time meters.
 - i. Number of starts (event) counters.
 - j. Magnetic contactors.
 - k. Intrinsic safety barriers.
 - l. Firestopping.
 - m. Enclosures: Include enclosure data for products having enclosures.
2. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals: Seismic anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.

1.03 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts and special tools:

1. Fuses, 0 Volt to 600 Volts: Three of each type and each current rating installed.

PART 2 PRODUCTS

2.01 MOLDED CASE CIRCUIT BREAKER THERMAL MAGNETIC, LOW VOLTAGE

A. Physical Characteristics:

1. Type: Molded case, thermal magnetic.
2. Suitable for mounting and operating in any position.

3. Connections suitable for 75 degrees C rated conductors without derating breaker or conductor ampacity.
4. Accessories: Shunt trip, auxiliary switches, handle lock ON devices, mechanical interlocks, key interlocks, unit mounting bases, double lugs as shown or otherwise required. Shunt trip operators shall be continuous duty rated or have coil-clearing contacts.
5. Connections:
 - a. Supply (line side) at either end.
 - b. Mechanical wire lugs, except crimp compression lugs where shown.
 - c. Lugs removable/replaceable for breaker frames greater than 100 amperes.
 - d. Use bolted bus connections, except where bolt-on is not compatible with existing breaker provisions.
6. Enclosures for Independent Mounting:
 - a. See Article Enclosures.
 - b. Service Entrance Use: Breakers in required enclosure and required accessories shall be UL 489 listed.
 - 1) Interlock: Enclosure and switch shall interlock to prevent opening cover with switch in the ON position. Provide bypass feature for use by qualified personnel.

B. Functional Characteristics:

1. UL 489 listed.
2. Trip Ratings: 15 amps to 800 amps.
3. Voltage Ratings: 120, 240, 277, 480, and 600V ac.
4. Short Circuit Interrupting Ratings:
 - a. Not less than the following rms symmetrical currents for the indicated trip ratings:
 - 1) Up to 100A, less than 250V ac: 22,000 amps, or as shown, whichever is greater.
 - 2) 250V ac to 600V ac: 65,000 amps, or as shown, whichever is greater.
 - b. Series-connected Ratings: Do not apply series connected short circuit ratings.
5. Operating Mechanism:
 - a. Overcenter, trip-free, toggle type handle.
 - b. Quick-make, quick-break action.
 - c. Locking provisions for padlocking breaker in OPEN position.
 - d. ON/OFF and TRIPPED indicating positions of operating handle.
 - 1) Operating handle to assume a CENTER position when tripped.
 - e. Provide ground fault circuit interrupter (GFCI) circuit breakers with push-to-test button.

6. Trip Mechanism:
 - a. Individual permanent thermal and magnetic trip elements in each pole.
 - b. Variable magnetic trip elements with a single continuous adjustment 3X to 10X for frames greater than 100 amps.
 - c. Two and three pole, common trip.
 - d. Automatically opens all poles when overcurrent occurs on one pole.
 - e. Test Button On Cover: Do not provide single-pole circuit breakers with handle ties where multi-pole circuit breakers are shown.

C. Performance Characteristics:

1. Trip mechanism Calibrated for 40 degrees C ambient, unless shown otherwise.
2. Ground Fault Circuit Interrupter (GFCI): Where indicated, equip breaker as specified above with ground fault sensor and rated to trip on 5-mA ground fault within 0.025 second (UL 943, Class A sensitivity, for protection of personnel).
 - a. Ground fault sensor shall be rated same as circuit breaker.
3. Equipment Ground Fault Interrupter (EGFI): Where indicated, equip breaker specified above with ground fault sensor and rated to trip on 30-mA ground fault (UL-listed for equipment ground fault protection).
4. Magnetic Only Type Breakers: Where shown; instantaneous trip adjustment which simultaneously sets magnetic trip level of each individual pole continuously through a 3X to 10X trip range.

2.02 FUSED SWITCH, INDIVIDUAL, LOW VOLTAGE

A. Physical Characteristics:

1. Quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type with external markings clearly indicating ON/OFF positions. Normal-duty switches are not acceptable.
2. Auxiliary Contact:
 - a. Operation: Make before power contacts make and break before power contacts break.
 - b. Contact Rating: 7,200VA make, 720VA break, at 600V, NEMA ICS 5 Designation A600.
3. Connections:
 - a. Suitable for 75 degrees C rated conductors at NEC 75 degrees C ampacity.
 - b. Mechanical lugs, except crimp compression lugs where shown.
 - c. Lugs removable/replaceable.

4. Fuse Provisions:
 - a. 30-amp to 600-amp rated shall incorporate rejection feature to reject all fuses except Class R.
 - b. 601-amp rated and greater shall accept Class L fuses, unless otherwise shown.
5. Enclosures: See Article Enclosures.
6. Interlock: Enclosure and switch to prevent opening cover with switch in ON position. Provide bypass feature for use by qualified personnel.

B. Functional Characteristics:

1. UL 98 listed for use and location of installation.
2. NEMA KS 1.
3. Short Circuit Rating: 200,000 amps rms symmetrical with Class R, Class J, or Class L fuses installed.

C. Performance Characteristics: None.

2.03 NONFUSED SWITCH, INDIVIDUAL, LOW VOLTAGE

A. Physical Characteristics:

1. Quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type with external markings clearly indicating ON/OFF positions. Normal-duty switches are not acceptable.
2. Auxiliary Contact:
 - a. Operation: Make before power contacts make and break before power contacts break.
 - b. Contact Rating: 7,200VA make, 720VA break, at 600V, NEMA ICS 5 Designation A600.
3. Enclosures: See Article Enclosures.
4. Interlock: Enclosure and switch to prevent opening cover with switch in ON position. Provide bypass feature for use by qualified personnel.
5. Withstand Rating: 65,000 amps.

B. Functional Characteristics:

1. NEMA KS 1.
2. Lugs: Suitable for use with 75 degrees C wire at NEC 75 degrees C ampacity.

C. Performance Characteristics: None.

2.04 NON-FUSED HEAVY-DUTY, DOUBLE-THROW, LOW VOLTAGE (MANUAL TRANSFER SWITCH)

A. Physical Characteristics:

1. Visible double-break rotary blade mechanism, with a clearly visible handle. Switch positions are to be clearly visible from a distance.
2. Auxiliary Contacts:
 - a. Operation: Make before power contacts make and break before power contacts break.
 - b. Contact Rating: 7,200VA make, 720VA break, at 600V, NEMA ICS 5 Designation A600.

B. Functional Characteristics:

1. Configured for two-source connections.
2. 600V ac, current ratings as indicated on the Drawings.
3. Suitable for service entrance applications.
4. UL-listed neutral switching capability where indicated on the Drawings.

C. Performance Characteristics: None.

2.05 FUSE, 250-VOLT AND 600-VOLT

A. Power Distribution, General:

1. Physical Characteristics: Provide to fit mountings specified with switches.
2. Functional Characteristics:
 - a. Current-limiting, with 200,000 ampere rms interrupting rating.
 - b. UL 248.
3. Performance Characteristics: None.

B. Power Distribution, Ampere Ratings 1 Amp to 600 Amps:

1. Physical Characteristics: None.
2. Functional Characteristics:
 - a. Type: Dual element, with time delay.
3. Performance Characteristics:
 - a. Class: RK-1.

C. Power Distribution, Ampere Ratings 601 Amps to 6,000 Amps:

1. Physical Characteristics: Double O-rings and silver links.
2. Functional Characteristics: None.
3. Performance Characteristics: Class L.

D. Cable Limiters:

1. Physical Characteristics: Crimp to copper cable, bolt to bus or terminal pad.
2. Functional Characteristics: 600V.
3. Performance Characteristics: None.

E. Ferrule:

1. Physical Characteristics:
 - a. Dual-element time-delay, time-delay, or nontime-delay, as required.
 - b. Provide with fuse blocks or fuseholders as indicated and suitable for location and use.
2. Functional Characteristics:
 - a. 600V or less, rated for applied voltage, small dimension.
 - b. Ampere Ratings: 1/10 amp to 30 amps.
3. Performance Characteristics: None.

2.06 PUSHBUTTON, INDICATING LIGHT, AND SELECTOR SWITCH

A. Physical Characteristics:

1. Size: 30 millimeter.
2. Selector switch operating lever: Standard.
3. Pushbutton and selector switch lockable in OFF position where indicated.
4. Legend Plate:
 - a. Material: Aluminum.
 - b. Engraving: Enamel filled in high contrasting color.
 - c. Text Arrangement: 11-character/spaces on one line, 14-character/spaces on each of two lines, as required, indicating specific function.
 - d. Letter Height: 1/8 inch.
5. Pushbutton colors:
 - a. ON or START: Black.
 - b. OFF or STOP: Red.
6. Indicating light colors:
 - a. OFF: Green.
 - b. ON or RUNNING: Red.
 - c. ALARM, SHUTDOWN, FAIL, etc.: Amber or Yellow.
 - d. POWER ON: White.

B. Functional Characteristics:

1. Contact ratings: 7200VA make, 720VA break at 600V, NEMA ICS 5, Designation A600.
2. Indicating Light: Push-to-test LED with built in transformer. Refer to control drawings for voltage utilized.

C. Performance Characteristics: None.

2.07 TERMINAL BLOCK, 600 VOLTS

A. Physical Characteristics:

1. Size components to allow insertion of necessary wire sizes.
2. Capable of termination of control circuits entering or leaving equipment, panels, or boxes.
3. Screw clamp compression, dead-front barrier type, with current bar providing direct contact with wire between compression screw and yoke.
4. Yoke, current bar, and clamping screw of high strength and high conductivity metal.
5. Yoke shall guide all strands of wire into terminal.
6. Current bar shall ensure vibration-proof connection.
7. Terminals:
 - a. Capable of wire connections without special preparation other than stripping.
 - b. Capable of jumper installation with no loss of terminal or rail space.
 - c. Individual, rail mounted.
8. Marking system, allowing use of preprinted or field-marked tags.
9. Withstand Rating: 65,000 amps.

B. Functional Characteristics: UL 486E and UL 1059.

C. Performance Characteristics: None.

2.08 MAGNETIC CONTROL RELAY

A. Physical Characteristics:

1. Latching Attachment (where indicated): Mechanical latch, having unlatching coil and coil clearing contacts.

B. Functional Characteristics:

1. NEMA ICS2, Designation A300 (300 volts).
2. Field convertible contacts rated 10 amps continuous, 7,200VA make, 720VA break.

C. Performance Characteristics: Industrial control.

2.09 TIME DELAY RELAY

A. Physical Characteristics:

1. Solid-state electronic, field convertible ON/OFF delay.
2. One normally open and one normally closed contact (minimum).
3. Repeat accuracy plus or minus 2 percent.
4. Timer adjustment from 1 second to 60 seconds, unless otherwise indicated on the Drawings.

B. Functional Characteristics:

1. NEMA ICS 2 Designation: B150 (150 volts).
2. Contacts rated 5 amps continuous, 3,600VA make, 360VA break.

C. Performance Characteristics: Industrial relay.

2.10 RESET TIMER

A. Physical Characteristics:

1. Drive: Synchronous motor, solenoid-operated clutch.
2. Mounting: Semi-flush panel.

B. Functional Characteristics: Contacts: 10 amps, 120 volts.

C. Performance Characteristics: None.

2.11 ELAPSED TIME METER

A. Physical Characteristics:

1. Drive: Synchronous motor.
2. Mounting: Semi-flush panel.

B. Functional Characteristics:

1. Range: 0 hour to 99,999.9 hours, non-reset type.

C. Performance Characteristics: None.

2.12 START (EVENT) COUNTER

A. Physical Characteristics:

1. Drive: Relay.
2. Mounting: Semi-flush panel.

B. Functional Characteristics:

1. Range:
 - a. Counter: 0 to 99,999, non-rest type.

C. Performance Characteristics: None.

2.13 COMBINATION ELAPSED TIME METER AND START (EVENT) COUNTER

A. Physical Characteristics:

1. Drive:
 - a. Timer: Synchronous motor.
 - b. Counter: Relay.
2. Mounting: Semi-flush panel.

B. Functional Characteristics:

1. Range:
 - a. Timer: 0 hour to 99,999.9 hours, non-reset type.
 - b. Counter: 0 to 99,999, non-rest type.

C. Performance Characteristics: None.

2.14 MAGNETIC CONTACTOR

A. Physical Characteristics:

1. Enclosures: See Article Enclosures.
2. Silver alloy contacts with wiping action and arc quenchers.
3. Number of poles: As shown.
4. Auxiliary contacts: One normally-open and one normally-closed, with more provided as required for control scheme.

B. Functional Characteristics:

1. UL listed.
2. Main contacts:
 - a. Power driven in one direction, with mechanical spring dropout.
 - b. Continuous-duty, rated 30 amperes, minimum.
3. Electrically-operated, electrically-held.

4. Auxiliary contacts: Rated 7200VA make, 720VA break, 600V, A600 per NEMA ICS 5.
5. Control: As shown.

C. Performance Characteristics: None.

2.15 MAGNETIC LIGHTING CONTACTOR

A. Physical Characteristics:

1. Clamp type, self-rising terminal plates for solderless connections.
2. Enclosures: See Article Enclosures.

B. Functional Characteristics:

1. Comply with NEMA ICS2; provide UL 508 certification.
2. Electrically operated by dual-acting, single coil mechanism.
3. Inherently interlocked and electrically held.
4. Main contacts:
 - a. Double-break, continuous-duty, rated 30 amperes, 600 volts, withstand rating of 22,000 amps rms symmetrical at 250 volts.
 - b. Marked for electric discharge lamps, tungsten, and general-purpose loads.
 - c. Position not dependent on gravity, hooks, latches, or semipermanent magnets.
 - d. Capable of operating in any position.
 - e. Visual indication for each contact.
5. Auxiliary contact relay for two-wire control.
6. One normally open and one normally closed auxiliary contact rated 10 amperes continuous, 7,200VA make, 720VA break with NEMA designation of A600 (600 volts).
7. 200 percent rated neutral terminal.
8. Provision for remote pilot lamp with use of auxiliary contacts.

C. Performance Characteristics: None.

2.16 SUPPORT AND FRAMING CHANNELS

A. Carbon Steel Framing Channel:

1. Physical Characteristics:
 - a. Material: Rolled, mild strip steel, 12-gauge minimum.
 - b. Finish: Hot-dip galvanized after fabrication.
2. Functional Characteristics: ASTM A1011/A1011M, Grade 33.
3. Performance Characteristics: None.

B. Stainless Steel Framing Channel:

1. Physical Characteristics: Rolled, 12-gauge minimum.
2. Functional Characteristics: Type 316 stainless steel.
3. Performance Characteristics: None.

C. Extruded Aluminum Framing Channel:

1. Physical Characteristics:
 - a. Channel: Extruded.
 - b. Fittings: Fabricated.
 - c. Channel: Type 6063-T6 aluminum alloy.
 - d. Fittings: Type 5052-H32 aluminum alloy.
2. Functional Characteristics: None.
3. Performance Characteristics: None.

D. Nonmetallic Framing Channel:

1. Physical Characteristics:
 - a. Channel fittings of same material as channel.
 - b. Channel Material: Fire retardant, fiber reinforced vinyl ester resin.
 - c. Nut and Bolt Material: Long glass fiber reinforced polyurethane.
2. Functional Characteristics: None.
3. Performance Characteristics: None.

2.17 SWITCHBOARD MATTING

A. Physical Characteristics: None.

B. Functional Characteristics: Breakdown of 20 kV minimum.

C. Performance Characteristics: None.

2.18 ENCLOSURES

A. Physical Characteristics:

1. Finish: Manufacturer's standard.
2. Barriers: Provide metal barriers within enclosures to separate wiring of different systems and voltage.

B. Functional Characteristics:

1. Enclosure Selections: As shown in the Area Classification and Material Selection Table on the Drawings.

C. Performance Characteristics: None.

PART 3 EXECUTION

3.01 GENERAL

- A. Install equipment in accordance with manufacturer's recommendations.

3.02 PUSHBUTTON, INDICATING LIGHT, AND SELECTOR SWITCH

- A. Install heavy-duty, oil-tight type in nonhazardous, indoor, dry locations, including motor control centers, control panels, and individual stations, unless otherwise shown.
- B. Install heavy-duty, watertight and corrosion-resistant type in nonhazardous, outdoor, or normally wet areas, unless otherwise shown.

3.03 SUPPORT AND FRAMING CHANNEL

- A. Install where required for mounting and supporting electrical equipment, raceway, and cable tray systems.
- B. Channel Type: As required by the material table as shown on the Drawings.
- C. Paint cut ends prior to installation with the following:
 - 1. Carbon Steel Channel: Zinc-rich primer.
 - 2. Painted Channel: Rust-inhibiting epoxy or acrylic paint.
 - 3. Nonmetallic Channel: Epoxy resin sealer.
 - 4. PVC-Coated Channel: PVC patch.

3.04 INTRINSIC SAFETY BARRIERS

- A. Install in compliance with ISA RP12.06.01.
- B. Arrange conductors such that wiring from hazardous areas cannot short to wiring from nonhazardous area.
- C. Stencil "INTRINSICALLY SAFE CIRCUIT" on all boxes enclosing barriers.

3.05 FIRESTOPS

- A. Install in strict conformance with manufacturer's instructions. Comply with installation requirements established by testing and inspecting agency.
- B. Sealant: Install sealant including forming, packing, and other accessory materials, to fill openings around electrical services penetrating floors and walls, to provide firestops with fire-resistance ratings indicated for floor or wall assembly in which penetration occurs.

END OF SECTION