

SECTION 16475 OVERCURRENT PROTECTIVE DEVICES

PART 1 GENERAL

1.1 SUMMARY:

- A. This Section includes overcurrent protective devices (OCPD's) rated 600 V and below and switching devices commonly used with them.
- B. Panelboards, Switchboards, and Motor Control Centers: Application, installation, and other related requirements for overcurrent protective device installations in distribution equipment are specified in other Division 16 sections.

1.2 DEFINITIONS:

- A. Overcurrent Protective Device (OCPD): A device operative on excessive current that causes and maintains the interruption of power in the circuit it protects.
- B. Ampere-Squared-Seconds: An expression of available thermal energy resulting from current flow. With regard to current-limiting fuses and circuit breakers, the ampere-squared-seconds during fault current interruption represents the energy allowed to flow before the fuse or breaker interrupts the fault current within its current limiting range.

1.3 SUBMITTALS:

- A. Product data for fuses, fusible switches, circuit breakers, and OCPD accessories specified in this Section, including descriptive data and time-current curves for all protective devices and let-through current curves for those with current limiting characteristics. Include coordination charts and tables and related data.
- B. Provide coordination study performed by a registered professional engineer in accordance with ANSI/IEEE Standard 242-1986, "Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems, where OCPD manufacturers other than those designated first in schedules or product listings of overcurrent protective devices are proposed for use. Submit a full coordination study showing graphically that the substitute OCPD's coordinate selectively with both upstream and downstream components. 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. Study shall be commissioned and paid for by the Contractor. Submit study with switchgear, switchboard and panelboard submittals.

1.4 QUALITY ASSURANCE:

- A. Manufacturers: Firms regularly engaged in manufacture of overcurrent protective devices of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Each type of OCPD shall be the product of a single manufacturer.

1.5 EXTRA MATERIALS:

- A. Spare Fuses: Furnish spares of each type and rating of fuse for fusible devices amounting to one set of 3 fuses for each 9 fuses installed but not less than 3 fuses of each type.

PART 2 PRODUCTS:

2.1 MANUFACTURERS:

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

1. Cartridge Fuses:
 - a. Bussmann Div., Cooper Industries, Inc.
 - b. Littelfuse Inc.
2. Fusible Switches:
 - a. Square D Co.
 - b. Allen-Bradley Co.
 - c. General Electric Co.
 - d. Siemens Energy & Automation, Inc.
 - e. Cutler-Hammer, Inc.
3. Fused Power Circuit Devices:
 - a. Square D Co.
 - b. General Electric Co.
 - c. Pringle Electrical Mfg. Co.
4. Molded-Case Circuit Breakers:
 - a. Square D Co.
 - b. General Electric Co.
 - c. Siemens Energy & Automation, Inc.
 - d. Cutler-Hammer, Inc.
5. Combination Circuit Breaker and Ground Fault Circuit Interrupters:
 - a. Square D Co.
 - b. General Electric Co.
 - c. Siemens Energy & Automation, Inc.
 - d. Cutler-Hammer, Inc.
6. Molded-Case Current-Limiting Circuit Breakers:
 - a. Square D Co.
 - b. General Electric Co.
 - c. Siemens Energy & Automation, Inc.
 - d. Cutler-Hammer, Inc.
7. Integrally Fused Molded-Case Circuit Breakers:
 - a. Square D Co.
 - b. General Electric Co.
 - c. Siemens Energy & Automation, Inc.
 - d. Cutler-Hammer, Inc.
8. Insulated Case Circuit Breakers:

- a. Square D Co.
 - b. General Electric Co.
 - c. Siemens Energy & Automation, Inc.
 - d. Cutler-Hammer, Inc.
9. Power Circuit Breakers:
- a. Square D Co.
 - b. General Electric Co.
 - c. Siemens Energy & Automation, Inc.
 - d. Cutler-Hammer, Inc.
10. When Mounting overcurrent protective devices in switchboards, switchgear, panelboards, MCC's, etc., provide equipment of same manufacturer as equipment into which they are being mounted.

2.2 OVERCURRENT PROTECTIVE DEVICES (OCPDS), GENERAL:

- A. General: Provide OCPDs in indicated types, as integral components of panelboards, switchboards, motor control centers, and other related equipment; and also as individually enclosed and mounted single units.
- B. Enclosures: NEMA 250 "Enclosures for Electrical Equipment (1,000 Volts Maximum)."
- C. Where OCPD's are to be installed in existing panelboards, switchboards, and motor control centers, they shall be of the same manufacture and type as those existing in the equipment. If this is not possible, provide devices which are compatible with the existing equipment and when installed will not void the U.L. label or reduce the short circuit rating of the equipment.
- D. Provide 100 percent rated equipment and feeder breakers unless otherwise noted.
- E. Provide standard rated branch circuit breakers unless otherwise noted.
- F. All overcurrent devices shall be individually rated for the available fault current unless otherwise noted. Series ratings of equipment will only be allowed where specifically called out.

2.3 CARTRIDGE FUSES:

- A. General: NEMA Standard FU1, "Low-Voltage Cartridge Fuses." Unless indicated otherwise, provide nonrenewable cartridge fuses of indicated types, classes, and current ratings that have voltage ratings consistent with the circuits on which used.
- B. All fuses used for main, feeder, or branch-circuit protection shall be Underwriters Laboratories listed, current-limiting fuses with 200,000 ampere interrupting rating and shall be so labeled. Fuses used for supplementary protection (other than branch circuit protection) shall be as specified above or shall be U.L. approved or component recognized for such purposes. All fuses provided shall be furnished by the same manufacturer. Should equipment provided require a different U.L. Class or size of fuse, the engineer shall be furnished sufficient data to ascertain that system function will not be adversely affected.
- C. In order to simplify fuse replacement, reduce spare fuse inventory and insure adequate thermal protection, all fuses 600 amperes and below shall be true dual-element time-delay fuses with separate spring-loaded thermal overload elements in all ampere ratings. All ampere ratings shall be designed to open at 400 degrees F or less when subjected to a non-load oven test.

- D. To eliminate induction heating, all fuse ferrules and end caps shall be non-ferrous and shall be bronze or other alloy not subject to stress cracking.
 - E. Class L Fuses: UL 198C, "High-Interrupting Capacity Fuses, Current-Limiting Type."
 - F. Class RK1 and RK5 Dual Element Time-Delay Fuses: UL 198E, "Class R Fuses."
 - G. Class J Low-Peak dual Element Fuse: UL 198C
- 2.4 NONFUSIBLE SWITCHES:
- A. General: UL 98 "Enclosed and Dead Front Switches" and NEMA KS 1 "Enclosed Switches," quick-make, quick-break heavy-duty units.
 - B. Rating: Load-breaking capacity in excess of the normal horsepower rating for the switch.
 - C. Withstand Capability: In excess of the available.
 - D. Operation: By means of external handle.
 - E. Interlock: Prevents access to switch interior except when in "off" position.
 - F. Enclosure for Independent Mounting: NEMA Type 1 enclosure except as otherwise indicated or required to suit environment where located.
 - G. Contacts shall be NEMA rated 75 degrees C.
 - H. Provide auxiliary contacts for disconnects supplied from variable frequency drives.
- 2.5 FUSIBLE SWITCHES:
- A. General: UL 98 "Enclosed and Dead Front Switches" and NEMA KS 1 "Enclosed Switches," quick-make, quick-break heavy-duty units.
 - B. Rating: Load-breaking capacity in excess of the normal horsepower rating for the switch.
 - C. Withstand Capability: In excess of the let-through current permitted by its fuse when subject to faults up to 100,000 RMS symmetrical amperes.
 - D. Operation: By means of external handle.
 - E. Interlock: Prevents access to switch interior except when in "off" position.
 - F. Fuse Clips: Rejection type.
 - G. Enclosure for Switchboard or Panel board Mounting: Suitable for panel mounting where indicated.
 - H. Enclosure for Independent Mounting: Provide NEMA Type 1 enclosure except as otherwise indicated or required to suit environment where located.
 - I. Contacts shall be NEMA rated 75 degrees C.
 - J. Provide fuses for safety switches and other equipment of classes, types, and rating needed to fulfill electrical requirements for services indicated.

- K. Provide auxiliary contacts for disconnects supplied from variable frequency drives.

2.6 FUSED POWER CIRCUIT DEVICES:

- A. General: UL 977, "Fused Power Circuit Devices," with either bolted-pressure-type or high-pressure contact-type switch.
- B. Operation: Manually closed, electrically tripped.

OR

Manually opened and closed.

OR

Electrically closed and tripped.

- C. Ground Fault Protection: Integral, self-powered type with mechanical ground fault indicator, test function, adjustable pick-up current and delay time with inverse and constant time characteristics, internal memory arranged to integrate intermittent arcing ground faults, and ground fault current sensor located as indicated.
- D. Open Fuse Trip Device: Arranged to trip switch open if a phase fuse opens.
- E. Enclosure for Switchboard Mounting: Suitable for individual mounting.
- F. Enclosure for Independent Mounting: NEMA Type 1 enclosure, except as indicated or except as required to suit environment where located.
- G. Minimum Fault Current Rating: As indicated.

2.7 MOLDED-CASE CIRCUIT BREAKERS:

- A. General: UL 489, "Molded Case Circuit Breakers and Circuit Breaker Enclosures," and NEMA AB 1, "Molded Case Circuit Breakers."
- B. Construction: Provide bolt-in type, except breakers 225-ampere frame size and larger which may be plug-in type if held in place by positive locking device requiring mechanical release for removal.
- C. Characteristics: Indicated frame size, trip rating, number of poles, and a short-circuit interrupting capacity rating as indicated or required to match existing devices or equipment.
- D. Tripping Device: Quick-make, quick-break toggle mechanism with inverse-time delay and instantaneous overcurrent trip protection for each pole. Trip unit to be interchangeable within frame sizes for breakers 200 amperes or larger. Breakers 150 amperes and above shall have adjustable trip selection for trip units. All 120/208 volt rated breakers shall be rated and labeled "High Magnetic".
- D. Adjustable Instantaneous Trip Devices: Factory adjusted to low-trip-setting current values. Provide adjustable instantaneous trip devices for each circuit breaker supplying individual motor loads and where indicated.
- E. Enclosure for Switchboard or Panelboard Mounting: Suitable for panel mounting in switchboard or panelboards where indicated.

- F. Enclosure for Switchboard or Motor Control Center Mounting: Provide individual mounting where indicated.
 - G. Enclosure for Independent Mounting: NEMA Type 1 enclosure, except as otherwise indicated or required to suit environment where located.
- 2.8 COMBINATION CIRCUIT BREAKERS AND GROUND FAULT CIRCUIT INTERRUPTERS:
- A. General: UL 943 "Ground Fault Circuit Interrupters," arranged for sensing and tripping for ground fault current in addition to overcurrent and short-circuit current. Provide features as follows:
 - B. Match features and module size of panelboard breakers and provide clear identification of ground fault trip function.
 - C. Trip Setting for Ground Fault: 4 to 6 milliamperes, listed and labeled as a class A, type 1 device.
- 2.9 CURRENT-LIMITING CIRCUIT BREAKERS:
- A. General: Arranged to limit let-through ampere-squared-seconds during fault conditions to a value less than the ampere-squared-seconds of one-half-cycle wave of the prospective symmetrical fault current. The circuit breaker shall use no fusible devices in its operation. The current-limiting characteristic shall be in addition to normal time-delay and instantaneous-trip characteristics and other features as indicated.
- 2.10 INTEGRALLY FUSED CIRCUIT BREAKERS:
- A. General: Arranged to limit let-through ampere-squared-seconds during fault conditions to a value less than the ampere-squared-seconds of one-half-cycle wave of the prospective symmetrical fault current. The current-limiting characteristic shall be achieved through the use of replaceable current-limiting fuses internally mounted within the circuit-breaker case. The opening of any one fuse shall trip all poles of the circuit breaker. For each trip rating the time-current characteristic of the fuses shall be coordinated with that of the normal inverse-time and instantaneous-trip devices of the circuit breaker so current-limiting fuse melting does not occur for faults within the interrupting rating of the basic breaker.
- 2.11 CIRCUIT BREAKERS WITH SOLID-STATE TRIP DEVICES:
- A. General: Provide indicated circuit breakers with solid-state trip devices having the following features:
 - 1. Ambient Compensation: Trip device insensitive to temperature changes between minus 20 degrees C and plus 55 degrees C.
 - 2. Adjustability: Breaker ratings and trip settings shall be changeable by operation of controls on front panel of breaker, by change of plug-in element without removing breaker from mounting, or by a combination of the two methods.
 - a. The trip device sensor shall have the same rating as the frame amperage of the circuit breaker unless noted otherwise.
 - 3. Ground-Fault Tripping: Adjustable for pick-up and time-delay values. Provide for indicated units.

2.12 INSULATED-CASE CIRCUIT BREAKERS:

- A. General: UL 489, "Molded-Case Circuit Breakers and Circuit Breaker Enclosures," and NEMA AB 1, "Molded-Case Circuit Breakers."
- B. Ratings: Continuous-current, interrupting, and short-time-current ratings, and voltage and frequency ratings as indicated. Provide breakers with short time ratings above available fault levels.
- C. Operating Mechanism: Mechanically and electrically trip-free, stored-energy operating mechanism with the following features:
 - 1. Moving Contacts Closing Speed: Independent of both control and operator.
 - 2. Stored-Energy Mechanism: Manually charged.
 - 3. Stored-Energy Mechanism: Electrically charged, with provision for optional manual charging.
 - 4. Operation Counter: Include except as otherwise indicated.
- D. Circuit-Breaker Trip Devices: Solid-state overcurrent trip device system that includes one integrally mounted current transformer or sensor per phase, a release mechanism, and the following features:
 - 1. Functions: Long-time-delay, short-time-delay, and instantaneous-trip functions, which are independent of each other in both action and adjustment.
 - 2. Temperature compensation to assure accuracy and calibration stability from minus 20 degrees C to plus 55 degrees C.
 - 3. Field-adjustable, time-current characteristics.
 - 4. Current Adjustability: Effected by operating controls on front panel or by changing plug-in elements or current transformers or sensors.
 - 5. Five pickup points, minimum, for long-time- and short-time-trip functions.
 - 6. Six pickup points, minimum, for instantaneous-trip functions.
 - 7. Ground fault protection with at least three short-time-delay settings and three trip-time-delay bands. Adjustable current pickup.
 - 8. Trip Indication: Labeled lights or mechanical indicators on trip device shall indicate type of fault causing breaker trip. If lights are used, integral power source shall maintain indication for 60 hours, minimum.
- E. Auxiliary Contacts for Remote Indication: Where remote indication of breaker position is indicated, provide a spare auxiliary switch in addition to other auxiliary switches required for normal breaker operation. The spare auxiliary switch shall consist of two Type "a" and two Type "b" stages (contacts), wired to a terminal block in the breaker housing.
- F. Drawout Features: Circuit-breaker mounting assembly equipped with a racking mechanism that properly positions the power circuit breaker and holds it rigidly in connected, test, and fully disconnected positions and includes the following features:
 - 1. Interlock arrangement, preventing movement of the circuit breaker to or from the connected position when it is in the closed position and closure of the circuit breaker unless it is in the connected, test, or disconnected position.
 - 2. Construction, permitting racking an open circuit breaker to or from the connected, test, and disconnected positions with the associated compartment door closed or equivalent dead-front barrier protection, and manual withdrawal to a position for removal from the structure with the door open.

3. Primary disconnecting devices disengaged and secondary disconnecting devices engaged when breaker is in test position.
4. Primary and secondary devices disengaged when circuit breaker is in the disconnected position.
5. Ground contact engaged when the circuit-breaker element is in the connected and test positions.

G. Circuit-Breaker Features and Accessories: Include the following:

1. Operating Handle: Provide one for each manually operated breaker.
2. Electric Close Button: Provide one for each electrically operated breaker.
3. Indicating Lights: Contacts for "Breaker Open" and "Breaker Closed," for main and bus tie circuit breakers, and for other indicated breakers.

2.13 POWER CIRCUIT BREAKERS:

A. General: Separate sections shall be provided for each breaker. An individual power circuit breaker compartment and associated drawout current limiting fuses shall be provided for each breaker as shown. The master control compartment shall be located above the main utility circuit breaker compartments and shall contain the associated protective relaying, load bus voltmeter, load bus ampere meter, load bus kilowatt, kilovar meters, power factor meters and associated meter selector switches.

B. Low Voltage Power Circuit Breaker: Furnish and install each breaker to provide overcurrent protection and transitioning functions. The breaker shall be rated for frame, trip and AIC as shown on drawings, 3-pole, single throw, 100 percent rated electrically operated, large air, dead front, drawout type with solid-state trip elements. The use of insulated case type circuit breakers shall not be permitted.

1. Breakers shall have 5-cycle, stored energy closing.
2. Drawout feature shall provide for connected, test, and disconnected positions.
 - a. In the connected position, the main line and load terminals and all auxiliary control contacts and circuitry shall be connected and the breaker shall be fully operable.
 - b. In the test position, the breaker auxiliary control contacts and circuitry only shall be connected to permit automatic operation of the complete control system without actually connecting the load or source to the main bus.
 - c. In the disconnected position, main and auxiliary control contacts and circuitry shall be completely disconnected.
3. The breaker drawout mechanism shall be mechanically interlocked with the breaker to permit drawout operation only when the breaker main contacts are open.
4. If a separate fuse compartment is provided, the fuse drawout tray shall be interlocked mechanically to the breaker.
5. Provide integral "Open" and "Close" operating buttons on each breaker. Provide "open", "close", and "tripped" position indicators.

6. A shutter shall automatically close the opening to the insulators for the primary disconnecting devices when the circuit breaker unit reaches the "disconnect" position. The shutter shall be a simple, one-piece unit, closed by gravity and raised automatically upon insertion of the air circuit breaker.
 7. Trip elements shall include the following adjustable settings:
 - a. Long time pick up
 - b. Long time delay
 - c. Short time pick up
 - d. Short time delay
 - e. Instantaneous pick up
 - f. Ground fault
 - C. The breaker operating mechanism shall be of the two-step, stored energy, quick-make/quick-break type. Operating the charging handle or one operation cycle of the breaker motor shall charge the closing springs. A separate operation of the breaker manual "close" button shall close the breaker contacts. Closing of the breaker contacts shall automatically charge the opening springs to insure quick-break operation. Provide for manual charging for breaker operation.
 - D. Padlocking provisions shall be furnished to receive up to three padlocks when the breaker is "open" and in the "disconnected" position, positively preventing unauthorized closing of the breaker contacts.
 - E. Provide a manual "trip" button, drawout position indicator, contact position indicator, and spring condition indicator on the breaker.
 - F. Provide one extra four-stage, auxiliary switch and one extra eight-stage, cell-mounted, auxiliary switch, mechanism operated (MOC). When in the test position, the interlocks shall be bypassed.
 - G. Provide testing, calibration, and certification of the breaker by an independent NETA certified, testing consultant. The breakers shall be UL listed and labeled.
 - H. The bus/cable compartment in the rear of each housing shall be provided with sleeves or Micarta supports for power bus/cables. The compartment shall be arranged for the bus/cables to enter from the top or bottom as shown or required. Rear access type switchgear shall be required.
 - I. The stationary structure and circuit breaker units shall be constructed so that each circuit breaker unit is interchangeable with every unit of similar rating.
 - J. Provide necessary copper bussing, AIC bracing as indicated with full neutral and properly sized ground bus. Rate breaker maximum short time setting above available fault level.
 - K. Provide dead bus relays 120VAC coil powered from internal and external source for logic purposes.
- 2.14 OCPD ACCESSORIES:
- A. Key Interlocks: Arrange interlocking so keys are held captive at devices indicated. Where future key interlocking provisions are indicated, provide necessary mountings and hardware as required for the future installation.

- B. Provide adjustable-time-delay under-voltage trip devices where indicated.
 - C. Provide shunt-trip devices for Circuit breakers unless otherwise indicated. Arrange to trip breaker from an external source of power through a control switch or relay contact.
 - D. Provide bell alarm contacts for tripped position.
 - E. Lock-Out Devices: Provide padlocking provisions on each overcurrent protective device, lockable in the open or closed position. Provide 3 sets of lockout/tagout devices for each type of breaker or switch provided. Include tags, locks and all accessories necessary.
 - F. Provide hand held battery powered trip unit power supply with labeled storage compartment for each switchboard.
- 2.15 SPARE FUSE CABINET:
- A. Cabinet: Wall-mounted, 18-gauge minimum steel unit with full-length, recessed piano-hinged door with key-coded cam lock and pull. Size to be adequate for orderly storage of spare fuses specified with 15 percent spare capacity minimum. Cabinet finish: gray baked enamel. Stencil legend "SPARE PARTS" in 1-1/2 inches (40-mm) letters on door.

PART 3 - EXECUTION:

3.1 INSTALLATION:

- A. Independently Mounted OCPDs: Locate as indicated and install in accordance with manufacturer's written installation instructions. Install OCPDs level and plumb.
- B. OCPDs in new distribution and branch circuit equipment shall be factory installed. OCPD's in existing distribution and branch circuit equipment shall match existing for type and be provided with features as listed herein.
- C. Install fuses in fusible devices as indicated. Arrange fuses so that fuse ratings are readable without removing fuse.
- D. All fuses for new disconnect switches or MCC's feeding motors or motor starters shall be provided with Class J fuses.

3.2 IDENTIFICATION:

- A. Identify components in accordance with Division 16 Section on electrical identification.

3.3 CONTROL WIRING INSTALLATION:

- A. Install wiring between OCPDs and control/indication devices.

3.4 CONNECTIONS:

- A. Check connectors, terminals, bus joints, and mountings for tightness. Tighten field-connected connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque values. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals to comply with torque values specified in UL 486A and UL 486B.

3.5 GROUNDING:

- A. Provide equipment grounding connections for individually mounted OCPD units as indicated and as required by NEC. Tighten connectors to comply with torque values specified in UL Standard 486A to assure permanent and effective grounding.

3.6 FIELD QUALITY CONTROL:

- A. Reports: Prepare written reports on tests and observations. Report defective materials and workmanship and unsatisfactory test results. Include complete records of repairs and adjustments made. Tests shall be made on all new and existing OCPD's provided and/or connected under this project in accordance with this section.
- B. Labeling: Upon satisfactory completion of tests and related effort, apply a label to tested components indicating test results, date, and responsible organization and person.
- C. Schedule visual and mechanical inspections and electrical tests with at least one week advance notification.
- D. Upon completing installation of the system, perform the following tests:
 - 1. Visual and mechanical inspection: Include the following inspections and related work.
 - a. Overcurrent-Protective-Device Ratings and Settings: Verify indicated ratings and settings to be appropriate for final system arrangement and parameters.
 - b. Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with current single line diagram.
 - c. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.
 - d. Check tightness of electrical connections of OCPD's with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
 - e. Clean OCPD's using manufacturer's approved methods and materials.
 - f. Verify installation of proper fuse types and ratings in fusible OCPD's.
 - 2. Electrical Tests: Perform the following tests in accordance with manufacturer's instructions:
 - a. Insulation resistance test of fused power circuit devices, insulated-case, and molded-case circuit breakers, 600-ampere frame size and over at 1000 degree V d.c. for one minute from pole to pole and from each pole to ground with breaker closed and across open contacts of each phase. Insulation resistance less than 100 megohms is not acceptable.
 - b. Make insulation resistance tests of OCPD buses, components, and connecting supply, feeder, and control circuits.
 - c. Make continuity tests of circuits.
 - d. Provide full rated primary current tests conforming to NETA testing standards of all new and existing breakers 800 amperes and greater, connected under this

project. Inspect breakers and provide test report. Set breakers to previous or new settings as directed prior to test.

- e. Verify relay operation by introduction of accurately metered currents into overcurrent/ground fault/ and other circuitry at values which will enable accurate determination of the tripping or activation values.
 - E. Make adjustments for final settings of adjustable-trip devices.
 - F. Activate auxiliary protective devices such as ground fault or under-voltage relays, to verify operation of shunt-trip devices.
 - G. Check stored-energy charging motors for proper operation of motor, mechanism, and limit switches.
 - H. Check operation of electrically operated OCPDs in accordance with manufacturer's instructions.
 - I. Check safety devices for operation and sequence. Make closing attempts on locked-open and opening attempts on locked-closed devices including moveable barriers and shutters.
 - J. Retest: Correct deficiencies identified by tests and observations and provide retesting of OCPDs by testing organization. Verify by the system tests that specified requirements are met.
- 3.7 CLEANING:
- A. Upon completion of installation, inspect OCPD's. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.
- 3.8 DEMONSTRATION:
- A. Training: Arrange and pay for the services of factory-authorized service representatives to demonstrate OCPD's and train Owner's maintenance personnel.
 - B. Conduct a minimum of one day of training in operation and maintenance as specified under in the Project Closeout Section of these specifications. Include both classroom training and hands-on equipment operation and maintenance procedures.
 - C. Schedule training with at least one week advance notification.

END OF SECTION 16475