

PART 1 GENERAL**1.1 DESCRIPTION**

- A. Provide overcurrent protective devices of a type as specified herein.
- B. Provide disconnect switches of a type as specified herein and where required by the National Electrical Code. Provide fused or unfused switches as required by equipment manufacturer or circuit requirements.

1.2 QUALITY ASSURANCE

- A. Underwriters Laboratories, Inc., listed.
- B. The circuit breaker(s) referenced herein shall be designed and manufactured according to the latest revision of the following standards.
 - 1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches
 - 2. UL 489 - Molded Case Circuit Breakers and Circuit Breaker Enclosures
 - 3. UL 943 - Standard for Ground Fault Circuit Interrupters
 - 4. CSA C22.2 No. 5.1 - M91 - Molded Case Circuit Breakers
 - 5. NEC

1.3 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver equipment with Underwriters Laboratories, Inc. label and bearing manufacturer's name.

1.4 SUBMITTAL AND RECORD DOCUMENTATION

- A. Submit product data for each disconnect switch, circuit breaker, and fuse type, including descriptive data, outline drawings with dimensions, time-current curves, let-through current curves for fuses with current limiting characteristics, and coordination charts and tables and related data.

PART 2 PRODUCTS**2.1 MOLDED CASE CIRCUIT BREAKERS**

- A. General Requirements
 - 1. Circuit breakers shall be constructed using glass reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
 - 2. Circuit breakers shall have an over center, trip free, toggle operating mechanism which will provide quick-make, quick-break contact action. The circuit breaker shall have common tripping of all poles.
 - 3. The circuit breaker handle shall reside in a tripped position between ON and OFF to provide local trip indication. Circuit breaker escutcheon shall be clearly marked ON and OFF in addition to providing International I/O markings.
 - 4. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker.
 - 5. Each circuit breaker larger than 100A shall be equipped with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit breaker tripping mechanism for maintenance and testing purposes.

6. Circuit breakers shall be factory sealed with a hologram quality mark and shall have date code on face of circuit breaker.
 7. Branch circuit breakers exposed to fault currents higher than their AIC rating shall be series-rated with upstream feeder breaker, unless noted otherwise on Drawings. Circuit breaker/circuit breaker and fuse/circuit breaker combinations for series connected interrupting ratings shall be listed by UL as recognized component combinations. Any series rated combination used shall be marked on the end use equipment along with the statement "Caution - Series Rated System. _____ A Available. Identical Replacement Component Required".
 8. Manufacturer shall provide electronic and hard copy time/current characteristic trip curves (and I_p & I^2t let through curves for current limiting circuit breakers) for each type of circuit breaker.
 9. Circuit breakers shall be equipped with UL Listed electrical accessories as noted on the Drawings. Circuit breaker handle accessories shall provide provisions for locking handle in the ON and OFF position.
 10. All circuit breakers shall be UL Listed for reverse connection without restrictive line and load markings and be suitable for mounting in any position.
 11. Circuit breakers shall have factory installed mechanical lugs. All circuit breakers shall be UL Listed to accept field installable/removable mechanical type lugs. Lug body shall be bolted in place; snap in design not acceptable. All lugs shall be UL Listed to accept solid (not larger than #8 AWG) and/or stranded copper conductors.
 12. All circuit breakers shall be capable of accepting bus connections.
 13. Circuit breakers used for motor disconnects and not in sight of the motor controller shall be capable of being locked in the open (OFF) position.
 14. Acceptable Manufacturers: Siemens, Square D, Cutler-Hammer/Westinghouse, and GE.
- B. Thermal-Magnetic Circuit Breakers
1. Circuit breakers shall have a permanent trip unit containing individual thermal and magnetic trip elements in each pole.
 2. Thermal trip elements shall be factory preset and sealed. Circuit breakers shall be true rms sensing and thermally responsive to protect circuit conductor(s) in a 40 deg C ambient temperature.
 3. Circuit breaker frame sizes above 100 amperes shall have a single magnetic trip adjustment located on the front of the circuit breaker.
 4. Standard two- and three-pole circuit breakers up to 250 amperes at 600 VAC shall be UL Listed as HACR type.
- C. Equipment Ground Fault Protection (in Thermal Magnetic Circuit Breakers)
1. Where indicated on the Drawings, circuit breakers shall be equipped with a Ground Fault Module.
 2. Ground fault sensing system shall be modified zero sequence sensing type.
 3. The ground fault system shall require no external power to trip the circuit breaker.
 4. Companion circuit breaker shall be equipped with a ground-fault shunt trip.
 5. The ground fault sensing system shall be suitable for use on grounded systems. The ground fault sensing system shall be suitable for use on three-phase, three-wire circuits where the system neutral is grounded but not carried through the system or on three-phase, four-wire systems.
 6. Ground fault pickup current setting and time delay shall be field adjustable. A switch shall be provided for setting ground fault pickup point. A means to seal the pickup and delay adjustments shall be provided.
 7. The ground fault sensing system shall include a ground fault memory circuit to sum the time increments of intermittent arcing ground faults above the pickup point.
 8. A means of testing the ground fault system to meet the on-site testing requirements of the NEC shall be provided.
 9. Local visual ground fault trip indication shall be provided.

10. Where noted on Drawings, the ground fault sensing system shall be provided with zone selective interlocking communication capabilities compatible with other thermal magnetic circuit breakers equipped with ground fault sensing, electronic trip circuit breakers with integral ground fault sensing and external ground fault sensing systems.
11. The companion circuit breaker shall be capable of being group mounted.
12. The ground fault sensing system shall not affect interrupting rating of the companion circuit breaker.

D. Electronic Trip Circuit Breakers

1. Where indicated on Drawings, provide electronic trip circuit breakers per the following.
2. Breakers shall have a microprocessor-based tripping system which consists of three current sensors, a trip unit, and a flux-transfer shunt trip. The trip unit shall use microprocessor-based technology to provide the adjustable time-current protection functions. True RMS sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current sensors and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time delay settings are reached.
3. Interchangeable rating plugs shall establish the continuous trip ratings of each circuit breaker. Rating plugs shall be fixed type as indicated. Rating plugs shall be interlocked so they are not interchangeable between frames, and interlocked such that a breaker cannot be closed and latched with the rating plug removed. Circuit breakers shall be UL listed to carry 80% of their ampere rating continuously.
4. System coordination shall be provided by the following microprocessor-based programmable time-current curve shaping adjustments. The short-time pick-up adjustment shall be dependent on the long-time pick-up setting.
 - a. Programmable long-time pick-up.
 - b. Programmable long-time delay with selectable I^2t and I^4t curve shaping.
 - c. Programmable short-time pick-up.
 - d. Programmable short-time delay with selectable flat or I^2t curve shaping and zone selective interlocking.
 - e. Programmable instantaneous pick-up.
 - f. Programmable ground fault pick-up trip or alarm.
 - g. Programmable ground fault delay with selectable flat or I^2t curve shaping and zone selective interlocking.

The microprocessor-based trip unit shall have a powered/unpowered selectable thermal memory to provide protection against cumulative overheating should a number of overload conditions occur in quick succession.

5. Means to seal the trip unit adjustments in accordance with the NEC shall be provided.
6. Local visual trip indication for overload, short circuit and ground fault trip occurrences shall be provided.
7. An ammeter to individually display all phase currents flowing through the circuit breaker shall be provided. Indication of inherent ground fault current flowing in the system shall be provided on circuit breakers with integral ground fault protection. All current values shall be displayed in true rms with 2% accuracy.
8. Long Time Pickup indication to signal when loading approaches or exceeds the adjusted ampere rating of the circuit breaker shall be provided.
9. The trip system shall include a Long Time memory circuit to sum the time increments of intermittent overcurrent conditions above the pickup point. Means shall be provided to reset Long Time memory circuit during primary injection testing.
10. Circuit breakers shall be equipped with back-up thermal and magnetic trip system.
11. Circuit breaker trip system shall be equipped with an externally accessible test port for use with a Universal Test Set. Disassembly of the circuit breaker shall not be required for testing. Test set shall be capable of verifying the operation of all trip functions with or without tripping the circuit breaker.

2.2 FUSES

- A. Fuses 0 through 600 amperes:
 - 1. Circuits protected with fuses 0 through 600 amperes shall be protected by current-limiting Class RK1 or J dual-element time-delay fuses.
 - 2. All fuses shall have separate overload and short-circuit elements.
 - 3. Fuses shall incorporate a spring activated thermal overload element that has a 284 degrees Fahrenheit melting point alloy.
 - 4. The fuses shall hold 500% of rated current for a minimum of 10 seconds with an interrupting rating of 300,000 amperes RMS symmetrical, and be listed by a nationally recognized testing laboratory.
 - 5. Peak let-through currents and i^2t let-through energies shall not exceed the values established for Class RK1 or J fuses.
- B. Fuses 601 through 6000 amperes.
 - 1. Circuits protected with fuses 601 through 6000 amperes shall be protected by current-limiting Class L time-delay fuses.
 - 2. Fuses shall employ "O" rings as positive seals between the end bells and the glass melamine fuse barrel.
 - 3. Fuse links shall be pure silver (99.9% pure) in order to limit the short-circuit current let-through values to low levels and comply with NEC Sections requiring component protection.
 - 4. Fuses shall be time-delay and shall hold 500% of rated current for a minimum of 4 seconds, clear 20 times rated current in 0.01 seconds or less, with an interrupting rating of 300,000 amperes RMS symmetrical, and be listed by a nationally recognized testing laboratory.
 - 5. Peak let-through currents and i^2t let-through energies shall not exceed the values established for Class L fuses.
- C. Spares:
 - 1. Upon completion of the project, the contractor shall provide the owner with the following:
 - a. 10% (minimum of 3) of each type and rating of installed fuses shall be supplied as spares.
 - b. Spare fuse cabinet(s) shall be provided to store the above spares.
- D. Acceptable Manufacturers: Bussman, Littelfuse, and Gould-Shawmut.

2.3 DISCONNECTS

- A. Enclosed safety switches shall be horsepower rated in conformance with Table III or Fed. Spec. W-S-865. Switches shall disconnect all ungrounded conductors.
- B. Safety and disconnect switches shall be NEMA type HD (heavy duty), quick-make, quick-break, dual rated with electrical characteristics as required by the system voltage and the load served. Switches shall be equipped with a defeatable cover interlock. Operating handles shall be located to side of switches.
- C. Enclosures shall be NEMA 1 for indoor use, unless specifically noted otherwise, NEMA 3R where installed exposed to the weather or designated by the subscript "WP," and explosionproof where designated with the subscript "EP" or as required by the environment. Exterior enclosures shall be stainless steel.

- D. Disconnects shall be fusible or non-fusible as required by function or code. Equip all fusible disconnects with dual element fuses required by the equipment served. Coordinate fuse sizes at the time equipment is connected. Adjust fuse sizes if necessary to accommodate actual equipment installed. In no case shall fuses be sized smaller than the starter heaters on motor circuits.
- E. For single-phase motors, a single- or double-pole toggle switch, rated only for alternating current will be acceptable for capacities less than 30 amperes, provided the ampere rating of the switch is at least 125 percent of the motor rating.
- F. All disconnects shall be of same manufacturer.
- G. Switches identified for use as service equipment are to be labeled for this application.
- H. Switches used for motor disconnects and not in sight of the motor controller shall be capable of being locked in the open (OFF) position.
- I. Acceptable Manufacturers: Square D, Siemens, Cutler-Hammer/Westinghouse, and GE approved.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install overcurrent protective devices as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to ensure that protective devices comply with requirements. Comply with NEC and NEMA standards for installation of overcurrent protective devices.
- B. Coordinate with other work, including electrical wiring work, as necessary to interface installation of overcurrent protective devices with other work.
- C. Fasten circuit breakers without causing mechanical stresses, twisting or misalignment being exerted by clamps, supports, or cabling.
- D. Inspect circuit breaker operating mechanisms for malfunctioning and, where necessary, adjust units for free mechanical movement.
- E. Adjust all adjustable/programmable features of electronic trip circuit breakers in accordance with results of electrical power system studies. Reference Section 26 05 73.
- F. Fuses shall not be installed until equipment is ready to be energized. This measure prevents fuse damage during shipment of the equipment from the manufacturer to the job site, or from water that may contact the fuse before the equipment is installed.
- G. Install safety and disconnect switches where indicated, in accordance with the manufacturer's written instructions, the applicable requirements of NEC and the National Electrical Contractors Association's "Standard of Installation," and in accordance with recognized industry practices to ensure that products serve the intended function.
- H. Install disconnect switches used with motor-driven appliances, motors, and controllers within sight of the controller position and within 25 feet.

3.2 TESTING

- A. Prior to energization of overcurrent protective devices, test devices for continuity of circuitry and for short circuits. Correct malfunctioning units, and then demonstrate compliance with requirements.

END OF SECTION