Motor Circuit Branch Circuit Protection

Is Resettability of Value?

Motor Circuits – Choice of Overcurrent Protection

Motor circuits have unique characteristics and several functions, such as short circuit protection, overload protection and automatic/remote start/stop, that may be required. Sometimes the comment is made that users prefer circuit breakers because they can be reset. Let’s examine the choice of either circuit breakers or current-limiting fuses for motor branch circuit protection.

In the case to be examined, fuses and circuit breakers (includes magnetic only circuit breakers which are called MCPs or motor circuit protectors) are sized with the intent to provide only short circuit and ground fault protection for the motor branch circuit protection per 430.52. Other means, such as overload relays, provide the motor overload protection. Typical thermal magnetic circuit breakers can only be sized for motor branch circuit protection (typically 200% - 250% of motor current) because if they are sized closer, the motor starting current trips the circuit breaker’s instantaneous mechanism. Magnetic only circuit breakers (MCPs) are intentionally not provided with overload capability; they only operate on short-circuit currents. There are some fuses such as the FRS-R, FRN-R, LPN-RK and LPS-RK fuses that can be sized close enough for motor running overload protection or backup motor running protection. But for the discussion in this section, assume current-limiting fuses are sized only for motor short circuit and ground fault protection.

It is important to note that in this protection level being discussed, a circuit breaker or fuses should only open if there is a fault on the motor circuit. Breakers or fuses need to be inserted in the circuit; the starter does not have to be repaired or replaced. Properly selected fuses for Type 2 protection, after the fault is repaired, only new fuses need to be inserted in the circuit; the starter does not have to be repaired or replaced.

3. Circuit breakers must be periodically tested to verify they mechanical operate and electrically tested to verify they still are properly calibrated within specification. The circuit breaker manufacturers recommend this. Typically circuit breakers should be mechanically operated at least every year and electrically tested every 1 to 5 years, depending on the service conditions. Modern current-limiting fuses do not have to be maintained or electrically tested to verify they still will operate as intended. The terminations of both circuit breakers and fusible devices need to be periodically checked and maintained to prevent thermal damage. Plus fuse clips should be periodically inspected and if necessary maintained.

4. After a circuit breaker interrupts a fault, it may not be suitable for further service. UL 489, the product standard for molded case circuit breakers, only requires a circuit breaker to interrupt two short-circuit currents at its interrupting rating. Circuit breakers that are rated 100 amps or less do not have to operate after only one short circuit operation under “bus bar” short circuit conditions. If the fault current is high, circuit breaker manufacturers recommend that a circuit breaker should receive a thorough inspection with replacement, if necessary. How does one know a circuit breaker’s service history or what level of fault current that a circuit breaker interrupts? With modern current-limiting fuses, if the fuse interrupts a fault, new factory calibrated fuses are installed in the circuit. The original level of superior short circuit protection can be there for the life of the motor circuit.

5. After a fault, the electrician has to walk back to the storeroom to get new fuses; that is if spare fuses are not stored adjacent to the equipment. This does require some additional time. However, if fuses opened under fault conditions, there is a fault condition that must be remedied. The electrician probably will be going back to the storeroom anyway for parts to repair the fault. If properly selected current-limiting fuses are used in the original circuit, the starter will not sustain any significant damage or loss of overload calibration.

With circuit breaker protection on motor circuits, after a fault condition, it may be necessary to repair or replace the starter, so a trip to the storeroom may be necessary. And if the starter is not significantly damaged, it may still need to be tested to insure the let-through energy by the circuit breaker has not caused the loss of starter overload calibration. Also, the circuit breaker needs to be evaluated for suitability before placing it back into service. Who is qualified for that evaluation? How much time will that take?

In summary, resettability is not an important feature for motor branch circuit (short circuit) protection and resettability of the branch circuit protective device is not a benefit for motor circuits. As a matter of fact, resettability of the motor branch circuit overcurrent protective device may encourage an unsafe practice. The function of motor branch circuit protection is fault protection: short circuit and ground fault protection. Faults do not occur on a regular basis. But when a fault does occur, it is important to have the very best protection. The best motor branch circuit protection can be judged by (1) reliability - its ability to retain its calibration and speed of operation over its lifetime, (2) current-limiting protection - its ability to provide Type 2 “no damage” protection to the motor starter, and (3) safety - its ability to meet a facility’s safety needs. Modern current-limiting fuses are superior to circuit breakers for motor branch circuit protection.

After a heavy fault on a motor branch circuit, you may need to (1) replace the fuses or (2) reset the circuit breaker and replace the starter (and maybe the circuit breaker, too).