# Overcurrent Protective Devices and Disconnects for Motor & Circuit Protection

## Overcurrent Protective Devices and Disconnecting Means For Motor & Motor Circuit Protection

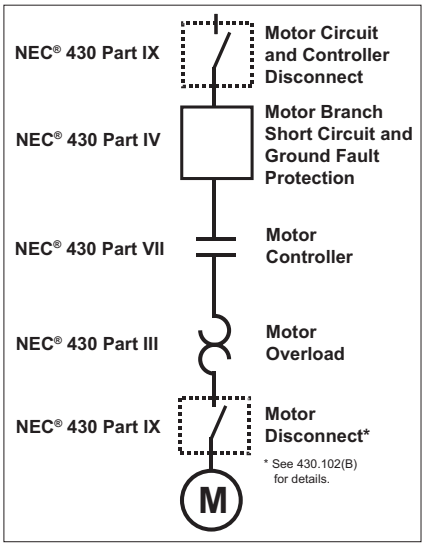



**Figure 1**

Of all the branch circuits encountered in the electrical industry, motor branch circuits remain as one of the most unique. Listed here are a few reasons why motor branch circuits are so unique:

- The harsh demand of motor loads, such as inrush and locked rotor currents,
- The desire for various levels of functionality, such as remote push button control
- The multitude of devices used in motor circuits

In order to provide a reliable motor branch circuit installation, a thorough understanding of the requirements for various functional parts of motor branch circuits, and their intended purpose, is required. Motor branch circuits can be broken down into 4 and sometimes 5 major functional blocks for motor operation as seen in figure 1.

They include:

- Motor Circuit and Controller Disconnecting Means
- Motor Branch Short-Circuit and Ground Fault Protection
- Motor Controller
- Motor Overload Protection
- And sometimes Motor Disconnecting Means, often referred to as the "At the Motor" Disconnecting Means

Overcurrent protection for motor circuits can be broken into two parts:

- Motor overload protection
- Motor branch circuit short-circuit and ground fault protection

Motor overload protective devices provide protection from low level, long time overcurrent conditions which generally cause overheating of motor or motor branch circuit components over a long period of time (10 seconds or longer). Motor branch circuit devices provide short-circuit and ground fault protection for motor branch circuits and the components of the circuit, i.e. motor starters, conductors, equipment grounding conductors, etc. The proper selection of overcurrent protection is extremely important. If not properly protected for short-circuit currents, motor circuit components can be extensively damaged under fault conditions. It is possible for the component to violently rupture and emit conductive gases that can lead to other faults.

Motor and motor circuit disconnecting means provide the function of isolating the motor or motor circuit from the source of supply for maintenance work. Motor controllers serve as an On/Off function for the motor and, as the name implies, serves as control of the motor.

In addition to these functional blocks, there are various requirements for motor control circuit components and other specialized components. This discussion will focus on the motor (power) branch circuit requirements and the devices corresponding thereto. Various devices are available on the market to provide these functions. Some devices perform only one of these functions and some perform multiple functions. Some devices, such as UL508 disconnects and Manual Motor Protectors have spacing requirements that are less than UL98 disconnects or UL489 molded case circuit breakers, and therefore, have limitations on their application. Below is an overview of such devices:

## Motor Circuit Devices

### Branch Circuit Fuses
### As Listed To UL/CSA/ANCE 248 Series of Standards


These are fuses that cannot be replaced with fuses having a lower voltage rating. When installed in rejection style clips, current-limiting branch circuit fuses cannot be replaced with fuses which are not current-limiting. Examples of branch circuit fuses are Class L, RK1, RK5, T, J, K1, K5, G, H, CC, and plug fuses. Interrupting ratings range from 10,000 amps to 300,000 amps. These fuses are listed for branch, feeder, and main protection. In a motor circuit they provide branch circuit, short-circuit, and ground fault protection. In addition, enhanced overcurrent protection such as back-up overload and Type 2 "No Damage" protection can be provided with the selection of certain fuse sizes and types.

### Allowed Uses:

- Motor Branch Short-circuit and Ground Fault Protection
- Motor Overload Protection (some fuse types based upon amount of time delay)
- Group Motor Protection as the short-circuit and ground fault protective device
- Motor Branch Circuit and "at the motor" Disconnecting Means when used in conjunction with a UL98 fusible switch
- Motor Controller when used in conjunction with a UL98 fusible switch, UL508 Manual Motor Controller, or UL1429 pullout.

### Identification

Fuses listed to UL/CSA/ANCE 248 will contain a marking near the agency symbol. This marking should read listed fuse.

**UND. LAB. INC.®**
**LISTED FUSE FP07-34**
**INT. RAT. 200kA**

## Fuse Holders As listed to UL 512


When used with a motor disconnecting means and properly sized branch circuit fuses, fuse holders may provide main, feeder, branch circuit, motor, motor circuit, and group motor protection. They cannot be used alone as a motor disconnecting means to meet NEC® 430.109, nor can they be used alone as a motor controller (On-Off function) to meet NEC® Article 430, Part VII.

LISTED
FUSE HOLDER

### Identification

Fuse holders as listed to UL 512 will contain a marking near the agency listing symbol. This marking should read Listed Fuse Holder.

## Disconnect Switches-Fused and Non-Fused As listed To UL 98

These are disconnect switches from 30 through 6000 amps, that may be used on service equipment, panelboards, switchboards, industrial control equipment, motor control centers, motor branch circuits, etc. These switches may be used as a motor disconnecting means to meet NEC® 430.109. They may also be used as a motor controller (on-off function) to meet NEC® article 430, Part VII, and may be used as both a motor disconnecting means and a motor controller (NEC® 430.111).

### Allowed Uses:

- Motor Branch Circuit and “at the motor” Disconnecting Means
- Motor Controller

GENERAL PURPOSE SWITCH
INTERRUPTEUR USAGE GENERAL
LISTED 3E73
MISC. SW.

### Identification

Disconnect switches as listed to UL98 will contain a marking near the agency symbol. This marking should read "Listed Misc. Sw."

## Motor Switches (Manual Motor Controllers) As listed To UL 508

These switches may be used as a motor controller (On-Off function) to meet NEC® Article 430 Part VII. As motor controllers, they have creepage and clearance distances that are less than those required by UL 98. As a result, they cannot be used as a motor disconnecting means to meet NEC® 430.109. If the device is listed as a “manual motor controller” and is additionally marked “Suitable as Motor Disconnect” it shall be permitted to serve as a motor disconnecting means if it is located between the final motor branch-circuit short-circuit and ground-fault protective device and the motor. This marking and listing is optional, so a review of the device markings will be required if intended to be used for this purpose.

### Allowed Uses:

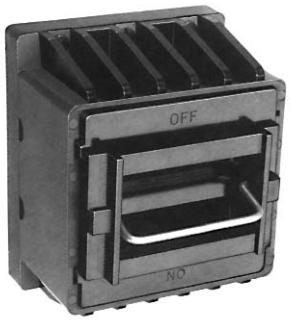
- Motor Controller
- “At the Motor” Disconnect if marked “Suitable as motor Disconnect” and located between the motor branch circuit short-circuit and ground fault protective device and the motor.

LISTED
MAN. MTR. CNTLR
Suitableas MotorDisconnect
40A 600Vac

### Identification

Motor Switches/Manual motor controllers as listed to UL508 will contain a marking near the agency symbol. This marking should read manual motor controller or an abbreviation such as Man. Mtr. Cntlr. Manual motor controllers listed for use as a motor disconnecting means will be marked “Suitable as Motor Disconnect.”

## Pullout Switches As Listed To UL 1429




These are switches from 30 through 200 amps at 600V or less. Pullout switches with horsepower ratings are suitable for motor disconnecting means to meet NEC® 430.109, as motor controllers to meet NEC® Article 430 Part VII (if rated 100Hp or less), and in general use for panelboards, switchboards, etc. They may be used as both a motor disconnecting means and a motor controller to meet NEC® 430.111. Pullout switches with amp ratings only (no Hp ratings) are suitable for general use only, not motor circuits. If they are marked “Motor circuit pullout switch” they may be used only in a motor circuit. When used with properly sized branch circuit fuses, pullout switches may be used for motor, motor circuit, and group motor protection.

### Allowed Uses:

- Motor Branch Circuit and “at the motor” Disconnecting Means
- Motor Controller

### Identification

Pullout switches as listed to UL1429 will contain a marking near the agency symbol. This marking should read Listed Pullout Switch.

LISTED
PULLOUT SWITCH

## Molded Case Switches As listed to UL 489

These switches are very similar to molded case thermal magnetic circuit breakers except that they have no thermal overload protection. They may or may not be equipped with a “magnetic” instantaneous trip as a self-protect mechanism. They may be used on service equipment, panelboards, switchboards, industrial control equipment, motor control centers, motor branch circuits, etc. They are suitable for use as a motor circuit disconnect per NEC® 430.109. They may be used as a motor controller (On-Off function) to meet NEC® Article 430 Part VII, and as both a motor disconnecting means and motor controller to meet NEC® 430.111.

### Allowed Uses:

- Motor Branch Circuit and “at the motor” Disconnecting Means
- Motor Controller

### Identification

Molded Case Switches as listed to UL489 will contain a marking near the agency listing symbol. This marking should read Listed Molded Case Switch.

## Thermal Magnetic (Inverse Time) Circuit Breakers As Listed to UL 489

These circuit breakers are intended to provide branch, feeder, and main protection, with interrupting ratings from 5,000 to 200,000 amps. Properly sized inverse time circuit breakers are intended to provide motor branch circuit short-circuit and ground fault protection. They may be used for group motor protection only when the circuit breaker is tested, listed and marked {430.53(C)} for group installation (see 430.53(A) & (B) for exceptions). There are no circuit breakers listed for group motor protection except for HVAC applications, in which case they are marked HACR. They are suitable for use as a motor disconnecting means per NEC® 430.109, as a motor controller (On-Off Function) per NEC® Article 430, Part VII, and as both a motor disconnecting means and motor controller per NEC® 430.111.

### Allowed Uses:

- Motor Branch Short-circuit and Ground Fault Protection
- Motor Overload Protection
- Group Motor Protection as the short-circuit and ground fault protective device only when the circuit breaker is tested, listed and marked for group installation. (See 430.53(A) & (B) for exceptions)
- Motor Branch Circuit Disconnecting Means
- Motor Controller

### Identification

Circuit Breakers listed to UL489 will contain a marking near the agency symbol. This marking should read circuit breaker or an abbreviation such as Cir. Bkr.


## Instantaneous Trip Circuit Breakers (MCPs) As recognized To UL 489

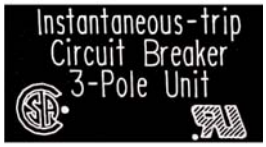
These are circuit breakers without overload (thermal) protection capability. They are intended to provide only branch circuit, short-circuit and ground protection for individual motor branch circuits. They may not be used to provide main, motor feeder, motor overload, general branch circuit or group motor protection. Because they are recognized, not listed, they cannot be used with loose control. NEC® 430.52 requires that they shall only be used as part of a listed combination controller. MCPs are short-circuit tested only in combination with a motor controller and overload device. They are not labeled with an interrupting rating by themselves. Per NEC® 430.109 exception 7, they may be used as a motor disconnecting means when part of a listed combination motor controller.

### Allowed Uses:

- Motor Branch Short-circuit and Ground Fault Protection only when listed for use in combination with a specific motor controller/overload device
- Motor Branch Circuit Disconnecting Means
- Motor Controller

### Identification

Instantaneous Trip Circuit Breakers recognized to UL489 will contain a recognized or component acceptance marking. This marking indicates that the product can not be used “stand alone” and is limited to certain conditions of use.



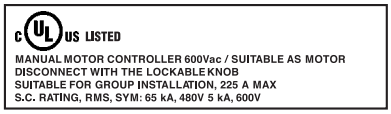

## Manual Motor Controllers (Manual Motor Protectors) As listed to UL 508

These manual motor starters, sometimes called MMPs, often combine a magnetic short-circuit trip and adjustable motor overload protection. They are intended to provide motor overload protection per NEC® 430.32. Creepage and clearance distances are typically not as great as required in UL 489, and therefore they cannot be listed as a circuit breaker. MMPs cannot provide motor branch circuit short-circuit and ground fault protection. They need a branch circuit overcurrent device and a motor disconnecting means on the line side for both single motor and group motor applications. Some IEC manual motor protectors have been tested and listed for group motor applications [as the protected (downstream) device, not the protecting (upstream) device] so that several of them may be able to be protected by one larger upstream fuse sized not to exceed the maximum size allowed per the device listing. Devices listed for use in group motor installations will be marked for such use to indicate that the device has undergone the appropriate testing to deem it suitable for such use. Some of these devices are rated with slash voltage limitations (such as 480Y/277V). This limits their use to solidly grounded wye type systems only. Manual motor controllers may be used as a motor controller (On-Off Function) to meet NEC® Article 430 Part VII. Unless otherwise marked, MMPs do not meet requirements for a motor disconnecting means as required in NEC® 430.109. If it is marked “Suitable as Motor Disconnect” it shall be permitted to serve as a motor disconnecting means if it is located between the final motor branch-circuit, short-circuit and ground fault protective device and the motor. This marking and listing is optional, so a review of the device markings will be required if it is intended to be used for this purpose.

### Allowed Uses:

- Motor Overload Protection
- Group motor applications as the protected (downstream) device only when the device is tested, listed and marked and the upstream fuse (protecting device) is sized within the maximum allowed per the device’s listing.
- Motor Controller
- “At the Motor” Disconnect if marked “Suitable as motor Disconnect” and located between the motor branch circuit short-circuit and ground fault protective device and the motor.

## Identification




Manual motor protectors as listed to UL508 will contain a marking near the agency symbol. This marking should read manual motor controller or an abbreviation such as Man. Mtr. Cntlr. Manual motor controllers listed for use within group motor applications, as the downstream, protected overload/controller device, will be marked for such use along with the required maximum size for the upstream fuses. Manual motor controllers, additionally listed for use as a motor disconnecting means, will be marked "Suitable as Motor Disconnect."

## Integrated Starters As Listed To UL 508

Integrated starters are a factory assembled combination of an IEC manual motor controller (manual motor protector), as just previously discussed, and an IEC contactor. Application requirements are the same as manual motor controllers including the need for a branch circuit overcurrent protective device and disconnecting means upstream. See the description above, for manual motor controllers, for application requirements and device identification.

## Self-Protected Type E Combination Starters As Listed To UL 508

Self-protected combination starters are often called "Coordinated protected starters" and "Type E" starters. They are intended to provide motor overload and motor branch circuit short-circuit and ground fault protection by combining a magnetic short-circuit trip and adjustable motor overload in one package. A "Type E" starter is a listed combination starter suitable for use without additional branch circuit short-circuit protection and is limited to single motor circuits. A self protected, type E, combination starter marked with a slash voltage rating is limited to use on **solidly grounded wye type systems only** per the device listing. Creepage and clearance on the line terminals has to be to branch circuit dimensions as UL 489 and UL 98 devices. A self protected type E combination motor starter marked for use with a terminal kit, shall be installed with a terminal kit to ensure line terminal spacings are adequate. Accessory parts may need to be added to off-the-shelf, self-protected type E combination motor starters, in order for the device to be suitable for use. Self-Protected Type E Combination Starters are suitable for use as a motor disconnecting means per NEC® 430.109, as a motor controller (On-Off Function) per NEC® Article 430, Part VII, and as both a motor disconnecting means and motor controller per NEC® 430.111.

## Allowed Uses:

- Motor Branch Circuit Short-circuit and Ground Fault Protection
- Motor Overload Protection
- Motor Branch Circuit and "at the motor" Disconnecting Means
- Motor Controller

## Identification


Self-Protected Type E combination starters as listed to UL 508 will contain a marking near the agency symbol. This marking should read self-protected combination motor controller. In addition, Self-Protected Type E combination starters which are limited in application to solidly grounded wye type systems will be marked with a slash voltage rating such as 480Y/277 or 600Y/347.

## Supplementary Overcurrent Protective Devices For Use in Motor Control Circuits

### Branch Circuit vs. Supplemental Overcurrent Protective Devices

Branch circuit overcurrent protective devices (OCPD) can be used everywhere OCPD are used, from protection of motors and motor circuits and group motor circuits, to protection of distribution and utilization equipment. Supplemental OCPD can only be used where proper protection is already being provided by a branch circuit device, by exception [i.e., 430.72(A)], or if protection is not required. Supplemental OCPD can often be used to protect motor control circuits but they cannot be used to protect motors or motor circuits. A very common misapplication is the use of a supplementary overcurrent protective device such as a UL 1077 mechanical overcurrent device for motor branch circuit short-circuit and ground fault protection. Supplementary OCPDs are incomplete in testing compared to devices that are evaluated for branch circuit protection. **THIS IS A SERIOUS MISAPPLICATION AND SAFETY CONCERN!!** Caution should be taken to assure that the proper overcurrent protective device is being used for the application at hand. Below is a description of popular supplementary overcurrent protective devices.

Most supplemental overcurrent protective devices have very low interrupting ratings. Just as any other overcurrent protective device, supplemental OCPDs must have an interrupting rating equal to or greater than the available short-circuit current.

## Supplemental Fuses As Listed or Recognized To The UL/CSA/ANCE Tri-national 248-14 Standard

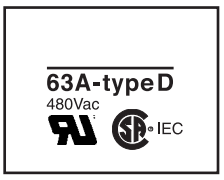
These are fuses that can have many voltages and interrupting ratings within the same case size. Examples of supplemental fuses are 13/32" X 1 1/2", 5 x 20mm, and 1/4" x 1 1/4" fuses. Interrupting ratings range from 35 to 100,000 amps.

## Supplementary Protectors (Mini-Breakers) As Recognized To UL 1077

With applications similar to supplemental fuses, these supplementary protectors, often referred to as mini-circuit breakers, cannot be used as a branch circuit protective device. As such they cannot provide motor, motor circuit, or group motor protection. They can only be used for protecting an appliance or other electrical equipment where branch circuit overcurrent protection is already provided, or is not required. They typically have creepage and clearance distances that are less than those in UL 489, so they cannot be listed as a circuit breaker or used as a motor disconnecting means to meet the requirements of NEC® 430.109. Interrupting ratings are quite low. Those devices that are short-circuit tested in series with a fuse must be applied with a fuse on their line side.

## Identification

Supplemental protectors as recognized to UL 1077 will contain a recognition mark rather than a listing mark.



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## Motor Circuit Protection Device Selection Chart & Supplemental Protectors

**Warning**
**Supplemental Protectors are NOT suitable for Motor Branch Circuit Protection**

Supplemental protectors are being used for motor branch circuit protection in numerous applications throughout the industry. This is a **MISAPPLICATION** and the urgency of the matter is prompting the creation of safety notices, articles, and technical bulletins to alert the users of this misapplication. Supplemental protectors are not suitable for branch circuit protection and cannot be used for this purpose per 240.10 of the National Electrical Code®. Supplemental protectors are intended to be used as a component of an end product such as commercial appliances, kitchen appliances, luminaires (lighting fixtures), etc. They are offered in a wide variety of performance characteristics, voltage ratings, and interrupting ratings and therefore each supplemental protector is only allowed to be used under specific conditions. Supplemental protectors are UL recognized to UL1077, Supplemental protectors for use in Electrical Equipment, for this reason. A recognized or restricted product is not field installable and therefore an investigation assuring application of the product within its conditions of acceptability is required.

### Why Are They Being Misapplied?

Here are some of the popular reasons why:

- Supplemental protectors look very similar to Molded Case Circuit Breakers leading to the assumption that they provide the same protection
- Supplemental protectors are often labeled as circuit breakers or Miniature Circuit Breakers (MCB) in literature
- Many of these devices are rated as a circuit breaker per IEC and confusion over North American and IEC ratings leads to misapplication

### So What Do I Need To Do?

In order to correct the application, suitable protection for the motor branch circuit needs to be provided. The simplest correction to this problem is the replacement of the misapplied supplemental protector with a device that is suitable for branch circuit protection.

- **A WORD OF CAUTION:** The supplemental protector can only be used in an end product that is evaluated as an assembly. If the equipment does not go through an investigation, there is no assurance that the supplemental protector is being used for its intended use within its conditions of acceptability. Therefore the replacement of this device is the safest approach.

### So What Can I Use?

NEC® 430.52 provides a list of acceptable devices for motor branch circuit protection. Among the list of acceptable devices are time delay and fast acting branch circuit fuses.

### Summary

Supplemental protectors are being misapplied on numerous occasions. Many reasons lead to this misapplication including mistaking supplemental protectors as North American circuit breakers. The key to properly identifying supplemental protectors is to look for the recognition mark. If the device you are using has a recognition mark, more than likely it is a supplemental protector and replacement is necessary for a proper installation.

For more in-depth discussion, download Tech Talk 3 and Supplement from www.cooperbussmann.com

| Motor Circuit Protection Device Selection Chart | UL248 Fuses and Disconnect | UL489 Circuit Breaker | IEC Manual Motor Controller (Manual Motor Protector) | Self Protected Type E Combo Starter | Magnetic Motor Starter | Manual Motor Controller (UL508 Switch) | Instantaneous Trip Circuit Breaker | UL1077 Supplemental Protector |
|---|---|---|---|---|---|---|---|---|
| **Allowed Uses Per 2002 NFPA79 and NEC®** |  |  |  |  |  |  |  |  |
| Motor Circuit and Controller Disconnect | Yes[1] | Yes | No | Yes[6,7] | No | No | Yes[5,6] | No |
| Motor Branch Short Circuit and Ground Fault Protection | Yes | Yes[8] | No | Yes[6,8] | No | No | Yes[5,6] | No |
| Motor Controller | Yes[2] | Yes | Yes[9] | Yes[9] | Yes | Yes[9] | No | No |
| Motor Overload | Yes | Yes[3] | Yes[10] | Yes[10] | Yes | No | No | No |
| Motor Disconnect | Yes[2] | Yes | Yes[4] | Yes | No | Yes[4] | No | No |


1. When used in conjunction with a UL98 Fusible Switch.
2. Where used in conjunction with a UL98 or UL508 fusible switch. If UL508 switch, see footnote 4
3. Often cannot be sized close enough.
4. Must be located on the load side of motor branch short-circuit protective device, marked "Suitable as Motor Disconnect," and be provided with a lockable handle.
5. When used in conjunction with a motor starter as part of a listed and labeled combination motor controller.
6. Limited to single motor circuit applications.
7. Additional Terminal Kit Often Required.
8. If Slash Voltage Rated, Limited to Solidly Grounded Wye Systems ONLY.
9. Additional Contactor Required for Remote Control.
10. Class 10 Overload Protection Only.

## 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. A separate overload protective device, such as an overload relays, provides motor overload protection per 430.32. Here are some important considerations:

1. OSHA regulation 1910.334(b)(2) Use of Equipment states:

   *Reclosing circuits after protective device operation. After a circuit is deenergized by a circuit protective device, the circuit may not be manually reenergized until it has been determined that the equipment and circuit can be safely energized. The repetitive manual reclosing of circuit breakers or reenergizing circuits through replaced fuses is prohibited. NOTE: When it can be determined from the design of the circuit and the overcurrent devices involved that the automatic operation of a device was caused by an overload rather than a fault condition, no examination of the circuit or connected equipment is needed before the circuit is reenergized.*

   So the speed of reclosing a circuit breaker after a fault is not an advantage. The law requires that if the condition is a fault (that is the only reason the circuit breaker or fuses should open on a motor circuit), then the fault must be corrected prior to replacing fuses or resetting the circuit breaker.

2. The typical level of short circuit protection for the motor starter provided by circuit breakers and MCPs is referred to as Type 1. This is because most circuit breakers are not current-limiting. So, for a loadside fault, the starter may sustain significant damage such as severe welding of contacts and rupturing of the heater elements. Or the heater/overload relay system may lose calibration. This is an acceptable level of performance per UL508, which is the product standard for motor starters. Current-limiting fuses can be selected that can provide Type 2 "no damage" short circuit protection for motor starters.

   Consequently, with circuit breaker protection, after a fault condition, significant downtime and cost may be incurred in repairing or replacing the starter. With 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. UL489, 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 down 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).