Supplementary overcurrent protection is permitted by the National Electrical Code® [422.11(B)]. Be sure to observe maximum branch circuit fuse size labels. When the equipment label is marked with a maximum fuse amp rating rather than marked with maximum overcurrent device amp rating, only fuses can be used for protection of this equipment.

**Panelboards**

A maximum of 42 fuses (excluding main fuses) are permitted to be installed in a lighting and appliance branch circuit panelboard [408.35]. Each lighting and appliance branch circuit panelboard must be individually protected on the supply side by not more than two sets of fuses having a combined rating not greater than that of the panelboard [408.36]. Exception No. 1: Individual protection is not required when the panelboard feeder has overcurrent protection not greater than that of the panelboard. Exception No. 2: Individual protection in existing installations is not required for individual residential occupancy service entrance panelboards [408.36(A)]. A power panelboard having supply conductors which include a neutral and having more than 10% of its overcurrent devices protecting branch circuits of 30A or less, shall have individual protection on the line side not greater than the rating of the panelboard. Individual protection is not required when the power panel is used as service equipment in accordance with 230.71 [408.36(B)]. Panels with snap switches rated at 30A or less must be protected by fuses not larger than 200A [408.36(C)]. Fusable panelboards are available with heavy duty toggle switches rated more than 30A; these panelboards are not restricted by this 200A requirement.

If the panelboard is supplied through a transformer, the fuses for the protection of the panelboard must be located on the transformer secondary [408.36(D)] except when the fuse on the primary complies with 240.2(C)(1). [408.36(D) Exception].

**Appliances**

Appliance branch circuits shall be protected in accordance with 240.5. If a fuse rating is marked on an appliance, the branch circuit fuse rating cannot exceed that rating marked on the appliance [422.11(A)]. See 430.6(A)(1) exception No.3 for situations where the appliance is marked with both a horsepower rating and an amp rating.

For branch circuits which supply a single non-motor operated appliance rated more than 13.3A, the fuse rating shall not exceed 150% of the appliance rating [422.11(E)(3)].

Electric heating appliances using resistance heating elements rated more than 48A shall have the heating elements subdivided such that each subdivision does not exceed 48 amps and each subdivision shall be protected by a branch circuit listed fuse not to exceed 60A in rating. These fuses shall be factory installed by the heater manufacturer, be accessible, and be suitable for branch circuit protection [422.11(F)(1)].

Fixed appliances are considered protected when supplied from 15, 20, 25, or 30A branch circuits. Fixed cooking appliances are permitted to be protected by 40 or 50A branch circuits [210.23]. Household appliances with surface heating elements that have a maximum rating greater than 60A must be divided into two or more circuits, each of which is protected by a fuse of no greater than 50A [422.11(B)].

Portable appliances are considered as protected when supplied from a 15, 20A, or 30A branch circuit [210-23].

**Supplementary Protection**

Supplementary overcurrent protection is permitted by the National Electrical Code® for specific uses such as in lighting fixtures, appliances, and other equipment or for certain internal control circuits and components of equipment. This type of protection must not be used as a substitute for branch circuit protection as described in Article 210. This type of protection is not required to be readily accessible as are branch circuit devices. There are a wide variety of supplementary fuses and fuse holders, which have small physical dimensions and are easily installed in or on equipment, appliances, or fixtures. The advantages of supplementary protection are closer fuse sizing for better individual protection, isolation of equipment on overcurrents so that the branch circuit fuse is not disturbed, ease in locating troubled equipment, and generally direct access to the fuse at the location of the equipment. For instance, the inline fuse and holder combination, such as the Type HLR fuse holder with Type GLR or GMF fuses, protects and isolates fluorescent lighting fixtures in the event of an overcurrent.

The Tri-National Standard for supplementary fuses is UL/CSA/ANCE 248-14. When supplementary overcurrent protective devices are considered for proper use, it is important (1) not to use these devices as a substitute for branch circuit protection and (2) to be sure that the device’s interrupting rating equals or exceeds the available short-circuit current (see the discussion for 110.9 in this booklet).

**Air Conditioning and Refrigeration**

Air conditioning and refrigeration equipment requirements are covered in Article 440 of the National Electrical Code®. Hermetic motor-compressors are not rated in “full-load amps” as are standard motors. Instead, different terms are used, such as rated load current, branch circuit selection current, maximum continuous current, minimum circuit ampacity, and maximum overcurrent protection. This equipment has overcurrent protection requirements that differ from that for ordinary motors covered in Article 430. Some highlights are presented here.

**Branch Circuit Protection HVAC**

**Individual Motor-Compressor(s) and HVAC Equipment Having Motor-Compressor(s) and Other Loads (Such as Fan Motors, Electric Heaters, Coils, etc.).**

Fuses sized for branch circuit protection only must not exceed 175% of the hermetic motor-compressor rated-load current or branch circuit selection current (whichever is larger). If this size fuse cannot withstand the motor starting current, a higher amp rating is permitted, but in no case can the fuse size exceed 225% [440.22(A)].

Low-Peak dual-element and Fusetron dual-element fuses are recommended for branch circuit protection of air conditioning and refrigeration hermetic motor-compressors because these fuses have an adequate time-delay for motor starting surges.

Refer to the nameplate on the equipment. The sizing (amp rating) for the overcurrent protection has been determined by the manufacturer of the equipment. It is not necessary to apply any further multipliers to arrive at the proper size. This has already been done by the manufacturer.

The marked protective device rating is the maximum protective device rating for which the equipment has been investigated and found acceptable by nationally recognized testing laboratories. See “Listed or Labeled Equipment” for requirement when nameplate states Maximum Size Fuse. This is a critical requirement, and must be followed without exception to be in compliance with 110.3(B) of the Code. NEC® 110.3(B) requires that listed or labeled equipment must be installed in accordance with any instructions included in the listing or labeling.
Devices for Motor Circuits

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. Cntr. 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. Supplementary 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 ⅜" X 1 ¾", 5 x 20mm, and ¼" x 1 ¼" 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.
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 & Supplemental Protectors

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<td>Yes4</td>
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</tr>
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</table>

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.
7. Additional Terminal Kit Often Required.
8. If Slash Voltage Rated, Limited to Solidly Grounded Wye Systems ONLY.
10. Class 10 Overload Protection Only.