

- F. Fuses are not required on the secondary of a single phase 2-wire or three phase, three wire, delta-delta transformer to provide conductor protection where all of the following are met:
1. The transformer is protected in accordance with 450.3.
 2. The overcurrent protective device on the primary of the transformer does not exceed the ampacity of the secondary conductor multiplied by the secondary to primary voltage ratio. [240.21 (C)(1)]. Selecting the next higher standard size overcurrent protective device is NOT allowed.
- G. Fuses are not required on the secondary of a transformer to provide conductor protection where all of the following are met:
1. The secondary conductors are not over 10 feet long.
 2. The secondary conductors' ampacity is not less than the combined computed loads.
 3. The secondary conductor ampacity is not less than the rating of the device they supply or the rating of the overcurrent device at their termination. Selecting the next higher standard size overcurrent protective device is NOT allowed.
 4. The secondary conductor ampacity is not less than $\frac{1}{2}$ of the rating of the overcurrent device protecting the primary of the transformer multiplied by the turns ratio.
 5. The secondary conductors do not extend beyond the enclosure(s) of the equipment they supply and they are enclosed in a raceway. [240.21(C)(2)]
- H. Transformer secondary conductors do not require fuses at the transformer terminals when all of the following conditions are met.
1. Must be an industrial location.
 2. Secondary conductors must not be more than 25 feet long.
 3. Secondary conductor ampacity must be at least equal to the secondary full-load current of transformer and sum of terminating, grouped, overcurrent devices. Selecting the next higher standard size overcurrent protective device is NOT allowed.
 4. Secondary conductors must be protected from physical damage in an approved raceway or other approved means. [240.21(C)(3)]

Note: Switchboard and panelboard protection (408.16) and transformer protection (450.3) must still be observed.

- I. Outside conductors that are tapped to a feeder or connected to the secondary terminals of a transformer do not require fuse protection when all of the following are met:
1. The conductors are protected from physical damage in an approved means.
 2. The conductors terminate in a single set of fuses, no larger than the ampacity of the conductors.
 3. The conductors are outside, except for point of load termination.
 4. The overcurrent device is near or a part of the disconnecting means.
 5. The disconnecting means is readily accessible outdoors or, if indoors, nearest the point of the entrance of the conductors or where installed inside per 230.6 nearest the point of conductor entrance. [240.21(C)(4)]

Branch Circuits—Lighting And/Or Appliance Load (No Motor Load)

The branch circuit rating shall be classified in accordance with the rating of the overcurrent protective device. Classifications for those branch circuits other than individual loads shall be: 15, 20, 30, 40, and 50A (210.3).

Branch circuit conductors must have an ampacity of the rating of the branch circuit and not less than the load to be served (210.19).

The minimum size branch circuit conductor that can be used is 14 AWG (210.19). For exceptions to minimum conductor size, see 210.19.

Branch circuit conductors and equipment must be protected by a fuse with an amp rating which conforms to 210.20. Basically, the branch circuit conductor and fuse must be sized for non-continuous load (as calculated per Article 220) plus 125% of the continuous load. The fuse size must not be greater than the conductor ampacity (for exceptions, see 210.20). Branch circuits rated 15, 20, 30, 40, and 50A with two or more outlets (other than receptacle circuits of 220.14(B) must be fused at their rating and the branch circuit conductor sized according to Table 210.24 (see 210.24).

Feeder Circuits (No Motor Load)

The feeder fuse amp rating and feeder conductor ampacity must be at least 100% of the non-continuous load plus 125% of the continuous load as calculated per Article 220. The feeder conductor must be protected by a fuse not greater than the conductor ampacity (for exceptions, see 240.3). Motor loads shall be computed in accordance with Article 430; see subsection on Motor Feeder Protection. For combination motor loads and other loads on feeders, see subsection on feeder combination motor, power, and lighting loads.

Service Equipment

Each ungrounded service entrance conductor shall have a fuse in series with a rating not higher than the ampacity of the conductor (for exceptions, see 230.90(A)). The service fuses shall be part of the service disconnecting means or be located immediately adjacent thereto (230.91).

Service disconnecting means can consist of one to six switches for each service (230.71) or for each set of service entrance conductors permitted in 230.2. When more than one switch is used, the switches must be grouped together (230.71).

Service equipment must have adequate short circuit ratings for the short-circuit currents available.

Transformer Secondary Conductors

Secondary conductors need to be protected from damage by the proper overcurrent protective device. Although 240.3(F) provides an exception for conductors supplied by a single phase transformer with a 2-wire secondary, or a three-phase delta-delta transformer with a 3-wire, single voltage secondary, it is recommended that these conductors be protected. Primary overcurrent devices cannot adequately provide protection during internal transformer faults.

Motor Circuit Conductor Protection

Motors and motor circuits have unique operating characteristics and circuit components and therefore must be dealt with differently than other type loads. Generally, two levels of overcurrent protection are required for motor branch circuits:

1. Overload protection—Motor running overload protection is intended to protect the system components and motor from damaging overload currents.
2. Short circuit protection (includes ground fault protection) – Short circuit protection is intended to protect the motor circuit components such as the conductors, switches, controllers, overload relays, etc. against short-circuit currents or grounds. This level of protection is commonly referred to as motor branch circuit protection.

Frequently, due to inherent limitations in various types of overcurrent devices for motor application, two or more separate protective devices are used to provide overload protection and short circuit protection. An exception is the dual-element fuse. For most motor applications, the beneficial features of dual-element fuse characteristic allow sizing of the Fusetron Class RK5 and Low-Peak Class RK1 fuses to provide both protection functions for motor circuits.

Listed or Labeled Equipment

Listed or labeled equipment must be installed in accordance with instructions included in the listing or labeling [110.3(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)]. Fusible 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 in-line 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.