Transformers — 600V or Less

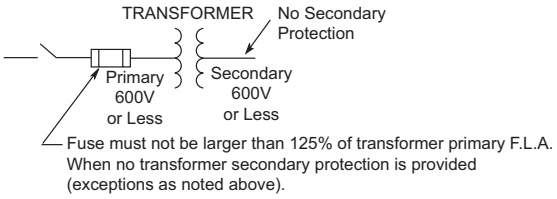
The requirements of 450.3 cover only transformer protection. In practice, other components must be considered in applying circuit overcurrent protection. For circuits with transformers, requirements for conductor protection per Articles 240 and 310 and for panelboards per Article 408, must be observed. Refer to 240.4(F), 240.21(B)(3), 240.21(C), 408.36(A) & (B).

Primary Fuse Protection Only [450.3(B)] (See Figure below) If secondary fuse protection is not provided (as discussed in the next Section) then the primary fuses must not be sized larger than as shown below.

Individual transformer primary fuses are not necessary where the primary circuit fuse provides this protection.

Primary Fuse Only

Primary Current	Primary Fuse Rating
9 amps or more	125% or next higher standard rating if 125% does not correspond to a standard fuse size.
2 amps to 9 amps	167% maximum
Less than 2 amps	300% maximum

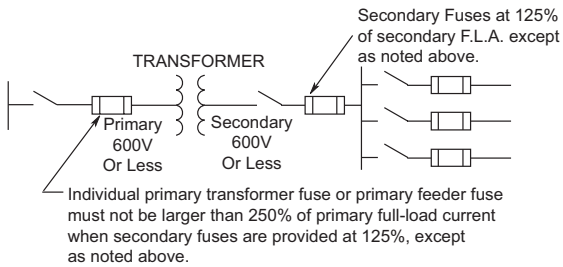


Note: Section 450.3 requirements pertain only to transformer protection. Additional circuit overcurrent protection for conductors or panelboards may be required per Articles 240, 310, 408, 430.72.

* Primary Fuse (600V or less) and Secondary Fuse (600V or less). If secondary (600V or less) fuses are sized not greater than 125% of transformer secondary current, individual transformer fuses are not required in the primary (600V or less) provided the primary feeder fuses are not larger than 250% of the transformer rated primary current. [See Note 3 of Table 450.3(B) for overcurrent protection requirements of thermally protected transformers].

Primary and Secondary Fuses

Secondary Current	Primary Fuse Rating	Secondary Fuse Rating
9 amps or more	250% max.	125% or next higher standard rating if 125% does not correspond to a standard fuse size
Less than 9 amps	250% max.	167% max.



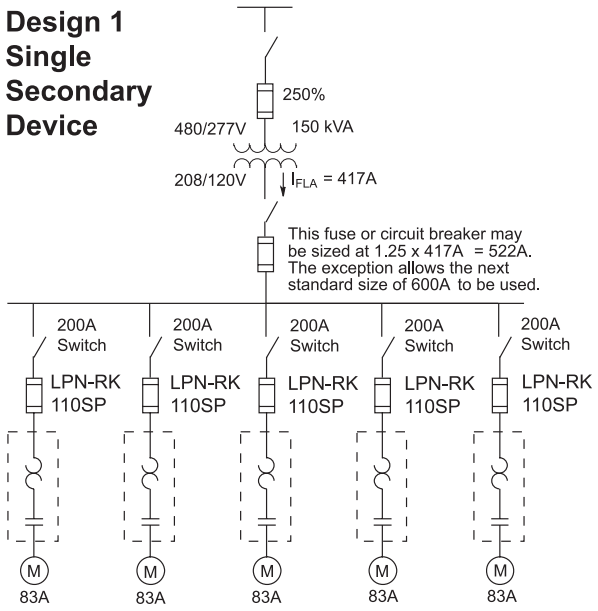
Note: Transformer overload protection will be sacrificed by using overcurrent protective devices sized much greater than the transformer F.L.A. The limits of 150%, 167%, 250% and 300% may not adequately protect transformers. It is suggested that for the highest degree of transformer overload protection the fuse size should be within 125% of the transformer full-load amps.

Normal magnetizing inrush currents for power transformers can range from 10 times to 12 times the transformer full load current, for up to 6 cycles, and as high as 25 times transformer full load current at 0.01 seconds. Some transformers may have inrush magnitudes substantially greater. Severe inrush should be compared with melting times to assure that unnecessary opening of the device does not occur.

There is a wide fuse amp rating range available to properly protect transformers. Fusetron Class RK5 and Low-Peak Class RK1 dual-element fuses can be sized on the transformer primary and/or secondary rated at 125% of the transformer F.L.A. These dual-element fuses have sufficient time-delay to withstand the high magnetizing inrush currents of transformers. There is a wide amp rating selection in the 0 to 15A range for these dual-element fuses to provide protection for even small control transformers.

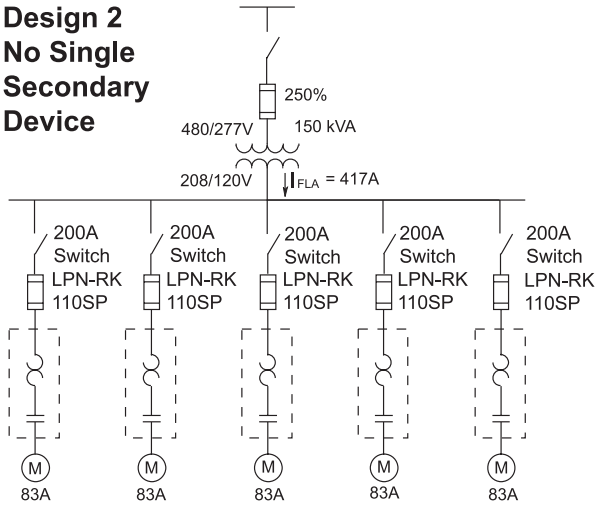
The required secondary protection may be satisfied with multiple overcurrent devices that protect feeders fed from the transformer secondary. The total amp rating of these multiple devices may not exceed the allowed value of a single secondary overcurrent device. If this method is chosen, dual-element, time-delay fuse protection offers much greater flexibility. Note the following examples:

Design 1
Single Secondary Device



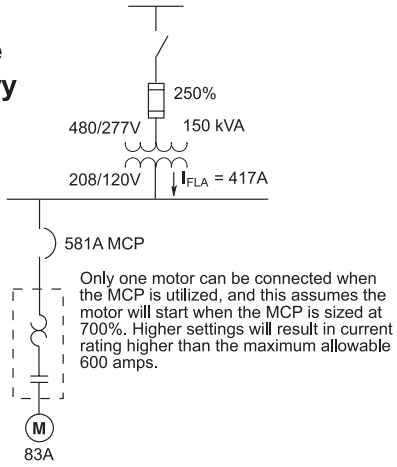
Design 1 utilizes a single secondary overcurrent device. It provides the greatest degree of selective coordination, transformer protection, secondary cable protection, and switchboard/panelboard/load center protection. The transformer cannot be overloaded to a significant degree if future loads are added (improperly). With this arrangement the transformer's full capacity is utilized.

Design 2 No Single Secondary Device



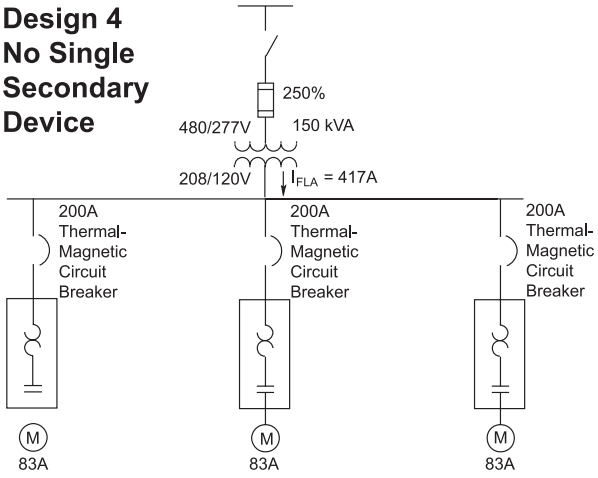
Design 2 In this case the single secondary overcurrent device is eliminated, much of the protection described in Design 1 will be reduced. If dual-element fuses are utilized as branch circuit protection, the transformer can continue to be loaded with the five 83A motors because 5 x 110 = 550A, (less than the maximum 600A). If additional loads are improperly added in the future, overload protection will be lost because the primary device can be sized at 250%.

Design 3 No Single Secondary Device



Design 3 If the single secondary overcurrent device is eliminated and MCPs are utilized as branch circuit protection, the transformer will be seriously under-utilized because only one motor can be connected. For one motor, 1 x 700% of 83 = 581 amps. For two motors, 2 x 700% of 83 = 1162 amps. Since the sum of the devices cannot exceed 600 amps, only one motor can be connected when the motor circuit is protected by an MCP.

Design 4 No Single Secondary Device



Design 4 Using the same procedure, if the single secondary main is eliminated and thermal magnetic circuit breakers are utilized as branch circuit protection per 430.52, only three of the motors can be connected because the thermal magnetic breakers will have been sized at approximately 250% of the motor F.L.A. (83 x 250% = 207.5A.)

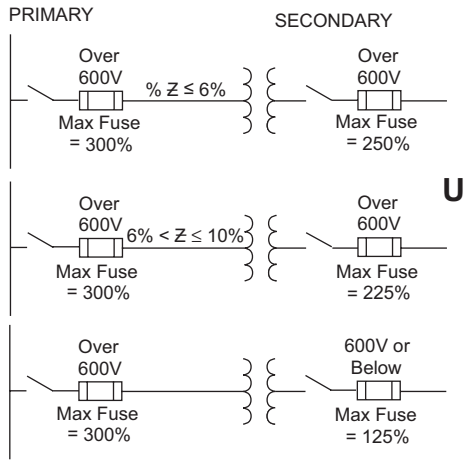
Note: If sized less than permitted by 430.52, nuisance tripping may result since the new energy efficient motors have higher inrush currents.

Using a 200A circuit breaker would allow only three (600 ÷ 200) motors to be connected. To add two additional motors of the same type as shown in Design 1 and Design 2 requires a larger transformer - one that would have a 1000A or more secondary capability. A 300kVA 208V transformer has a 830A secondary rating which is not sufficient. Therefore, the next standard size 3Ø transformer is a 400kVA with a 1110A capacity to meet the new rule.

Transformers — Over 600V

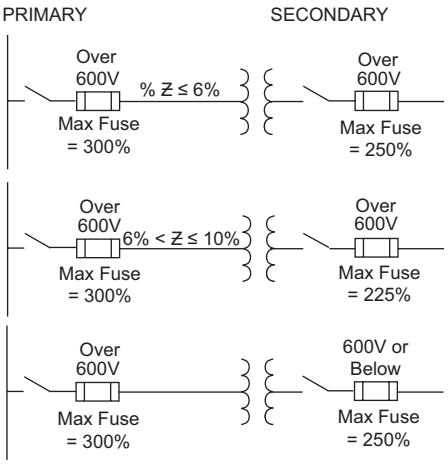
Primary and Secondary Protection

In unsupervised locations, with primary over 600V, the primary fuse can be sized at a maximum of 300%. If the secondary is also over600V, the secondary fuses can be sized at a maximum of 250% for transformers with impedances not greater than 6% or 225% for transformers with impedances greater than 6% and not more than 10%. If the secondary is 600V or below, the secondary fuses can be sized at a maximum of 125%. Where these ratings do not correspond to a standard fuse size, the next higher standard size is permitted.



Unsupervised Locations

In supervised locations, the maximum ratings are as shown in the next diagram. These are the same maximum settings as the unsupervised locations except for secondary voltages of 600V or less, where the secondary fuses can be sized at maximum of 250%.



Supervised Locations

Primary Protection Only

In supervised locations, the primary fuses can be sized at a maximum of 250%, or the next larger standard size if 250% does not correspond to a standard fuse size.

Note: The use of "Primary Protection Only" does not remove the requirements for compliance with Articles 240 & 408. See (FPN) in Section 450.3, which references 240.4, 240.21, 240.100 and 240.101 for proper protection for secondary conductors.

E-Rated Fuses for Medium Voltage Potential & Small Power Transformers

Low amperage, E-Rated medium voltage fuses are general purpose current-limiting fuses. A general purpose current-limiting fuse is capable of interrupting all current from the rated interrupting current down to the current that causes melting of the fusible element in 1 hour (ANSI C37.40). The E rating defines the melting-time-current characteristic of the fuse and permits electrical interchangeability of fuses with the same E Rating. For a general purpose fuse to have an E Rating the following condition must be met:

The current responsive element shall melt in 300 seconds at an RMS current within the range of 200% to 240% of the continuous current rating of the fuse, fuse refill, or link (ANSI C37.46).

Cooper Bussmann low amperage, E-Rated fuses are designed to provide primary protection for potential, small service, and control transformers. These fuses offer a high level of fault current interruption in a self-contained non-venting package which can be mounted indoors or in an enclosure.

Application

As for all current-limiting fuses, the basic application rules found in the fuseology section of this brochure should be adhered to. In addition, potential transformer fuses must have sufficient inrush capacity to successfully pass through the magnetizing inrush current of the transformer. If the fuse is not sized properly, it will open before the load is energized. The maximum magnetizing inrush currents to the transformer at system voltage, and the duration of this inrush current varies with the transformer design. Magnetizing inrush currents are usually denoted as a percentage of the transformer full-load current, i.e., 10x, 12x, 15x, etc. The inrush current duration is usually given in seconds. Where this information is available, an easy check can be made on the appropriate Cooper Bussmann minimum melting curve to verify proper fuse selection. In lieu of transformer inrush data, the rule of thumb is to select a fuse size rated at 300% of the primary full-load current and round up to the next larger standard size.

Example:

The transformer manufacturer states that an 800VA 2400V, single phase potential transformer has a magnetizing inrush current of 12x lasting for 0.1 second.

A. I_{FL} = 800VA/2400V = 0.333A

Inrush Current = 12 x 0.333 = 4A

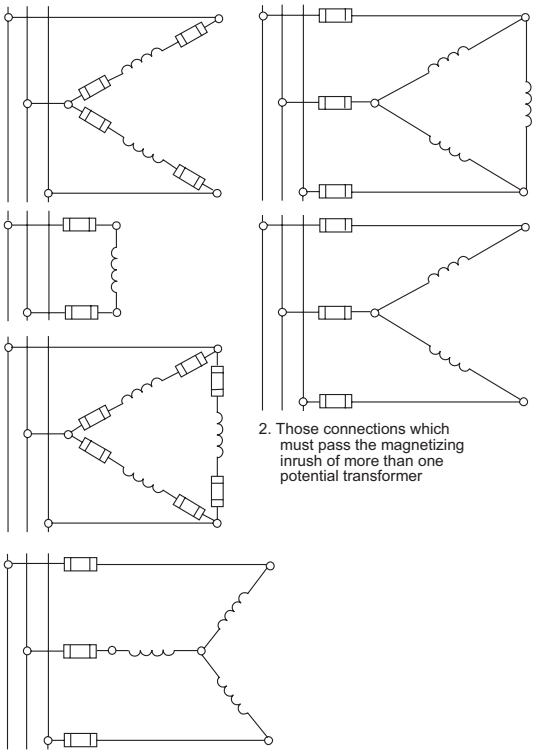
Since the voltage is 2400 volts we can use either a JCW-1E or JCD-1 E.

B. Using the rule of thumb–300% of 0.333A is 0.999A.

Therefore we would choose a JCW-1E or JCD-1E.

Typical Potential Transformer Connections

The typical potential transformer connections encountered in industry can be grouped into two categories:



2. Those connections which must pass the magnetizing inrush of more than one potential transformer

1. Those connections which require the fuse to pass only the magnetizing inrush of one potential transformer

E-Rated Fuses for Medium Voltage Transformers & Feeders

Cooper Bussmann E-Rated medium voltage fuses are general purpose current-limiting fuses. A general purpose current-limiting fuse is capable of interrupting all currents from the rated interrupted current down to the current that causes melting of the fusible element in 1 hour (ANSI C37.40). The fuses carry either an 'E' or an 'X' rating which defines the melting-time-current characteristic of the fuse. The ratings are used to allow electrical interchangeability among different manufacturers' fuses.

For a general purpose fuse to have an E rating, the following conditions must be met:

1. 100E and below - the fuse element must melt in 300 seconds at 200% to 240% of its rating (ANSI C37.46).
2. Above 100E - the fuse element must melt in 600 seconds at 220% to 264% of its rating (ANSI C37.46).

Cooper Bussmann E-Rated Medium Voltage Fuse.

A fuse with an 'X' rating does not meet the electrical inter-changeability for an 'E' rated fuse but offers the user other ratings that may provide better protection for a particular application.

Application

Transformer protection is the most popular application of E-Rated fuses. The fuse is applied to the primary of the transformer and is used solely to prevent rupture of the transformer due to short circuits. It is important, therefore, to size the fuse so that it does not clear on system inrush or permissible overload currents. See section on transformers over 600V for applicable sizing recommendations. Magnetizing inrush must also be considered when sizing a fuse. In general, power transformers have a magnetizing inrush current of 12x the full-load rating for a duration of 1/10 second.

Three-Phase Transformers (Or Transformer Bank)

Transformer kVA Rating	System Voltage 2.4kV Full-load Fuse Amps		4.16kV Full-load Fuse Amps		4.8kV Full-load Fuse Amps	
9	2.17	**JCX-7E**	1.25	**JCY-5E**	1.08	**JCY-5E**
15	3.6	**JCX-10E**	2.08	**JCY-7E**	1.8	**JCY-7E**
30	7.3	**JCX-20E**	4.2	**JCY-15E**	3.6	**JCY-10E**
45	10.8	**JCX-25E**	6.2	**JCY-15E**	5.4	**JCY-15E**
75	18.0	**JCX-40E**	10.4	**JCY-25E**	9.0	**JCY-20E**
112.5	27.0	**JCX-65E**	15.6	**JCY-40E**	13.5	**JCY-30E**
150	36.0	**JCX-65E**	20.8	**JCY-40E**	18.0	**JCY-40E**
225	54.0	**JCX-100E**	31.2	**JCY-65E**	27.0	**JCY-65E**
300	72.0	**JCX-125E**	41.6	**JCY-80E**	36.0	**JCY-65E**
500	120.0	**JCX-200E**	69.4	**JCY-125E**	60.0	**JCY-100E**
750	—	—	104.0	**JCY-150E**	90.0	**JCY-125E**
1000	—	—	139.0	**JCY-200E**	120.0	**JCY-200E**
Single-Phase Transformers						
3	1.25	**JCX-5E**	0.72	**JCY-3E**	0.63	**JCY-3E**
5	2.08	**JCX-7E**	1.20	**JCY-5E**	1.04	**JCY-5E**
10	4.17	**JCX-15E**	2.40	**JCY-7E**	2.08	**JCY-7E**
15	6.25	**JCX-15E**	3.61	**JCY-10E**	3.13	**JCY-10E**
25	10.4	**JCX-25E**	6.01	**JCY-15E**	5.21	**JCY-15E**
37.5	15.6	**JCX-40E**	9.01	**JCY-20E**	7.81	**JCY-20E**
50	20.8	**JCX-40E**	12.0	**JCY-25E**	10.4	**JCY-25E**
75	31.3	**JXC-65E**	18.0	**JCY-40E**	15.6	**JCY-30E**
100	41.7	**JCX-80E**	24.0	**JCY-80E**	20.8	**JCY-40E**
167	70.0	**JCX-100E**	40.0	**JCY-100E**	35.0	**JCY-65E**
250	104.0	**JCX-150E**	60.0	**JCY-125E**	52.0	**JCY-100E**
333	139.0	**JCX-200E**	80.0	**JCY-125E**	69.5	**JCY-100E**
500	—	—	120.0	**JCY-200E**	104.0	**JCY-150E**
667	—	—	—	—	139.0	**JCY-200E**

Table 430.72(B). Maximum Rating of Overcurrent Protective Device-Amperes

	Column A Basic Rule		Column B Exception No. 1		Column C Exception No. 2	
Control Circuit Conductor Size, AWG	Copper	Alum. or Copper-Clad Alum.	Copper	Alum. or Copper-Clad Alum.	Copper	Alum. or Copper-Clad Alum.
18	7	–□	25	–□	7	–□
16	10	–□	40	–□	10	–□
14	Note 1	–□	100	–□	45	–□
12	Note 1	Note 1	120	100	60	45
10	Note 1	Note 1	160	140	90	75
larger than 10	Note 1	Note 1	Note 2	Note 2	Note 3	Note 3

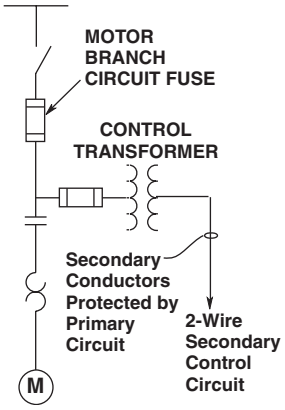
Note 1: Value specified in Section 310-15, as applicable.
Note 2: 400 percent of value specified in Table 310-17 for 60°C conductors.
Note 3: 300 percent of value specified in Table 310-16 for 60°C conductors.

430.72(C)

Secondary conductors of a single-phase transformer having only a 2-wire secondary are protected by the primary fuse (600V or less) if the primary fuse rating is:

1. Not larger than that determined in Table 430.72(B), multiplied by secondary-to-primary voltage ratio and,
2. not more than the following percent of transformer rated primary current:

Control conductors are permitted to be protected by the motor branch circuit overcurrent device where the opening of the control circuit would create a hazard.

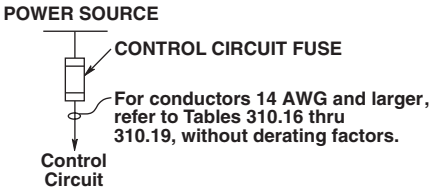


Transformer Primary Current	Primary Fuse Ampacity Must Not Exceed†
Less than 2 amps	500%
2 to 9 amps	167%
9 amps or more	125%*

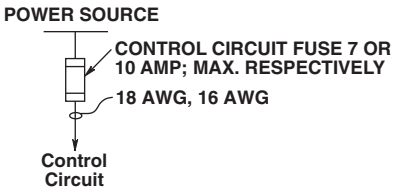
* If 125% of rated primary current does not correspond to a standard fuse rating, then the next higher standard fuse rating is permitted.
† Refer to Section 8.12 of NFPA79 for the allowable sizing for control transformers in Industrial Machinery.

Class 1 POWER LIMITED, Class 2 and Class 3 Remote Motor Control Circuits

1. Control circuit conductors shall be protected from overcurrent in accordance with Article 725.



2. Control circuit conductors 18 AWG and 16 AWG, shall be protected by a control circuit fuse not to exceed 7 and 10 amps respectively.



Exception No. 2 Relative to Transformer Protection

Refer to Exception 3, [430.72(B)], covered in preceding paragraphs.

Motor Control Circuit Transformers [430.72(C)]

Control circuit transformers (600V or less) shall be protected as shown previously in Exception No. 3 under 430.72(B).

430.72(C)(3): Control circuit transformers rated less than 50VA can be protected by a primary fuse, impedance limiting means, or other inherent means. The transformer must be an integral part of the motor controller, and be located within the controller.

430.72(C)(4): Allows transformers with primary currents less than 2 amps to be protected with primary fuses at 500% or less of primary full-load amps.

430.72(C)(1): Allows the control transformer to be protected by the motor branch circuit overcurrent device when the transformer supplies a Class 1 power-limited, circuit [see 725.11(A)] Class 2, or Class 3 remote control circuit conforming with the requirements of Article 725.

430.72(C)(5): Allows the control transformer to be protected by the motor branch circuit overcurrent device where protection is provided by other approved means.

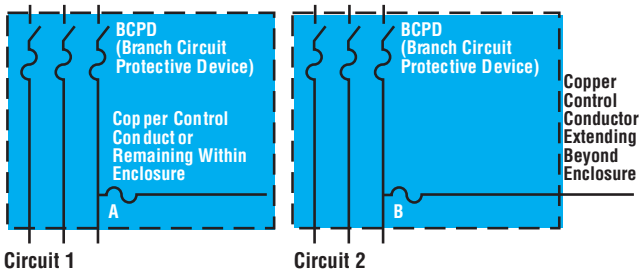
430.72(C) Exception: States that overcurrent protection shall be omitted where the opening of the control circuit would create a hazard, as for example, the control circuit of a fire pump motor and the like.

Catalog Number Designations for Fuse Blocks.

Fuse		Amp Rating	Single Pole	Double Pole	Single Pole Dove Tail for Ganging
Supplementary	13/32" x 1 1/2"	1/10-30A	BM6031SQ	BM6032SQ	
Branch Circuit	FRN-R	1/10-30A	R25030-1SR	R25030-2SR	
	LPN-RK_SP	1/10-30A	R25030-1SR	R25030-2SR	
	FRS-R	1/10-30A	R60030-1SR	R60030-2SR	
	LPS-RK_SP	1/10-30A	R60030-1SR	R60030-2SR	
	SC	1/2-15A	BG3011SQ	BG3012SQ	
		20A	BG3021SQ	BG3022SQ	
	KTK-R	1/10-30A	BC6031S	BC6032S	
	FNQ-R	1/10-30A			
	LP-CC	1/2-30A			
	TCF	1-30A			TCFH 30
		1-60A			TCFH 60

The following Selection Guide Tables simplify and permit easy application of fuses for the protection of the motor control circuits in accordance within the National Electrical Code®. Apply fuses per Table 1 for control circuit without a control transformer (see Circuit Diagrams 1 and 2). Apply fuses per Table 2 for a control circuit with a control transformer (see Circuit Diagrams 3 and 4).

Control Circuit Without Control Transformer (See Table 1)



Control Circuit With Control Transformer (See Table 2)

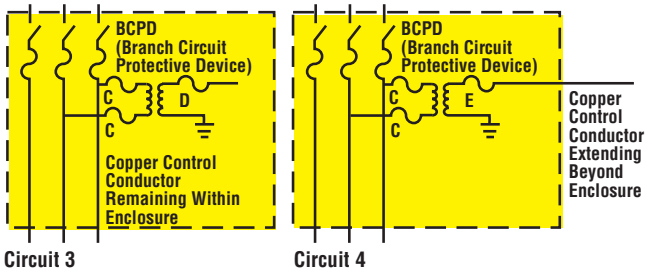


Table 1. Fuse Selection Guide–ControlCircuit WithoutControl Transformer (See Circuit Diagrams 1 & 2)

Ampere Rating of Branch Circuit Protective Device (BCPD)	Circuit 1 (Control Conductor (AWG) Not Extending Beyond Enclosure)				Circuit 2 (Control Conductor (AWG) Extending Beyond Enclosure)			
	18 Wire	16 Wire	14 Wire	12 Wire	18 Wire	16 Wire	14 Wire	12 Wire
Fuse Size	7A	10A	15A	20A	7A	10A	15A	20A
Requirements For Control Circuit Protection (See footnote data)								
1/10 – 7	■	■	■	■	■	■	■	■
7 1/2 – 10	■	■	■	■	▲	■	■	■
12 – 25	■	■	■	■	▲	▲	■	■
30 – 40	▲	■	■	■	▲	▲	■	■
45	▲	▲	■	■	▲	▲	■	■
50 – 60	▲	▲	■	■	▲	▲	▲	■
65 – 100	▲	▲	■	■	▲	▲	▲	▲
110	▲	▲	▲	■	▲	▲	▲	▲
125 – up	▲	▲	▲	▲	▲	▲	▲	▲

▲ Control circuit fuse protection required.

■ Protection recommended but not mandatory when BCPD is a Class CC, G, J, R, or T fuse. Protection is mandatory when BCPD is a thermal magnetic or a magnetic-only circuit breaker (MCP), and available short-circuit current exceeds the values in the table below.

Control Circuit Conductor (AWG Copper)	Available Short-Circuit Current At Branch Circuit Protective Device (BCPD)	
	1 Cycle Clearing Time†	1/2 Cycle Clearing Time†
18	660A	940A
16	1050A	1500A
14	1700A	2400A
12	2700A	3800A

*Thermoplastic Insulation. †Based on ICEA Conductor Withstand Data.

Table 2. Fuse Selection Guide–Control Circuit With Control Transformer (See Circuit Diagrams 3 and 4)

Control Xfmr Rating	V_{pri}/V_{sec} (Volts)	Ipri (Amps)	I_{sec} (Amps)	[1]Fuse C [2]Req'd. If BCPD Exceeds These Amps Values	[4,5]Maximum Amps	Fuse D or E Required if BCPD and Fuse C (When Provided) Exceed These Amp Values 18 AWG Wire	16 AWG Wire	14 AWG Wire	12 AWG Wire	Recommended Amps Time Delay[1]	Non-Time Delay[3]
25VA	480/120	0.05	0.21	[6]See 430-72(C) Except. 1	0.25	0.25	0.25	0.25	0.25	0.25	0.60
	480/24	0.05	1.00		0.25	0.25	0.25	0.25	0.25	1.25	3.0
	240/120	0.10	0.21		0.50	0.50	0.50	0.50	0.50	0.25	0.60
	240/24	0.10	1.00		0.50	0.50	0.50	0.50	0.50	1.25	3.0
50VA	480/120	0.10	0.42	0.5	0.50	0.50	0.50	0.50	0.50	0.50	1.0
	480/24	0.10	2.10	0.5	0.50	0.50	0.50	0.50	0.50	2.5	6.0
	240/120	0.21	0.42	1.0	1.0	1.0	1.0	1.0	1.0	0.50	1.0
	240/24	0.21	2.10	1.0	1.0	1.0	1.0	1.0	1.0	2.5	6.0
100VA	480/120	0.21	0.83	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0
	480/24	0.21	4.20	1.0	1.0	1.0/.35[9]	1.0/.50[9]	1.0	1.0	5.0	12.0[7]
	240/120	0.42	0.83	2.0	2.0	2.0	2.0	2.0	2.0	1.0	2.0
	240/24	0.42	4.20	2.0	2.0	2.0/.70[9]	2.0/1.0[9]	2.0	2.0	5.0	12.0[7]
150VA	480/120	0.31	1.25	1.5	1.5	1.5	1.5	1.5	1.5	1.50	3.50
	480/24	0.31	6.25	1.5	1.5	—	1.5/0.5[9]	1.5	1.5	7.50	15.0[7]
	240/120	0.62	1.25	3.0	3.0	3.0	3.0	3.0	3.0	1.50	3.50
	240/24	0.62	6.25	3.0	3.0	—	3.0/1.0[9]	3.0	3.0	7.50	15.0[7]
200VA	480/120	0.42	1.67	2.0	2.0	2.0/1.75[9]	2.0	2.0	2.0	2.0	5.0
	480/24	0.42	8.33	2.0	2.0	—	—	2.0	2.0	10.0	20.0[8]
	240/120	0.84	1.67	4.0	4.0	4.0/3.5[9]	2.0	4.0	4.0	2.0	5.0
	240/24	0.84	8.33	4.0	4.0	—	—	4.0	4.0	10.0	20.0[8]

[1] Time-Delay Fuses: FNQ, FNW, FNM, FNA–Supplementary Type; FNQ-R, FRN-R, FRS-R, LPN-RK_SP, LPS-RK_SP, LPJ_SP, LP-CC, SC6 & above–Branch Circuit Fuses (Rejection Type).
[2] For exceptions, see 430.72(C).
[3] Non-Time-Delay Fuses: KTK, BAN, BAF, MIN, MIC–Supplementary Fuses; KTK-R, JJN, JJS, SC½-5–Branch Circuit Fuses (Rejection Types).
[4] These are maximum values as allowed by 430.72(C). Closer sizing at 125%-300% may be possible for better overload protection using time-delay branch circuit fuses.
[5] Fuse shall be a rejection type branch circuit fuse when withstand rating of controller is greater than 10,000 amps RMS symmetrical
[6] These transformers less than 50VA still need protection–either primary overcurrent protection, inherent protection, or the equivalent. Note that the primary conductors may be protected as shown in Circuit 1 Table 1. [7] Minimum copper secondary control conductor for this application is 14 AWG. [8] Minimum copper secondary control conductor for this application is 12 AWG.
[9] Smaller value applied to Fuse "E".

Cooper Bussmann FNQ-R Maximum Primary Fuse Selection Guide for Motor Control Circuit Transformer Protection***

XFMR VA	600V	550V	480V	460V	415V	380V	277V	240V	230V	208V
50	4/10A	4/10A	½A	½A	5/10A	5/10A	5/10A	1A	1A	1 ⅛A
75	5/10A	5/10A	3/4A	5/10A	5/10A	5/10A	1 3/10A	1 ½A	1 5/10A	1 8/10A
100	8/10A	8/10A	1A	1A	1 ⅛A	1 3/10A	1 8/10A	2A	2A	2 ¼A
150	1 ¼A	1 3/10A	1 ½A	1 6/10A	1 8/10A	1 8/10A	2 ½A	3A	3 2/10A	3 ½A
200	1 6/10A	1 8/10A	2A	2A	2 ¼A	2 ½A	3 ½A	4A	4A	4 ½A
250	2A	2 ¼A	2 ½A	2 ½A	3A	3 2/10A	4 ½A	5A	5A	6A
300	2 ½A	2 6/10A	3A	3 2/10A	3 ½A	3 ½A	5A	6 ¼A	6 ¼A	7A
350	2 8/10A	3A	3 ½A	3 ½A	4A	4 ½A	6 ¼A	7A	7 ½A	8A
500	4A	4 ½A	5A	5A	6A	6 ¼A	9A	3 2/10A**	3 ½A**	4A**
750	6 ¼A	6 ¼A	7 ½A	8A	9A	9A	4 ½A*	5A**	5A**	6A**
1000	8A	9A	3 2/10A*	3 ½A*	4A*	4A*	6A*	6 ¼A**	7A**	8A**
1500	4A*	4 ½A*	5A*	5A*	6A*	6 ¼A*	9A*	10A**	10A**	12A**
2000	5A*	6A*	6 ¼A*	7A*	8A*	8A*	12A*	12A**	12A**	15A**

*For increased time-delay, use FRS-R, LPS-RK_SP, LPJ_SP, or TCF **For increased time-delay, use FRN-R, LPN-RK_SP ***Based upon the NEC®

Supplementary Fuses (13/32" x 1½") (All Voltage and Interrupting Ratings are AC)

Dual-Element, Time-Delay

FNA
1/10-8/10A
250V†
1-15A
125V*
20-30A
32V**

FNM
1/10-10A
250V†
12-15A
125V*
20-30A
32V**

Time-Delay

FNQ
1/10-30A
500V
10K AIR
(FNQ 1/10 - 3 2/10 Dual-Element)

FNW
12-30A
250V*

Non-Time-Delay

BAF
½-15A
250V†
20-30A
125V*

BAN
2/10-30A
250V††

KTK
1/10-30A
600V
100K AIR

MIC
1-15A
250V†
20-30A
32V**

MIN
1-15A
250V†
20-30A
32V**

Branch Circuit Fuses (All Voltage and Interrupting Ratings are AC)

Class R Dual-Element, Time-Delay

LPN-RK_SP
1/10-30A
250V
300K AIR

FRN-R
1/10-30A
250V
200K AIR

FRS-R
1/10-30A
600V
200K AIR

LPS-RK_SP
1/10-30A
600V
300K AIR

Class G

SC
½-20A 600V§
25-30A 480V§
100K AIR

Class CC Fast-Acting, Time-Delay

KTK-R
1/10-30A
600V
200K AIR

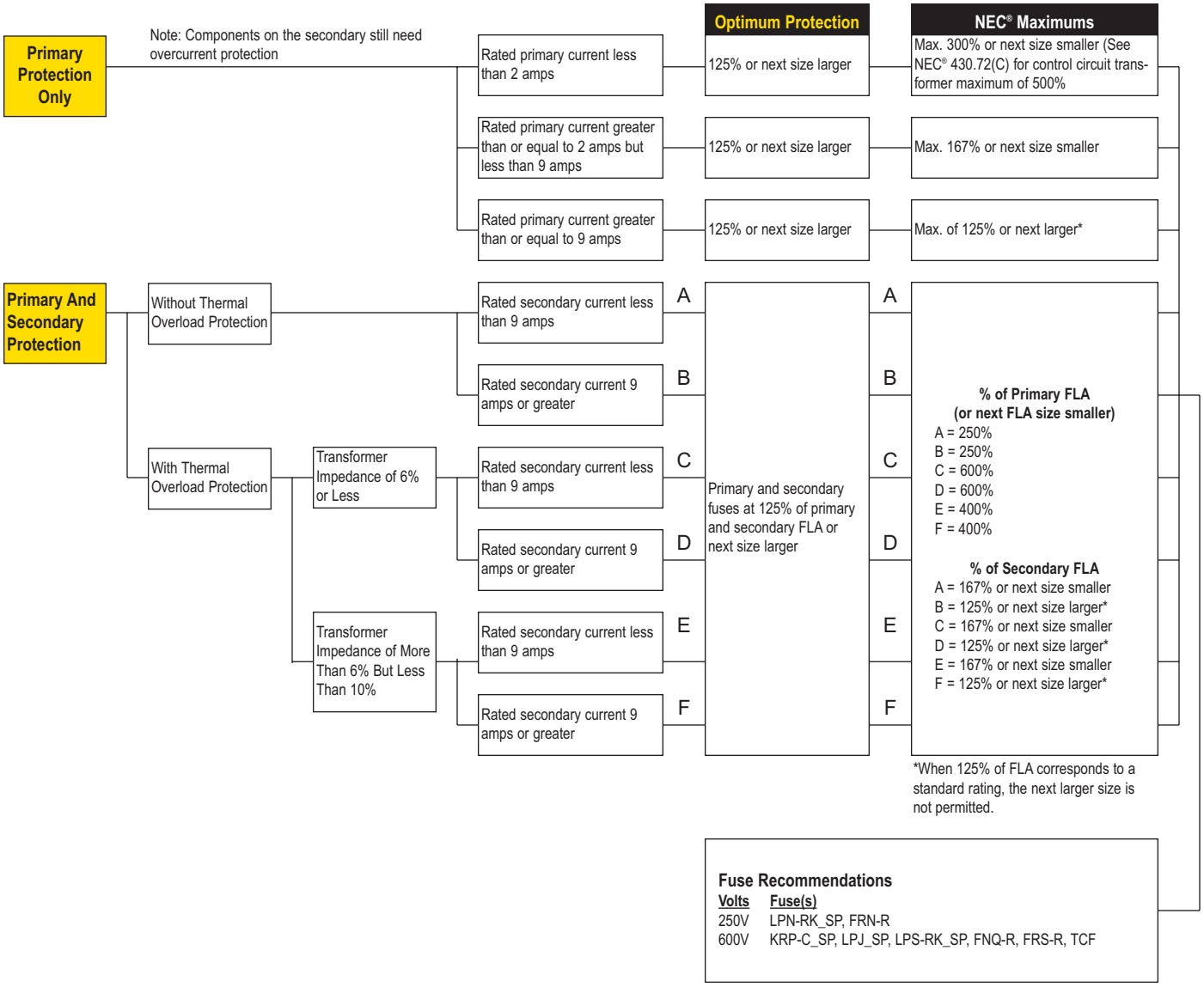
FNQ-R
¼-30A
600V
200K AIR

LP-CC
½-30A
600V
200K AIR

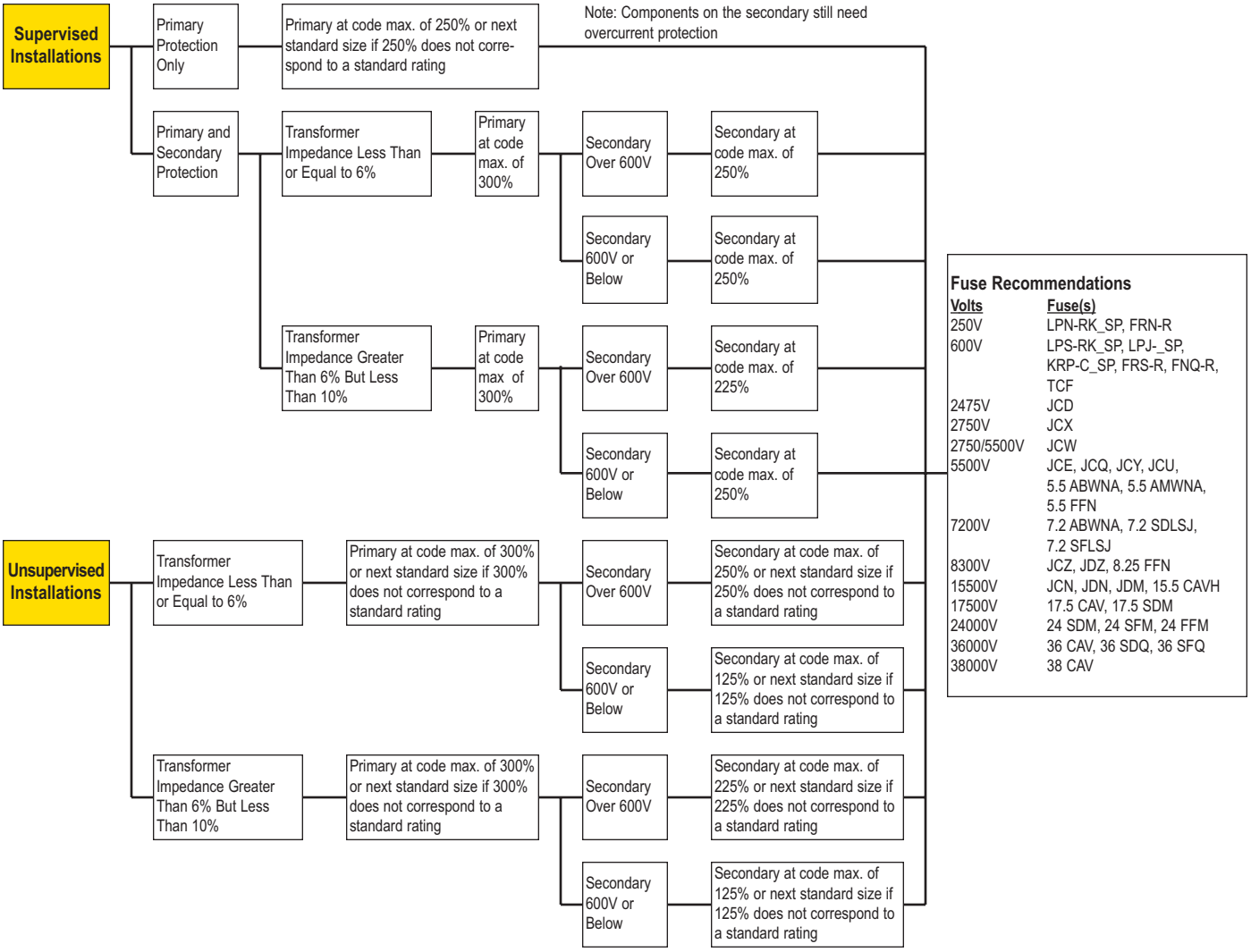
TCF
1-30A
600V
300K AIR

† 0 to 1 amp–35 AIR; 1.1 to 3.5 amp–100 AIR; 3.6 to 10 amp–200 AIR; 10.1 to 15 amp–750 AIR; 15.1 to 30 amps–1500AIR *10K AIR. **1K AIR.
§ ½ thru 6 amp fuses are Non-Time-Delay Type; 7 thru 60 amp fuses are Time-Delay Type.
††0 to 3.5 amp-35 AIR; 3.6 to 10 amp-100 AIR; 10.1 to 15 amp-200 AIR; 15.1-30 amp-750 AIR

Transformers 600V Nominal or Less (NEC® 450.3)



Transformers Over 600V Nominal (NEC® 450.3)



Fuse Recommendations

Volts	Fuse(s)
250V	LPN-RK_SP, FRN-R
600V	LPS-RK_SP, LPJ-_SP, KRP-C_SP, FRS-R, FNQ-R, TCF
2475V	JCD
2750V	JCX
2750/5500V	JCW
5500V	JCE, JCQ, JCY, JCU, 5.5 ABWNA, 5.5 AMWNA, 5.5 FFN
7200V	7.2 ABWNA, 7.2 SDLSJ, 7.2 SFLSJ
8300V	JCZ, JDZ, 8.25 FFN
15500V	JCN, JDN, JDM, 15.5 CAVH
17500V	17.5 CAV, 17.5 SDM
24000V	24 SDM, 24 SFM, 24 FFM
36000V	36 CAV, 36 SDQ, 36 SFQ
38000V	38 CAV

Solid State Devices (Diodes, SCRs, Triacs, Transistors)

Fuse Recommendations

Volts	Fuse(s)
0-130	FWA
0-250	FWX
0-500	FWH
0-600	FWC, KAC, KBC
0-700	FWP, 170M Series, SPP
0-1000	FWJ, 170M Series, SPJ