

## **NEC® Article 430 and Tables Explanation**

#### Columns 1 & 2

Motor horsepower ratings are listed in Column 1. Full load amps from Tables 430.247 through 430.250 are provided in Column 2.

#### Column 3

Various fuse types are listed in Column 3. The LPJ\_SP is a 600Vac, 0 - 600 amp, time-delay, Class J, "Low-Peak fuse, with a 300,000 amp interrupting rating. The TCF is a 600Vac, 1 - 100 amp dual-element, time-delay, IP-20 finger-safe fuse with Class J performance. The LP-CC is a 600Vac, 0 - 30 amp, time-delay, Class CC, Low-Peak fuse with a 200,000 amp interrupting rating. The LPS-RK\_SP and LPN-RK\_SP are 600 and 250Vac, 0 - 600 amp, time-delay, Class RK1, Low-Peak fuses with interrupting ratings of 300,000 amps. FRS-R and FRN-R are 600 and 250Vac, 0 - 600 amp, time-delay, Class RK5, Fusetron Dual-Element fuses with interrupting ratings of 200,000 amps. The KRP-C\_SP is a 600Vac, 601 - 6000 amp, time-delay, Class L, Low-Peak fuse, with a 300,000 amp AC interrupting rating. The DC listed ratings for these fuses are:

0					
LPJ	1 to 600SP	300Vdc	LPN-RK	0 to 60SP	125Vdc
TCF	1 to 100	300Vdc	LPN-RK	70 to 600SP	250Vdc
LP-CC	½ to 2 ‰	300Vdc	LPS-RK	0 to 600SP	300Vdc
LP-CC	3 to 15	150Vdc	FRN-R	0 to 600	125Vdc
LP-CC	20 to 30	300Vdc	FRS-R	0 to 600	300Vdc

#### **Column 4 - Optimal Branch Circuit Protection**

There are two distinct levels of protection philosophy provided in this Column. LPS-RK\_SP, LPN-RK\_SP, FRS-R and FRN-R fuses are sized for motor running "back-up" protection and provide superb short circuit protection at the same time. LPJ\_SP, TCF, and LP-CC fuses are sized a little larger but are even more current limiting, providing an even greater degree of short circuit protection for the motor circuit.

All the fuses selected from this column provide short circuit and ground-fault protection for motor branch circuits (430.52), but typically are not the maximum allowed. Fuses sized in accordance with Column 4 must be used in conjunction with properly sized motor overload protection such as overload relays or solid state motor controllers (430.32). This fuse sizing is normally large enough to allow the overload protective device to operate on overloads without opening the fuse. Yet for many cases, this fuse amp rating selection is smaller than the maximums allowed per Columns 5 or 6 (430.52). In some cases, this smaller amp rating selection may provide the benefits of a smaller size disconnect and better short circuit protection. If a motor has a long starting time, high starting current profile or is cycled frequently, it may be necessary to use Column 5 or 6.

The LPS-RK\_SP, LPN-RK\_SP, FRS-R and FRN-R fuses sized per this column provide short circuit and ground-fault protection for motor branch circuits (430.52) as discussed in the previous paragraph. In addition, these dual-element fuses exhibit longer time-delay characteristics and can therefore be sized to provide back-up motor overload protection. The fuse sizing in Column 4 for LPS-RK\_SP, LPN-RK\_SP, FRS-R and FRN-R fuses provides a degree of motor and circuit overload protection to back-up the normal motor overload protective device. Note: This level of protection requires a well-designed, true dual-element fuse. The Fusetron Fuses, FRS-R and FRN-R, and Low-Peak Fuses, LPS-RK\_SP and LPN-RK\_SP, are the industry leading dual-element fuses with excellent over-load time-delay characteristics and current-limiting short circuit ability. The Low-Peak Dual-Element Fuses have better current-limiting ability than Fusetron Dual-Element Fuses.

The amp ratings in Column 4 are determined by using Column 2 motor ampacity values and the following:

- LPJ\_SP & TCF: 150% or the next larger Cooper Bussmann amp rating if 150% does not correspond to a Cooper Bussmann fuse amp rating.
- LP-CC ½ to 15A: 200% (150% for DC) or the next larger Cooper Bussmann size if 200% (150% for DC) does not correspond to a Cooper Bussmann fuse amp rating.

LP-CC 20 to 30A: 300% (150% for DC) or the next larger Cooper Bussmann size if 300% (150% for DC) does not correspond to a Cooper Bussmann fuse amp rating.

LPS-RK\_SP and LPN-RK\_SP: 130% or the next larger Cooper Bussmann amp rating if 130% does not correspond to a Cooper Bussmann fuse amp rating.

FRS-R and FRN-R: 125% or the next larger Cooper Bussmann amp rating if 125% does not correspond to a Cooper Bussmann fuse amp rating.

# Column 5 - Branch Circuit Protection, Max. General Applications

Fuses selected from this column are intended to provide short circuit and groundfault protection for motor branch circuits. Fuses sized in accordance with Column 5 must be used in conjunction with properly sized motor overload protection such as overload relays or solid state motor controllers (430.32). Column 5 fuse sizing provides the maximum NEC<sup>®</sup> Table 430.52 amp ratings for general purpose applications. It takes into account 430.52(C)(1) Exception No. 1, which allows the next standard amp rating fuse (per standard fuse amp ratings in 240.6) to be used if the maximum percentage in Table 430.52 does not correspond to a standard fuse amp rating. If this Column 5 fuse sizing does not allow the motor to start, then Column 6 may provide a larger amp rating.

The amp ratings in Column 5 are deter-mined by using Column 2 motor ampacity values and the following:

- LPJ\_SP, TCF, LPS-RK\_SP, LPN-RK\_SP, FRS-R, FRN-R and KRP-C\_SP: 175% (150% for DC motors) or the next larger 240.6 standard fuse amp rating if 175% (150% for DC motors) does not correspond to a standard fuse amp rating.
- LP-CC: 300% (150% for DC motors) or the next larger 240.6 standard fuse amp rating if 300% (150% for DC motors) does not correspond to a standard fuse amp rating.
- Sizes shown for the LP-CC can also be used for non-time delay fuses such as JKS, KTN-R, KTS-R, JJN, JJS, and KTK-R.

**Column 6 - Branch Circuit Protection, Max. Heavy Start** When the amp rating shown in Column 5 is not sufficient to start a motor, a larger amp rating is often available by utilizing 430.52(C)(1) Exception No. 2. The amp ratings in Column 6 are the larger of the amp rating allowed by 430.52(C)(1)Exception No. 1, or 430.52(C)(1) Exception No. 2. These amp ratings will often be required when acceleration times are greater than 5 seconds, when plugging or jogging applications exist, or where there are high inrush currents (such as Design E or energy efficient Design B motors). (In a few cases, the amp rating in Column 6 may be smaller than the maximum permitted due to the limitation of the fuse type, such as LP-CC, Class CC fuses that are only available in ratings up to 30 amps. In these cases, if the amp rating shown is not sufficient to start the motor, select a different family of fuses that meet the requirements.) The amp ratings in Column 6 are determined by using Column 2 motor ampacity values and the following:

- LPJ\_SP, TCF, LPS-RK\_SP, LPN-RK\_SP, FRS-R, and FRN-R: 225% or the next smaller Cooper Bussmann amp rating if 225% does not correspond to a Cooper Bussmann fuse amp rating.
- LP-CC: 400% or the next smaller Cooper Bussmann amp rating if 400% does not correspond to a Cooper Bussmann fuse amp rating.
- **KRP-C\_SP: 300%** or the next smaller Cooper Bussmann amp rating, if 300% does not correspond to a Cooper Bussmann amp rating.

Sizes shown for the LP-CC can also be used for non-time delay fuses such as JKS, KTN-R, KTS-R, JJN, JJS, AND KTK-R.

#### Column 7

Horsepower-rated switch sizes given in Column 7 are based on 115% (430.110) of Column 2. Switch sizes need to be increased when, because of starting requirements, the fuses are sized above the rating of the switch shown in this column.

#### Column 8

Sizes listed are for general-purpose magnetic controllers (single speed, fullvolt-age for limited plugging and jogging-duty) as shown in NEMA Standards Publication ICS-2-2000.



## **NEC® Article 430 and Tables Explanation**

#### Column 9

Copper wire sizes are based upon 125% (430.22) of values shown in Column 2 and ampacities listed in Table 310.16 for 75°C terminals. Although the NEC<sup>®</sup> allows 60°C terminations for equipment rated 100 amp or less, most equipment terminations have been rated for 75°C conductors. If equipment terminations are rated for 60°C conductors only, the 60°C ampacities must be utilized and therefore larger conductor sizes may be required than those shown in this column. See 110.14(C) (1)(a)(4).

200Vac Three-Phase Motors & Circuits

#### Column 10

These rigid metallic conduit sizes are based upon copper conductors with THWN or THHN insulation, Table C8 of Annex C, and 75°C equipment terminals.

Conduit sizes are for three conductors per circuit for three phase motors and two conductors per circuit for single phase and DC motors. Conduit sizes may need to be increased if equipment grounding conductors or neutrals are also installed in the conduit.

If equipment terminations are rated for 60°C conductors only, the 60°C ampacities must be utilized and therefore larger conductor sizes and conduit sizes may be required.

Conductors operated in a high ambient temperature may need to be derated. (See correction factor table at the bottom of Table 310.16.)

1	2	3		4	5	6	7	8	9	10
Motor	Motor	Fus	e	Optimal	NEC®	NEC <sup>®</sup> Max	Minimum	Minimum	Minimum	Minimum
Size	FLA			Branch Ckt	Max for	for Heavy	Switch	NEMA	Copper Wire	Rigid Metallic
0.20				Protection	Gen Applic	Start	Sizo	Startor	THWN or THHN AWG	Conduit
Table	Tabla			TOLECTION	420 52(C)/4)	420 52(C)(4)	420.440			Annex C
Table	Table	-		-	430.52(C)(1)	430.52(0)(1)	430.110	NEIVIA ICS 2-		Annex C
430.250	430.250	Type	Class		Exc. No. 1	Exc. No. 2		2000	Table 310.16	Table C8
HP	AMPS			AMPS <sup>1</sup>	AMPS <sup>1</sup>	AMPS <sup>1</sup>	AMPS	Size	Size	Inches
		LPJ_SP	J	4	6	6				
		TCF	Jf	6	6	6				
1/2	2.5	LP-CC	CC	5	10	10	30	00	14	1/2
		LPN-RK_SP	RK1	3 ½	6	6				
		FRN-R	RK5	3 %	6	6				
		LPJ_SP	J	5 %	10	10				
		TCF	Jf	6	10	10				
3/4	3.7	LP-CC	CC	7 ½	15	15	30	00	14	1/2
		LPN-RK_SP	RK1	5	10	10				
		FRN-R	RK5	5	10	10				
		LPJ_SP	J	8	10	10				
		TCF	Jf	10	10	10				
1	4.8	LP-CC	CC	10	15	15	30	00	14	1/2
		LPN-RK_SP	RK1	6 ¼	10	10				
		FRN-R	RK5	6	10	10				
		LPJ_SP	J	12	15	15				
		TCF	Jf	15	15	15				
1 ½	6.9	LP-CC	CC	15	25	25	30	00	14	1/2
		LPN-RK_SP	RK1	9	15	15				
		FRN-R	RK5	9	15	15				
		LPJ_SP	J	12	15	17 ½				
	7.0	ICF	J	15	15	17 ½	00			
2	7.8	LP-CC	CC	25	25	30	30	0	14	1/2
		LPN-RK_SP	RK1	12	15	17 ½				
		FRN-R	RK5	10	15	17 ½				
		LPJ_SP	J	17 ½	20	20				
2	11		J,	17 /2	20	20	20	0	4.4	1/
3	11			20	- 20	- 20	30	0	14	/2
				15	20	20				
				30	20	20				
5	17.5		Jf	30	35	35	30*	1	12	1/
Ŭ	17.0	I DN RK SD	PK1	25	35	35	00		12	12
		FRN-R	RK5	25	35	35				
		I P.I SP		40	45	50				
7 %	25.3	TCF	Jf	40	45	50	60	1	10**	1/**
	2010	I PN-RK SP	RK1	35	45	50				/-
		FRN-R	RK5	35	45	50				
		LPJ SP	J	50	60	70				
10	32.2	TCF	Jf	50	60	_	60*	2	8**	1/**
		LPN-RK_SP	RK1	45	60	70				
		FRN-R	RK5	45	60	70				
	1	LPJ_SP	J	80	90	100				
15	48.3	TCF	Jf	80	90	100	100	3	6**	3/4**
		LPN-RK_SP	RK1	70	90	100				
		FRN-R	RK5	70	90	100				
		LPJ_SP	J	100	110	125				
20	62.1	TCF	Jf	100	-	-	100*	3	4**	1
		LPN-RK_SP	RK1	90	110	125				
		FRN-R	RK5	80	110	125				

\* Switch size must be increased if the amp rating of the fuse exceeds the amp rating of the switch.

1 Per 430.52(C)(2), if the motor controller manufacturer's overload relay tables state a maximum branch circuit protective device of a lower rating, that lower rating must be used in lieu of the sizes shown in Columns 4, 5, or 6.

\*\* If equipment terminations are rated for 60°C conductors only, the 60°C conductor ampacities must be utilized and therefore larger conductor sizes or conduit sizes may be required.

Class J performance, special finger-safe dimensions.

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## 200Vac Three-Phase Motors & Circuits continued

1	2	3		4	5	6	7	8	9	10
Motor	Motor	Fuse	9	Optimal	NEC®	NEC <sup>®</sup> Max	Minimum	Minimum	Minimum	Minimum
Size	FLA			Branch Ckt	Max for	for Heavy	Switch	NEMA	Copper Wire	Rigid Metallic
				Protection	Gen. Applic	Start	Size	Starter	THWN or THHN AWG	Conduit
Table	Table				430.52(C)(1)	430.52(C)(1)	430.110	NEMA ICS 2-	or KCMIL	Annex C
430.250	430.250	Type	Class	]	Exc. No. 1	Exc. No. 2		2000	Table 310.16	Table C8
HP	AMPS	.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		AMPS 1	AMPS 1	AMPS 1	AMPS	Size	Size	Inches
		LPJ SP	J	125	150	175				
25	78.2	LPN-RK_SP	RK1	110	150	175	100*	3	3**	1**
		FRN-R	RK5	100	150	175				
-		LPJ_SP	J	150	175	200				
30	92	LPN-RK_SP	RK1	125	175	200	200	4	2**	1**
		FRN-R	RK5	125	175	200				
		LPJ_SP	J	200	225	250				
40	120	LPN-RK_SP	RK1	175	225	250	200*	4	1/0	1 ¼
		FRN-R	RK5	150	225	250				
50	450	LPJ_SP	J	225	300	300	000*	-	2/0	4.1/
50	150	LPN-RK_SP	RKI	200	300	300	200"	5	3/0	1 /2
			KK5	200	300	300				
60	177			250	350	350	400	5	4/0	2
00	111	EDN D	DK5	230	350	350	400	5	4/0	2
		IPLSP	1	350	400	450				
75	221	I PN-RK SP	RK1	300	400	450	400*	5	300	2
		FRN-R	RK5	300	400	450	100	Ŭ		-
		KRP-C SP	L	-	-	650				
		LPJ_SP	J	450	500	600				
100	285	LPN-RK_SP	RK1	400	500	600	400*	6	500	3
		FRN-R	RK5	400	500	600				
		KRP-C_SP	L	-	-	800				
		LPJ_SP	J	600	-	-				
125	359	LPN-RK_SP	RK1	500	-	-	600*	6	4/0 2/PHASE	(2)2
		FRN-R	RK5	450	-	-				
		KRP-C_SP	L	-	700	1000				
450		LPN-RK_SP	RK1	600	-	-	0001		000.0/004.05	(0)0
150	414	FKN-K	RK5	600	-	-	600*	6	300 2/PHASE	(2)2
000	550	KRP-C_SP		-	800	1200	4000	70		(0) 0
200	55Z	KKP-6_5P	L	-	1000	1600	1200	12	JUU Z/PHASE	(2)3

Switch size must be increased if the amp rating of the fuse exceeds the amp rating of the switch.

Per 430.52(C)(2), if the motor controller manufacturer's overload relay tables state a maximum branch circuit protective device of a lower rating, that lower rating must be used in lieu of the sizes shown in Columns 4, 5, or 6.

If equipment terminations are rated for 60°C conductors only, the 60°C conductor ampacities must be utilized and therefore larger conductor sizes or conduit sizes may be required.

2 These sizes are typical. They are not shown in NEMA ICS 2-2000.

## 208Vac Three-Phase Motors & Circuits

1	2	3		4	5	6	7	8	9	10
Motor	Motor	Fuse	e	Optimal	NEC <sup>®</sup>	NEC <sup>®</sup> Max	Minimum	Minimum	Minimum	Minimum
Size	FLA			Branch Ckt	Max for	for Heavy	Switch	NEMA	Copper Wire	Rigid Metallic
				Protection	Gen. Applic	Start	Size	Starter	THWN or THHN AWG	Conduit
Table	Table				430.52(C)(1)	430.52(C)(1)	430.110	NEMA ICS 2-	or KCMIL	Annex C
430.250	430.250	Type	Class		Exc. No. 1	Exc. No. 2		2000	Table 310.16	Table C8
HP	AMPS			AMPS <sup>1</sup>	AMPS <sup>1</sup>	AMPS <sup>1</sup>	AMPS	Size2	Size	Inches
		LPJ_SP	J	4	6	6				
		TCF	<b>J</b> f	6	6	6				
1/2	2.4	LP-CC	CC	5	10	10	30	00	14	1/2
		LPN-RK_SP	RK1	3 ½	6	6				
		FRN-R	RK5	3	6	6				
		LPJ_SP	J	5 %	10	10				
		TCF	Jf	6	10	10				
3/4	3.5	LP-CC	CC	7	15	15	30	00	14	1/2
		LPN-RK_SP	RK1	5	10	10				
		FRN-R	RK5	4 ½	10	10				
		LPJ_SP	J	7	10	10				
		TCF	Jf	10	10	10				
1	4.6	LP-CC	CC	10	15	15	30	00	14	1/2
		LPN-RK_SP	RK1	6	10	10				
		FRN-R	RK5	6	10	10				
		LPJ_SP	J	10	15	15				
		TCF	Jf	10	15	15				
1 ½	6.6	LP-CC	CC	15	20	25	30	00	14	1/2
		LPN-RK_SP	RK1	9	15	15				
		FRN-R	RK5	9	15	15				

\*Switch size must be increased if the amp rating of the fuse exceeds the amp rating of the switch.

1 Per 430.52(C)(2), if the motor controller manufacturer's overload relay tables state a maximum branch circuit protective device of a lower rating, that lower rating must be used in lieu of the sizes shown in Columns 4, 5, or 6. \*\*If equipment terminations are rated for 60°C conductors only, the 60°C conductor ampacities must be utilized and therefore larger conductor sizes or conduit sizes may be required.

2 These sizes are typical. They are not shown in NEMA ICS 2-2000.



# 208Vac Three-Phase Motors & Circuits continued

1	2	3		4	5	6	7	8	٩	10
Motor	Motor	Euc		Ontimal	NEC®	NEC <sup>®</sup> Max	Minimum	Minimum	Minimum	Minimum
Size	ELA	1 USC	-	Bronch Ckt	Max for	for Hoovy	Switch	NEMA	Connor Wire	Digid Motollio
Size	FLA			Dialicii CKL		IOI neavy	Switch	NEWA		
L				Protection	Gen. Applic	Start	Size	Starter	THWN OF THHN AWG	Conduit
Table	Table	_		-	430.52(C)(1)	430.52(C)(1)	430.110	NEMA ICS 2-	OF KCMIL	Annex C
430.250	430.250	Туре	Class		Exc. No. 1	Exc. No. 2		2000	Table 310.16	Table C8
HP	AMPS			AMPS <sup>1</sup>	AMPS <sup>1</sup>	AMPS <sup>1</sup>	AMPS	Size <sup>2</sup>	Size	Inches
		LPJ_SP	J	12	15	15				
		TCF	Jf	15	15	15				
2	7.5	LP-CC	CC	15	25	30	30	0	14	1/2
		LPN-RK_SP	RK1	10	15	15				
		FRN-R	RK5	10	15	15				
		LPJ_SP	J	17 ½	20	20				
3	10.6	TCF	Jf	17 ½	20	20	30	0	14	1/2
		LPN-RK_SP	RK1	15	20	20				
		FRN-R	RK5	15	20	20				
-	40.7	LPJ_SP	J	30	30	35	0.0*		40	
5	16.7		J <i>t</i>	30	30	35	30^	1	12	1/2
		LPN-RK_SP	RK1	25	30	35				
		FRN-R	RK5	25	30	35				
7.1/	04.0	LPJ_SP	J	40	45	50	00		4.0**	14
1 1/2	24.2		J	40	45	50	60	1	10^^	1/2
		LPN-RK_SP	RK1	35	45	50				
		FRN-R	RK5	35	45	50				
10	00.0	LPJ_SP	J	50	60	60	00			1/++
10	30.8		JJ	50	60	60	60	2	8	1/2**
		LPN-RK_SP	RKI	45	60	60				
		FRN-R	RK5	40	60	60				
45	40.0	LPJ_SP	J	70	90	100	CO*	2	C**	2/##
15	46.2		J	70	90	100	60	3	0	74
		LPN-RK_SP	RKI	70	90	100				
			RK5	60	90	100				
20	50.4		J	90	110	120	100*	2	4**	4
20	55.4			80	110	125	100	5		1
		EDN D	DK5	80	110	125				
				125	150	125				
25	7/ 8	I PN_RK SP		120	150	150	100*	3	2**	1**
20	74.0	FRN-R	RK5	100	150	150	100	, v		1
		I P.I.SP		150	175	175				
30	88	LPN-RK SP	RK1	125	175	175	200	4	2**	1**
		FRN-R	RK5	110	175	175			_	
		LPJ SP	J	175	200	250				
40	114	LPN-RK SP	RK1	150	200	250	200*	4	1/0	1 ¼
		FRN-R	RK5	150	200	250				
		LPJ_SP	J	225	300	300				
50	143	LPN-RK_SP	RK1	200	300	300	200*	5	3/0	1 ½
		FRN-R	RK5	200	300	300				
		LPJ_SP	J	300	300	350				
60	169	LPN-RK_SP	RK1	225	300	350	400	5	4/0	2
		FRN-R	RK5	225	300	350				
		LPJ_SP	J	350	400	450				
75	211	LPN-RK_SP	RK1	300	400	450	400*	5	300	2
		FRN-R	RK5	300	400	450				
		KRP-C_SP	L	-	-	601				
		LPJ_SP	J	450	500	600				
100	273	LPN-RK_SP	RK1	400	500	600	400*	6	500	3
		FRN-R	RK5	350	500	600				
		KRP-C_SP		-	-	800				
105	0.40	LPJ_SP		600	-	-	000+	_		(0)0
125	343	LPN-RK_SP	KK1	450	-	-	600*	6	4/0 2/PHASE	(2)2
		FKN-K	KK5	450	-	-				
		KKP-C_SP		-	601	1000				
150	200			000	-	-	600*	6	250 2/01405	(2)2
150	390	EDN D		500	-	-	000"	ø	200 Z/PHASE	(2)2
				300	700	1100				
200	528	KRP-C SP			1000	1500	1200*	7	400 2/PHASE	(2)2-2 1/
200	020	1 IUU -0_0F	I -	<u> </u>	1000	1 1000	1 1200	1 /	1 TOU ZIT TIAGE	L L L - L /2

\*Switch size must be increased if the amp rating of the fuse exceeds the amp rating of the switch.

1 Per 430.52(C)(2), if the motor controller manufacturer's overload relay tables state a maximum branch circuit protective device of a lower rating, that lower rating must be used in lieu of the sizes shown in Columns 4, 5, or 6.

\*\*If equipment terminations are rated for 60°C conductors only, the 60°C conductor ampacities must be utilized and therefore larger conductor sizes or conduit sizes may be required.

2 These sizes are typical. They are not shown in NEMA ICS 2-2000.



## 230Vac Three-Phase Motors & Circuits (220-240Vac Systems)

					-		-		-	
1	2	3		4	5	6	7	8	9	10
Motor	Motor	Fus	e	Optimal	NEC®	NEC <sup>®</sup> Max	Minimum	Minimum	Minimum	Minimum
Sizo	FLA			Branch Ckt	Max for	for Heavy	Switch	NEMA	Copper Wire	Rigid Metallic
0120	1.5			Dianon okt		TOT TIEdvy	Owitch		Copper Wire	
				Protection	Gen. Applic	Start	Size	Starter	THWN or THHN AWG	Conduit
Table	Table				430.52(C)(1)	430.52(C)(1)	430.110	NEMA ICS 2-	or KCMIL	Annex C
430,250	430,250	Type	Class		Exc. No. 1	Exc. No. 2		2000	Table 310.16	Table C8
	AMDS	.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	0.000	AMDS1	AMDEI	AMDS1	AMDS	Size2	Sizo	Inches
	AIVIFS			AIVIFS	AIVIFS	AIVIFS	AIVIFS	JIZE	3120	Inches
		LPJ_SP	J	3 ½	0	6				
		ICF	Jf	6	6	6				
1/2	2.2	LP-CC	CC	4 ½	10	10	30	00	14	1/2
		LPN-RK_SP	RK1	3	6	6				
		FRN-R	RK5	2 8/10	6	6				
		LPJ SP	J	5	6	7				
		TCF	lf	6	6	6				
3/.	3.2	IP-CC		7	10	12	30	00	14	12
74	0.2			A 1/	6	7	50	00	14	12
		LFIN-RR_OF		4 /2	0					
		FRN-R	RKS	4	6	1				
		LPJ_SP	J	1	10	10				
		TCF	Jf	10	10	10				
1	4.2	LP-CC	CC	9	15	15	30	00	14	1/2
		LPN-RK_SP	RK1	5 %	10	10				
		FRN-R	RK5	5 %	10	10				
		I P.I. SP	J	9	15	15				
		TCF	.lt	10	15	15				
1 1/	6		00	10	20	20	20	00	14	1/
1 /2	0			12	20	20	30	00	14	/2
		LPN-RK_SP	RKI	8	15	15				
		FRN-R	RK5	1 ½	15	15				
		LPJ_SP	J	12	15	15				
		TCF	Jf	15	15	15				
2	6.8	LP-CC	CC	15	25	25	30	0	14	1/2
		LPN-RK SP	RK1	9	15	15				
		FRN-R	RK5	9	15	15				
		I P.I.SP		15	20	20				
			lf	15	20	20				
2	0.6		5,	20	20	20	20	0	14	1/
3	9.0			30	30	30	30	0	14	/2
		LPN-RK_SP	RKT	15	20	20				
		FRN-R	RK5	12	20	20				
		LPJ_SP	J	25	30	30				
5	15.2	TCF	<b>J</b> f	25	30	30	30	1	14	1/2
		LPN-RK_SP	RK1	20	30	30				
		FRN-R	RK5	20	30	30				
		LPJ SP	J	35	40	45				
7 %	22	TCF	lf	34	40	45	30*	1	10	16
1 12		I PN-RK SP	RK1	30	40	45			10	/2
			DK5	30	40	45				
			1110	45	<del>4</del> 0	40				
10	00	LFJ_OF	J	40	50	00	c0	0	40**	17
10	20		J)	40	50	60	00	2	10	12
		LPN-RK_SP	RK1	40	50	60				
		FRN-R	RK5	35	50	60				
		LPJ_SP	J	70	80	90				
15	42	TCF	Jf	70	80	90	60*	2	6	3/4
		LPN-RK_SP	RK1	60	80	90				
		FRN-R	RK5	60	80	90				
		LPJ SP	J	90	100	110				
20	54	TCF	.lf	90	100	_	100*	3	4	1
20	01	I PN-RK SP	RK1	80	100	110	100	Ŭ		
			RK5	70	100	110				
				110	100	110				
05		LPJ_SP	J	110	125	150	400*		4++	
25	68	LPN-RK_SP	RK1	90	125	150	100^	3	4^^	1
		FRN-R	RK5	90	125	150				
		LPJ_SP	J	125	150	175				
30	80	LPN-RK_SP	RK1	110	150	175	100*	3	3**	1**
	1	FRN-R	RK5	100	150	175				
	1	LPJ SP	J	175	200	225				
40	104	LPN-RK SP	RK1	150	200	225	200*	4	1**	1 ¼**
1		FRN-R	RK5	150	200	225				
·	+			200	250	250				
50	120			175	250	200	200*	4	2/0	1 1/
50	130	EDN D		1/0	200	200	200	4	2/0	1 /2
			KK5	1/5	200	250				
		LPJ_SP	J	250	300	300		_		
60	154	LPN-RK_SP	RK1	225	300	300	200*	5	3/0	1 ½
1	1	FRN-R	RK5	200	300	300			1	1

\*Switch size must be increased if the amp rating of the fuse exceeds the amp rating of the switch.

1 Per 430.52(C)(2), if the motor controller manufacturer's overload relay tables state a maximum branch circuit protective device of a lower rating, that lower rating must be used in lieu of the sizes shown in Columns 4, 5, or 6.

\*\*If equipment terminations are rated for 60°C conductors only, the 60°C conductor ampacities must be utilized and therefore larger conductor sizes or conduit sizes may be required.

2 These sizes are typical. They are not shown in NEMA ICS 2-2000.

Class J performance, special finger-safe dimensions.

Limited by 600 amp being the largest amp rating for FRN-R and LPN-RK\_SP.



## 230Vac Three-Phase Motors & Circuits (220-240Vac Systems) continued

1	2	3		4	5	6	7	8	9	10
Motor	Motor	Fus	e	Optimal	NEC®	NEC <sup>®</sup> Max	Minimum	Minimum	Minimum	Minimum
Size	FLA			Branch Ckt	Max for	for Heavy	Switch	NEMA	Copper Wire	Rigid Metallic
				Protection	Gen, Applic	Start	Size	Starter	THWN or THHN AWG	Conduit
Table	Table				430.52(C)(1)	430.52(C)(1)	430,110	NEMA ICS 2-	or KCMIL	Annex C
430.250	430.250	Type	Class	1	Exc. No. 1	Exc. No. 2		2000	Table 310.16	Table C8
HP	AMPS	.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	Chaot Chaot	AMPS <sup>1</sup>	AMPS <sup>1</sup>	AMPS <sup>1</sup>	AMPS	Size <sup>2</sup>	Size	Inches
		LPJ SP	J	300	350	400	-			
75	192	LPN-RK_SP	RK1	250	350	400	400	5	250	2
		FRN-R	RK5	250	350	400				
		LPJ_SP	J	400	450	500				
100	248	LPN-RK_SP	RK1	350	450	500	400*	5	350	2 ½
		FRN-R	RK5	350	450	500				
		KRP-C_SP	L	-	-	700				
		LPJ_SP	J	500	600	-				
125	312	LPN-RK_SP	RK1	450	600	-	400*	6	3/0 2/PHASE	(2) 1 ½
		FRN-R	RK5	400	600	-				
		KRP-C_SP	L	-	-	900				
		LPJ_SP	J	600	-	-				
150	360	LPN-RK_SP	RK1	500	6004	-	600*	6	4/0 2/PHASE	(2) 2
		FRN-R	RK5	450	6004	-				
		KRP-C_SP	L	-	700	1000		-		
200	480	FRN-R	RK5	600	-	-	600*	6	350 2/PHASE	(2) 2-2 ½
		KRP-C_SP	L	-	1000	1400				

\*Switch size must be increased if the amp rating of the fuse exceeds the amp rating of the switch.

1 Per 430.52(C)(2), if the motor controller manufacturer's overload relay tables state a maximum branch circuit protective device of a lower rating, that lower rating must be used in lieu of the sizes shown in Columns 4, 5, or 6.

\*\*If equipment terminations are rated for 60°C conductors only, the 60°C conductor ampacities must be utilized and therefore larger conductor sizes or conduit sizes may be required.

2 These sizes are typical. They are not shown in NEMA ICS 2-2000.
Limited by 600 amp being the largest amp rating for FRN-R and LPN-RK\_SP.

## 460Vac Three-Phase Motors & Circuits (440-480Vac Systems)

1	2	3		4	5	6	7	8	9	10
Motor Size Table	Motor FLA Table	Fus	e	Optimal Branch Ckt Protection	NEC <sup>®</sup> Max for Gen. Applic 430.52(C)(1)	NEC <sup>®</sup> Max for Heavy Start 430.52(C)(1)	Minimum Switch Size 430.110	Minimum NEMA Starter NEMA ICS 2-	Minimum Copper Wire THWN or THHN AWG or KCMIL	Minimum Rigid Metallic Conduit Annex C
430.250	430.250	Туре	Class		Exc. No. 1	Exc. No. 2		2000	Table 310.16	Table C8
HP	AMPS			AMPS <sup>1</sup>	AMPS <sup>1</sup>	AMPS <sup>1</sup>	AMPS	Size <sup>2</sup>	Size	Inches
		LPJ_SP	J	1 %	3	3				
		TCF	Jf	3	3	3				
12	1.1	LP-CC	CC	2 1/4	6	6	30	00	14	1/2
		LPS-RK_SP	RK1	1 1½	3	3				
		FRS-R	RK5	1 %	3	3				
		LPJ_SP	J	2 %	3	3 ½				
3/	1.6		J	3	3	3	20	00	4.4	1/
74	1.0			3 710 0 1/	0	0 /4	30	00	14	12
				Z /4	3	3 /2				
			I I	2 2/.	5	5 /2				
			J	5 /10	6	6				
1	21			1 16	10	10	30	00	1/	1/
1	2.1	I PS-RK SP	RK1	2 %	6	6	50	00		12
		FRS-R	RK5	2 %	6	6				
		I P.I.SP		4 1/2	6	6				
		TCF	Jf	6	6	6				
1 %	3	LP-CC	CC	6	10	12	30	00	14	16
	l i	LPS-RK SP	RK1	4	6	6 1/4				/2
		FRS-R	RK5	4	6	6 1/4				
		LPJ SP	J	5 %	6	7				
		TCF	<b>J</b> f	6	6	6				
2	3.4	LP-CC	CC	7 1	5	15	30	00	14	1/2
		LPS-RK_SP	RK1	4 ½	6	7				
		FRS-R	RK5	4 ½	6	7 ½				
		LPJ_SP	J	8	10	10				
		TCF	<b>J</b> f	10	10	10				
3	4.8	LP-CC	CC	10	15	15	30	0	14	1/2
		LPS-RK_SP	RK1	6 ¼	10	10				
		FRS-R	RK5	6	10	10				
		LPJ_SP	J	12	15	15				
		TCF	Jf	15	15	15				
5	7.6	LP-CC	CC	25	25	30	30	0	14	1/2
		LPS-RK_SP	RK1	10	15	15				
		FRS-R	RK5	10	15	15				

\* Switch size must be increased if the amp rating of the fuse exceeds the amp rating of the switch.

Per 430.52(C)(2), if the motor controller manufacturer's overload relay tables state a maximum branch circuit protective device of a lower rating, that lower rating must be used in lieu of the sizes shown in Columns 4, 5, or 6. f equipment terminations are rated for 60°C conductors only, the 60°C conductor ampacities must be utilized and therefore larger conductor sizes or conduit sizes may be required.



# 460Vac Three-Phase Motors & Circuits (440-480Vac Systems) continued

1	2	3		4	5	6	7	8	9	10
Motor	Motor	Fus	۵	Ontimal	NEC®	NEC <sup>®</sup> Max	Minimum	Minimum	Minimum	Minimum
Size	ELA	i us	c	Branch Ckt	Max for	for Honur	Switch	NEMA	Connor Wire	Digid Matallia
Size	FLA			Dialicii CKL		IOI Heavy	Switch	NEINA Otenten		
				Protection	Gen. Applic	Start	Size	Starter	THWN OF THHN AWG	Conduit
Table	Table	_		-	430.52(C)(1)	430.52(C)(1)	430.110	NEMA ICS 2-	OF KCMIL	Annex C
430.250	430.250	Туре	Class		Exc. No. 1	Exc. No. 2		2000	Table 310.16	Table C8
HP	AMPS			AMPS <sup>1</sup>	AMPS <sup>1</sup>	AMPS <sup>1</sup>	AMPS	Size <sup>2</sup>	Size	Inches
7 1/		LPJ_SP	J	17 ½	20	20	20			1/
1 1/2	11		J	17 ½	20	20	30	1	14	1/2
		LPS-RK_SP		15	20	20				
				25	20	30				
10	14	TCF	J If	25	25	30	30	1	14	14
10	17	I PS-RK SP	RK1	20	25	30	00	1	T T	12
		FRS-R	RK5	17 ½	25	30				
		LPJ SP	J	35	40	45				
15	21	TCF	Jf	35	40	45	30*	2	10	1/2
		LPS-RK_SP	RK1	30	40	45				
		FRS-R	RK5	30	40	45				
		LPJ_SP	J	45	50	60				
20	27	TCF	Jf	45	50	60	60	2	10**	1/2
		LPS-RK_SP	RK1	40	50	60				
		FRS-R	RK5	35	50	60				
05	24	LPJ_SP	J	60	60	70	CO*	0	0**	1/**
25	34		J/	60	60	70	60^	2	8^^	1/2 **
		EDG D		40	60	70				
				60	70	90				
30	40	TCF	Jf	60	70	90	60*	3	8**	1/**
00	10	LPS-RK SP	RK1	60	70	90		Ű	Ů	72
		FRS-R	RK5	50	70	90				
		LPJ_SP	J	80	100	110				
40	52	TCF	Jf	80	100	-	100*	3	6**	3/**
		LPS-RK_SP	RK1	70	100	110				
		FRS-R	RK5	70	100	110				
		LPJ_SP	J	100	125	125				
50	65	TCF	J <i>f</i>	100	-	-	100*	3	4**	1
		LPS-RK_SP	RK1	90	125	125				
		FKS-K	KK5	90	125	125				
60	77			120	150	150	100*	4	2**	1**
00		ERS-R	RK5	100	150	150	100	4	5	1
		I P.I.SP		150	175	200				
75	96	LPS-RK SP	RK1	125	175	200	200	4	1**	1 ¼**
		FRS-R	RK5	125	175	200		-		
		LPJ_SP	J	200	225	250				
100	124	LPS-RK_SP	RK1	175	225	250	200*	4	2/0	1 ½
		FRS-R	RK5	175	225	250				
		LPJ_SP	J	250	300	350		_		
125	156	LPS-RK_SP	RK1	225	300	350	200*	5	3/0	1 ½
		FRS-R	RK5	200	300	350				
150	100		J DK1	300	350	400	400	F	4/0	2
150	100	ERS_R		230	350	400	400	5	4/0	2
				400	450	500				
200	240	I PS-RK SP	RK1	350	450	500	400*	5	350	2 %
200	2.0	FRS-R	RK5	300	450	500				- /2
		KRP-C SP	L	-	-	700				
		LPJ_SP	J	500	600	-				
250	302	LPS-RK_SP	RK1	400	600	-	400*	6	3/0 2/PHASE	(2) 1 ½
		FRS-R	RK5	400	600	-				
		KRP-C_SP	L	-	-	900				
000	0.01	LPJ_SP		600	-	-	0000	_	4/0.0/0/0/00	(0) 0
300	361	LPS-RK_SP	RK1	500	6004	-	600*	6	4/0 2/PHASE	(2) 2
		FKS-K	KK5	500	0004	1000				
		I DO DK OD			100	1000				
350	414	FRS-R	RK5	600	_		600*	6	300 2/PHASE	(2) 2
000	714	KRP-C SP			800	1200	000	0	JUU ZATTAGE	14/2
400	477	KRP-C SP	ι Γ	-	1000	1400	600*	6	350 2/PHASE	(2)2 %
		FRS-R	RK5	600	-	-		, v		(= ,= ,- ,-
450	515	KRP-C_SP	L	-	1000	1500	1200*	7	400 2/PHASE	(2) 2 ½
500	590	KRP-C_SP	L	-	1200	1600	1200*	7	500 2/PHASE	(2) 3
* Cuvitale a	the second has been a	and if the own roting a	f the free evened	- the second section of the	han an Mada	-		-		

\* Switch size must be increased if the amp rating of the fuse exceeds the amp rating of the switch

Per 430.52(C)(2), if the motor controller manufacturer's overload relay tables state a maximum branch circuit protective device of a lower rating, that lower rating must be used in lieu of the sizes shown in Columns 4, 5, or 6.

\*\* If equipment terminations are rated for 60°C conductors only, the 60°C conductor ampacities must be utilized and therefore larger conductor sizes or conduit sizes may be required.

Limited by 600 amp being the largest amp rating for FRS-R and LPS-RK\_SP.



# 575Vac Three-Phase Motors & Circuits (550-600Vac Systems)

4	0				-	C	7	0	•	40
1	2	3		4	5	6	1	8	9	10
Motor	Motor	Fus	e	Optimal	NEC®	NEC <sup>®</sup> Max	Minimum	Minimum	Minimum	Minimum
Size	FLA			Branch Ckt	Max for	for Heavy	Switch	NEMA	Copper Wire	Rigid Metallic
0120	12/1			Dratestion	Con Annlia	Chart	Cine	Charten		Conduit
				Protection	Gen. Applic	Start	Size	Starter	THWN OF THHN AWG	Conduit
Table	Table		T	4	430.52(C)(1)	430.52(C)(1)	430.110	NEMA ICS 2-	or KCMIL	Annex C
430.250	430.250	Type	Class		Exc. No. 1	Exc. No. 2		2000	Table 310.16	Table C8
HP	AMPS				AMPS <sup>1</sup>		AMPS	Size <sup>2</sup>	Size	Inches
	74411 0		1	1 4/2	3	3	74111 0	0120	0.20	Indited
			lf	3	3	3				
17	0.0		0,00	1.8/	2	2.1/	20		14	17
/2	0.9			1 /10	3	3 /2	30	0	14	/2
		LPS-RK_SP	RKI	1 1/4	3	3				
		FRS-R	RK5	1 %	3	3				
		LPJ_SP	J	2	3	3				
		TCF	Jf	3	3	3				
3/4	1.3	LP-CC	CC	2 %	6	6	30	0	14	1/2
		LPS-RK_SP	RK1	1 %	3	3				
		FRS-R	RK5	1 %	3	3				
		LPJ SP	J	2 %	3	3 ½				
		TCF	.]f	3	3	3				
1	17	IP-CC	00	31/	6	6 %	30	0	14	1/
1'	1.7	I PS-RK SP	RK1	2 1/	3	3 1/	00	0	14	12
			DKE	2 /4	2	2 1/				
			INNU	<u>Z</u> /4	5	J /2				
		LPJ_SP	J	4	0	0				
			J	0	0	6				
1 ½	2.4	LP-CC	CC	5	10	10	30	0	14	1/2
		LPS-RK_SP	RK1	3 1/10	6	6				
		FRS-R	RK5	3	6	6				
		LPJ_SP	J	4 ½	6	6				
		TCF	Jf	6	6	6				
2	2.7	LP-CC	CC	5 %	10	10	30	0	14	1/2
		LPS-RK SP	RK1	4	6	6				
		FRS-R	RK5	3 %	6	6				
		I P.I.SP		6	10	10				
		TCE	lf	6	10	10				
3	3.0	IP-CC		5	15	15	30	0	14	1/
5	5.5			56/	10	10	50	0	14	/2
				5 710	10	10				
		FRO-R	RKD	5	10	10				
		LPJ_SP	J	10	15	15				
		ICF	Jf	10	15	15				
5	6.1	LP-CC	CC	15	20	20	30	0	14	1/2
		LPS-RK_SP	RK1	8	15	15				
		FRS-R	RK5	8	15	15				
		LPJ_SP	J	15	20	20				
		TCF	Jf	15	20	20				
7 ½	9	LP-CC	CC	30	30	30	30	1	14	1/2
		LPS-RK SP	RK1	12	20	20				
		FRS-R	RK5	12	20	20				
		LPJ SP	J	17 %	20	20				
10	11	TCF	lf	17 %	20	20	30	1	14	1/2
		I PS-RK SP	RK1	15	20	20				/-
		FRS-R	RK5	15	20	20				
				30	30	20				
15	17		J.	20	30	35	30*	2	12	14
15				00	30	35	50	<u> </u>	12	/2
				20	20	30				
		FKO-K	RN3	25	30	35				
00	00	LPJ_SP	J	35	40	45	0.04	_	40	1/
20	22	ICF	Jf	35	40	45	30^	2	10	1/2
		LPS-RK_SP	RK1	30	40	45				
		FRS-R	RK5	30	40	45				
		LPJ_SP	J	45	50	60				
25	27	TCF	Jf	45	50	60	60	2	10**	1/2**
		LPS-RK_SP	RK1	40	50	60				
		FRS-R	RK5	35	50	60				
-		LPJ SP	J	50	60	70				
30	32	TCF	Jf	50	60	70	60*	3	8	1/2
1		LPS-RK SP	RK1	45	60	70				
1		FRS-R	RK5	40	60	70				
	1			70	80	00				
40	41	TCF	If	70	80	an	60*	2	6	3/
10	, T			60	80	00		5		/4
		EDO D		00	00	30				
		FK5-K	KK5	00	80	90				
		LPJ_SP	J	80	100	110		_		244
50	52	I CF	Jf	80	100	-	100*	3	6**	3/**
		LPS-RK_SP	RK1	70	100	110				
		FRS-R	RK5	70	100	110			1	

\*Switch size must be increased if the amp rating of the fuse exceeds the amp rating of the switch.

1 Per 430.52(C)(2), if the motor controller manufacturer's overload relay tables state a maximum branch circuit protective device of a lower rating, that lower rating must be used in lieu of the sizes shown in Columns 4, 5, or 6.

\*\*If equipment terminations are rated for 60°C conductors only, the 60°C conductor ampacities must be utilized and therefore larger conductor sizes or conduit sizes may be required.

2 These sizes are typical. They are not shown in NEMA ICS 2-2000.



# 575Vac Three-Phase Motors & Circuits (550-600Vac Systems) continued

1	2	3		4	5	6	7	8	9	10
Motor Size	Motor FLA	Fus	e	Optimal Branch Ckt Protection	NEC <sup>∞</sup> Max for Gen. Applic	NEC <sup>®</sup> Max for Heavy Start	Minimum Switch Size	Minimum NEMA Starter	Minimum Copper Wire THWN or THHN AWG	Minimum Rigid Metallic Conduit
430.250 HP	430.250 AMPS	Туре	Class	AMPS <sup>1</sup>	430.32(0)(1) Exc. No. 1 AMPS <sup>1</sup>	Exc. No. 2 AMPS <sup>1</sup>	AMPS	2000 Size <sup>2</sup>	Table 310.16 Size	Table C8
60	62	LPJ_SP LPS-RK_SP FRS-R	J RK1 RK5	100 90 80	110 110 110 110	125 125 125	100*	4	4**	1
75	77	LPJ_SP LPS-RK_SP FRS-R	J RK1 RK5	125 110 100	150 150 150	150 150 150	100*	4	3**	1**
100	99	LPJ_SP LPS-RK_SP FRS-R	J RK1 RK5	150 150 125	175 175 175	200 200 200	200	4	1**	1 ¼**
125	125	LPJ_SP LPS-RK_SP FRS-R	J RK1 RK5	200 175 175	225 225 225	250 250 250	200*	5	2/0	1 ½
150	144	LPJ_SP LPS-RK_SP FRS-R	J RK1 RK5	225 200 200	300 300 300	300 300 300	200*	5	3/0	1 ½
200	192	LPJ_SP LPS-RK_SP FRS-R	J RK1 RK5	300 250 250	350 350 350	400 400 400	400	5	250	2
250	242	LPJ_SP LPS-RK_SP FRS-R KRP-C SP	J RK1 RK5 L	400 350 350 -	450 450 450	500 500 500 700	400*	6	350	2 ½
300	289	LPJ_SP LPS-RK_SP FRS-R KRP-C SP	J RK1 RK5 L	450 400 400	600 600 600	600 600 600 800	400*	6	500	3
350	336	LPJ_SP LPS-RK_SP FRS-R KRP-C SP	J RK1 RK5 L	600 450 450	600 600 600 601	- - - 1000	600*	6	4/0 2/PHASE	(2) 2
400	382	LPJ_SP LPS-RK_SP FRS-R KRP-C SP	J RK1 RK5 L	600 500 500	- - - 700	- - - 1100	600*	6	250 2/PHASE	(2) 2
450	412	LPS-RK_SP FRS-R KRP-C_SP	RK1 RK5 L	600 600	800	1200	600*	7	300 2/PHASE	(2) 2
500	472	FRS-R KRP-C_SP	RK5 L	600	- 1000	- 1400	600*	7	350 2/PHASE	(2) 2 ½

Switch size must be increased if the amp rating of the fuse exceeds the amp rating of the switch.

Per 430.52(C)(2), if the motor controller manufacturer's overload relay tables state a maximum branch circuit protective device of a lower rating, that lower rating must be used in lieu of the sizes shown in Columns 4, 5, or 6.

r If equipment terminations are rated for 60°C conductors only, the 60°C conductor ampacities must be utilized and therefore larger conductor sizes or conduit sizes may be required.

2 These sizes are typical. They are not shown in NEMA ICS 2-2000.



# 115Vac Single-Phase Motors & Circuits (110-120Vac Systems)

1	2	2		4	5	6	7	9	0	10
Matan	Z Matan	5		4 Outine al	J		I Minimum	0		IV Minimum
Motor	Motor	Fus	e	Optimal	NEC®	NEC <sup>®</sup> Max	Minimum	Minimum	Minimum	Minimum
Size	FLA			Branch Ckt	Max for	for Heavy	Switch	NEMA	Copper Wire	Rigid Metallic
				Protection	Gen. Applic	Start	Size	Starter	THWN or THHN AWG	Conduit
Table	Table				430.52(C)(1)	430.52(C)(1)	430.110	NEMA ICS 2-	or KCMIL	Annex C
130 248	130 248	Туре	Class	1	Exc No 1	Exc No 2		2000	Table 310 16	Table C8
430.240	430.240	Type	01035	44001	LAC. NO. 1	LAC. NO. 2	41400	2000		
нР	AIVIPS			AMP5	AMPS	AMPS	AMPS	Size	Size	Inches
		LPJ_SP	J	8	10	10				
		ICF	Jf	10	10	10				
1/6	4.4	LP-CC	CC	9	15	15	30	00	14	1/2
		LPN-RK_SP	RK1	6	10	10				
		FRN-R	RK5	5 6/10	10	10				
		LPJ_SP	J	9	15	15				
		TCF	Jf	10	15	15				
1/4	5.8	LP-CC	CC	12	20	20	30	00	14	1/2
		LPN-RK SP	RK1	8	15	15				
		FRN-R	RK5	7 ½	15	15				
		LPJ SP	J	12	15	15				
		TCF	Jf	15	15	15				
1/2	72	IP-CC	00	15	25	25	30	00	14	16
/-		I PN-RK SP	RK1	10	15	15				,-
		FRN-R	RK5	9	15	15				
		I PL SP	100	15	20	20				
			lf	15	20	20				
12	0.8		00	30	20	20	30	0	14	12
/2	9.0			15	20	20	50	0	14	/2
			DKE	15	20	20				
			RK3	10	20	20				
3/	12.0	LPJ_SP	J	20	20	30	20	0	44	17
74	13.8		J/	25	25	30	30	0	14	12
		LPN-RK_SP	RKI	20	25	30				
		FRN-R	RK5	17 ½	25	30				
	10	LPJ_SP	J	25	30	35	0.0*			
1	16		JI	25	30	35	30^	0	14	1/2
		LPN-RK_SP	RK1	25	30	35				
		FRN-R	RK5	20	30	35				
		LPJ_SP	J	30	35	45				
1 ½	20	TCF	Jf	30	35	45	30*	1	12	1/2
		LPN-RK_SP	RK1	30	35	45				
		FRN-R	RK5	25	35	45				
		LPJ_SP	J	40	45	50				
2	24	TCF	Jf	40	45	50	30*	1	10	1/2
		LPN-RK_SP	RK1	35	45	50				
		FRN-R	RK5	30	45	50				
		LPJ_SP	J	60	60	70				
3	34	TCF	Jf	60	60	70	60*	2	8**	1/2**
		LPN-RK SP	RK1	45	60	70				
		FRN-R	RK5	45	60	70				
		LPJ SP	J	90	100	125				
5	56	TCF	Jf	90	100	_	100*	3	4	3/**
-		LPN-RK SP	RK1	80	100	125		-		
		FRN-R	RK5	70	100	125				
	1	I P.J. SP		125	150	175				
7 1%	80	I PN-RK SP	RK1	110	150	175	100*	3	3**	1**
1 12		FRN-R	RK5	100	150	175				'
	1			150	175	225				
10	100	I DNLRK OD		150	175	223	200*	10	1	11/
10	100			100	175	220	200	42		1 /4
1	1			120	1/0	220	1	1	1	1

\* Switch size must be increased if the amp rating of the fuse exceeds the amp rating of the switch.

1 Per 430.52(C)(2), if the motor controller manufacturer's overload relay tables state a maximum branch circuit protective device of a lower rating, that lower rating must be used in lieu of the sizes shown in Columns 4, 5, or 6.

\*\* If equipment terminations are rated for 60°C conductors only, the 60°C conductor ampacities must be utilized and therefore larger conductor sizes or conduit sizes may be required.

2 These sizes are typical. They are not shown in NEMA ICS 2-2000.



# 230Vac Single-Phase Motors & Circuits (220-240Vac Systems)

1	2	3		4	5	6	7	8	9	10
Motor	Motor	Fus	e	Optimal	NEC®	NEC <sup>®</sup> Max	Minimum	Minimum	Minimum	Minimum
Size	FLA			Branch Ckt	Max for	for Heavy	Switch	NEMA	Copper Wire	Rigid Metallic
Table	Table			Protection	Gen. Applic	Start 430 52(C)(1)	Size 430 110	Starter	I HWN of I HHN AWG	Conduit Annex C
430.248	430.248	Type	Class	-	Exc. No. 1	Exc. No. 2	430.110	2000	Table 310.16	Table C8
HP	AMPS	.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		AMPS <sup>1</sup>	AMPS <sup>1</sup>	AMPS <sup>1</sup>	AMPS	Size <sup>2</sup>	Size	Inches
		LPJ_SP	J	3 ½	6	6				
1/	2.2			6	6	6	30	00	14	12
/6	2.2	LPN-RK SP	RK1	3	6	6	50	00	14	/2
		FRN-R	RK5	2 %10	6	6				
		LPJ_SP	J	4 ½	6	6				
1/4	2.9	LP-CC	cc	6	10	10	30	00	14	16
		LPN-RK_SP	RK1	4	6	6 ¼				,-
		FRN-R	RK5	4	6	6 ¼				
		LPJ_SP TCF	J If	5 %	10	10				
1/3	3.6	LP-CC	cc	7	15	15	30	00	14	1/2
		LPN-RK_SP	RK1	5	10	10				
		FRN-R	RK5	4 ½	10	10				
		TCF	Jf	10	10	10				
1/2	4.9	LP-CC	CC	10	15	15	30	00	14	1/2
		LPN-RK_SP	RK1	8	10	10				
			J	12	10	10				
		TCF	J <i>f</i>	15	15	15				
3/4	6.9	LP-CC	CC	15	25	25	30	00	14	1/2
		LPN-RK_SP	RK1	9	15	15				
		LPJ_SP	J	12	15	17 ½				
		TCF	Jf	15	15	17 ½				
1	8	LP-CC		25	25	30	30	00	14	1/2
		FRN-R	RK5	10	15	17 ½				
		LPJ_SP	J	15	20	20				
4 1/	10	TCF	Jf	15	20	20	20	0	14	17
1 /2	10	LP-CC LPN-RK SP	RK1	15	20	20	30	0	14	12
		FRN-R	RK5	15	20	20				
		LPJ_SP	J	20	25	25				
2	12	IP-CC	CC	20	25	25	30	0	14	16
-		LPN-RK_SP	RK1	17 ½	25	25				/~
		FRN-R	RK5	15	25	25				
3	17	LPJ_SP TCF	J If	30	30	35	30*	1	12	1/
0		LPN-RK_SP	RK1	25	30	35	00		12	12
		FRN-R	RK5	25	30	35				
5	28	LPJ_SP	J	45	50	60 60	60	2	10**	12
5	20	LPN-RK SP	RK1	40	50	60	00	2	10	12
		FRN-R	RK5	35	50	60				
7 1/	40	LPJ_SP	J	60	70	90	60*	2	0**	1/**
1 /2	40	LPN-RK SP	RK1	60	70	90	00		0	/2
		FRN-R	RK5	50	70	90				
10	50	LPJ_SP	J	80	90	110	400*		0**	1/#*
10	50	I DF	J/ RK1	80 70	90	110	100^	3	٥^^	1/2^^
		FRN-R	RK5	70	90	110				

Switch size must be increased if the amp rating of the fuse exceeds the amp rating of the switch.

Per 430.52(C)(2), if the motor controller manufacturer's overload relay tables state a maximum branch circuit protective device of a lower rating, that lower rating must be used in lieu of the sizes shown in Columns 4, 5, or 6. If equipment terminations are rated for 60°C conductors only, the 60°C conductor ampacities must be utilized and therefore larger conductor sizes or conduit sizes may be required.



## 90Vdc<sup>3</sup> Motors & Circuits

1	2	3		4	5	6	7	8	9	10
Motor	Motor	Fuse	9	Optimal	NEC®	NEC <sup>®</sup> Max	Minimum	Minimum	Minimum	Minimum
Size	FLA			Branch Ckt	Max for	for Heavy	Switch	NEMA	Copper Wire	Rigid Metallic
				Protection	Gen. Applic	Start	Size	Starter	THWN or THHN AWG	Conduit
Table	Table				430.52(C)(1)	430.52(C)(1)	430.110	NEMA ICS 2-	or KCMIL	Annex C
430.257	430.257	Туре	Class		Exc. No. 1	Exc. No. 2		2000	Table 310.16	Table C8
HP	AMPS			AMPS <sup>1</sup>	AMPS <sup>1</sup>	AMPS <sup>1</sup>	AMPS	Size <sup>2</sup>	Size	Inches
		LPJ_SP	J	6	6	6				
		TCF	Jf	6	6	6				
1/4	4.0	LPC_CC	CC	6	6	15	30	1	14	1/2
		LPN-RK_SP	RK1	6	6	9				
		FRN-R	RK5	5	6	9				
		LPJ_SP	J	8	10	10				
		TCF	Jf	10	10	10				
1/3	5.2	LP-CC	CC	10	10	20	30	1	14	1/2
		LPN-RK_SP	RK1	8	10	10				
		FRN-R	RK5	7	10	10				
		LPJ_SP	J	12	15	15				
		TCF	Jf	15	15	15				
1/2	6.8	LP-CC	CC	15	15	25	30	1	14	1/2
		LPN-RK_SP	RK1	9	15	15				
		FRN-R	RK5	9	15	15				
		LPJ_SP	J	15	15	20				
		TCF	Jf	15	15	20				
3/4	9.6	LP-CC	CC	15	15	30	30	1	14	1/2
		LPN-RK_SP	RK1	15	15	20				
		FRN-R	RK5	12	15	20				

Per 430.52(C)(2), if the motor controller manufacturer's overload relay tables state a maximum branch circuit protective device of a lower rating, that lower rating must be used in lieu of the sizes shown in Columns 4, 5, or 6. \* If equipment terminations are rated for 60°C conductors only, the 60°C conductor ampacities must be utilized and therefore larger conductor sizes or conduit sizes may be required.

2 These sizes are typical. They are not shown in NEMA ICS 2-2000.

3 All equipment manufacturers should be consulted about DC voltage ratings of their equipment.



## 120Vdc<sup>3</sup> Motors & Circuits

1	2	3		4	5	6	7	8	9	10
Motor	Motor	Fus	e	Optimal	NEC®	NEC <sup>®</sup> Max	Minimum	Minimum	Minimum	Minimum
Size	FLA			Branch Ckt	Max for	for Heavy	Switch	NEMA	Copper Wire	Rigid Metallic
0.20				Protection	Gen Applic	Start	Size	Starter	THWN or THHN AWG	Conduit
Tabla	Table			Trotection	430 52(C)(4)	430 52(C)(1)	430 110	NEMA ICS 2	or KCMII	Annox C
1400.057	100.057	Ture	01	-	430.52(0)(1)	430.52(C)(1)	430.110	INEINA ICS 2-		Annex C
430.257	430.257	туре	Class		EXC. NO. 1	EXC. NO. 2		2000	Table 310.16	Table C8
HP	AMPS			AMPS'	AMPS	AMPS	AMPS	Size <sup>2</sup>	Size	Inches
		LPJ_SP	J	5	6	6				
17	24		J	6	6	0	20		44	17
74	3.1			0	6	12	30	1	14	12
		LPIN-RK_SP		4 /2	0	0 /4 6 1/				
			RK0	4	0	0 /4				
		LPJ_SP	J If	10	10	10				
1/	11			0	10	10	30	1	14	1/
73	4.1			56/	10	10	30		14	/2
		EDN D		5 %	10	10				
				0 J /10	10	10				
			lf	10	10	10				
1/	54	LP-CC	00	10	10	20	30	1	14	1/
/2	0.4	I PN-RK SP	RK1	7 %	10	12	00		17	12
		FRN-R	RK5	7	10	12				
		I P.I SP		12	15	15				
		TCF	Jf	15	15	15				
3/4	7.6	LP-CC	CC	15	15	30	30	1	14	16
		LPN-RK SP	RK1	10	15	15				,-
		FRN-R	RK5	10	15	15				
		LPJ_SP	J	15	15	20				
		TCF	Jf	15	15	20				
1	9.5	LP-CC	CC	15	15	30⁵	30	1	14	1/2
		LPN-RK_SP	RK1	15	15	20				
		FRN-R	RK5	12	15	20				
		LPJ_SP	J	20	20	25				
		TCF	Jf	20	20	25				
1 ½	13.2	LP-CC	CC	20	20	30⁵	30	1	14	1/2
		LPN-RK_SP	RK1	17 ½	20	25				
		FRN-R	RK5	17 ½	20	25				
		LPJ_SP	J	30	30	35				
	47	I CF	Ji	30	30	35	0.0*		10	1/
2	17			30	30	30°	30^	1	12	1/2
		LPIN-RK_SP		20	30	30				
·				20	30	50				
2	25		J	40	40	50	60	1	10**	1/
5	25			35	40	50	00	1	10	12
		ET N-R	RK5	35	40	35				
		I P.I.SP		60	60	90				
5	40	TCF	.lf	60	60	60	60*	2	8**	1/**
ľ	10	I PN-RK SP	RK1	60	60	90		-	Ŭ	12
		FRN-R	RK5	50	60	90				
		LPJ SP	J	90	90	125				
7 ½	58	TCF	J <i>f</i>	90	90	_	100*	3	4**	3/**
		LPN-RK SP	RK1	80	90	125		-		
		FRN-R	RK5	80	90	125				
		LPJ_SP	J	125	125	150				
10	76	LPN-RK_SP	RK1	100	125	150	100*	3	3**	1
1	1	FRN-R	RK5	100	125	150			1	

Switch size must be increased if the amp rating of the fuse exceeds the amp rating of the switch.

Per 430.52(C)(2), if the motor controller manufacturer's overload relay tables state a maximum branch circuit protective device of a lower rating, that lower rating must be used in lieu of the sizes shown in Columns 4, 5, or 6. 1 If equipment terminations are rated for 60°C conductors only, the 60°C conductor ampacities must be utilized and therefore larger conductor sizes or conduit sizes may be required.

2 Reduced voltage magnetic controller ratings

3 All equipment manufacturers should be consulted about DC voltage ratings of their equipment.

5 Largest LP-CC Fuse 30 amp. With other type fuse, could use larger amp rating in this application.



## 180Vdc<sup>3</sup> Motors & Circuits

1	2	3		4	5	6	7	8	9	10
Motor	Motor	Fus	e	Optimal	NEC®	NEC <sup>®</sup> Max	Minimum	Minimum	Minimum	Minimum
Size	FLA			Branch Ckt	Max for	for Heavy	Switch	NEMA	Copper Wire	Rigid Metallic
0.20				Protection	Gen Applic	Start	Size	Starter	THWN or THHN AWG	Conduit
Table	Table			rotoodon	430 52(C)(1)	430 52(C)(1)	430 110	NEMA ICS 2-	or KCMII	Annex C
430 257	430 257	Type	Class		Exc No 1	Exc No 2	400.110	2000	Table 310 16	Table C8
HP	AMPS	Type	01033		AMPS <sup>1</sup>		AMPS	Size <sup>2</sup>	Size	Inches
<u></u>		I P.I. SP	L.	3	3	4 %	Aiii U	UILC	0120	menes
1/4	2.0	TCF	Jf	3	3	3	30	1	14	16
/4	2.0	I PS-RK SP	RK1	2 %	3	4 %				/-
		FRS-R	RK5	2 %	3	4 %				
		LPJ SP	J	4	6	6				
1/3	2.6	TCF	Jf	6	6	6	30	1	14	1/2
		LPS-RK SP	RK1	3 ½	6	6				
		FRS-R	RK5	3 ½	6	6				
		LPJ_SP	J	5 %	6	6				
1/2	3.4	TCF	Jf	6	6	6	30	1	14	1/2
		LPS-RK_SP	RK1	4 ½	6	6 ¼				
		FRS-R	RK5	4 ½	6	7 ½				
		LPJ_SP	J	8	10	10				
3/4	4.8	TCF	Jf	10	10	10	30	1	14	1/2
		LPS-RK_SP	RK1	6 ¼	10	10				
		FRS-R	RK5	6	10	10				
		LPJ_SP	J	10	10	12				
1	6.1	TCF	Jf	10	10	10	30	1	14	1/2
		LPS-RK_SP	RK1	8	10	12				
		FRS-R	RK5	8	10	12				
		LPJ_SP	J	15	15	17 ½				
		TCF	Jf	15	15	15				
1 ½	8.3	LP-CC	CC	-	-	30	30	1	14	12
		LPS-RK_SP	RK1	12	15	17 ½				
		FRS-R	RK5	12	15	17 ½				
		LPJ_SP	J	15	20	20				
0	10.0		J	15	20	20	20	4	44	1/
2	10.0			20	20	30	30		14	12
		LPS-RK_SP		10	20	20				
			RK0	10	20	20				
			J	20	25	35				
2	16		0,000	25	25	30	30*	1	14	12
3	10			20	25	35	30		14	/2
		ERS_R	RK5	20	25	35				
	1	I P.I.SP		40	45	60				
5	27	TCF	.lf	40	45	60	60	2	10**	16
Ĭ		I PS-RK SP	RK1	40	45	60				12
		FRS-R	RK5	35	45	60				

Switch size must be increased if the amp rating of the fuse exceeds the amp rating of the switch.

Per 430.52(C)(2), if the motor controller manufacturer's overload relay tables state a maximum branch circuit protective device of a lower rating, that lower rating must be used in lieu of the sizes shown in Columns 4, 5, or 6.

If equipment terminations are rated for 60°C conductors only, the 60°C conductor ampacities must be utilized and therefore larger conductor sizes or conduit sizes may be required.

These sizes are typical. They are not shown in NEMA ICS 2-2000. 2

All equipment manufacturers should be consulted about DC voltage ratings of their equipment. 3

Class J performance, special finger-safe dimensions.

## 240Vdc<sup>3</sup> Motors & Circuits

1	2	3		4	5	6	7	8	9	10
Motor	Motor	Fus	e	Optimal	NEC <sup>®</sup>	NEC <sup>®</sup> Max	Minimum	Minimum	Minimum	Minimum
Size	FLA			Branch Ckt	Max for	for Heavy	Switch	NEMA	Copper Wire	Rigid Metallic
				Protection	Gen. Applic	Start	Size	Starter	THWN or THHN AWG	Conduit
Table	Table				430.52(C)(1)	430.52(C)(1)	430.110	NEMA ICS 2-	or KCMIL	Annex C
430.257	430.257	Туре	Class		Exc. No. 1	Exc. No. 2		2000	Table 310.16	Table C8
HP	AMPS			AMPS <sup>1</sup>	AMPS <sup>1</sup>	AMPS <sup>1</sup>	AMPS	Size <sup>2</sup>	Size	Inches
		LPJ_SP	J	2 ½	3	3 ½				
1/4	1.6	TCF	Jf	3	3	3	30	1	14	1/2
		LPN-RK_SP	RK1	2 ¼	3	3 ½				
		FRS-R	RK5	2	3	3 ½				
		LPJ_SP	J	3	3	4 ½				
1/3	2.0	TCF	Jf	3	3	3	30	1	14	1/2
		LPS-RK_SP	RK1	2 ‰	3	4 ½				
		FRS-R	RK5	2 ½	3	4 ½				

Switch size must be increased if the amp rating of the fuse exceeds the amp rating of the switch.

1 Per 430.52(C)(2), if the motor controller manufacturer's overload relay tables state a maximum branch circuit protective device of a lower rating, that lower rating must be used in lieu of the sizes shown in Columns 4, 5, or 6. If equipment terminations are rated for 60°C conductors only, the 60°C conductor ampacities must be utilized and therefore larger conductor sizes or conduit sizes may be required.

2 Reduced voltage magnetic DC controller ratings.

3

All equipment manufacturers should be consulted about DC voltage ratings of their equipment.



## 240Vdc<sup>3</sup> Motors & Circuits continued

1	2	3		4	5	6	7	8	9	10
Motor Size	Motor FLA	Fus	e	Optimal Branch Ckt Protection	NEC <sup>®</sup> Max for Gen. Applic	NEC <sup>®</sup> Max for Heavy Start	Minimum Switch Size	Minimum NEMA Starter	Minimum Copper Wire THWN or THHN AWG	Minimum Rigid Metallic Conduit
430.257	430.257	Туре	Class		430.52(C)(1) Exc. No. 1 AMPS <sup>1</sup>	430.52(C)(1) Exc. No. 2 AMPS <sup>1</sup>	430.110 AMPS	NEMA ICS 2- 2000 Size <sup>2</sup>	Table 310.16	Table C8
	7.001 0	LPJ_SP	J	4 ½	6	6	74411 0	0120	0120	moneo
1/2	2.7	TCF	Jf	6	6	6	30	1	14	1/2
		LPS-RK_SP	RK1	4	6	6				
		FRS-R	RK5	3 ½	6	6				
		LPJ_SP	J	6	6	8				
3/	20		J	6	6	b 15	20	1	14	1/
/4	3.0	IPS-RK SP	RK1	5	6	8	30		14	12
		FRS-R	RK5	5	6	8				
		LPJ_SP	J	8	10	10				
1	4.7	TCF	J <i>f</i>	10	10	10	30	1	14	1/2
		LPS-RK_SP	RK1	6 ¼	10	10				
		FRS-R	RK5	6	10	10				
1 1/	6.6	LPJ_SP	J	10	10	12	20	1	14	1/
1 /2	0.0		RK1	9 9	10	12	30		14	12
		FRS-R	RK5	9	10	12				
		LPJ_SP	J	15	15	17 ½				
2	8.5	TCF	Jf	15	15	15	30	1	14	1/2
		LPS-RK_SP	RK1	12	15	17 ½				
		FRS-R	RK5	12	15	17 ½				
		LPJ_SP	J	20	20	25				
3	12.2			20	20	20	30	1	14	1/
5	12.2	I PS-RK SP	RK1	17 %	20	25	50	· ·	17	12
		FRS-R	RK5	17 ½	20	25				
		LPJ_SP	J	30	30	45				
		TCF	Jf	30	30	45				
5	20	LP-CC	CC	30	30	30	30*	1	12	1/2
		LPS-RK_SP	RK1	30	30	45				
		I P.I SP		45	45	60				
7 %	29	TCF	Jf	45	45	60	60	2	8	16
		LPS-RK_SP	RK1	40	45	60			-	,-
		FRS-R	RK5	40	45	60				
		LPJ_SP	J	60	60	80				
10	38	TCF	J/	60	60	60	60*	2	8**	1/2**
		LPS-KK_SP		50	60	80				
		I P.I.SP		90	90	110				
15	55	TCF	J <i>f</i>	90	90	-	100*	3	4	3/4**
		LPN-RK_SP	RK1	80	90	110				
		FRS-R	RK5	70	90	110				
00	70	LPJ_SP	J	110	110	150	400*		0**	
20	12	LPN-RK_SP		100	110	150	100*	3	3	1
		I P.J. SP		150	150	200				
25	89	LPN-RK_SP	RK1	125	150	200	200	3	2**	1**
		FRS-R	RK5	125	150	200				
		LPJ_SP	J	175	175	225				
30	106	LPN-RK_SP	RK1	150	175	225	200*	4	1/0**	1 ¼
		IPISP	KK0	225	225	300				
40	140	LPN-RK SP	RK1	200	225	300	200*	4	2/0**	1 1/**
		FRS-R	RK5	175	225	300	200		2.0	
		LPJ_SP	J	300	300	350				
50	173	LPN-RK_SP	RK1	225	300	350	400	5	4/0**	1 ½**
		FRS-R	RK5	225	300	350				
60	206			350	350	450	400*	E	200**	0**
00	200	FRS-R	RK1 RK5	300	350	450	400"	, o	300	<u>ک</u>
		LPJ SP	J	400	400	500				
75	255	LPN-RK_SP	RK1	350	400	500	400*	5	400**	2**
		FRS-R	RK5	350	400	500				
		LPJ_SP	J	600	600	-			10.0/5//	(0) ( ) (1)
100	341	LPN-RK_SP	RK1	450	600	-	600	6	4/0 2/PHASE	(2) 1 ½**
1		FKS-K	I KK5	450	600			1	1	1

Switch size must be increased if the amp rating of the fuse exceeds the amp rating of the switch.

1 Per 430.52(C)(2), if the motor controller manufacturer's overload relay tables state a maximum branch circuit protective device of a lower rating, that lower rating must be used in lieu of the sizes shown in Columns 4, 5, or 6.

\* If equipment terminations are rated for 60°C conductors only, the 60°C conductor ampacities must be utilized and therefore larger conductor sizes or conduit sizes may be required.

2 Reduced voltage magnetic DC controller ratings.

3 All equipment manufacturers should be consulted about DC voltage ratings of their equipment.

## **Motor Protection**



## **Tips For Electricians & Maintenance Crews**

# Recommendations for Electrician and Maintenance Crews

Often, for various reasons, motors are oversized for applications. For instance, a 5Hp motor is installed when the load demand is only 3Hp. In these cases a much higher degree of protection can be obtained by sizing the overload relay elements and/or Fusetron and Low-Peak dual-element, time-delay fuses based on the actual full-load current draw.



 Preferable – With a clamp-on meter, determine running RMS current when the motor is at normal full-load. (Be sure this current does not exceed nameplate current rating.) The advantage of this method is realized when a lightly loaded motor (especially those over 50 HP) experiences a single-phase condition. Even though the relays and fuses may be sized correctly based on motor nameplate, circulating currents within the motor may cause damage.



Alternate – if unable to meter the motor current, then take the current rating off the nameplate.



460V.

- 2. Then size the overload relay elements and Fusetron FRS-R and FRN-R or Low-Peak LPS-RK\_SP and LPN-RK\_SP dual-element fuses based on this current. For optimum motor circuit protection offering a high degree of "back-up overload" protection, use the table that follows to assist in sizing dual-element fuses. The other fuses in the table LPJ\_SP, TCF and LP-CC can provide excellent short circuit protection when sized for Optimum Motor Circuit Protection. However, they typically can not be sized close enough to provide motor back-up overload protection.
- 3. Use a labeling system to mark the type and amp rating of the fuse that should be in the fuse clips, such as FRS-R 6 1/4. This simple step makes it easy to run spot checks for proper fuse replacement. When installing the proper fuses in the switch to give the desired level of protection, it often is advisable to leave spare fuses on top of the disconnect, the starter enclosure or in a cabinet adjacent to the motor control center. In this way, should the fuses open, the problem can be corrected and proper size fuses easily reinstalled.

Abnormal installations may require Fusetron or Low-Peak dual-element fuses of a larger size than shown providing only short circuit protection. These applications include:

(a) Fusetron or Low-Peak dual-element fuses in high ambient temperature environments.

(b) A motor started frequently or rapidly reversed.

- (c) Motor is directly connected to a machine that cannot be brought up to full speed quickly (large fans, centrifugal machines such as extractors and pulverizers, machines having large fly wheels such as large punch presses.)
- (d) Motor has a high Code Letter (or possibly no Code Letter) with full voltage start.
- (e) WYE delta open transition start.
- (f) Motor has a large inrush current, such as a Design B.

#### Selection of Fusetron or Low-Peak Dual-Element Fuses based upon Motor FLA for Optimum Motor Circuit Protection\*

Low-Peak		Motor	Current	
Dual-	FRN-R	LPN-RK SP	T	
Element	FRS-R	LPS-RK_SP	LPJ_SP	LP-CC
Fuse Size	Class RK5	Class RK1	Class J	Class CC
1/10	0-0.08	0.0000-0.0769	_	_
1/8	0.09-0.10	0.0770-0.0961	-	_
15/100	0.11-0.12	0.0962-0.1153	—	_
<del>%</del> 0	0.13-0.16	0.1154-0.1538	—	—
1/4	0.17-0.20	0.1539-0.1923	-	
3/10	0.21-0.24	0.1924-0.2307	_	
<u>%</u> 0	0.25-0.32	0.2308-0.3076	-	
1/2	0.33-0.40	0.3077-0.3846	_	0.0000-0.2500
%10 8/	0.41-0.48	0.3847-0.4615	_	0.2501-0.3000
<sup>/10</sup> 1	0.49-0.04	0.4010-0.0155	0.0-0.6666	0.3001-0.4000
1 1%	0.81-0.90	0.7693-0.8653	0.6667-0.7500	0.5001-0.5625
1 1/2	0.91-1.00	0.8654-0.9615	0 7501-0 8333	0.5626-0.6250
1 1/10	1.01-1.12	0.9616-1.076	0.8334-0.9333	0.6251-0.7000
1 ½	1.13-1.20	1.077-1.153	0.9334-1.000	0.7001-0.7500
1 %	1.21-1.28	1.154-1.230	1.001-1.066	0.7501-0.8000
1 ‰	1.29-1.44	1.231-1.384	1.067-1.200	0.8001-0.9000
2	1.45-1.60	1.385-1.538	1.201-1.333	0.9001-1.000
2 1/4	1.61-1.80	1.539-1.730	1.334-1.500	1.001-1.125
2½	1.81-2.00	1.731-1.923	1.501-1.666	1.126-1.250
2 %	2.01-2.24	1.924-2.153	1.667-1.866	1.251-1.400
3	2.25-2.40	2.154-2.307	1.867-2.000	1.401-1.500
3 7/10	2.41-2.00	2.300-2.401	2.001-2.133	1.001-1.000
<u>J /2</u>	3.81-3.20	2.402-2.092	2.134-2.333	1.001-1.750
4 1/2	3 21-3 60	3 077-3 461	2.667-3.000	2 001-2 250
5	3.61-4.00	3.462-3.846	3.001-3.333	2.251-2.500
5 %	4.01-4.48	3.847-4.307	3.334-3.733	2.501-2.800
6	4.49-4.80	4.308-4.615	3.734-4.000	2.801-3.000
6 ¼	4.81-5.00	4.616-4.807	_	3.001-3.125
7	5.01-5.60	4.808-5.384	4.001-4.666	3.126-3.500
7 ½	5.61-6.00	—	—	3.501-3.750
8	6.01-6.40	5.385-6.153	4.667-5.333	3.751-4.000
9	6.41-7.20	6.154-6.923	5.334-6.000	4.001-4.500
10	7.21-8.00	6.924-7.692	6.001-6.666	4.501-5.000
12	8.01-9.60	7.093-9.230	0.007-8.000	5.001-6.000
17 1/	9.01-12.00	9.231-11.00	10.01-10.00	7 501-8 750
20	14.01-16.00	13 47-15 38	11 67-13 33	8 751-10 00
25	16.01-20.00	15 39-19 23	13 34-16 66	10.01-12.50
30	20.01-24.00	19.24-23.07	16.67-20.00	12.51-15.00
35	24.01-28.00	23.08-26.92	20.01-23.33	-
40	28.01-32.00	26.93-30.76	23.34-26.66	_
45	32.01-36.00	30.77-34.61	26.67-30.00	—
50	36.01-40.00	34.62-38.46	30.01-33.33	_
60	40.01-48.00	38.47-46.15	33.34-40.00	
70	48.01-56.00	46.16-53.84	40.01-46.66	
75	50.01-60.00		46.67.52.00	
00	64.01.72.00	61 54 60 23	40.07-00.00	
100	72.01-80.00	69 24-76 92	60.01-66.66	+
110	80.01-88.00	76 93-84 61	66 67-73 33	
125	88.01-100.00	84.62-96.15	73.34-83.33	+
150	100.01-120.00	96.16-115.3	83.34-100.0	-
175	120.01-140.00	115.4-134.6	100.1-116.6	-
200	140.01-160.00	134.7-153.8	116.7-133.3	
225	160.01-180.00	153.9-173.0	133.4-150.0	
250	180.01-200.00	173.1-192.3	150.1-166.6	
300	200.01-240.00	192.4-230.7	166.7-200.0	
350	240.01-280.00	230.8-269.2	200.1-233.3	<u> </u>
400	280.01-320.00	269.3-307.6	233.4-266.6	<u> </u>
450	320.01-360.00	307.7-346.1	266.7-300.0	+
500	300.01-400.00	340.2-384.0	300.1-333.3	+
000	40001-40000	1 304 / 4013	1	



## 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].





**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 timedelay 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 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.



## Transformers — 600V or Less



**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  $5 \times 110 = 550A$ , (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 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** 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 ( $600 \div 200$ ) 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.



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%.



#### **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 currentlimiting 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 nonventing 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 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<sub>FL</sub> = 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.



## Transformers — Over 600V

#### **Typical Potential Transformer Connections**

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



#### 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:

- 100E and below the fuse element must melt in 300 seconds at 200% to 240% of its rating (ANSI C37.46).
- 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 ½ second.

#### Three-Phase Transformers (Or Transformer Bank)

Transformer kVA Rating	Syste 2.4kV Full-lo Amps	m Voltage bad Fuse	4.16k) Full-lo Amps	/ pad Fuse	4.8kV Full-l Amps	oad Fuse
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-Pha	se Trans	formers				
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 I Basic Ru	A le	Column Exceptio	B n No. 1	Column ( Exception	C n 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	-0	25	-0	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-toprimary 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.

MOTOR BRANCH	Transformer Primary Current	Primary Fuse Ampacity Must Not Exceed†
	Less than 2 amps	500%
	2 to 9 amps	167%
	9 amps or more	125%*
Secondary Conductors Protected by Primary 2-Wire Circuit Secondary Control (M) Circuit	* If 125% of rated primar spond to a standard fuse standard fuse rating is p † Refer to Section 8.12 of sizing for control transfor	y current does not corre- e rating, then the next higher ermitted. of NFPA79 for the allowable rmers 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.

		Amp			Single Pole Dove
Fuse		Rating	Single Pole	Double Pole	Tail for Ganging
Supplementary	<sup>13</sup> 32" <b>x 1</b> ½"	1⁄10 <b>-30A</b>	BM6031SQ	BM6032SQ	
	FRN-R	1⁄10 <b>-30A</b>	R25030-1SR	R25030-2SR	
	LPN-RK_SP	1⁄10 <b>-30A</b>	R25030-1SR	R25030-2SR	
	FRS-R	1⁄10 <b>-30A</b>	R60030-1SR	R60030-2SR	
	LPS-RK_SP	1⁄10 <b>-30A</b>	R60030-1SR	R60030-2SR	
Branch Circuit		1⁄2 <b>-15A</b>	BG3011SQ	BG3012SQ	
	50	20A	BG3021SQ	BG3022SQ	
	KTK-R	1⁄10 <b>-30A</b>			
	FNQ-R	1⁄10 <b>-30A</b>	BC6031S	BC6032S	
	LP-CC	1⁄2 <b>-30A</b>			
	TOF	1-30A			TCFH 30
	ICF	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<sup>®</sup>. 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 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	Circuit (Contr Extend Enclos	: 1 olCondu ding Bey sure)	uctor (AW ond	/G) Not	Circuit 2 (Control Conductor (AWG) Extending Beyond Enclosure)			
Device	18	16	14	12	18	16	14	12
(BCPD)	Wire	Wire	Wire	Wire	Wire	Wire	Wire	Wire
Fuse Size	7A	10A	15A	20A	7A	10A	15A	20A
Requirements For Control Circuit Protection (See footnote data)								
V <sub>10</sub> -7								•
7 ½ – 10								•
12 – 25								•
30 – 40								•
45						<b>A</b>		
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.

ControlCircuit Conductor	Available Short-Circuit Current At Branch Circuit Protective Device (BCPD)						
AWG Copper)	1 Cycle Clearing Time†	$\frac{1}{2}$ Cycle Clearing Time†					
18	660A	940A					
16	1050A	1500A					
14	1700A	2400A					
12	2700A	3800A					
Thermonlectic In-	- Internet - Internet - Internet	In stars Mildle stars of Dista					

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	V <sub>pri</sub> /V <sub>sec</sub>	lpri	l <sub>sec</sub>	<sup>1</sup> Fuse C Fuse D or E							
Xfmr	(Volts)	(Amps)	(Amps)	<sup>2</sup> Req'd. If	<sup>₄,₅</sup> Maximum	Required if	BCPD and Fus	e C (When		Recomme	nded Amps
Rating				BCPD Exceeds	Amps	Provided) E	te AWC	mp Values	10 AWC	Time	Non Time
				Values		Wire	Wire	Wire	Wire	Delay <sup>1</sup>	Delay <sup>3</sup>
	480/120	0.05	0.21	6 <u>500</u>	0.25	0.25	0.25	0.25	0.25	0.25	0.60
25VA	480/24	0.05	1.00	430-72(C)	0.25	0.25	0.25	0.25	0.25	1.25	3.0
20171	240/120	0.10	0.21	Except 1	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
	480/120	0.10	0.42	0.5	0.50	0.50	0.50	0.50	0.50	0.50	1.0
50VA	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
	480/120	0.21	0.83	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0
100VA	480/24	0.21	4.20	1.0	1.0	1.0/.35°	1.0/.50°	1.0	1.0	5.0	12.0 <sup>7</sup>
	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 <sup>9</sup>	2.0/1.0 <sup>9</sup>	2.0	2.0	5.0	12.0 <sup>7</sup>
	480/120	0.31	1.25	1.5	1.5	1.5	1.5	1.5	1.5	1.50	3.50
150VA	480/24	0.31	6.25	1.5	1.5	_	1.5/0.5 <sup>9</sup>	1.5	1.5	7.50	15.0 <sup>7</sup>
100171	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°	3.0	3.0	7.50	15.0 <sup>7</sup>
	480/120	0.42	1.67	2.0	2.0	2.0/1.75°	2.0	2.0	2.0	2.0	5.0
200VA	480/24	0.42	8.33	2.0	2.0	_	_	2.0	2.0	10.0	20.0 <sup>8</sup>
	240/120	0.84	1.67	4.0	4.0	4.0/3.5°	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 <sup>8</sup>

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). <sup>1</sup> Time-Delay Fuses, Frog, Frow, From, From, From, Cooppositionary, Type, From, Cooppositionary, Type, From, Cooppositionary, From, Coo

<sup>6</sup> 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. <sup>7</sup> Minimum copper secondary control conductor for this application is 14 AWG. <sup>8</sup> Minimum copper secondary control conductor for this application is 12 AWG

9 Smaller value applied to Fuse "E"



XFMR VA	600V	550V	480V	460V	415V	380V	277V	240V	230V	208V
50	⁴⁄10A	⁴⁄10A	½A	1⁄2A	%10A	%юA	%10 <b>A</b>	1A	1A	1 %A
75	%10A	%10A	3/4A	%10 <b>A</b>	%10A	%10 <b>A</b>	1 ¾₀A	1 ½A	1 %₀A	1 %₀A
100	%₁₀A	%10A	1A	1A	1 ¼A	1 ¾0A	1 %10A	2A	2A	2 ¼A
150	1 ¼A	1 ¾0A	1 ½A	1 %oA	1 %oA	1 %10A	2 ½A	ЗA	3 ⅔₀A	3 ½A
200	1 %oA	1 %10A	2A	2A	2 ¼A	2 ½A	3 ½A	4A	4A	4 ½A
250	2A	2 ¼A	2 ½A	2 ½A	ЗA	3 %0A	4 ½A	5A	5A	6A
300	2 ½A	2 %oA	ЗA	3 ⅔₀A	3 ½A	3 ½A	5A	6 ¼A	6 ¼A	7A
350	2 %10A	ЗA	3 ½A	3 ½A	4A	4 ½A	6 ¼A	7A	7 ½A	8A
500	4A	4 ½A	5A	5A	6A	6 ¼A	9A	3 ⅔₀A**	3 ½A**	4A**
750	6 ¼A	6 ¼A	7 ½A	8A	9A	9A	4 ½A*	5A**	5A**	6A**
1000	8A	9A	3 ⅔₀A*	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**
creased time-de	5A" lay, use FRS-R	LPS-RK SP, L	<u>6 ¼А^</u> РЈ SP, or TCF	/ A^ **For incr	eased time-dela	y, use FRN-R, LI	PN-RK SP	12A^^ ***Based up	on the NEC®	

# Supplementary Fuses $(1\frac{1}{32}" \times 1\frac{1}{2}")$ (All Voltage and Interrupting Ratings are AC)

Dual-Element, Time-Delay		Time-Delay	Time-Delay		Non-Time-Delay					
RISETROM AULELENS AUSE FINA-2	RISETRON PULLELENER FNIM-1	TRON The-DeLA FUSE FN0-1 Tallen Instru	RON EDELA EUSE FNW-20	BUSS FUSE BAF-5		Limitron Hacting FL Intra A 40 Nos cuality	BUSS HOICATHIS FUSE			
FNA ½10-½10A 250V <sup>†</sup> 1-15A 125V* 20-30A 32V**	FNM <sup>1</sup> /10-10A <u>250V</u> <sup>†</sup> <u>12-15A</u> <u>125V*</u> <u>20-30A</u> <u>32V</u> **	FNQ ½10-30A 500V 10K AIR (FNQ ½ - 3 ½ Dual-Element)	<b>FNW</b> 12-30A 250V*	<b>BAF</b> <sup>1</sup> / <sub>2</sub> -15A 250V <sup>†</sup> 20-30A 125V*	BAN <sup>2</sup> /10-30A 250V <sup>tt</sup>	<b>КТК</b> У10-30А 600V 100К АІЯ	MIC 1-15A 250V <sup>†</sup> 20-30A 32V**	MIN 1-15A 250V† 20-30A 32V**		

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

Class R				Class G	Class CC					
Dual-Element, Time-Delay				01033 0	Fast-Acting, Time-Delay					
				BUSS Rase Gruss Per Anset SC-2	Limitron Class co Smill Limit Rick-Rad		UN-PEAN Case of Control of Contro			
LPN-RK_SP	FRN-R	FRS-R	LPS-RK_SP	SC	KTK-R	FNQ-R	LP-CC	TCF		
1⁄10-30A	<sup>1</sup> ∕10 <b>-30A</b>	<sup>1</sup> /10-30A	1⁄10-30A	½-20A 600V <b>§</b>	1⁄10-30A	1⁄4-30A	1⁄2-30A	1-30A		
250V	250V	600V	600V	25-30A 480V§	600V	600V	600V	600V		
300K AIR	200K AIR	200K AIR	300K AIR	100K AIR	200K AIR	200K AIR	200K AIR	300K AIR		
+ 0 to 1 amp-35 AIR;	1.1 to 3.5 amp-100 A	IR; 3.6 to 10 amp-200	AIR; 10.1 to 15 amp-	750 AIR; 15.1 to 30 a	mps-1500AIR *10K	AIR. **1K AIR.				

 $\frac{1}{2}$  thru 6 amp fuses are Non-Time-Delay Type; 7 thru 60 amp fuses are Time-Delay Type. To 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

# **Fuse Diagnostic Sizing Charts**



## Transformers 600V Nominal or Less (NEC® 450.3)



# **Fuse Diagnostic Sizing Charts**



## Transformers Over 600V Nominal (NEC® 450.3)



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

Short-Circuit		Fuse R	ecommendations
Protection Only	"F," "S," "K," & 170M Series fuses sized up to several sizes larger than full load RMS or dc rating of device.	Volts	Fuse(s)
		0-130	FWA
		0-500	FWH
		0-600	FWC, KAC, KBC
		0-700	FWP, 170M Series, SPP
		0-1000	FWJ, 170M Series, SPJ