

Capacitor Expulsion Fuse

GENERAL

Cooper Power Systems offers a wide variety of fuse kV and amp ratings for use on both horizontal and vertical capacitor block bank configurations. The bus-mounted expulsion-type capacitor fuse (Figure 1) provides highly reliable, economical protection for capacitor banks where medium-energy-interrupting ability is required. See Table 1 for electrical ratings.

FUSE TUBE DESIGN FEATURES

The fuse tube is constructed of bone-grade fibre overwrapped with epoxy-bonded filament-wound fiberglass or grade XX phenolic. The upper contact, depending on the rating, is either aluminum or tin-plated bronze. The fuseholder accepts ANSI standard removable or non-removable buttonhead fuse links.

The function of the fuse tube is to confine the arc and produce arc-quenching gases which are expelled from the end of the tube.

Voltage stress across the fuse tube is eliminated by the gap between the end of the fuse tube and the capacitor terminal. There is no possibility of tracking and eventual flashover, even after exposure to weather and contaminants. When the spring ejects the leader, positive indication of a blown fuse can also be easily detected from a distance.

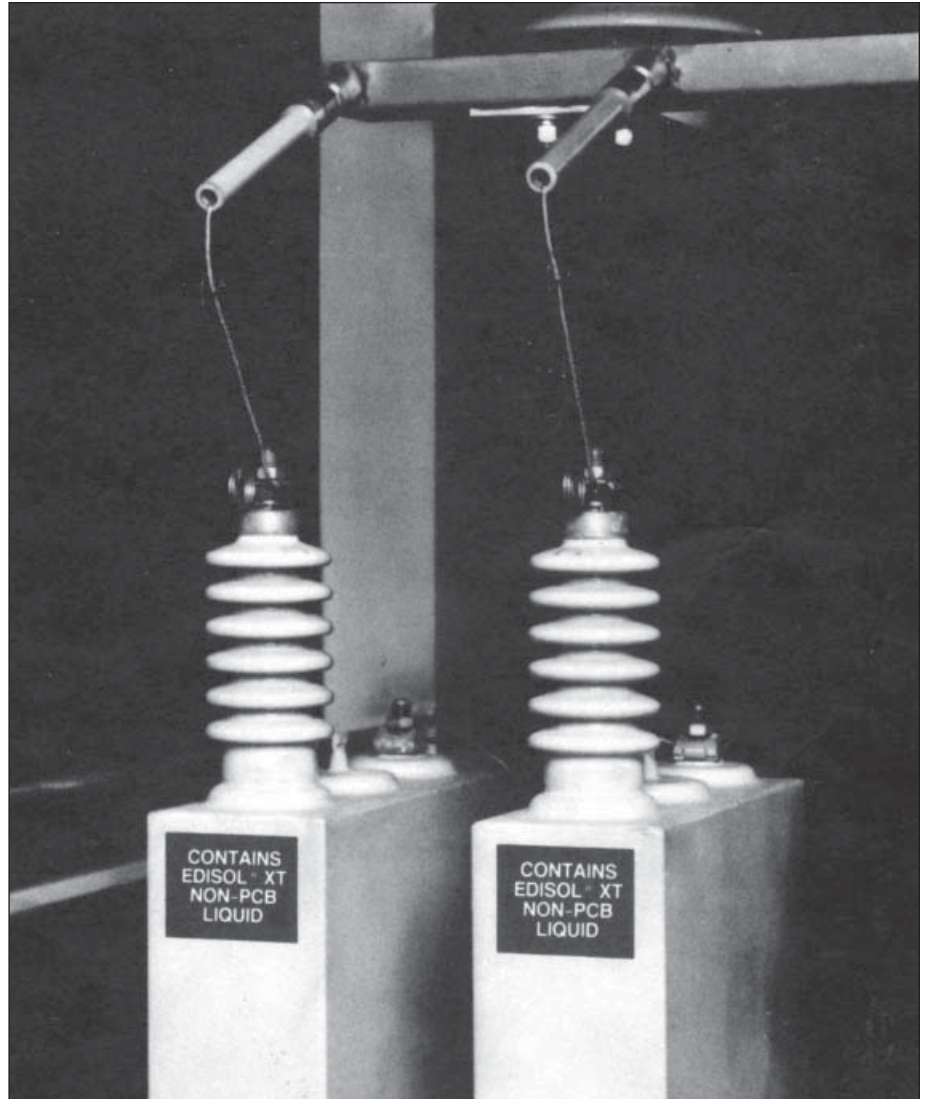


Figure 1.
ELF Current-Limiting Dropout Fuses.

TABLE 1
Electrical Ratings

Fuse Max Voltage Rating (kV)	Capacitor Voltage Rating (kV)	Catalog No.		Current Rating (amps)	Interrupting Rating (joules)	Power Frequency Interrupting Rating (amps)	
		Capacitor Mounting Configuration*				Symmetrical	Asymmetrical
		Vertical	Horizontal				
8.7	2.4 - 8.32	FN 5B1**	-	50	10000	7100	10000
8.7	2.4 - 8.32	FN10B5	FN13B3	50	15000	3600	5000
8.7	2.4 - 8.32	FN19B1	FN20B1	80	15000	3600	5000
15	9.96 - 15.2	FN11B1***	FN14B1***	50	15000	3600	5000
23	19.92 - 21.6	FN11B1***	FN14B1***	50	15000	1800	2500

* See Figure 2.

** FN5B1 is the only unit using tin-plated bronze; all others use aluminum.

*** Both FN11B1 and FN14B1 expulsion fuses are dual rated for 15 and 23 kV.

EJECTOR SPRING DESIGN FEATURES

The ejector spring is constructed of non-current-carrying stainless steel. The spring serves to move the leader end of the fuse out of the tube.

Cooper Power Systems ejector springs are engineered to control lateral motion of the fuse leader during ejection. If lateral motion is not controlled the leader can strike adjacent capacitor units resulting in unnecessary fuse operation and possible capacitor failures.

The geometry of the ejector springs are optimized to ensure that no dragging of the leader across the mouth of the fuse tube or leader cutting will occur. Either of these two effects can impede the proper operation of the fuse.

APPLICATION

In the event of a capacitor fault, excess current will flow through the fuse of the faulted unit. This current causes the fuse element to melt and vaporize. An arc will form across the vaporized section within the fuse tube. The function of the fuse tube and ejector (or filpper) spring is to extinguish the arc and eliminate the possibility of its re-establishment. See Tables 2-4 for fusing recommendations.

TABLE 2
Group Fusing Recommendations For Safe Fusing of All-Film Capacitors With Cooper Power Systems EEI-NEMA Tin Expulsion Fuse Links in Grounded-Wye Capacitor Racks

System Voltage: Wye, Line to Neutral/Line to Line	Three-Phase Kvar	Rated Line Current in Amperes	Capactor Unit Size	
			50 to 100 Kvar	150 to 400 Kvar
			Recommended Link Size	Recommended Link Size
2400/4160	150	20.8	20 T	*
	300	41.6	40 K	*
	450	62.5	NA	65 K
	600	83.3	NA	80 K
2770/4800	150	18.0	20 T	*
	300	36.1	40 K	*
	450	54.2	50 K	50 K
	600	72.2	NA	65 K
	900	108.3	NA	100 K
4160/7200	150	12.0	12 T	*
	300	24.0	25 T	*
	450	36.0	40 K	40 K
	600	48.1	50 K	50 K
	900	72.1	NA	65 K
	1200	96.2	NA	100 K
	1350	108.2	NA	100 K
4800/8320	150	10.4	10 T	*
	300	20.8	20 T	*
	450	31.2	30 K	30 K
	600	41.7	40 K	40 K
	900	62.5	NA	65 K
	1200	83.3	NA	80 K
	1350	93.8	NA	100 K
7200/12470	150	6.9	8 T	*
	300	13.9	15 T	*
	450	20.8	20 T	20 T
	600	27.8	25 T	25 T
	900	41.7	40 K	40 K
	1200	55.6	50 K	50 K
	1350	62.5	NA	65 K
	1800	83.3	NA	80 K
	2400	111.1	NA	80 K
7620/13200	150	6.6	6 T	*
	300	13.1	12 T	*
	450	19.7	20 T	25 T
	600	26.2	25 T	25 T
	900	39.4	40 K	40 K
	1200	52.5	50 K	50 K
	1350	59.0	NA	65 K
	1800	78.7	NA	80 K
	2400	105.00	NA	100 K

(continued)

TABLE 2 (continued)

System Voltage: Wye, Line to Neu- tral/Line to Line	Three-Phase Kvar	Rated Line Cur- rent in Amperes	Capactor Unit Size	
			50 to 100 Kvar	150 to 400 Kvar
			Recommended Link Size	Recommended Link Size
7960./13800	150	6.3	6 T	*
	300	12.6	12 T	*
	450	18.8	20 T	20 T
	600	25.1	25 T	25 T
	900	37.7	40 K	40 K
	1200	50.2	50 K	50 K
	1350	56.5	NA	50 K
	1800	75.4	NA	80 K
2400	100.5	NA	100 K	
8320/14400	150	6.0	6 T	*
	300	12.0	12 T	*
	450	18.0	20 T	20 T
	600	24.0	25 T	25 T
	900	36.0	40 K	40 K
	1200	48.1	50 K	40 K
	1350	54.1	50 K	50 K
	1800	72.1	NA	65 K
2400	96.2	NA	100 K	
2700	108.2	NA	100 K	
9540/16500	150	5.2	5 T	*
	300	10.3	10 T	*
	450	15.7	15 T	15 T
	600	21.0	20 T	20 T
	900	31.4	30 K	30 K
	1200	41.9	NA	40 K
	1350	47.2	NA	50 K
	1800	62.9	NA	65 K
	2400	83.8	NA	80 K
	2700	94.3	NA	100 K
9960/17250	150	5.0	5 T	*
	300	10.0	10 T	*
	450	15.0	15 T	15 T
	600	20.1	20 T	20 T
	900	30.1	30 K	30 K
	1200	40.2	NA	40 K
	1350	45.2	NA	40 K
	1800	60.2	NA	65 K
	2400	80.3	NA	80 K
	2700	90.4	NA	80 K

(continued)

TABLE 2 (continued)

System Voltage: Wye, Line to Neutral/Line to Line	Three-Phase Kvar	Rated Line Current in Amperes	Capacitor Unit Size	
			50 to 100 Kvar	150 to 400 Kvar
			Recommended Link Size	Recommended Link Size
12470/21600	300	8.0	8 T	*
	450	12.0	12 T	12 T
	600	16.0	15 T	15 T
	900	24.0	25 K	25 T
	1200	32.1	30 K	30 K
	1350	36.1	NA	40 K
	1800	48.1	NA	50 K
	2400	64.2	NA	65 K
	2700	72.2	NA	65 K
	3600	96.2	NA	100 K
13200/22860	300	7.6	8 T	*
	450	11.4	10 T	10 T
	600	15.2	15 T	15 T
	900	22.7	20 T	20 T
	1200	30.3	30 K	30 K
	1350	34.1	30 K	30 K
	1800	45.4	NA	40 K
	2400	60.6	NA	65 K
	2700	68.2	NA	65 K
	3600	90.9	NA	80 K
13800/23900	300	7.2	8 T	*
	450	10.9	10 T	10 T
	600	14.5	15 T	15 T
	900	21.7	20 T	20 T
	1200	29.0	30 K	30 K
	1350	32.6	30 K	30 K
	1800	43.5	NA	40 K
	2400	58.0	NA	65 K
	2700	65.2	NA	65 K
	3600	87.0	NA	80 K
14400/24900	300	6.9	8 T	*
	450	10.4	10 T	10 T
	600	13.9	15 T	15 T
	900	20.8	20 T	20 T
	1200	27.8	25 K	25 K
	1350	31.2	30 K	30 K
	1800	41.7	NA	40 K
	2400	55.6	NA	50 K
	2700	62.5	NA	65 K
	3600	83.3	NA	80 K

(continued)

TABLE 2 (continued)

System Voltage: Wye, Line to Neutral/Line to Line	Three-Phase Kvar	Rated Line Current in Amperes	Capactor Unit Size	
			50 to 100 Kvar	150 to 400 Kvar
			Recommended Link Size	Recommended Link Size
19920/34500	300	5.0	5 ET	*
	450	7.5	8 ET	8 ET
	600	10.0	10 ET	10 ET
	900	15.1	15 ET	15 ET
	1200	20.1	20 ET	20 ET
	1350	22.6	20 ET	20 ET
	1800	30.2	30 ET	30 EK
	2400	40.2	NA	40 EK
	2700	45.2	NA	40 EK
	3600	60.3	NA	65 EK
21600/37400	450	6.9	8 ET	8 ET
	600	9.2	10 ET	10 ET
	900	13.9	15 ET	15 ET
	1200	18.5	20 ET	20 ET
	1350	20.8	20 ET	20 ET
	1800	27.8	25 EK	25 ET
	2400	37.0	NA	40 EK
	2700	41.7	NA	40 EK
3600	55.6	NA	50 EK	

NA = Cannot be fused properly using Cooper Power Systems tin expulsion fuse links.

* = Rack Kvar size cannot be built using these capacitor sizes.

TABLE 3
Group Fusing Recommendations For Safe Fusing of All-Film Capacitors with
EEI-NEMA Tin Expulsion Fuse Links in Ungrounded Wye and Delta Connected
Capacitor Racks

System Voltage: Wye, Line to Neutral/Line to Line	Three-Phase Kvar	Rated Line Current in Amperes	Capactor Unit Size	
			50 to 100 Kvar	150 to 400 Kvar
			Recommended Link Size	Recommended Link Size
2400/4160	150	20.8	20 T	*
	300	41.6	40 K	*
	450	62.5	na	65 K
	600	83.3	NA	80 K
2770/4800	150	18.0	15 T	*
	300	36.1	30 K	*
	450	54.2	50 K	50 K
	600	72.2	NA	65 K
	900	108.3	NA	100 K
4160/7200	150	12.0	10 T	*
	300	24.0	10 T	*
	450	36.0	30 K	30 K
	600	48.1	40 K	40 K
	900	72.1	NA	65 K
	1200	96.2	NA	80 K
	1350	108.2	NA	100 K

(continued)

TABLE 3 (continued)

System Voltage: Wye, Line to Neutral/Line to Line	Three-Phase Kvar	Rated Line Current in Amperes	Capactor Unit Size	
			50 to 100 Kvar	150 to 400 Kvar
			Recommended Link Size	Recommended Link Size
4800/8320	150	10.4	10 T	*
	300	20.8	20 T	*
	450	31.2	30 K	30 K
	600	41.76	40 K	40 K
	900	62.5	NA	65 K
	1200	83.3	NA	80 K
	1350	93.8	NA	80 K
7200/12470	150	6.9	6 T	*
	300	13.9	12 T	*
	450	20.8	20 T	20 T
	600	27.8	25 T	25 T
	900	41.7	40 K	40 K
	1200	55.6	50 K	50 K
	1350	62.5	NA	65 K
	1800	83.3	NA	80 K
7620/13200	150	6.6	6 T	*
	300	13.1	12 T	*
	450	19.7	20 T	20 T
	600	26.2	25 T	25 T
	900	39.4	40 K	40 K
	1200	52.5	50 K	50 K
	1350	59.0	50 K	50 K
	1800	78.7	NA	65 K
	2400	105.0	NA	100 K
7960/13800	150	6.3	6 T	*
	300	12.6	12 T	*
	450	18.8	20 T	20 T
	600	25.1	25 T	25 T
	900	37.7	40 K	40 K
	1200	50.2	50 K	50 K
	1350	56.5	50 K	50 K
	1800	75.4	NA	65 K
	2400	100.5	NA	100 K
8320/14400	150	6.0	5 T	*
	300	12.0	10 T	*
	450	18.0	15T	15 T
	600	24.0	20 T	20 T
	900	36.0	30 K	30 K
	1200	48.1	40 K	40 K
	1350	54.1	50 K	50 K
	1800	72.1	NA	65 K
	2400	96.2	NA	80 K
2700	108.2	NA	100 K	

(continued)

TABLE 3 (continued)

System Voltage: Wye, Line to Neutral/Line to Line	Three-Phase Kvar	Rated Line Current in Amperes	Capactor Unit Size	
			50 to 100 Kvar	150 to 400 Kvar
			Recommended Link Size	Recommended Link Size
9540/16500	150	5.2	5 T	*
	300	10.4	10 T	*
	450	15.7	15 T	15 T
	600	21.0	20 T	20 T
	900	31.4	30 K	30 K
	1200	41.9	na	40 K
	1350	47.2	NA	40 K
	1800	62.9	NA	65 K
	2400	83.8	NA	80 K
	2700	94.3	NA	80 K
9960/17250	150	5.0	5 T	*
	300	10.0	10 T	*
	450	15.0	15 T	15 T
	600	20.1	20 T	20 T
	900	30.1	25 K	25 T
	1200	40.2	NA	40 K
	1350	45.2	NA	40 K
	1800	60.2	NA	50 K
	2400	80.3	NA	80 K
	2700	90.4	NA	80 K
12470/21600	300	8.0	8 T	*
	450	12.0	10 T	10 T
	600	16.0	15 T	15 T
	900	24.0	20 T	20 T
	1200	32.1	30 K	30 K
	1350	36.1	30 K	30 K
	1800	48.1	NA	40 K
	2400	64.2	NA	65 K
	2700	72.2	NA	65 K
	3600	96.2	NA	80 K
13200/22860	300	7.6	8 T	*
	450	11.4	10 T	10 T
	600	15.2	15 T	15 T
	900	22.7	20 T	20 T
	1200	30.3	25 K	25 T
	1350	34.1	30 K	30 K
	1800	45.4	NA	40 K
	2400	60.6	NA	50 K
	2700	68.2	NA	65 K
	3600	90.9	NA	80 K

(continued)

TABLE 3 (continued)

System Voltage: Wye, Line to Neutral/Line to Line	Three-Phase Kvar	Rated Line Current in Amperes	Capactor Unit Size	
			50 to 100 Kvar	150 to 400 Kvar
			Recommended Link Size	Recommended Link Size
13800/23900	300	7.2	6 T	*
	450	10.9	10 T	10 T
	600	14.5	12 T	12 T
	900	21.7	20 T	20 T
	1200	29.0	25 K	25 T
	1350	32.6	30 K	30 K
	1800	43.5	NA	40 K
	2400	58.0	NA	50 K
	2700	65.2	NA	65 K
3600	87.0	NA	80 K	
14400/24900	300	6.9+	6 T	*
	450	10.4	10 T	10 T
	600	13.9	12 T	12 T
	900	20.8	20 T	20 T
	1200	27.8	25 K	25 T
	1350	31.2	30 K	30 K
	1800	41.7	NA	40 K
	2400	55.6	NA	50 K
	2700	62.5	NA	65 K
3600	83.3	NA	80 K	
19920/34500	300	5.0	5 ET	*
	450	7.5	8 ET	8 ET
	600	10.0	10 ET	10 ET
	900	15.1	15 ET	15 ET
	1200	20.1	20 ET	20 ET
	1350	22.6	20 ET	20 ET
	1800	30.2	25 EK	25 ET
	2400	40.2	NA	40 EK
	2700	45.2	NA	40 EK
3600	60.3	NA	50 EK	
21600/37400	450	6.9	6 ET	6 ET
	600	9.2	8 ET	8 ET
	900	13.9	12 ET	12 ET
	1200	18.5	20 ET	20 ET
	1350	20.8	20 ET	20 ET
	1800	27.8	25 EK	25 ET
	2400	37.0	NA	40 EK
	2700	41.7	NA	40 EK
3600	55.6	NA	50 EK	

DIMENSIONS AND ORDERING INFORMATION

Figure 2 depicts expulsion fuse mounting configurations for horizontal and vertical capacitor banks.

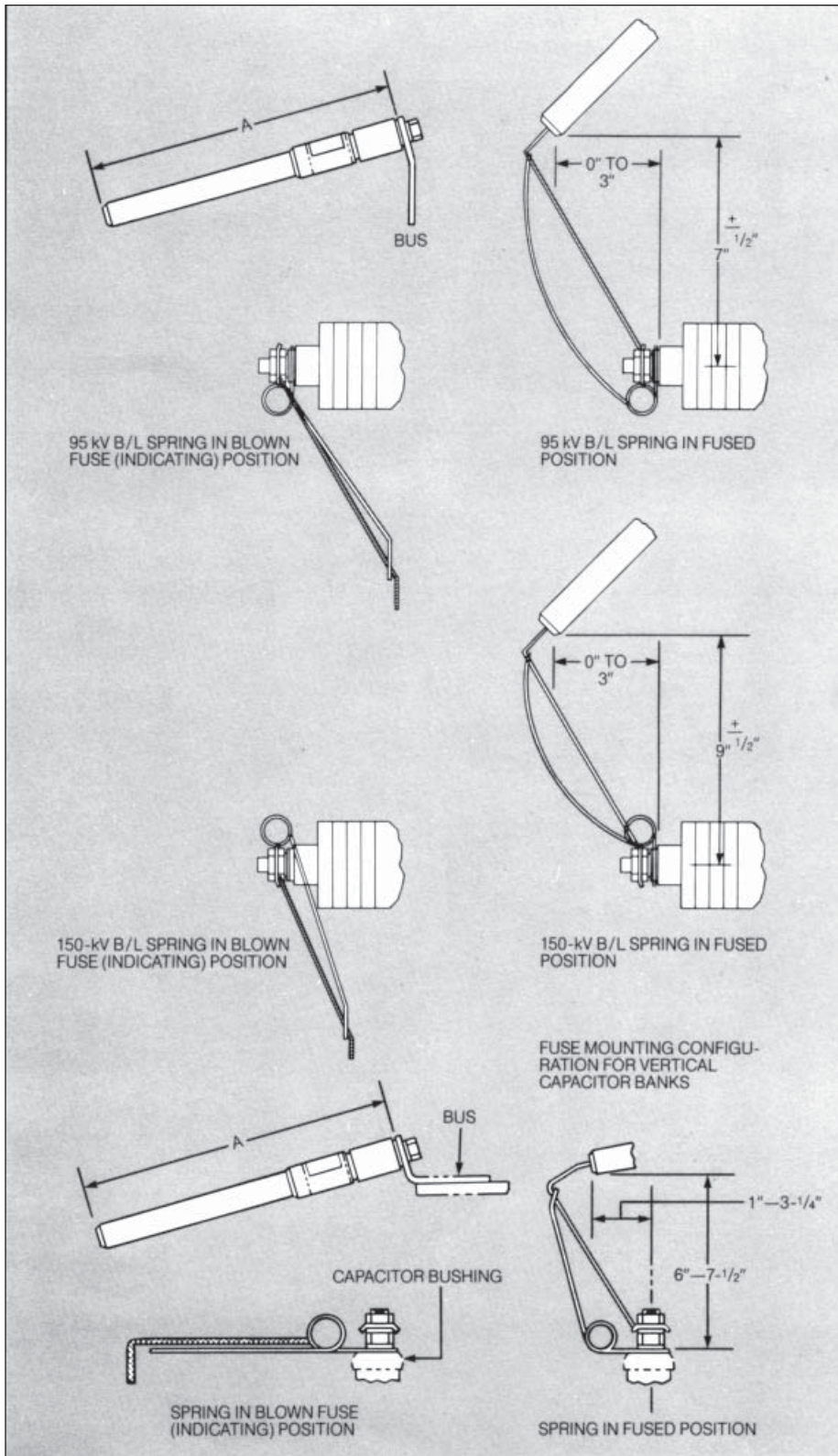


Figure 2. Expulsion fuse mounting configurations, dimensions, and catalog numbers for horizontal and vertical capacitor banks.

TABLE 4
Individual Fusing Recommendations Bank Applications

Unit Voltage Rating	Fuse Voltage Rating (kV)	50 Kvar*	100 Kvar	150 Kvar	200 Kvar	300 Kvar	400 Kvar
	Exp.	Exp.	Exp.	Exp.	Exp.	Exp.	Exp.
2400	8.7	20 T	40 K	65 K	80 K		
2770	8.7	20 T	40 K	50 K	65 K		
4160	8.7	12 T	25 T	40 T	50 K		
4800	8.7	12 T	20 T	30 T	40 T		
6640	8.7	12 T	15 T	25 T	30 T	50 T	65 K
7200	8.7	10 T	15 T	20 T	25 T	40 T	50 T
7620	8.7	10 T	15 T	20 T	25 T	40 T	50 T
7960	8.7	10 T	15 T	20 T	25 T	40 T	50 T
8320	8.7	10 T	15 T	20 T	25 T	40 T	50 T
9960	15.0	8 T	15 T	20 T	25 T	30 T	40 T
12470	15.0		12 T	15 T	20 T	25 T	30 T
13280	15.0		12 T	15 T	20 T	25 T	30 T
13800	15.0		12 T	15 T	20 T	25 T	30 T
14400	15.0		10 T	15 T	20 T	25 T	30 T
19920	23.0		8 T	12 T	15 T	20 T	25 T
21600	23.0		8 T	10 T	15 T	20 T	25 T

* For 50-Kvar capacitors, it is difficult to choose reasonably sized fuses which will withstand the I^2t outrush. This occurs due to the fact that I^2t withstand goes down exponentially with fuse link rating rather than linearly. Consequently, the 50-Kvar capacitor fusing recommendations only cover those units with voltages up to 9960 V.

TABLE 5
Dimensions and Catalog Numbers for Horizontal and Vertical Capacitor Banks

Fuse Max. Voltage Rating (kV)	Mounting Configuration Horizontal: H Vertical: V	Dimensions (in.)		Catalog No.
		A	Bolt Thread Size	
8.7	V	8-3/8	5/16-18 X 3/4"	FN5B1
8.7	V	9-3/8	5/16-18 X 3/4"	FN10B5
8.7	H	9-3/8	5/16-18 X 3/4"	FN13B3
15	V	10-5/8	5/16-18 X 3/4"	FN11B1
15	H	10-5/8	5/16-18 X 3/4"	FN14B1
23	V	10-5/8	5/16-18 X 3/4"	FN11B1
23	H	10-5/8	5/16-18 X 3/4"	FN14B1

Note: Fuse link ordered separately to suit application.

