

ELF™ current-limiting dropout fuse



General

Eaton's Cooper Power™ series ELF™ current-limiting dropout fuse is a full range current-limiting fuse designed for mounting in an industry standard interchangeable cutout that is presently used for expulsion fuses. The ELF fuse is designed to be used to protect pole-type transformers, single-phase and three-phase laterals and underground taps.

The full-range current-limiting rating ensures reliable operation of all over-loads and fault currents. The element construction consists of two separate sections (low-current section and high-current section) which are self-contained in one housing. The low-current section provides consistent, reliable clearing of all currents high enough to melt the element. The high-current section is a punched-hole ribbon design which controls peak arc voltage levels and limits both current and energy (I^2t) let-through levels during high-current fault clearing operation.

The ELF dropout fuse operates silently, unlike expulsion fuses. In addition, the expulsive shower that exists with an expulsive fuse operation is eliminated. This offers increased safety to line personnel during circuit energization operations. In addition, the reliable drop open design makes locating the fault easy.

Production tests

Tests are conducted on 100% of production in accordance with Eaton requirements.

- Physical Inspection
- I^2t Testing
- Resistance Testing
- Helium Mass Spectrometer Leak Testing

Installation

The ELF fuse is designed to be mounted in 15 kV and 27 kV, (110 kV, 125 kV or 150 kV BIL) rated interchangeable open distribution cutouts including MacLean/S&C Type XST™, Hubble Type C™ and ABB Type ICX™ cutouts. Designs for use in 35 kV (170 kV BIL) rated ABB Series V™ cutouts are also available.

It is easy to install using a clampstick due to its small size. Refer to *Service Information S240-66-1 ELF Current-Limiting Dropout Fuse Installation Instructions* for installation instructions.

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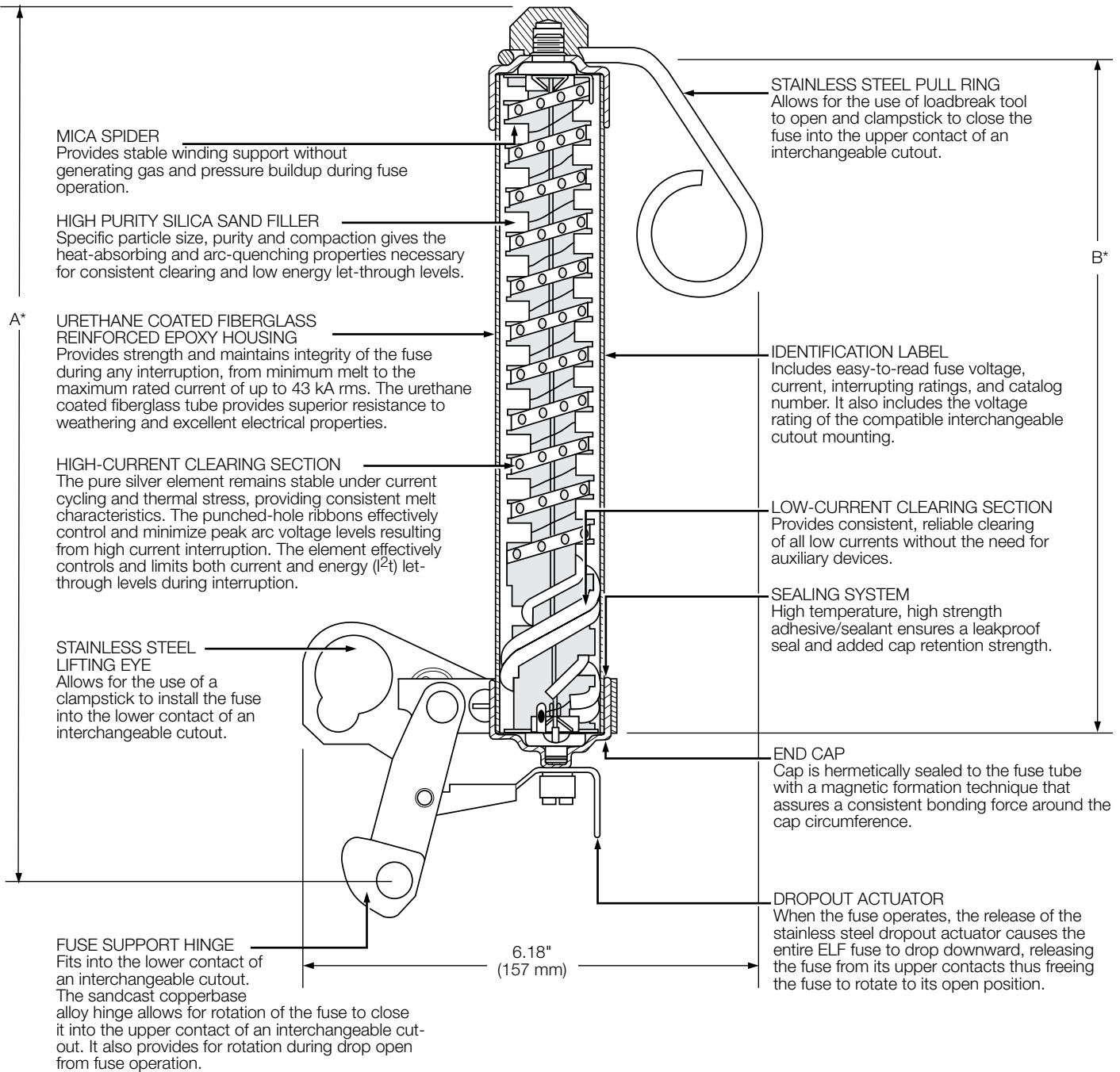


Figure 1. Line illustration of single-barrel ELF fuse cutaway with dimensions.

* See Table 5, 6, or 7 for dimensions A and B.

Table 1. ELF Fuse Electrical Ratings and Characteristics

Fuse Ratings		Cutout Rating		Continuous Current Ratings (A) ^a			Minimum Melt I ² t (A ² • s)	Maximum Clear I ² t (A ² • s)	Maximum Interrupting Current (A rms symmetrical)
Voltage (kV)	Current (A)	Voltage (kV)	BIL (kV)	25°C	40°C	55°C			
8.3	6	15	110	8	7	6	520	4550	31000
	8			12	11	11	1150	6500	
	12			18	17	16	1150	7000	
	18			25	24	23	1350	8600	
	20			27	26	25	2000	11700	
	25			34	33	31	2900	17000	
	30			43	41	39	4000	20000	
	40			50	48	46	8000	39000	
	50*			68	65	62	16000	65000	
	65*			78	75	71	20000	100000	
	80*			95	91	87	32000	150000	
100*	120	114	109	46000	215000				
15.0	6	15	110	8	7	6	520	4550	20000
	8			12	11	11	1150	6500	
	12			18	17	16	1150	7000	
	18			25	24	23	1350	8600	
	20			27	26	25	2000	11700	
8.3	6	27	150	8	7	6	520	4550	31000
	8			12	11	11	1150	6500	
	12			18	17	16	1150	7000	
	18			25	24	23	1350	8600	
	20			27	26	25	2000	11700	
	25			34	33	31	2900	17000	
	30			43	41	39	4000	20000	
	40			50	48	46	8000	39000	
	50*			68	65	62	16000	65000	
	65*			78	75	71	20000	100000	
	80*			95	91	87	32000	150000	
100*	120	114	109	46000	215000				
15.0**	6	27	150	8	7	6	520	4550	43000
15.0**	8			12	11	11	1150	6500	43000
15.0**	12			18	17	16	1150	7000	43000
15.0**	18			25	24	23	1350	8600	43000
15.0**	20			27	26	25	2000	11700	43000
15.0**	25			34	33	31	2900	17000	43000
15.0	30			43	41	39	5100	25000	20000
15.0**	30*			43	41	39	5100	25000	43000
15.0**	40*			50	48	46	8000	39000	43000
15.0**	50*			68	65	62	16000	65000	43000
23.0	6			27	150	8	7	6	520
	8	12	11			11	1150	7000	
	12	18	17			16	1150	8000	
	18	25	24			23	1350	10000	
	20	27	26			25	2000	14000	
	25*	34	33			31	2900	20000	
	30*	43	41			39	5100	30000	
24.0	6	36	170	8	7	6	520	5200	13000
	8			12	11	11	1150	7000	
	12			18	17	16	1150	8000	
	18			25	24	23	1350	10000	
	20			27	26	25	2000	14000	

Notes: a. For temperatures other than listed, a deration factor of 0.26% per °C can be applied.
 * Multi-barrel design
 ** 15 kV, 125 kV BIL, 6 through 25 A (single barrel part numbers FAK44W6 through FAK44W25) and 30 through 50 A (double barrel part numbers FAK44W30P, FAK44W40, and FAK44W50) have been tested and approved for 17.2 kV application.

Table 2. Recommended ELF Current-Limiting Dropout Fuse Voltage Ratings

System Voltage (kV)		Recommended Fuse Ratings (kV)			
		Four-Wire Multi-Grounded Neutral		Three-Wire Wye or Delta	
Nominal	Maximum	Single-Phase	Three-Phase	Single-Phase (Line-to-Line)	Three-Phase
2.4	2.54	–	–	8.3	8.3
4.16/2.4	4.4/2.54	8.3	8.3	–	–
4.16	4.4	–	–	8.3	8.3
4.8	5.08	–	–	8.3	8.3
6.9	7.26	–	–	8.3	8.3
7.2	7.62	–	–	8.3	8.3
7.97	8.4	–	–	8.3	8.3
8.32/4.8	8.8/5.08	8.3	8.3	–	–
11.0	12.0	–	–	15	15
12.0/6.93	12.7/7.33	8.3	15 or 8.3 ^a	–	–
12.47/7.2	13.2/7.62	8.3	15 or 8.3 ^a	–	–
12.47	13.2	–	–	15	15
13.2/7.62	13.97/8.07	8.3	15 or 8.3 ^a	–	–
13.2	13.97	–	–	15	15
13.8/7.97	14.52/8.38	8.3	15 or 8.3 ^a	–	–
13.8	14.52	–	–	15	15
14.4	15.24	–	–	15	15
16.3	17.1	–	–	15 ^c	15 ^c
20.78/12.0	22.0/12.7	15	23 or 15 ^a	–	–
22.0	24.0	–	–	23 ^b	23 ^b
22.86/13.2	24.2/13.97	15	23 or 15 ^a	–	–
23.0	24.34	–	–	23 ^b	23 ^b
24.9/14.4	26.4/15.24	15	23 or 15 ^{a,c}	–	–
34.5/19.92	36.51/21.08	23	–	–	–

Notes: a. This lower voltage fuse rating may be used if either of the following conditions are met:
 1) If the probability of a line-to-line and a three-phase ungrounded fault is very low.

-or-

2) If all of the below conditions are met:

- If the probability of a three-phase ungrounded primary fault is very low.
- If a secondary breaker or other series connected device is used to interrupt secondary faults.
- If no more than 50% of the secondary load is delta connected.
- If the line-to-line primary fault current is high enough to assure simultaneous operation of two fuses by melting at a maximum of 0.2 seconds.

b. A 23 kV rated fuse is recommended where 125 kV BIL interchangeable cutout mountings are used and a 24 kV rated fuse is recommended where 170 kV BIL interchangeable cutout mountings are used.

c. 15 kV, 125 kV BIL, 6 through 25 A (single barrel part numbers FAK44W6 through FAK44W25) and 30 through 50 A (double barrel part numbers FAK44W30P, FAK44W40, and FAK44W50) are recommended for this application.

Table 3. Recommendations for Distribution Transformers in Single-Phase Applications (Refer to Figure 3 for primary voltage connections, Figures A and D.) †

Fuse Voltage	8.3 kV		8.3 kV		8.3 kV		15.0 kV	
System Voltage	2400 Δ		4160 Y/2400		4800 Δ		8320 Y/4800	
Single-Phase Transformer Size (kVA)	Figure A		Figure D		Figure A		Figure D	
	Rated Amps	Fuse Rating	Rated Amps	Fuse Ratings	Rated Amps	Fuse Ratings	Rated Amps	Fuse Ratings
10	4.17	6	4.17	6	2.08	6 ^a	2.08	6 ^a
15	6.25	12 ^a	6.25	12 ^a	3.13	6	3.13	6
25	10.42	18	10.42	18	5.21	8	5.21	8
37.5	15.63	20	15.63	20	7.81	12	7.84	12
50	20.83	30	20.83	30	10.42	18	10.42	18
75	31.25	40	31.25	40	15.63	20	15.63	20
100	41.67	50	41.67	50	20.83	30	20.83	30
167	69.58	80	69.58	80	34.79	50	34.79	50
250	104.17	100 ^d	104.17	100 ^d	52.08	65	52.08	65
333	138.75	—	138.75	—	69.38	80	69.38	80

Fuse Voltage	8.3 kV		8.3 kV		8.3 kV		15.0 kV	
System Voltage	7200 Δ		12470 Y/7200		13200 Y/7620		12000 Δ	
Single-Phase Transformer Size (kVA)	Figure A		Figure D		Figure D		Figure A	
	Rated Amps	Fuse Rating	Rated Amps	Fuse Ratings	Rated Amps	Fuse Ratings	Rated Amps	Fuse Ratings
10	1.39	6 ^a	1.39	6 ^a	1.31	6 ^a	.83	6 ^a
15	2.08	6 ^a	2.08	6 ^a	1.97	6 ^a	1.25	6 ^a
25	3.47	6	3.47	6	3.28	6	2.08	6 ^a
37.5	5.21	8	5.21	8	4.92	8	3.13	6
50	6.94	12 ^a	6.94	12 ^a	6.56	12 ^a	4.17	6
75	10.42	18	10.42	18	9.84	18 ^a	6.25	12 ^a
100	13.89	20	13.89	20	13.12	18	8.33	12
167	23.19	30	23.19	30	21.92	30	13.92	20
250	34.72	50	34.72	50	32.81	40 ^b	20.83	30
333	46.25	65	46.25	65 ^c	43.70	50	27.75	40
500	69.44	80	69.44	80 ^c	65.62	80 ^c	41.67	50

Fuse Voltage	15.0 kV		15.0 kV		15.0 kV		23.0 kV	
System Voltage	13200 Δ		14400 Δ		24940 Y/14400		34500 Y/19920	
Single-Phase Transformer Size (kVA)	Figure A		Figure A		Figure D		Figure D	
	Rated Amps	Fuse Rating	Rated Amps	Fuse Ratings	Rated Amps	Fuse Ratings	Rated Amps	Fuse Ratings
10	.76	6 ^a	.69	6 ^a	.69	6 ^a	.50	6 ^a
15	1.14	6 ^a	1.04	6 ^a	1.04	6 ^a	.75	6 ^a
25	1.89	6 ^a	1.74	6 ^a	1.74	6 ^a	1.25	6 ^a
37.5	2.84	6 ^a	2.60	6 ^a	2.60	6 ^a	1.88	6 ^a
50	3.79	6	3.47	6	3.47	6	2.51	6 ^a
75	5.68	8	5.21	8	5.21	8	3.77	6
100	7.58	12	6.94	12 ^a	6.94	12 ^a	5.02	8
167	12.65	18	11.60	18	11.60	18	8.38	12
250	18.94	25	17.36	25	17.36	25	12.55	18
333	25.23	30	23.13	30	23.13	30	16.72	25
500	37.88	50	34.72	50	34.72	50	25.10	30

† See notes on page 7.

Effective June 2015

Table 4. Recommendations for Distribution Transformers in Three-Phase Applications (Refer to Figure 3 for primary voltage connections, Figures B, C, E, and F) †

Fuse Voltage	8.3 kV				8.3 kV		8.3 kV		8.3 kV			
System Voltage	2400 Δ		Figure C		4160 Y/2400		4800 Δ		Figure C		8320 Y/4800	
Single-Phase kVA	Rated Amps	Fuse Rating	Rated Amps	Fuse Ratings	Rated Amps	Fuse Ratings	Rated Amps	Fuse Ratings	Rated Amps	Fuse Ratings	Rated Amps	Fuse Ratings
10	4.17	6	7.22	12 ^a	4.17	6	2.08	6 ^a	3.61	6	2.08	6 ^a
15	6.25	12 ^a	10.83	18	6.25	12 ^a	3.13	6	5.41	8	3.13	6
25	10.42	18	18.04	25	10.42	18	5.21	8	9.02	12	5.21	8
37.5	15.63	20	27.06	40	15.63	20	7.81	12	13.53	18	7.84	12
50	20.83	30	36.09	50	20.83	30	10.42	18	18.04	25	10.42	18
75	31.25	40	54.13	80	31.25	40	15.63	20	27.06	40	15.63	20
100	41.67	50	72.17	100	41.67	50	20.83	30	36.08	50	20.83	30
167	69.58	80	120.28	—	69.58	80	34.79	50	60.14	80	34.79	50
250	104.17	100 ^d	180.42	—	104.17	100 ^d	52.08	65	90.21	—	52.08	65
333	138.75	—	240.56	—	138.75	—	69.38	80	120.28	—	69.38	80

Fuse Voltage	8.3 kV				15.0 kV or 8.3 kV ^d		15.0 kV or 8.3 kV ^d		15.0 kV			
System Voltage	7200 Δ		Figure C		12470 Y/7200		13200 Y/7620		Figure B		12000 Δ	
Single-Phase kVA	Rated Amps	Fuse Rating	Rated Amps	Fuse Ratings	Rated Amps	Fuse Ratings	Rated Amps	Fuse Ratings	Rated Amps	Fuse Ratings	Rated Amps	Fuse Ratings
15	2.08	6 ^a	3.61	6	2.08	6 ^a	1.97	6 ^a	1.25	6 ^a	2.17	6 ^a
25	3.47	6	6.01	8	3.47	6	3.28	6	2.08	6 ^a	3.61	6
37.5	5.21	8	9.02	12	5.21	8	4.92	8	3.13	6	5.41	8
50	6.94	12 ^a	12.03	18	6.94	12 ^a	6.56	12 ^a	4.17	6	7.22	12 ^a
75	10.42	18	18.04	25	10.42	18	9.84	18 ^a	6.25	12 ^a	10.83	18
100	13.89	20	24.06	30	13.89	20	13.12	18	8.33	12	14.43	20
167	23.19	30	40.10	50	23.19	30	21.92	30	13.92	20	24.06	30
250	34.72	50	60.14	80	34.72	50	32.81	40 ^b	20.83	30	36.08	50
333	46.25	65	80.19	100	46.25	65 ^c	43.70	50	27.75	40	48.11	50
500	69.44	80	120.28	—	69.44	80 ^c	65.62	80 ^c	41.67	50	72.17	—

Fuse Voltage	15.0 kV				15.0 kV		15 kV ^{d, e}			
System Voltage	13200		Figure C		14400		Figure C		24940 Y/14400	
Single-Phase kVA	Rated Amps	Fuse Rating	Rated Amps	Fuse Ratings	Rated Amps	Fuse Ratings	Rated Amps	Fuse Ratings	Rated Amps	Fuse Ratings
10	.76	6 ^a	1.31	6 ^a	.69	6 ^a	1.20	6 ^a	.69	6 ^a
15	1.14	6 ^a	1.97	6 ^a	1.04	6 ^a	1.80	6 ^a	1.04	6 ^a
25	1.89	6 ^a	3.28	6	1.74	6 ^a	3.01	6	1.74	6 ^a
37.5	2.84	6	4.92	8	2.60	6 ^a	4.51	8 ^a	2.60	6 ^a
50	3.79	6	6.56	12 ^a	3.47	6	6.01	8	3.47	6
75	5.68	8	9.84	18 ^a	5.21	8	9.02	12	5.21	8
100	7.58	12	13.12	25	6.94	12 ^a	12.03	18	6.94	12 ^a
167	12.65	18	21.87	30	11.60	18	20.05	25	11.60	18
250	18.94	25	32.80	50	17.36	25	30.07	40	17.36	25
333	25.23	30	43.74	—	23.13	30	40.09	50	23.13	30
500	37.88	50	65.61	—	34.72	50	60.14	—	34.72	50

* The recommended fuse sizes for this connection are based on equal size transformers in the bank. If a larger transformer is used in the bank for supplying single-phase loads, the fuse selections should be based on the larger transformer kVA.

† See notes on page 7.

Notes: (Table 4): Recommended fuse ratings are based on the use of ELF fuse time-current characteristics in R240-91-42, R240-91-43 and R240-91-44. Recommendations provide overload protection (fusing ratio) between 200-300% rated load.

$$\text{Fusing Ratio} = \frac{\text{Fuse Min. Melt Current at 300 sec.}}{\text{Transformer Full Load Current}} \times 100$$

- a. Fuse allows more than 300% load for 300 seconds.
 - b. 8.3 kV rated fuse is a single-barrel fuse, 15 kV rated fuse is a double-barrel fuse.
 - c. Available only at 8.3 kV.
 - d. This lower voltage fuse rating may be used if either of the following conditions are met:
 - 1) If the probability of a line-to-line or a three-phase ungrounded fault is very low.
- or-
- 2) If all of the below conditions are met:
 - If the probability of a three-phase ungrounded primary fault is very low.
 - If a secondary breaker or other series connected device is used to interrupt secondary faults.
 - If no more than 50% of the secondary load is delta connected.
 - If the line-to-line primary fault current is high enough to assure simultaneous operation of two fuses by melting at a maximum of 0.2 seconds.
- e. 15 kV, 125 kV BIL 6 through 25 A (single-barrel part numbers FAK44W6 through FAK44W25) and 30 through 50 A (double-barrel part numbers KAF44W30P, FAK44W40, and FAK44W50) are recommended for this application.

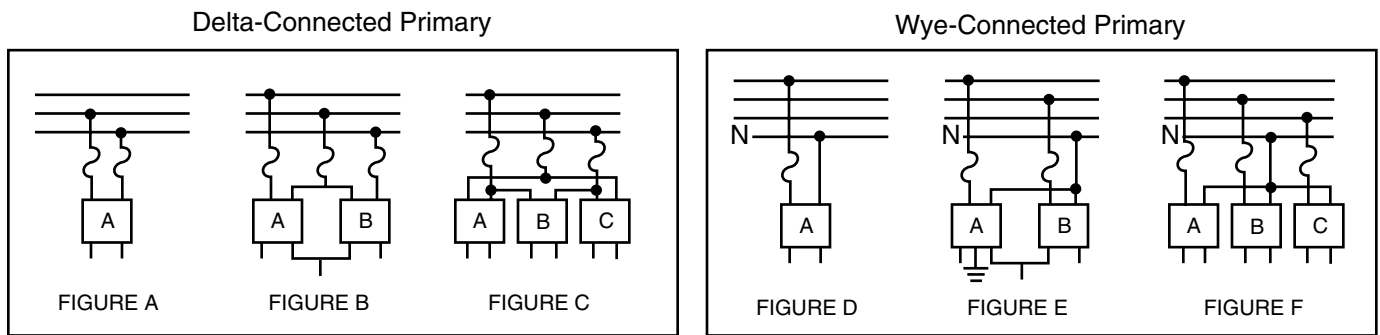


Figure 2. Schematic of primary voltage system connections.

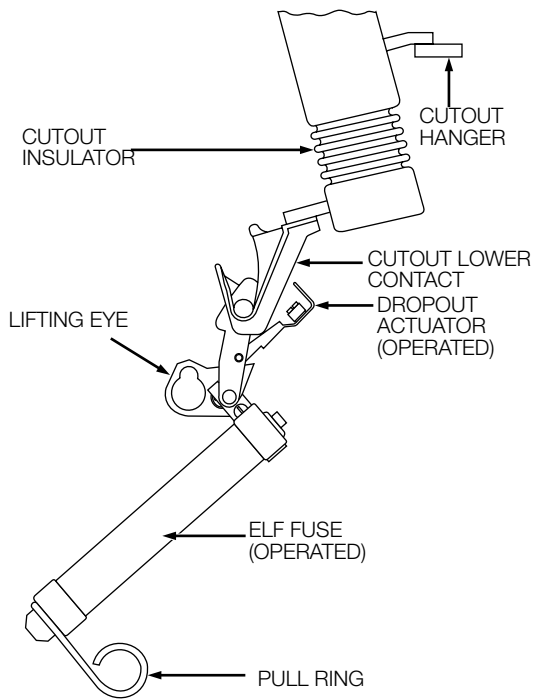


Figure 3. ELF fuse in interchangeable cutout after dropping open due to operation of dropout actuator.

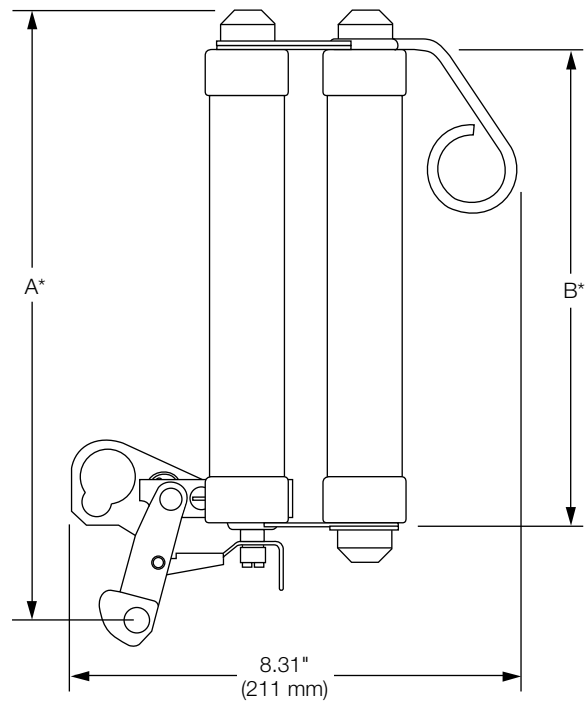


Figure 4. Double-barrel ELF fuse dimensions.

* See Table 5, 6, or 7 for dimensions A and B.

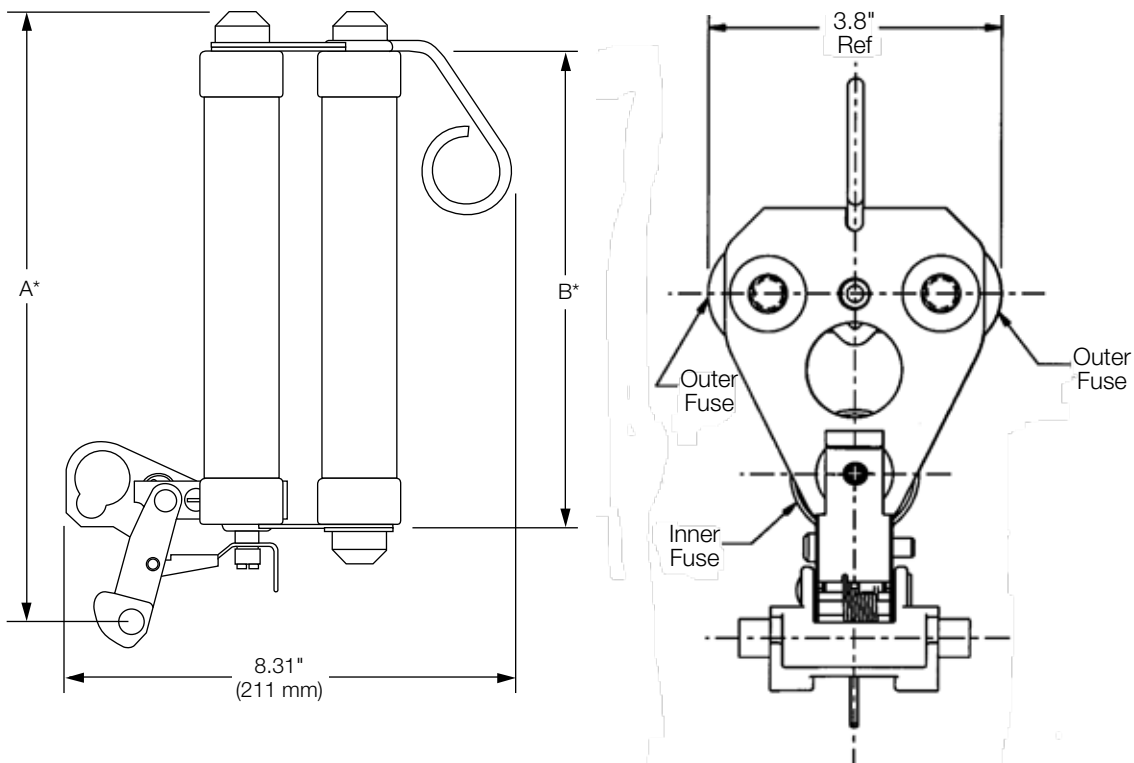


Figure 5. Triple-barrel ELF fuse dimensions.

* See Table 5 or 6 for dimensions A and B.

Operation

When the ELF fuse clears a fault, the dropout actuator operates and allows the fuse to drop open in the cutout. (Refer to Figure 3.)

Ordering information

To order an ELF current-limiting dropout fuse, determine the amperage rating and the voltage ratings of the application, specify required fuse from Tables 5, 6, or 7.

Table 5. ELF Current-Limiting Dropout Fuse Catalog Numbers for 15 kV, 110 kV BIL Interchangeable Cutouts

Fuse Rating			Dimensions		
Voltage (kV)	Current Rating (A)	ELF Fuse Catalog Number	Figure	A	B
8.3	6	FAK23W6	1	11.37" (289 mm)	8.83" (224 mm)
	8	FAK23W8	1		
	12	FAK23W12	1		
	18	FAK23W18	1		
	20	FAK23W20	1		
	25	FAK23W25	1		
	30	FAK23W30	1		
	40	FAK23W40	1		
	50	FAK23W50*	4		
	65	FAK23W65*	4		
	80	FAK23W80*	4		
100	FAK23W100**	5			
15.0	6	FAK24W6	1	11.37" (289 mm)	8.83" (224 mm)
	8	FAK24W8			
	12	FAK24W12			
	18	FAK24W18			
	20	FAK24W20			

* Double-barrel design

** Triple-barrel design

Table 6. ELF Current-Limiting Dropout Fuse Catalog Numbers for 15 kV, 125 kV or 150 kV BIL and 27 kV, 125 kV BIL Interchangeable Cutouts

Fuse Rating		ELF Fuse Catalog Number	Figure	Dimensions	
Voltage (kV)	Current Rating (A)			A	B
8.3	6	FAK43W6	1	15.16" (385 mm)	12.34" (313 mm)
	8	FAK43W8	1		
	12	FAK43W12	1		
	18	FAK43W18	1		
	20	FAK43W20	1		
	25	FAK43W25	1		
	30	FAK43W30	1		
	40	FAK43W40	1		
	50	FAK43W50*	4		
	65	FAK43W65*	4		
	80	FAK43W80*	4		
100	FAK43W100**	5			
15.0***	6	FAK44W6	1	15.16" (385 mm)	12.34" (313 mm)
15.0***	8	FAK44W8	1		
15.0***	12	FAK44W12	1		
15.0***	18	FAK44W18	1		
15.0***	20	FAK44W20	1		
15.0***	25	FAK44W25	1		
15.0	30	FAK44W30	1		
15.0***	30	FAK44W30P*	4		
15.0***	40	FAK44W40*	4		
15.0***	50	FAK44W50*	4		
23.0	6	FAK45W6	1		
	8	FAK45W8	1		
	12	FAK45W12	1		
	18	FAK45W18	1		
	20	FAK45W20	1		
	25	FAK45W25*	4		
	30	FAK45W30*	4		

* Double-barrel design

** Triple-barrel design

***15 kV, 125 kV BIL, 6 through 25 A (single barrel part numbers FAK44W6 through FAK44W25) and 30 through 50 A (double barrel part numbers FAK44W30P, FAK44W40, and FAK44W50) have been tested and approved for 17.2 kV application.

Table 7. ELF Current-Limiting Dropout Fuse Catalog Numbers for 36 kV, 170 kV BIL ABB Cutouts*

Fuse Rating		ELF Fuse Catalog Number	Figure	Dimensions	
Voltage (kV)	Current Rating (A)			A	B
24.0	6	FAK46W6	1	18.55" (471 mm)	15.7" (399 mm)
	8	FAK46W8			
	12	FAK46W12			
	18	FAK46W18			
	20	FAK46W20			

* 36 kV ABB Non-Loadbreak Cutout Series V

Additional information

Refer to the following reference literature for application recommendations:

- B240-12060 CAL Fire Exempt Full-Range, Current-Limiting Dropout Fuse Reduces Fire Risk on Distribution Lines
- PA132007EN Protect Your Upstream Personnel and Investment While Increasing Distribution Reliability with the ELF Fuse
- R240-66-1 ELF Fuse Coordination Tables with Protecting Fuse Links
- R240-66-2 ELF Fuse Coordination Tables with Protected Fuse Links
- R240-91-42 8.3 kV ELF Fuse Time-Current Characteristic Curves
- R240-91-43 15.0 kV ELF Fuse Time-Current Characteristic Curves
- R240-91-44 23.0 kV ELF Fuse Time-Current Characteristic Curves
- S240-66-1 ELF Current-Limiting Dropout Fuse Installation Instructions
- 93033 Application Solutions Provided with ELF Fuse
- CP-9415 ELF Certified Test Report

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