Fusing Equipment
Catalog Data
CA132050EN

Effective December 2019
Supersedes October 2019

COOPER POWER SERIES

X-Limiter™ full-range current-limiting fuse

General

Eaton's Cooper Power™ series X-Limiter™ full-range current-limiting fuses are used for transformer protection, capacitor protection and sectionalizing. Their non-gas evolving element design allows for maximum energy limitation and minimum peak arc voltages without corrosive by-products. Thus, they can significantly limit the electrical and mechanical stresses on the protected equipment and the whole system supplying the fault.

The X-Limiter fuse is tested to meet ANSI® and IEEE® standard design requirements for power fuses as well as distribution-class fuses. The standard X-Limiter fuse is designed for clip-mounting in enclosures (refer to catalog section CA132046EN) or for a drywell canister mounting.

X-Limiter clip style fuses

The X-Limiter fuse's patented element design allows a "tailored" time-current curve and superior full-range clearing characteristics. This ensures easy coordination with upstream and downstream protective equipment. The X-Limiter current-limiting fuses have the ability to interrupt any current which will melt its element, from its minimum melt rating through its maximum interrupting rating. In most applications it does not require derating in elevated temperature environments. For applications requiring higher load capacity, X-Limiter fuses can be used in parallel to double current ratings.

Powering Business Worldwide

Production tests

Tested are conducted in accordance with Eaton requirements.

- Physical Inspection
- I^2t Testing
- Resistance Testing

Table 1. Electrical Characteristics

Fuse Type	Full Range
Maximum Interrupting Current	50,000 A rms symmetrical

Installation

The X-Limiter fuse is designed to fit industry standard mountings. Each fuse is marked with its mounting code number (either 1, 2, 4, 5, 6 or 9). The mounting code number defines the mounting's insulation level, contact spacing, and contact type. Refer to Catalog Section CA132046EN for specific mountings.

X-Limiter clip-style fuses fit 5/8" standard clip-style mountings in pad-mounted transformers, switchgear, sectionalizing enclosures, industrial vaults and metal clad switchgear. They also fit drywell canisters, both deadbreak and loadbreak. In single drywell canister applications the X-Limiter fuse can provide continuous load current capability through 50 A.

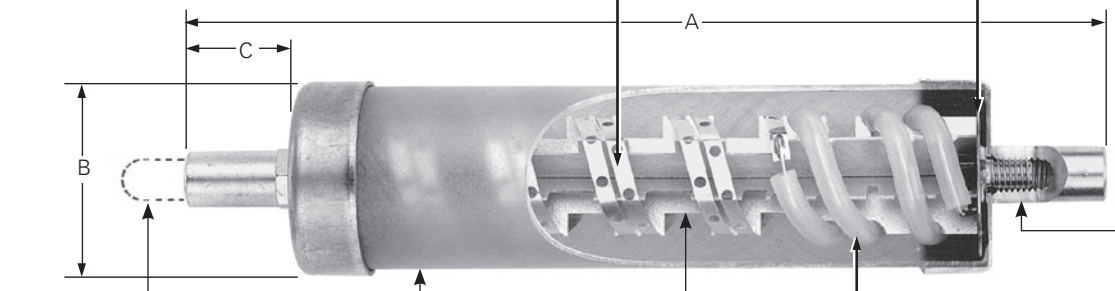
Review *Service Information MN132026EN X-Limiter Full-Range Current-Limiting Fuse Installation Instructions* included with every shipment of fuses, for more detailed information.

Table 2. X-Limiter Time Current Characteristic Curves

Voltage Rating (kV)	TCC Curves	Fuse Design
4.3	R240-91-105	Single Fuse
4.3, 5.5	R240-91-106	Parallel-Mounted Fuse
5.5	R240-91-107	Single Fuse
8.3, 15.5, 23.0	R240-91-109	Single Fuse
8.3, 15.5, 23.0	R240-91-110	Parallel-Mounted Fuse
8.3, 15.5, 23.0	R240-91-111	50A "DW" Fuse

Table 3. Electrical Ratings

	Maximum Design Voltage									
	4.3 kV		5.5 kV		8.3 kV		15.5 kV		23 kV	
Continuous Current Rating (A)	Minimum Melt I^2t (A^2S)	Maximum Clear I^2t (A^2S)	Minimum Melt I^2t (A^2S)	Maximum Clear I^2t (A^2S)	Minimum Melt I^2t (A^2S)	Maximum Clear I^2t (A^2S)	Minimum Melt I^2t (A^2S)	Maximum Clear I^2t (A^2S)	Minimum Melt I^2t (A^2S)	Maximum Clear I^2t (A^2S)
10	900	5,300	900	5,300	750	8,400	750	8,400	750	10,000
12	900	5,300	900	5,300	750	8,400	750	8,400	750	10,000
18	1,700	7,900	1,700	10,000	1,658	11,000	1,658	12,000	1,658	13,200
20	–	–	1,700	10,000	1,658	11,000	1,658	12,000	1,658	13,200
25	2,100	12,500	3,000	38,000	2,035	25,000	2,035	23,000	2,035	30,000
30	–	–	3,000	38,000	4,000	31,000	4,000	31,000	4,000	38,000
35	2,950	24,500	–	–	–	–	–	–	–	–
40	–	–	6,600	66,000	8,140	50,000	8,140	50,000	8,140	90,000
45	6,300	64,000	–	–	–	–	–	–	–	–
50DW	–	–	–	–	8,140	50,000	8,140	50,000	8,140	90,000
50	9,000	72,000	9,000	98,000	11,720	80,000	11,720	90,000	11,720	95,000
65	18,000	99,000	18,000	165,000	26,460	180,000	26,460	181,000	26,460	181,000
75	26,000	150,000	36,000	240,000	–	–	–	–	–	–
80	–	–	–	–	46,900	270,000	46,900	270,000	46,900	300,000
100	47,000	240,000	–	–	100,000	580,000	100,000	600,000	100,000	704,000
125	–	–	–	–	100,000	580,000	100,000	600,000	–	–
130	–	–	–	–	–	–	–	–	–	–
140	–	–	–	–	100,000	580,000	–	–	—	–



HIGH CURRENT ASSEMBLY
Only pure silver ribbons are used for high current elements. Silver has a superior field record in both current-limiting and expulsion fuses. It minimizes heat build-up that can thermally stress and prematurely age/damage parts of the fuse.

COPPER ALLOY END PLATE ASSEMBLY
Each element is terminated on an individual tab, symmetrically spaced around the end plate. This provides uniform current density from the elements through the end plate to the external contact.

END CAP ASSEMBLY
Threaded end cap style.

LOW CURRENT ASSEMBLY
The X-Limiter fuse's patented low current assembly is housed in a tightly fitted, proprietary, silicone sleeve. The sleeve withstands extremely high arc temperatures without degradation, maintaining high bursting strength, and arc withstand characteristics.

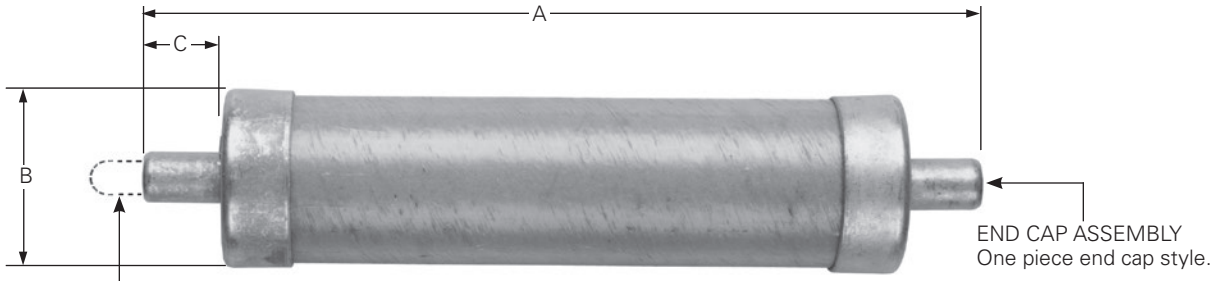
OPTIONAL BLOWN-FUSE INDICATOR
A red button is clearly visible after the fuse has operated.

MICA SPIDER
The use of mica assures the fuse will not produce gas that can contaminate and corrode drywell canisters or cause corrosion of the fuse contacts.

FIBERGLASS HOUSING
The X-Limiter fuse is housed in a special high bursting strength, high temperature resin tube.

SAND FILL
Using a programmed variable impact/vibration cycle each fuse is completely filled with high purity, grain size and moisture-controlled silica sand. A compression spacer washer is then installed with the final cap assembly, ensuring the sand stays in compression and void free.

Figure 1. X-Limiter full-range current-limiting clip-style fuse cutaway shows details and dimensions. (See Table 4 for dimensions.)



END CAP ASSEMBLY
One piece end cap style.

Optional Blown-Fuse Indicator
A red button is clearly visible after the fuse has operated.

FIBERGLASS HOUSING WITH HIGH CURRENT ASSEMBLY, MICA SPIDER, LOW CURRENT ASSEMBLY AND SAND FILL
Using a programmed variable impact/vibration cycle each fuse is completely filled with high purity, grain size and moisture-controlled silica sand. A compression spacer washer is then installed with the final cap assembly, ensuring the sand stays in compression and void free.

Figure 2. X-Limiter full-range current-limiting clip-style fuse shows details and dimensions. (See Table 4 for dimensions.)

Table 4. X-Limiter Clip-style Fuse Dimensional Information (See Figures 1 and 2 for dimensional drawings.)

Fuse Rating		Dimensions – Inches (mm)			Weight lbs (kg)	Mounting Code
Voltage (kV)	Current (A)	A	B	C		
4.3 *	10-100	10.0 (254)	2.13 (54)	1.0 (25)	2.0 (0.9)	4
5.5 *	10-75	10.0 (254)	2.13 (54)	1.0 (25)	2.0 (0.9)	4
8.3 **	10-40	10.11 (257)	2.15 (55)	1.0 (25)	2.0 (0.9)	4
8.3 *	50 DW	10.0 (254)	2.13 (54)	1.0 (25)	2.0 (0.9)	4
8.3 *	50-140	14.69 (373)	3.16 (80)	1.19 (30)	5.5 (2.5)	5
15.5 **	10-40	14.37 (365)	2.15 (55)	1.0 (25)	3.0 (1.4)	5
15.5 *	50 DW	14.31 (363)	2.13 (54)	1.0 (25)	3.0 (1.4)	5
15.5 *	50-125	17.5 (444)	3.16 (80)	1.19 (30)	8.0 (3.6)	6
23 **	10-40	17.21 (437)	2.15 (55)	1.0 (25)	4.0 (1.8)	6
23 *	50 DW	17.13 (435)	2.13 (54)	1.0 (25)	4.0 (1.8)	6
23 *	50-100	27.37 (695)	3.16 (80)	1.19 (30)	12.0 (5.4)	9

* All dimensions from Figure 1.

** All dimensions from Figure 2.

Application peak let-through current

Maximum peak let-thru curves provide the opportunity of comparing an unprotected system or one protected with an expulsion fuse, boric acid fuse, or recloser to a system protected with X-Limiter current-limiting fuses. For example, as shown in Figure 4, an unprotected circuit with 20,000 A available fault current can deliver a maximum peak current to a fault of about 50,000 A (find the intersection of the 20,000 A available current line with the peak current line, and read the result on the left maximum let-thru axis). This would be the current delivered, regardless of the size of any expulsion fuse that could be applied.

Protecting this apparatus with a 15.5 kV, 40 A, X-Limiter fuse however, would limit the peak let-thru current to the apparatus to about 8500 A. This is the same peak let-thru delivered to a fault by a system having only 3800 A available current.

Peak arc voltage

The peak arc voltage of an X-Limiter fuse is controlled by fuse design to be less than 2.1 times the peak applied voltage. As an example, an 8.3 kV fuse can be used to protect apparatus on a 2400 V system. During operation the peak arc voltage will be less than one-half of the system basic insulation level (BIL).

Example: EqEpeak = 2.4 kV X 1.414 X 2.1 = 7.2 kV Distribution-Class BIL of 2.4 kV system is 45 kV.

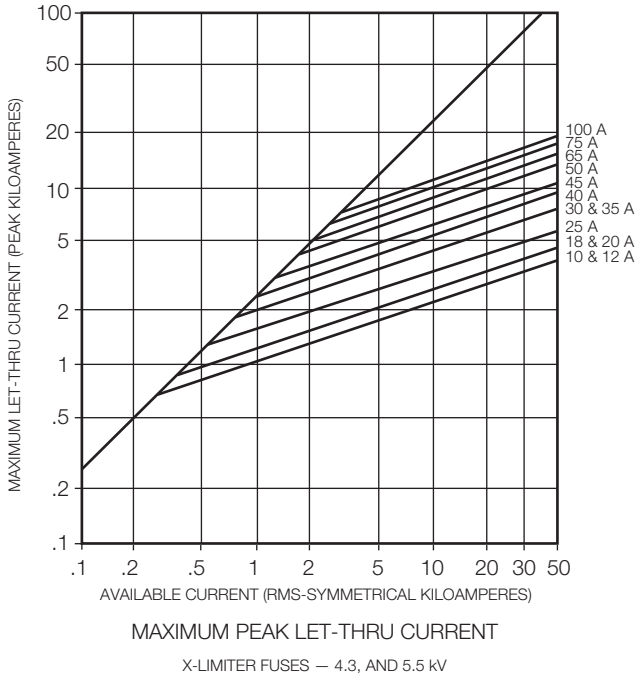


Figure 3. Maximum peak let-thru current 4.3 and 5.5 kV X-Limiter fuses.

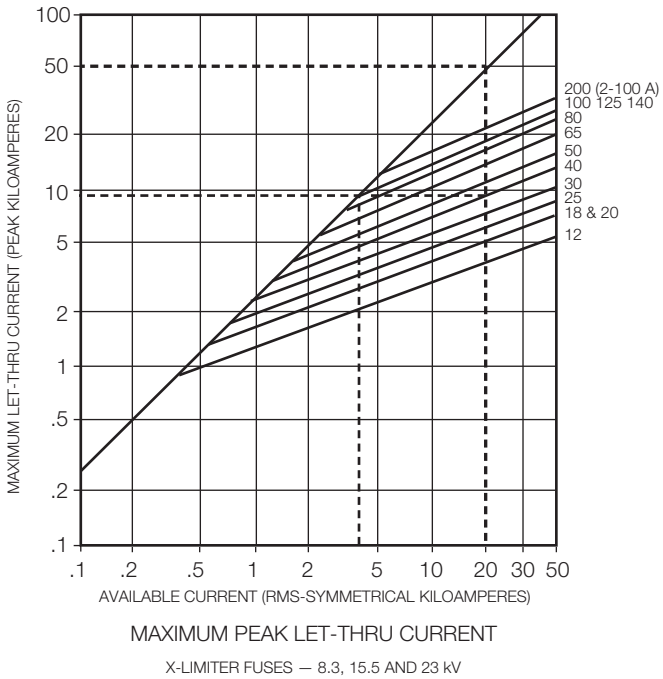


Figure 4. Maximum peak let-thru current 8.3, 15.5 and 23 kV X-Limiter fuses.

Table 5. Recommended X-Limiter Fuse Current Ratings (Amperes)

	Fuse Voltage													
	4.3 kV		8.3 kV				15.5				15.5[7]/23 kV		23 kV	
	Single-phase Transformer Voltage Rating (kV)													
Single-Phase Transformer kVA	2.4		7.2		7.62\7.96		12.0		14.4		16.0		19.4	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
10	–	12	–	–	–	–	–	–	–	–	–	–	–	–
15	10	18	–	–	–	–	–	–	–	–	–	–	–	–
25	18	25	–	–	–	12	–	–	–	–	–	–	–	–
37.5	25	40	–	12	10	12	–	–	–	–	–	–	–	–
50	30	50	10	18	10	18	–	12	–	10	–	–	–	–
75	50	80	18	25	18	25	10	18	–	12	–	12	–	10
100	65	125	20	40	20	30	18	25	10	18	10	18	–	12
167	100[8]	200[p]	40	65	25	65	20	40	18	30	18	30	10	25
250	160[p]	280[p2]	50	80	50	80	30	50	25	50	25	40	20	30
333	200[p]	280[p2]	80	125	65	125	50	80	40	65	30	50	25	50
500	–	–	100	140	125	200[p]	65	125	50	100	50	80	40	65
833	–	–	160[p]	280[p]	160[p]	280[p]	100	200[p]	80	125	80	125	65	100
1000	–	–	–	–	200[p]	280[p]	125	250[p]	100	200[p]	100	160[p]	80	130[p]

	Fuse Voltage																			
	4.3 kV		5.5 kV		8.3 kV						8.3[3]\15.5 kV[7]				15.5[3]/23[3] kV[7]				23[3] kV	
	Three-Phase Transformer Voltage Rating (kV)																			
Three-Phase Transformer kVA	2.4		4.16		4.8		7.2\7.96		8.32		12.47		13.2\14.4		20.8		22.9\24.9		34.5	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
15	–	10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
30	12	20	–	12	–	10	–	–	–	–	–	–	–	–	–	–	–	–	–	–
45	18	30	10	18	–	18[5]	–	10	–	–	–	–	–	–	–	–	–	–	–	–
75	30	50	18	30	18	25	10	18	10	12	–	10	–	10	–	–	–	–	–	–
112.5	40	75	25	40	20	30	18	25	12	20	–	12	–	12	–	–	–	–	–	–
150	65	100	30	50	30	50	20	30	20	30	12	20	12	20	–	12	–	10	–	–
225	80	140	50	80	40	80[p2]	30	50	25	40	18	25	18	25	12	18	10	18	–	10
300	125	200[p]	65	125	65	100[p2]	40	50	30	50	20	30	20	40	12	20	12	18	10	12
500	200[p]	280[p2]	100[8]	200[p]	100[p2]	140[2]	60	100	50	80	40	65	30	50	25	40	18	30	12	25
750	280[p2]	–	160[p]	280[p2]	140[2]	250[p2]	100	140	80	140	65	100	50	80	30	50	30	50	20	30
1000	–	–	200[p]	280[p2]	200[p2]	280[p2]	125	200[p]	125	200[p]	80	125	35	125	40	65	40	65	25	40
1500	–	–	–	–	280[p2]	–	200[p]	250[p]	140	250[p]	125	200	100	160[p]	65	125	65	100	40	65
2000	–	–	–	–	–	–	250[p]	–	250[p]	280[p]	140	250[p]	125	200[p]	80	160[p]	80	160[p]	50	80
2500	–	–	–	–	–	–	–	–	280[p]	–	200[p]	280[p]	200[p]	250[p]	100	200[p]	100	160[p]	65	130[p]
3000	–	–	–	–	–	–	–	–	–	–	280[p]	–	250[p]	–	125	200[p]	125	200[p]	80	130[p]

Notes:
Column A = 140% - 200% Transformer Rating
Column B = 200% - 300% Transformer Rating

1. Not all current ratings are available in all voltage ratings. Check fuse size listing.
2. 8.3 kV fuse can be used on 2.4, 4.16 and 4.8 kV applications. Mounting requirements however, should be checked.
3. Phase-to-ground voltage rated fuses are frequently recommended for Y-Y connected transformers.
   Application of this voltage rating limited to ground wye/ground wye transformers with no more than 50% delta connected secondary load.
4. Fuse selected to meet inrush criteria and cold lead pickup criteria of:
   25 times transformer full load current for .01 seconds.
   12 times transformer full load current for .1 seconds.
   3 times transformer full load current for 10 seconds.
5. Fuse application allows in excess of 300% load.
6. Drywell application limited to 50 A single barrel and 100 A parallel.
7. 8.3 kV fuses 6 through 50 A (paralleled to 100 A) have been tested to 9.8 kV.
   15.5 kV fuses 6 through 50 A (paralleled to 100 A) have been tested to 17.1 kV.
8. 4.3 kV 100 A fuse derated to 90 A in drywell applications.

p Recommendation consists of 2 fuses of equal current rating connected in parallel.

Ordering information

To order an X-Limiter fuse, first determine the amperage and voltage ratings of the fuse(s) desired, and then select the appropriate catalog number from Table 6. For parallel fusing, order two fuses.

DW at the end of a catalog number denotes a 50 A fuse that will fit a 2" drywell mounting.

Specific fuse amperage and voltage ratings can be determined using Table 5 and/or the time current curves listed in Table 2.

Fuse extenders are available as follows:

- Catalog No. FEXT45, adapts Code 4 fuses to Code 5 mountings.
- Catalog No. FEXT56, adapts Code 5 fuses to Code 6 mountings.

Test shorting bars are available as follows:

- Catalog No. SB1019A01, Mounting Code 4.
- Catalog No. SB1019A02, Mounting Code 5.
- Catalog No. SB1019A03, Mounting Code 6.

Additional information

Refer to the following reference literature for more information:

S240-56-1, X-Limiter Full-Range Current-Limiting Fuse Installation Instructions

CA132046EN, Current-Limiting Fuse Mounts

R240-91-105, 4.3 kV X-Limiter Fuse TCC

R240-91-106, 4.3, 5.5 kV (130-200) Parallel Mounted X-Limiter Fuse TCC

R240-91-107, 5.5 kV X-Limiter Fuse TCC

R240-91-109, 8.3, 15.5, 23.0 kV X-Limiter Fuse TCC

R240-91-110, 8.3, 15.5, 23.0 kV (130-280) Parallel X-Limiter Fuse TCC

R240-91-111, 8.3,15.5,23.0 kV DW X-Limiter Fuse TCC

CA132054EN, X-Limiter™ hinge-mounted current-limiting fuse

Table 6. X-Limiter Full-range Current-limiting Fuse (Refer to Figures 1 and 2)

Continuous Current Rating (A)	Catalog Number				
	4.3 kV	5.5 kV	8.3 kV	15.5 kV	23 kV
10	43F010-I	55F010-I	83F010-I	155F010-I	23F010-I
12	43F012-I	55F012-I	83F012-I	155F012-I	23F012-I
18	43F018-I	55F018-I	83F018-I	155F018-I	23F018-I
20	–	55F020-I	83F020-I	155F020-I	23F020-I
25	43F025-I	55F025-I	83F025-I	155F025-I	23F025-I
30	–	55F030-I	83F030-I	155F030-I	23F030-I
35	43F035-I	–	–	–	–
40	–	55F040-I	83F040-I	155F040-I	23F040-I
45	43F045-I	–	–	–	–
50DW	–	–	83F050-DW	155F050-DW	23F050-DW
50	43F050-I	55F050-I	83F050-I	155F050-I	23F050-I
65	43F065-I	55F065-I	83F065-I	155F065-I	23F065-I
75	43F075-I	55F075-I	–	–	–
80	–	–	83F080-I	155F080-I	23F080-I
100	43F100-I	–	83F100-I	155F100-I	23F100-I
125	–	–	83F125-I	155F125-I	–
140	–	–	83F140-I	–	–

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