Surge Arresters
Catalog Data
CA235037EN

Effective May 2021
Original edition

COOPER POWER SERIES

15, 25 and 35 kV 200 A metal oxide varistor (MOV) elbow and parking stand arrester

General

Eaton's Cooper Power™ series molded rubber elbow arrester features Eaton's metal oxide varistor (MOV) disks in a pre-molded rubber elbow to provide overvoltage system protection in an insulated, fully shielded, submersible, deadfront device.

The arrester housing interface conforms to IEEE Std 386-2016 – Separable Insulated Connector Systems. The housing is molded of ethylene propylene diene monomer (EPDM) insulating rubber which provides deadfront safety in a small, clampstick operable unit.

Elbow arrester applications include use on underground systems in pad-mounted transformer and entry cabinets, vaults, switching enclosures and other devices to provide shielded deadfront arrester protection. They are designed for use with 200 A loadbreak interfaces that conform to IEEE Std 386-2016 to limit overvoltages protecting equipment and extending cable life.

Construction

The rubber body is constructed of high-quality precision molded peroxide-cured EPDM insulation and semi-conductive materials.

The MOV disks are held tightly under pre-load from the molded rubber housing and against the probe connection guaranteeing high quality current interchange when an overvoltage event occurs. The ground plug at the bottom of the disk stack places pressure on the disks during normal operation but allows for safe short-circuit disk expulsion in the case of an end of life event.

The #4 AWG flexible copper stranded woven ground lead reliably carries current to ground during voltage surges and runs through the drain wire tab ensuring the jacket remains at ground potential.

Powering Business Worldwide

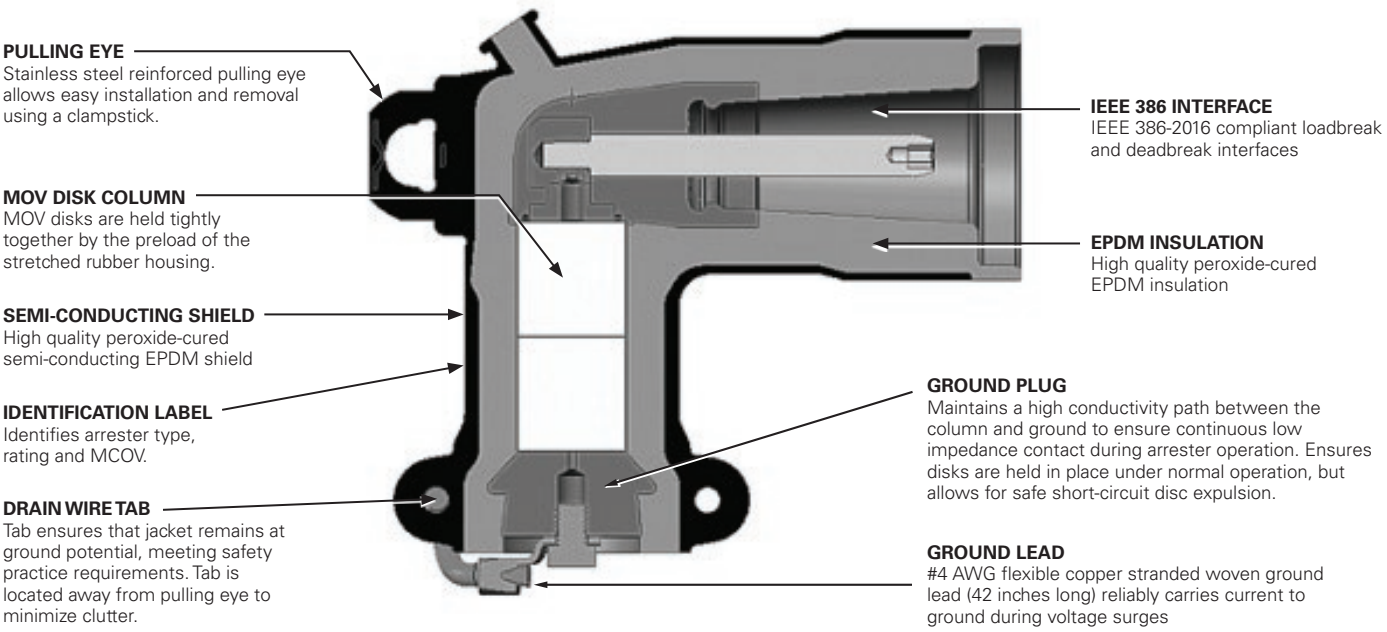

Figure 1. Cutaway illustration of deadfront elbow arrester.

Operation

Installing a molded rubber elbow arrester at the end of a radial system or at both ends of an open point on a loop system provides excellent overvoltage protection. In particular, the elbow arrester will clip the overvoltage event and eliminate the voltage doubling effect as the surge bounces back off an end point.

The addition of a second elbow arrester at a mid-point on a rotatable feedthrough insert increases levels of protection even further.

On 600 A feeder circuits, elbow arresters can be utilized on Eaton's Cooper Power™ series T-OP II and BT-TAP separable connector systems.

Standards

Eaton's Cooper Power series deadfront elbow arrester complies with IEEE C62.11-2020 standard for "Metal Oxide Surge Arrester for AC Power Circuits" and the IEEE Std 386-2016 standard "Separable Insulated Connectors for Power Distribution Systems above 600 Volts."

Installation

Eaton's metal oxide varistor elbow arresters can be installed or removed from energized bushings with a clampstick, eliminating the need for special tools. The elbow arrester is placed on a 200 amp interface by using a standard clampstick. The parking stand arrester is simply placed in a parking pocket and ready to accept a loadbreak elbow. Refer to installation manual MN235028EN installation instructions for more details.

Production tests

Tests conducted in accordance with IEEE Std 386-2016 and IEEE Std C62.11-2020:

- Partial discharge extinction voltage level
- AC 60 Hz watts loss

Tests conducted in accordance with Eaton requirements:

- Physical inspection
- Periodic dissection
- Reference voltage test at 3 mA
- Periodic X-ray analysis

Metal oxide varistor disk tests:

- 100% physical inspection
- 100% discharge voltage test
- 100% V 1mA/cm2
- 100% leakage current at 80% of V 1mA/cm2 voltage (watts loss)
- Batch high-current, short-duration test
- Batch thermal stability test
- Batch aging test

General application recommendations

The rating of an arrester is the maximum power frequency line-to-ground voltage at which the arrester is designed to pass an operating duty-cycle test. Table 1 provides a general application guide for the selection of the proper arrester rating for a given system voltage and system grounding configuration as outlined in the IEEE Std C62.22 application guide.

Under fault conditions and other system anomalies, higher voltages can be experienced by the arrester. To ensure that the arrester ratings will not be exceeded, Eaton's application engineers are available to make recommendations. The following information is normally required:

1. System maximum operating voltage
2. System grounding conditions
   A. For four-wire circuits, grounding conditions depend upon whether the system is multi-grounded, whether it has a neutral impedance, and whether common primary and secondary neutrals are used
   B. For three-wire circuits, grounding conditions depend upon whether the system is solidly grounded at the source, grounded through neutral impedance at the source transformers, or ungrounded

Protective characteristics

The protective characteristics of the elbow surge arresters are shown in Table 2.

Table 1. Commonly applied voltage ratings of MOV surge arrester

System voltage (kV rms)		Commonly applied arrester duty-cycle (MCOV) Voltage rating (kV rms) on distribution systems		
Nominal voltage	**Maximum voltage range B**	**Four-wire multigrounded neutral wye**	**Three-wire low impedance grounded**	**Three-wire high impedance grounded**
2400	2540	–	–	3 (2.55)
4160 Y/2400	4400 Y/2540	3 (2.55)	6 (5.1)	6 (5.1)
4160	4400	–	–	6 (5.1)
4800	5080	–	–	6 (5.1)
6900	7260	–	–	9 (7.65)
8320 Y/4800	8800 Y/5080	6 (5.1)	9 (7.65)	–
12 000 Y/6930	12 700 Y/7330	9 (7.65)	12 (10.2)	–
12 470 Y/7200	13 200 Y/7620	9 (7.65) or 10 (8.4)	15 (12.7)	–
13 200 Y/7620	13 970 Y/8070	10 (8.4)	15 (12.7)	–
13 800 Y/7970	14 520 Y/8380	10 (8.4) and 12 (10.2)	15 (12.7)	–
13 800	14 520	–	–	18 (15.3)
20 780 Y/12 000	22 000 Y/12 700	15 (12.7)	21 (17.0)	–
22 860 Y/13 200	24 200 Y/13 970	18 (15.3)	24 (19.5)	–
23 000	24 340	–	–	30 (24.4)
24 940 Y/14 400	26 400 Y/15 240	18 (15.3)	27 (22.0)	–
27 600 Y/15 935	29 255 Y/16 890	21 (17.0)	30 (24.4)	–
34 500 Y/19 920	36 510 Y/21 080	27 (22.0)	36 (29.0)	–
46 000 Y/26 600	48 300 Y/28 000	36 (29.0)	–	–

Table 2. Electrical ratings and characteristics

Duty cycle voltage rating (kV)	MCOV (kV)	Equivalent front-of-wave (kV crest)*	Maximum discharge voltage (kV crest) 8/20 µs current wave					
			1.5 kA	**3 kA**	**5 kA**	**10 kA**	**20 kA**	**40 kA**
3	2.55	11.6	9.0	9.7	10.4	11.4	13.0	15.3
6	5.1	22.0	18.0	19.4	20.8	22.7	26.0	28.9
9	7.65	32.5	26.0	28.0	30.0	32.8	37.4	44.3
10	8.4	35.6	28.5	30.3	31.6	35.0	39.4	48.6
12	10.2	42.5	33.9	36.6	39.2	42.9	48.9	57.8
15	12.7	53.3	42.7	45.7	49.0	53.6	61.1	72.9
18	15.3	63.3	50.9	54.9	58.8	64.3	73.4	86.7
21	17.0	68.6	55.1	58.7	62.4	68.2	77.9	94.1
24	19.5	79.2	63.8	67.9	72.8	79.6	90.8	108.8
27	22.0	91.4	73.5	78.3	82.4	90.3	103.0	125.4
30	24.4	104.5	84.1	89.6	93.4	103.4	116.5	143.5
33	27.0	108.0	87.8	95.1	102.0	112.0	127.0	144.4
36	29.0	116.0	95.3	103.0	110.0	120.0	137.0	156.7

* Equivalent front-of-wave voltage is the expected discharge voltage of the arrester when tested with a 5 kA current surge cresting in 0.5 µs.

Temporary overvoltage (TOV) capability

The temporary overvoltage (TOV) capability of Eaton's elbow arrester is shown in Figure 2.

Performance test characteristics

Eaton's elbow arrester consistently withstands the following design tests as described by IEEE Std C62.11:

- **Duty cycle –** 22 current surges of 5 kA crest 8/20 us waveshape
- **High-current, short-duration discharge –** 2 current surges of 40 kA crest 4/10 us waveshape
- **Low-current, long-duration discharge –** 20 current surges of 75 A crest 2000 us rectangular wave duration

Following each of these tests, the arresters remain thermally stable as verified by continually decreasing power values during a thirty-minute power monitoring period and no evidence of physical or electrical deterioration.

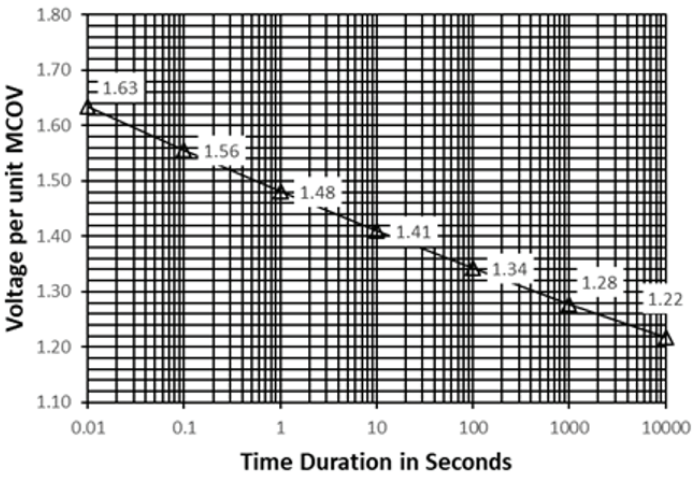

Figure 2. Temporary overvoltage curve. No prior duty at 85 °C ambient.

Ordering information

To order an Eaton elbow arrester, determine the arrester maximum continuous operating voltage (MCOV) rating for the intended application using Table 1 and specify the appropriate catalog number utilizing Table 3 and Figure 4.

Table 3. Elbow arrester catalog number configurations

Arrester type			Amp	Voltage		Config	Duty kV (MCOV)		Design
D	A	L	2	2	5	E	1	8	P

Arrester type	Amp	Voltage	Config	Duty kV (MCOV)	Design
DAL - Deadfront Elbow Arrester	**2** - 200 A ANSI	**15** - 15 kV	**E** - Elbow	**03** - 3(2.55) kV	**P** - Posi-Break**
		25 - 25 kV	**P -** Parking Stand*	**06** - 6(5.1) kV	Blank if standard
		35 - 35 kV***		**09** - 9(7.65) kV	
				10 - 10(8.4) kV	
				12 - 12(10.2) kV	
				15 - 15(12.7) kV	
				18 - 18(15.3) kV	
				21 - 21(17) kV	
				24 - 24(19.5) kV	
				27 - 27(22) kV	
				30 - 30(24.4) kV	
				33 - 33(27) kV	
				36 - 36(29) kV	

* Parking stand configuration only available in 15 and 25 kV designs
** Posi-Break only available in 25 kV designs
*** 35 kV designs are IEEE 386 large interface

Available duty cycles - kV (MCOV)

Voltage Class	3 (2.55)	6 (5.1)	9 (7.6)	10 (8.4)	12 (10.2)	15 (12.7)	18 (15.3)	21 (17)	24 (19.5)	27 (22)	30 (24.4)	33 (27)	36 (29)
15 kV													
25 kV*													
35 kV													

Figure 4. Available duty cycles by voltage class.

* 25 kV parking stand not available in 3 and 6 kV duty cycle

Dimensional information

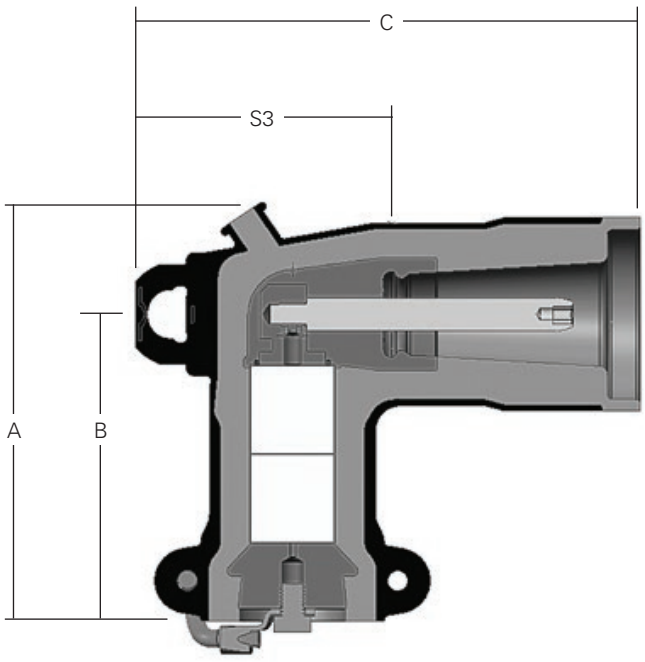

Figure 5. Dimensional information of standard elbow arrester.

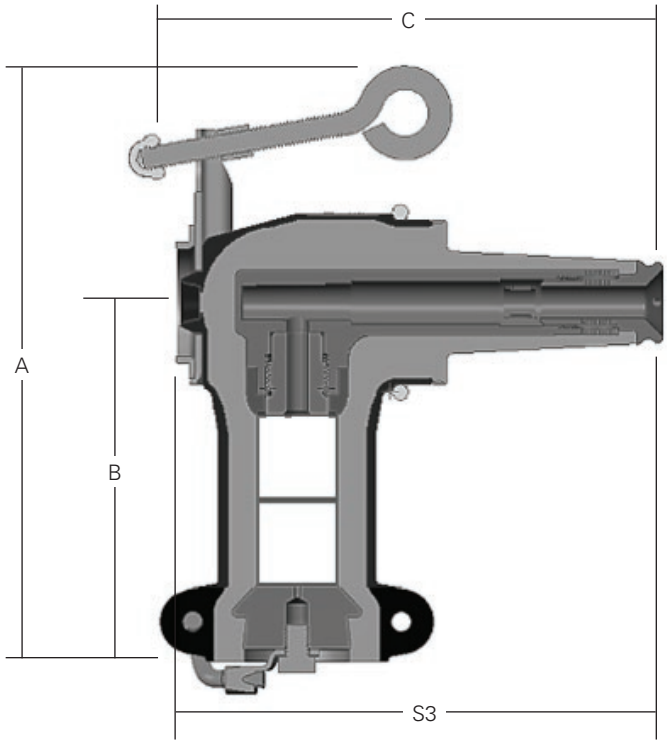

Figure 6. Dimensional information of parking stand arrester.

Table 4. Dimensional information by part number

Part number	Arrester type	Voltage class	A	B	C	S3
DAL215E03	Elbow	15	6.75	5	8	4
DAL215E06	Elbow	15	6.75	5	8	4
DAL215E09	Elbow	15	6.75	5	8	4
DAL215E10	Elbow	15	6.75	5	8	4
DAL215E12	Elbow	15	9	7.25	8	4
DAL215E15	Elbow	15	9	7.25	8	4
DAL215E18	Elbow	15	9	7.25	8	4
DAL225E03	Elbow	25	6.75	5	8	4
DAL225E06	Elbow	25	6.75	5	8	4
DAL225E09	Elbow	25	6.75	5	8	4
DAL225E10	Elbow	25	6.75	5	8	4
DAL225E12	Elbow	25	9	7.25	8	4
DAL225E15	Elbow	25	9	7.25	8	4
DAL225E18	Elbow	25	9	7.25	8	4
DAL225E21	Elbow	25	9	7.25	8	4
DAL225E03P	Posi-Break Elbow	25	6.75	5	8	4
DAL225E06P	Posi-Break Elbow	25	6.75	5	8	4
DAL225E09P	Posi-Break Elbow	25	6.75	5	8	4
DAL225E10P	Posi-Break Elbow	25	6.75	5	8	4
DAL225E12P	Posi-Break Elbow	25	9	7.25	8	4
DAL225E15P	Posi-Break Elbow	25	9	7.25	8	4
DAL225E18P	Posi-Break Elbow	25	9	7.25	8	4
DAL225E21P	Posi-Break Elbow	25	9	7.25	8	4
DAL235E18	Elbow	35	11	9	10.25	4.5
DAL235E21	Elbow	35	11	9	10.25	4.5
DAL235E24	Elbow	35	11	9	10.25	4.5
DAL235E27	Elbow	35	11	9	10.25	4.5
DAL235E30	Elbow	35	12.75	10.75	10.25	4.5
DAL235E33	Elbow	35	12.75	10.75	10.25	4.5
DAL235E33	Elbow	35	12.75	10.75	10.25	4.5
DAL235E36	Elbow	35	12.75	10.75	10.25	4.5
DAL215P03	Parking Stand	15	9.75	6	8.25	7.75
DAL215P06	Parking Stand	15	9.75	6	8.25	7.75
DAL215P09	Parking Stand	15	9.75	6	8.25	7.75
DAL215P10	Parking Stand	15	9.75	6	8.25	7.75
DAL215P12	Parking Stand	15	12	8.25	8.25	7.75
DAL215P15	Parking Stand	15	12	8.25	8.25	7.75
DAL215P18	Parking Stand	15	12	8.25	8.25	7.75
DAL225P09	Parking Stand	25	9.75	6	8.25	7.75
DAL225P10	Parking Stand	25	9.75	6	8.25	7.75
DAL225P12	Parking Stand	25	12	8.25	8.25	7.75
DAL225P15	Parking Stand	25	12	8.25	8.25	7.75
DAL225P18	Parking Stand	25	12	8.25	8.25	7.75
DAL225P21	Parking Stand	25	12	8.25	8.25	7.75

Additional information

Refer to the following literature for additional information:

- MN235028EN – Deadfront elbow arrester installation manual

Eaton
1000 Eaton Boulevard
Cleveland, OH 44122
United States
Eaton.com

Eaton's Power Systems Division
2300 Badger Drive
Waukesha, WI 53188
United States
Eaton.com/cooperpowerseries

Printed in USA
Publication No. CA235037EN
May 2021

For Eaton's Cooper Power series product information call 1-877-277-4636 or visit: www.eaton.com/cooperpowerseries.