DirectConnect Catalog Data
CA235038EN
Effective August 2022

COOPER POWER SERIES

600 A, 35 kV metal oxide varistor (MOV) DirectConnect elbow arrester

Powering Business Worldwide

Contents

General

Eaton's Cooper Power™ series DirectConnect™ elbow arrester combines metal oxide varistor (MOV) technology 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 arrester housing is molded of EPDM insulating rubber, which provides deadfront safety in a small, clampstick operable unit.

DirectConnect elbow arresters are used in pad-mounted transformer and entry cabinets, vaults, switching enclosures and other underground system installations to provide shielded deadfront arrester protection. They are designed for use with 600 A, 35 kV Class deadbreak interfaces that conform to IEEE Std 386-2016 to limit overvoltage to acceptable levels, protect equipment, and extend 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 strand 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.

Operation

Installing a DirectConnect 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.

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 "Separable Insulated Connectors for Power Distribution Systems above 600 Volts".

Installation

All DirectConnect elbow arresters must be installed on or removed from de-energized systems. No special tools are required. An adapter is threaded into the 600 A apparatus bushing. The DirectConnect elbow arrester is then placed on the 600 A apparatus bushing using a clampstick. Refer to Service Information MN235029EN, 35 kV Class DirectConnect Elbow Arrester Installation Instructions for more details.

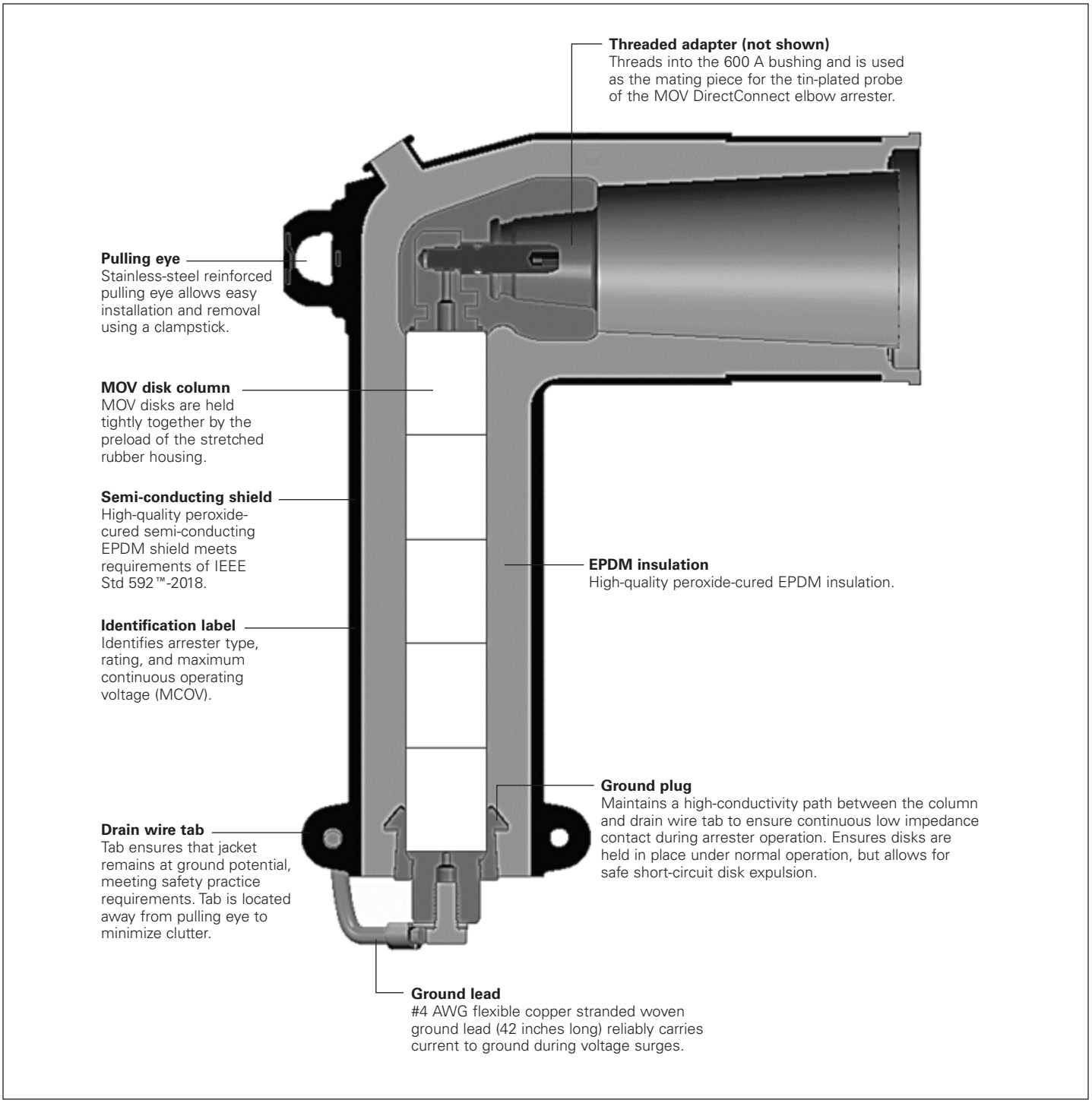

Figure 1. Cutaway illustration of DirectConnect deadfront elbow arrester

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

MOV disk tests

- 100% physical inspection
- 100% discharge voltage test
- 100% V 1 mA/cm^2
- 100% leakage current at 80% of V 1 mA/cm^2 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

Table 1. Commonly applied voltage ratings of DirectConnect elbow arrester

System voltage (kV rms)		Commonly applied arrester duty-cycle (MCOV) voltage rating (kV rms) on distribution systems		
Nominal voltage (kV)	**Maximum voltage range B (kV)**	**Four-wire multi-grounded neutral wye**	**Three-wire low impedance grounded ①**	**Delta and three-wire high impedance grounded**
24.94 Y / 14.40	26.40 Y / 15.24	18.00 (15.3)	27.00 (22.0)	—
27.60 Y / 15.93	29.25 Y / 16.89	21.00 (17.0)	30.00 (24.4)	—
34.50 Y / 19.92	36.51 Y / 21.10	27.00 (22.0)	36.00 (29.0)	—
46.00 Y / 26.60	48.30 Y / 28.00	36.00 (29.0)	—	—

① Line-to-ground fault duration not to exceed 30 minutes. For longer durations, contact the factory for proper rating.

Protective characteristics

The protective characteristics of the DirectConnect elbow arrester are shown in **Table 2**.

Table 2. Electrical ratings and characteristics

Duty cycle voltage rating (kV)	MCOV (kV)	Equivalent front-of-wave (kV crest) ①	Maximum discharge voltage (kV crest) 8/20 µs current wave					
			1.5 kA	**3 kA**	**5 kA**	**10 kA**	**20 kA**	**40 kA**
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

① 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 TOV capability of Eaton's DirectConnect elbow arrester is shown in **Figure 2**.

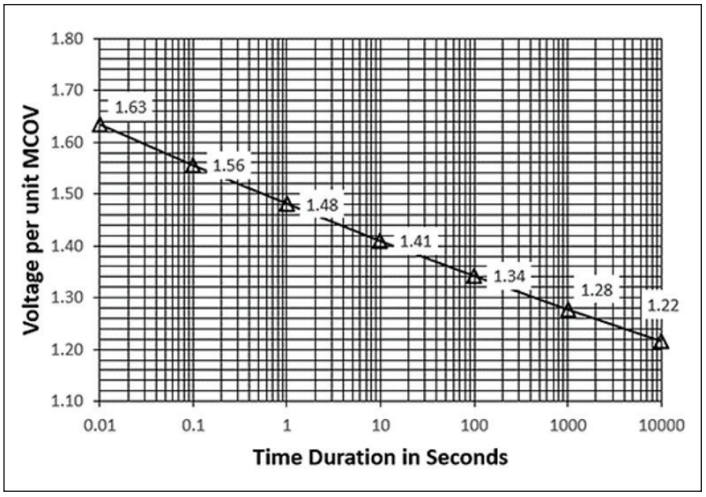

Figure 2. TOC—no prior duty at 85 °C

Performance test characteristics

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

- Operating duty (Qth)
  - Preconditioned with one current surge of 40 kA crest 4/10 µs wave shape
  - Two 8/20 µs impulses with minimum charge of 0.23 C at 85 °C
  - Energized at 1.25 times MCOV for 10 seconds followed by recovery voltage for a minimum of 30 minutes
  - Discharge voltage confirmed to be within ±5% of value prior to test with no physical damage
- Single impulse charge transfer rating (Qrs)
  - Disks subjected to 10 groups of two 2 ms current impulses greater than the required charge of 0.12 C
  - Discharge voltage and reference voltage confirmed to be within ±5% of value prior to test
  - Disks subjected to a final 8/20 current impulse greater than 0.5 kA/cm^2 and confirmed to have no physical damage

Following each of these tests, the arresters remain thermally stable as verified by continually decreasing power values during a 30-minute power monitoring period and showing no evidence of physical or electrical deterioration.

Ordering information

To order an Eaton elbow arrester, determine the arrester MCOV rating for the intended application using **Table 1** and specify the appropriate catalog number using **Table 3**.

Table 3. DirectConnect elbow arrester selection chart

Catalog number	IEEE Std 386 interface	Duty cycle (kV)	MCOV rating (kV)	Dimensions in inches refer to Figure 3			
				A	B	C	S3
DAL635E27	35 kV Class 600 A	27	22.0	11.00	9.00	9.25	3.50
DAL635E30	35 kV Class 600 A	30	24.4	12.75	10.75	9.25	3.50
DAL635E33	35 kV Class 600 A	33	27.0	12.75	10.75	9.25	3.50
DAL635E36	35 kV Class 600 A	36	29.0	12.75	10.75	9.25	3.50

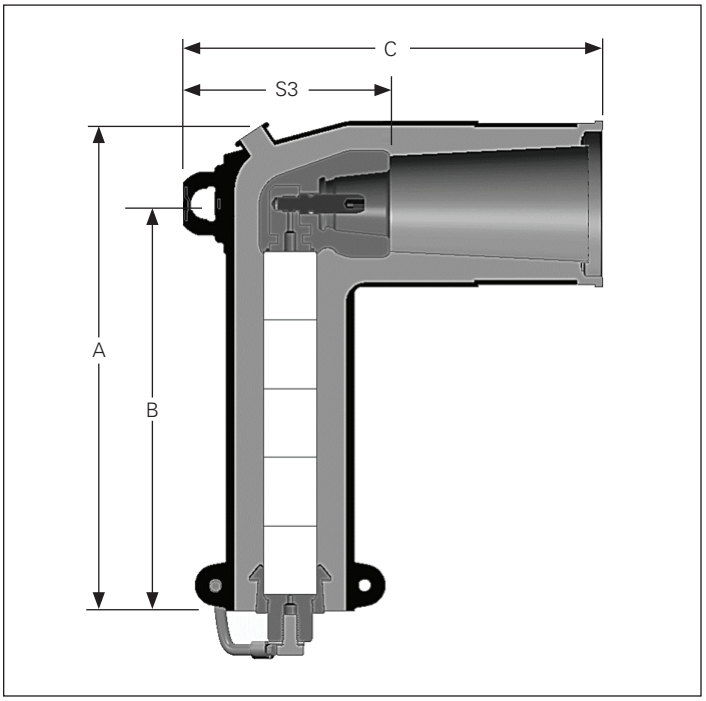

Figure 3. Dimensional information of DirectConnect elbow arrester

Note: Dimensions given are for reference only.

Additional information

Refer to the following reference literature for additional information:

- CA800020EN, 600 A, 35 kV Class deadbreak apparatus bushing catalog
- MN235029EN, 35 kV Class DirectConnect elbow arrester installation instructions
- CT235014EN, Deadfront arresters certified test report
- CA235037EN, 15, 25 and 35 kV, 200 A MOV elbow and parking stand arrester catalog

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