

Metal Oxide Varistor Elbow (M.O.V.E.) Surge Arrester

Electrical Apparatus
235-65

GENERAL

The M.O.V.E. Surge Arrester combines metal (zinc) oxide varistor technology in a premolded rubber elbow to provide overvoltage system protection in an insulated, fully shielded, submersible, deadfront device.

The arrester housing interface conforms to IEEE Std 386™ standard – Separable Insulated Connector Systems. The arrester housing is molded of EPDM insulating rubber, which provides deadfront safety in a small, clampstick operable unit.

M.O.V.E. Arresters are used on underground systems in pad-mounted transformer and entry cabinets, vaults, switching enclosures and other installations to provide shielded deadfront arrester protection. They are designed for use with 200 A loadbreak interfaces that conform to IEEE Std 386™ standard to limit overvoltages 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 copper alloy probe and probe retainer are connected to the MOV block stack via welded flexible tin-plated copper leads. This ensures that the column cannot be damaged during installation and that a reliable current path to the MOV blocks is maintained. The disk column is composed of MOV disks bonded together with high-conductivity, silver-loaded epoxy to yield the most reliable electrical connection and eliminate air voids. The #4 AWG flexible copper ground lead, which reliably carries current to ground during voltage surges, is attached to the housing by a brass magneformed end cap. The brass end cap provides a tight, weatherproof seal.



Figure 1.
M.O.V.E. Surge Arresters shown from left to right: 35 kV, 25 kV and 15 kV.

OPERATION

Installing a M.O.V.E. Arrester at the end of a radial system or at both ends of an open point on a loop system provides excellent overvoltage protection. The addition of a second M.O.V.E. Arrester at the mid-point on a rotatable feedthrough insert provides optimum protection. 600 A feeder circuits can be protected with elbow arresters installed on the Cooper T-OP™ II and BT-TAP™ Separable Connector Systems.

STANDARDS

The M.O.V.E. Arrester complies with the latest revisions of IEEE Std C62.11™ standard "IEEE Standard for Metal Oxide Surge Arresters for AC Power Circuits" and IEEE Std 386™ standard "Separable Insulated Connectors for Power Distribution Systems Above 600 Volts."

INSTALLATION

All Cooper M.O.V.E. Arresters can be installed or removed from energized bushings with a clampstick. No special tools are required. The arrester is placed on a 200 A interface by using a clampstick. Refer to Installation Instruction Sheet S235-55-1 for more details.

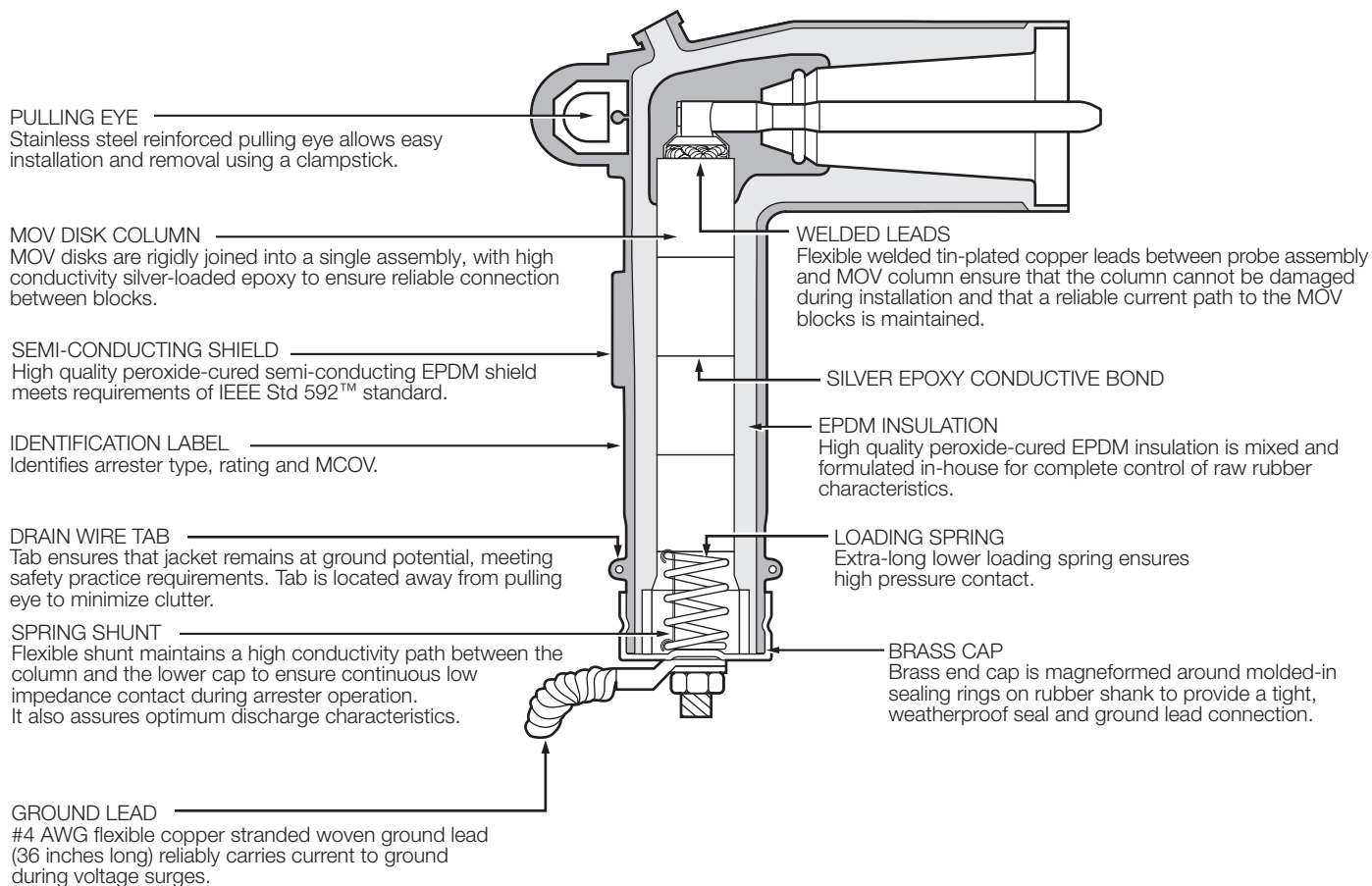


Figure 2. Cutaway illustration shows 25 kV Class Metal Oxide Varistor Elbow Surge Arrester.

PRODUCTION TESTS

Tests conducted in accordance with IEEE Std 386™ and Std C62.11™ standards:

- Partial Discharge Extinction Voltage Level
- AC 60 Hz 1 Minute Withstand
- AC 60 Hz Watts Loss

Tests conducted in accordance with Cooper Power Systems requirements:

- Physical Inspection
- Periodic Dissection
- Arrester Assembly:
 - Voltage at 1 mA
- Periodic X-ray Analysis

PRODUCTION TESTS OF MOV BLOCKS

A complete production test program ensures a quality product. Each metal oxide varistor receives a series of electrical tests. Quality is demonstrated by a series of destructive tests performed on every batch of varistors. Listed are the tests performed on the varistors:

- 100% Physical Inspection
- 100% Discharge Voltage test
- 100% V_{1mA/cm^2}
- 100% Leakage Current at 80% of V_{1mA/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 2 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™ standard 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, Cooper Power Systems 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.

Consult your Cooper representative to have your individual system application needs studied.

PROTECTIVE CHARACTERISTICS

The protective characteristics of the M.O.V.E. Surge Arresters are shown in Table 1.

TABLE 1
Electrical Ratings and Characteristics

Duty Cycle Voltage Rating (kV)	MCOV (kV)	Equivalent Front-of-Wave (kV crest)*	Maximum Discharge Voltage (kV crest) 8/20 μ s Current Wave				
			1.5 kA	3 kA	5 kA	10 kA	20 kA
3	2.55	11	9	9.7	10.4	11.4	13
6	5.1	22	18.0	19.4	20.8	22.7	26
9	7.65	31.7	26	28	30	32.8	37.4
10	8.4	33	27	29.1	31.2	34.1	38.9
12	10.2	41.5	33.9	36.6	39.2	42.9	48.9
15	12.7	51.8	42.4	45.7	49	53.6	61.1
18	15.3	62.2	50.9	54.9	58.8	64.3	73.4
21	17.0	66	54.0	58.2	62.4	68.2	77.9
24	19.5	77	63.0	67.9	72.8	79.6	90.8
27	22.0	87.2	71.4	76.9	82.4	90.1	103
30	24.4	97.1	79.5	85.7	91.8	100.0	115.0
33	27	108	87.8	95.1	102	112	127
36	29	116	95.3	103	110	120	137

* 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 μ s.

TABLE 2
Commonly Applied Voltage Ratings of M.O.V.E. 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	4-Wire Multigrounded Neutral Wye	3-Wire Low Impedance Grounded	Delta and 3-Wire High Impedance Grounded
2.40	2.54	–	–	3 (2.55)
4.16 Y/2.40	4.40 Y/2.54	3 (2.55)	6 (5.1)	6 (5.1)
4.26	4.40	–	–	6 (5.1)
4.80	5.08	–	–	6 (5.1)
6.90	7.26	–	–	9 (7.65)
8.32 Y/4.80	8.80 Y/5.08	6 (5.1)	9 (7.65)	–
12.00 Y/6.93	12.70 Y/7.33	9 (7.65)	12 (10.2)	–
12.47 Y/7.20	13.20 Y/7.62	9 (7.65) or 10 (8.4)	15 (12.7)	–
13.20 Y/7.62	13.97 Y/8.07	10 (8.4)	15 (12.7)	–
13.80 Y/7.97	14.52 Y/8.388	10 (8.4) and 12 (10.2)	15 (12.7)	–
13.80	14.52	–	–	18 (15.3)
20.78 Y/12.00	22.00 Y/12.70	15 (12.7)	21 (17.0)	–
22.86 Y/12.00	22.00 Y/12.70	15 (12.7)	21 (17.0)	–
23.00	24.34	–	–	30 (24.4)
24.94 Y/14.40	26.40 Y/15.24	18 (15.3)	27 (22.0)	–
27.60 Y/15.935	29.255 Y/16.89	21 (17.0)	30 (24.4)	–
34.50 Y/19.92	36.51 Y/21.08	27 (22.0)	36 (29.0)	–
46.00 Y/26.60	48.30 Y/28.00	36 (29.0)	–	–

TEMPORARY OVERVOLTAGE (TOV) CAPABILITY

The Temporary Overvoltage (TOV) capability of the M.O.V.E. Arrester is shown in Figure 3.

PERFORMANCE TEST CHARACTERISTICS

The M.O.V.E. Surge Arrester consistently withstands the following design tests as described by IEEE Std C62.11™ standard:

- **Duty Cycle:**
22 current surges of 5 kA crest
8/20 μs waveshape.
- **High-Current, Short-Duration Discharge:**
2 current surges of 40 kA crest 4/10 μs waveshape.
- **Low-Current, Long-Duration Discharge:**
20 current surges of 75 A crest
2000 μs 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.
- No evidence of physical or electrical deterioration.

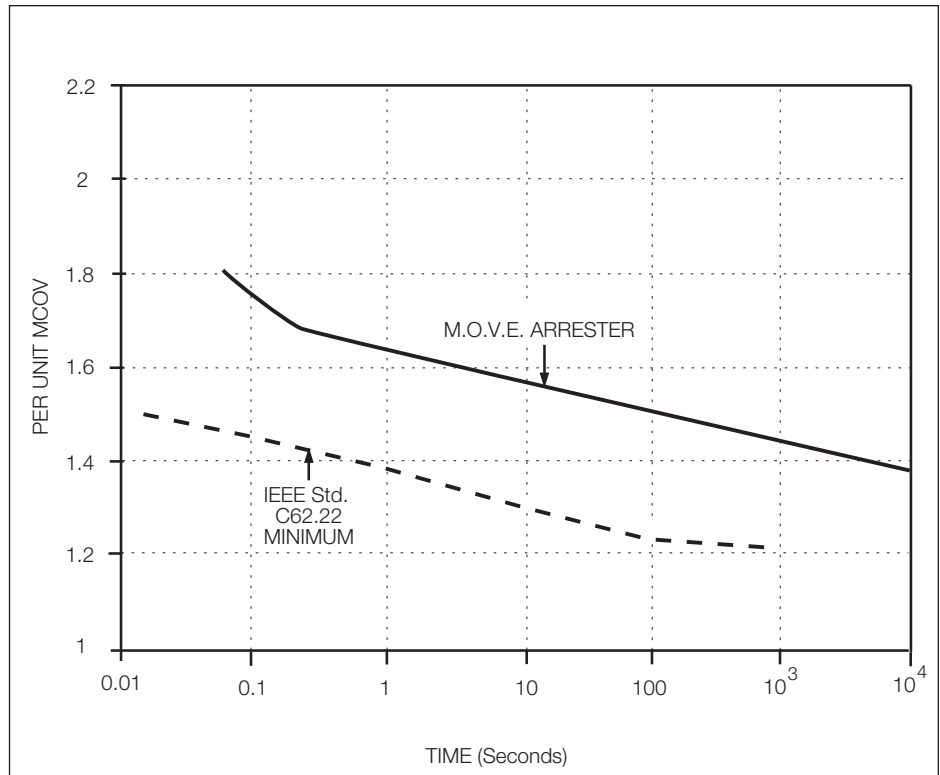


Figure 3. Temporary overvoltage curve. No prior duty at 85P C ambient.

TABLE 3
M.O.V.E. Surge Arrester Selection Chart

IEEE Std 386™ standard Interface	Duty Cycle (kV)	MCOV Rating (kV)	Dimensions in./(mm)			Catalog Number
			A	B	C	
15 kV Class	3	2.55	8.5 (216)	7.0 (178)	7.9 (201)	3238018C03M
	6	5.1	8.5 (216)	7.0 (178)	7.9 (201)	3238018C06M
	9	7.65	8.5 (216)	7.0 (178)	7.9 (201)	3238018C09M
	10	8.4	8.5 (216)	7.0 (178)	7.9 (201)	3238018C10M
	12	10.2	8.5 (216)	7.0 (178)	7.9 (201)	3238018C12M
	15	12.7	8.5 (216)	7.0 (178)	7.9 (201)	3238018C15M
	18	15.3	8.5 (216)	7.0 (178)	7.9 (201)	3238018C18M
25 kV Class	9	7.65	8.5 (216)	7.0 (178)	7.9 (201)	3238019C09M
	10	8.4	8.5 (216)	7.0 (178)	7.9 (201)	3238019C10M
	12	10.2	8.5 (216)	7.0 (178)	7.9 (201)	3238019C12M
	15	12.7	8.5 (216)	7.0 (178)	7.9 (201)	3238019C15M
	18	15.3	8.5 (216)	7.0 (178)	7.9 (201)	3238019C18M
	21	17.0	8.5 (216)	7.0 (178)	7.9 (201)	3238019C21M
35 kV Class Interface 1A Large Interface	18	15.3	13.3 (338)	11.2 (284)	10.4 (264)	3238020C18M
	21	17.0	13.3 (338)	11.2 (284)	10.4 (264)	3238020C21M
	24	19.5	13.3 (338)	11.2 (284)	10.4 (264)	3238020C24M
	27	22.0	13.3 (338)	11.2 (284)	10.4 (264)	3238020C27M
	30	24.4	13.3 (338)	11.2 (284)	10.4 (264)	3238020C30M
	33	27	13.3 (338)	11.2 (284)	10.4 (264)	3238020C33M
	36	29	13.3 (338)	11.2 (284)	10.4 (264)	3238020C36M

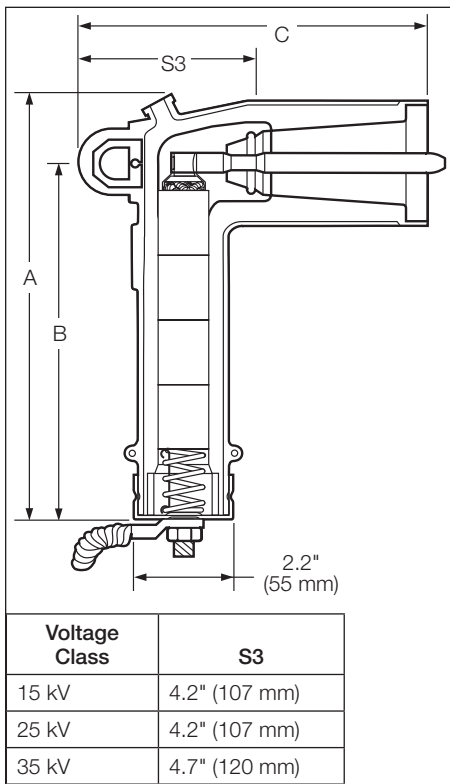


Figure 4.
Dimensional information of M.O.V.E. Arrester (refer to Table 3).

Note: Dimensions given are for reference only.

ORDERING INFORMATION

To order a M.O.V.E. Surge Arrester kit, determine the arrester Maximum Continuous Operating Voltage (MCOV) rating for the intended application using Table 2 and specify the appropriate catalog number from Table 3. Contact the Cooper Power Systems sales engineer in your location for applications not listed.

ADDITIONAL INFORMATION

Refer to the following reference literature for additional information:

- 500-13, 200 A 15 kV Class
Loadbreak Rotatable Feedthru Insert
Catalog Section
- 500-30, 200 A 25 kV Class
Rotatable Feedthru Insert
Catalog Section
- 600-12, 600 A 15 kV Class
T-OP™ II Deadbreak Connector
Catalog Section
- 600-32, 600 A 25 kV Class
T-OP II Deadbreak Connector
Catalog Section
- 600-51, 600 A 35 kV Class
T-OP II Deadbreak Connector
Catalog Section

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