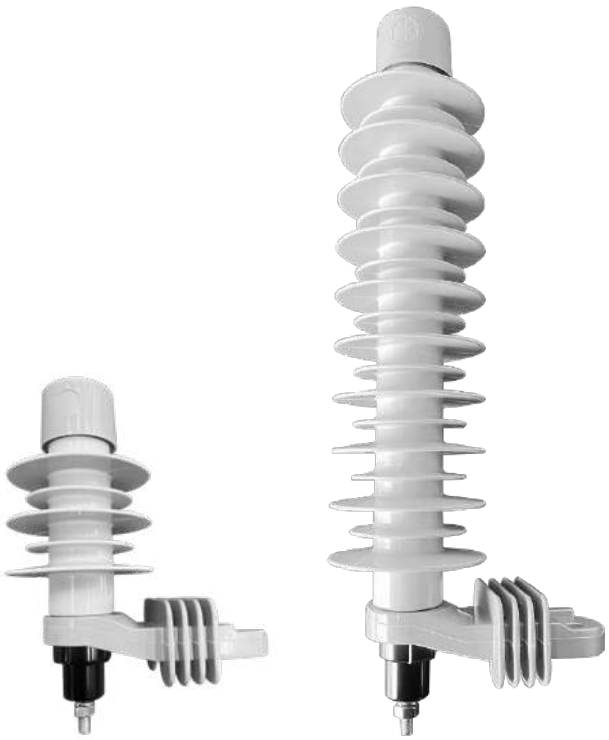
MHD: Molded polymer-housed IEEE heavy-duty (10 kA) distribution class surge arrester



General

Eaton's Cooper Power series molded polymer-housed heavy-duty distribution class surge arresters for systems up to 36kV meet or exceed the requirements of IEEE C62.11.

Table 1. MHD arrester ratings and characteristics

Arrester characteristic	Ratings
Voltage ratings: U_r (kV)	3–36
Continuous operating voltages: U_c (kV)	2.55–29
Arrester IEEE Std C62.11 classification	HD
Nominal discharge current: I_n (kA)	10
Repetitive charge transfer rating: Q_{rs} (C)	0.4
Thermal charge transfer rating: Q_{th} (C)	1.1
High current impulses (peak current 4/10 µs kA)	100
Rated short-circuit current: I_s (kA)	20
System frequency (Hz)	50/60

Construction

Eaton's MHD arresters begin with MOVs that must pass a series of physical and electrical tests designed to ensure that only disks meeting the requried standards are used. Every MOV must pass a series of physical and electrical tests designed to ensure that only disks meeting quality standards.

The MOV disks are combined with aluminum end electrodes, then wrapped with a composite weave to form the MOV disk module. The silicone rubber polymer housing is molded onto the module to create the external moisture barrier.

Following assembly, each arresters is subjected to a series of electrical tests to ensure quality and performance.

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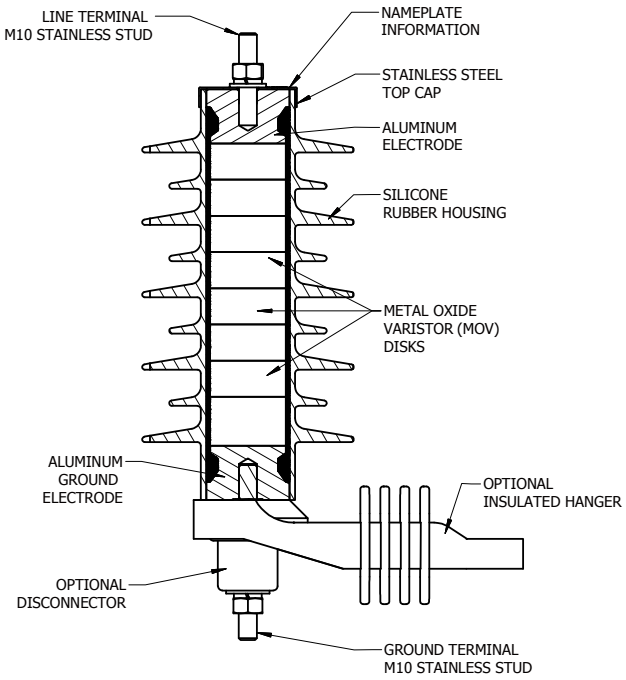


Figure 1. Cutaway illustration of MHD distribution arrester

Features

An optional insulated mounting hanger is available to allow connecting to a wide variety of brackets, and has been designed to provide the needed mechanical strength for standard loading conditions.

A ground lead disconnector is available for use on systems having 10 A or more of available fault current If an end-of-life event where to occur, the disconnector will separate, preventing a permanent line-to-ground short across the arrester. A disconnector that has operated also provides a visual indication of an arrester that had an end-of-life event and requires replacement. **Figure 2** shows the disconnector operating characteristics.

Line terminal wildlife guards are available to provide additional protection from wildlife-related outages caused by birds or other animals inadvertently bridging the voltage potential across the arrester. See **Figure 8** for additional details.

A variety of line terminal and ground terminal hardware and wiring options are available through the catalog configurator, see **Table 9**.

Seven different optional high creepage housings are available for MHD surge arrester, see **Table 9 Digits 6&7**.

Operation

The operation of MHD arrester is typical of gapless metal oxide arresters. During steady-state conditions, line-to-ground voltage is applied continuously across the arrester terminals. When surges occur, the MHD arresters immediately limit the overvoltage to the required protective level by conducting the surge current to ground. Upon passage of the surge, the arrester returns to its initial state, conducting minimal leakage current.

See **page 6** for protective characteristics of the MHD arresters.

Design testing

The housing material, internals, and hardware work together as a system and must stand up to exposure to environmental conditions.

The components and the assembled arresters meet the relevant IEEE C62.11 requirements as certified by an independent laboratory.

Production tests

A complete production test program ensures a quality product. Each MOV 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:

- Physical inspection
- Discharge voltage
- Reference voltage
- Leakage current
- Single-impulse charge transfer
- Batch high-current, short-duration
- Batch thermal stability
- Batch aging

Each fully assembled arrester must pass the following production tests:

- Physical inspection
- Leakage current
- Partial discharge

General application recommendations

Performance test characteristics

Distribution-class arresters withstand the following design tests as described by IEEE Std C62.11-2020™ standard:

- **Single-impulse charge transfer rating test (Qrs):**

  Distribution Heavy-Duty: 20 current impulses of 1.1x0.4C with crest 8/20 µs lightning impulses waveshape.

  High-current, preconditioning for Operating duty test:

  Distribution Heavy-Duty: 1 current surges of 100 kA crest, 4/10 µs waveshape.

- **The thermal charge transfer rating Qth for Operating duty test:**

  Distribution Heavy-Duty: 2 current impulses of 0.5x1.1C with crest 8/20 µs lightning impulses waveshape.

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.
- The 10 kA heavy-duty discharge voltages measured after each test changed less then 5% from the initial values.

Table 2. Commonly applied voltage ratings of arresters

System voltage (kV rms)		Recommended arrester rating per IEEE Std C62.22™ (kV rms)		
Nominal	**Maximum**	**Four-wire wye multi-grounded neutral**	**Three-wire wye solidly grounded neutral**	**Delta and ungrounded wye**
2.4	2.54	-	-	3
4.16Y/2.4	4.4Y/2.54	3	6	6
4.16	4.4	-	-	6
4.8	5.08	-	-	6
6.9	7.26	-	-	9
8.32Y/4.8	8.8Y/5.08	6	9	-
12.0Y/6.93	12.7Y/7.33	9	12	-
12.47Y/7.2	13.2Y/7.62	9	15	-
13.2Y/7.62	13.97Y/8.07	10	15	-
13.8Y/7.97	14.52Y/8.38	10	15	-
13.8	14.52	-	-	18
20.78Y/12.0	22Y/12.7	15	21	-
22.86Y/13.2	24.2Y/13.87	18	24	-
23	24.34	-	-	30
24.94Y/14.4	26.4Y/15.24	18	27	-
27.6Y/15.93	29.3Y/16.89	21	30	-
34.5Y/19.92	36.5Y/21.08	27	36	-
46Y/26.6	48.3Y/28	36	-	-

In addition, full IEEE Std C62.11-2020™ certification has been completed and verified.

Fault current withstand tests

Fault current withstand tests demonstrate the ability to withstand fault currents for specific durations without expelling any internal components. All arrester designs have been tested in accordance with the requirements listed in IEEE Std C62.11-2020™, and are non-fragmenting to the levels shown in **Table 3**.

Table 3. Fault current withstand tests

Fault current amplitude (kA rms)	Fault current duration (second)
0.6	1
20	0.2

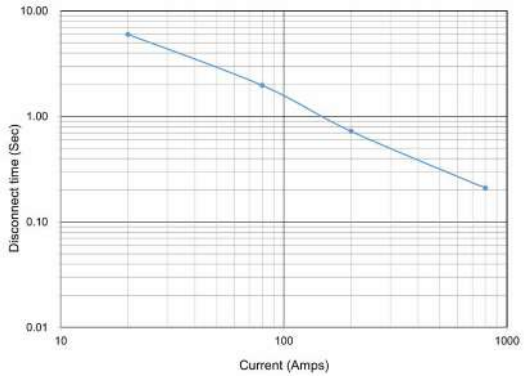


Figure 2. Isolator operating characteristics

Table 4. Insulation withstand characteristics of optional insulated mounting bracket

Insulated mounting bracket	Bracket mounting length center-to-center (inches)	Leakage distance (inches)	Strike (inches)	Power frequency voltage withstand (10 sec, wet, kV)	1.2/50 µs impulse (kV crest)
Standard for rating 3–36 kV	5.1	8.9	4.1	48	85

Dimensions and clearances

Outline drawings for several common design options are shown in **Figure 3–Figure 6**. Dimensions for these designs are listed in **Table 5**.

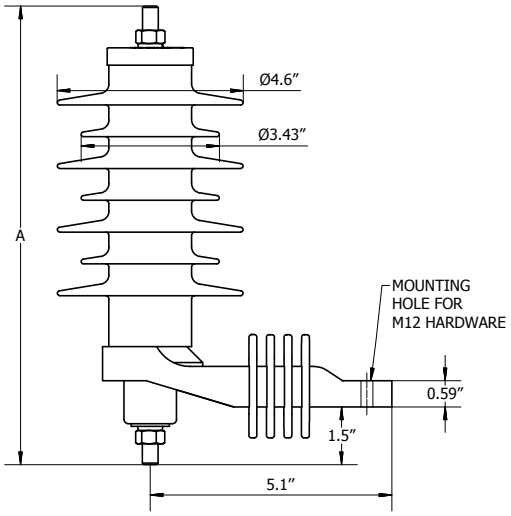


Figure 3. Arrester with isolator and insulated hanger

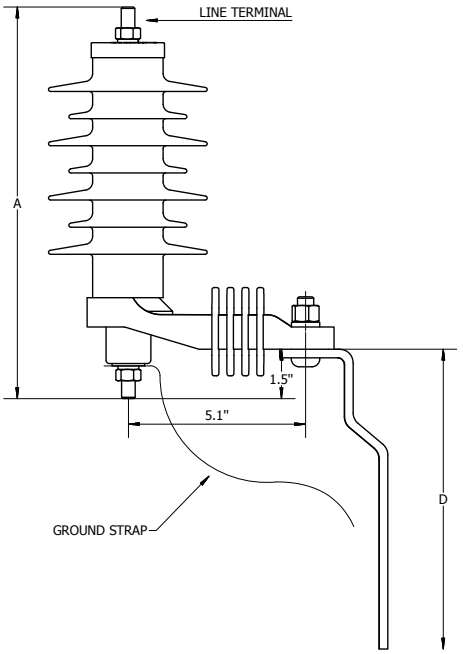


Figure 5. Arrester with isolator, insulated hanger, and transformer mounting bracket

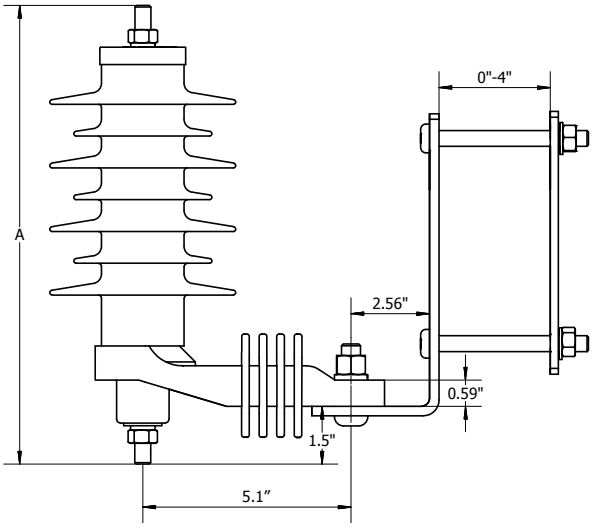


Figure 4. Arrester with isolator, insulated hanger, and NEMA® cross-arm bracket

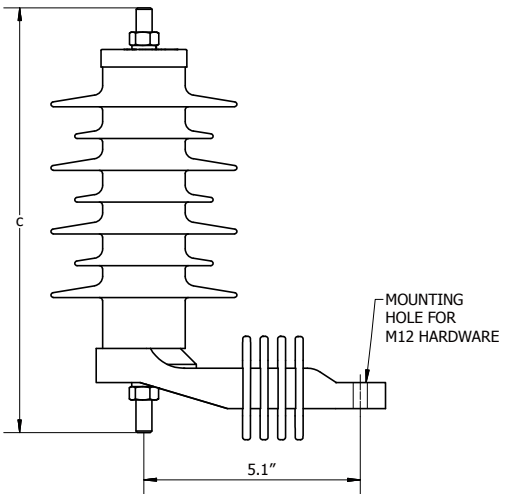


Figure 6. Arrester with insulated hanger without isolator

Table 5. Dimensional data—arresters

Arrester rating (kV rms)	Standard housing code (digits 6 and 7 Table 10)	Dimensions Figures 3–6, page 4 (inches)			Minimum recommended clearances (inches) ①	
					Heavy-duty	
		A	C	D ②	Phase-to- ground	Phase-to- phase
3	H1	10.4	8.5	8.7	3	4.25
6	H1	10.4	8.5	8.7	4	5.5
9	H2	12.0	10.0	8.7	5.25	7
10	H2	12.0	10.0	8.7	5.25	7
12	H2	12.0	10.0	8.7	6	7.75
15	H3	13.6	11.6	8.7	6.75	8.75
18	H3	13.6	11.6	8.7	9.25	11.25
21	H5	16.7	14.8	8.7	9.25	11.25
24	H5	16.7	14.8	8.7	10.75	13.25
27	H6	18.3	16.3	14.3	10.75	13.25
30	H6	18.3	16.3	14.3	10.75	13.25
33	H7	21.5	19.5	14.3	12.75	16.25
36	H7	21.5	19.5	14.3	12.75	16.25

① All clearances are measured from center line of arrester per IEEE Std C62.22™.
② With optional wildlife protector, add 0.2 inches.

Insulation characteristics

The insulation characteristics of arrester family are shown in **Table 6.**

Table 6. Housing insulation withstand voltages of arresters

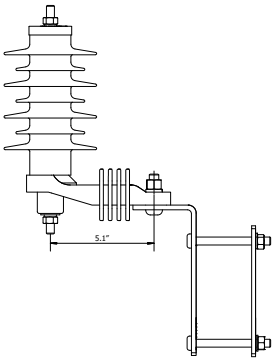
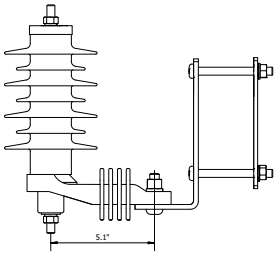
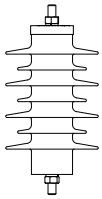
Arrester mounting configuration / Arrester housing code digits (6 and 7)	Creep distance (inches)	Strike (inches)									
			1.2/50 µs impulse (kV crest)	1 min. dry (kV rms)	1 min. wet (kV rms)	1.2/50 µs impulse (kV crest)	1 min. dry (kV rms)	1 min. wet (kV rms)	1.2/50 µs impulse (kV crest)	1 min. dry (kV rms)	1 min. wet (kV rms)
H1	14.8	6.0	82	51	42	82	51	42	82	51	42
H2	19.7	7.6	100	62	51	100	62	51	100	62	51
H3	24.6	9.1	125	89	74	125	89	74	125	89	74
H4	29.5	10.7	135	92	76	135	92	76	135	92	76
H5	34.4	12.3	140	109	90	140	109	90	140	109	90
H6	39.4	13.9	177	130	108	177	130	108	177	130	108
H7	49.2	17.0	245	152	128	245	152	128	245	152	128

Table 7. Protective characteristics—heavy-duty (MHD) arrester

Arrester rating (kV rms)	MCOV (kV rms)	Equivalent front-of-wave protective level ① (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	10.5	8.0	8.3	8.5	9.0	10.0	12.0
6	5.1	21.0	16.0	16.6	17.0	18.0	20.0	24.0
9	7.65	31.5	24.0	24.9	25.5	27.0	30.0	36.0
10	8.4	34.4	26.0	27.7	28.3	30.0	33.3	39.4
12	10.2	42.0	32.0	33.2	34.0	36.0	40.0	48.0
15	12.7	52.2	39.6	41.5	42.5	45.0	50.0	59.8
18	15.3	63.0	48.0	49.8	51.0	54.0	60.0	72.0
21	17	68.8	52.5	56.0	58.0	63.0	70.0	78.7
24	19.5	79.5	60.2	64.1	67.0	72.0	80.0	91.1
27	22	92.4	70.0	74.7	76.5	81.0	90.0	106.0
30	24.4	100.5	76.1	81.0	84.7	90.0	100.0	115.0
33	27	114.2	86.5	91.3	93.5	99.0	110.0	131.0
36	29	120.8	91.5	97.3	102.0	108.0	120.0	138.0

① Based on 10 kA current impulse that results in a discharge voltage cresting in 1/4 µs.

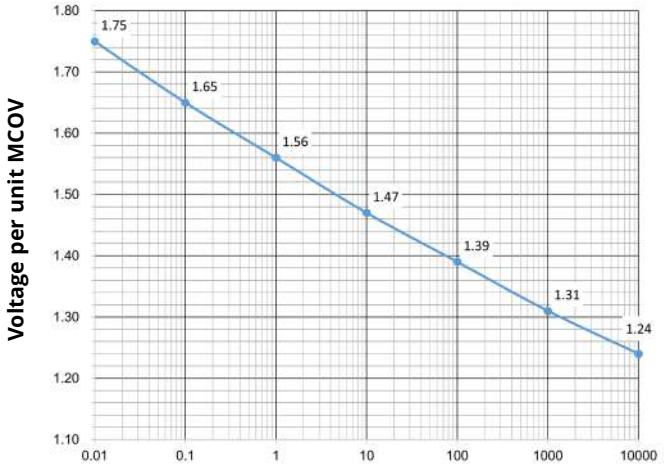


Figure 7. Temporary overvoltage curve, no prior duty- 60°C ambient

Table 8. Catalog numbers— MHD distribution-class surge arresters

Arrester rating	With isolator and insulated hanger (Figure 3)	With isolator, insulated hanger and NEMA cross-arm bracket (Figure 4)	With insulated hanger without isolator (Figure 6)	With isolator, insulated hanger, and transformer mounting bracket (Figure 5)
3	MHD03H10A1A1A1A	MHD03H10A1A1B1A	MHD03H10A0A1A1A	MHD03H10A1C1C1C
6	MHD06H10A1A1A1A	MHD06H10A1A1B1A	MHD06H10A0A1A1A	MHD06H10A1C1C1C
9	MHD09H20A1A1A1A	MHD09H20A1A1B1A	MHD09H20A0A1A1A	MHD09H20A1C1C1C
10	MHD10H20A1A1A1A	MHD10H20A1A1B1A	MHD10H20A0A1A1A	MHD10H20A1C1C1C
12	MHD12H20A1A1A1A	MHD12H20A1A1B1A	MHD12H20A0A1A1A	MHD12H20A1C1C1C
15	MHD15H30A1A1A1A	MHD15H30A1A1B1A	MHD15H30A0A1A1A	MHD15H30A1C1C1C
18	MHD18H30A1A1A1A	MHD18H30A1A1B1A	MHD18H30A0A1A1A	MHD18H30A1C1C1C
21	MHD21H50A1A1A1A	MHD21H50A1A1B1A	MHD21H50A0A1A1A	MHD21H50A1C1C1C
24	MHD24H50A1A1A1A	MHD24H50A1A1B1A	MHD24H50A0A1A1A	MHD24H50A1C1C1C
27	MHD27H60A1A1A1A	MHD27H60A1A1B1A	MHD27H60A0A1A1A	MHD27H60A1C1C1A
30	MHD30H60A1A1A1A	MHD30H60A1A1B1A	MHD30H60A0A1A1A	MHD30H60A1C1C1A
33	MHD33H70A1A1A1A	MHD33H70A1A1B1A	MHD33H70A0A1A1A	MHD33H70A1C1C1A
36	MHD36H70A1A1A1A	MHD36H70A1A1B1A	MHD36H70A0A1A1A	MHD36H70A1C1C1A

Note: All catalog numbers listed above include a universal wildlife protector.

Table 9. MHD distribution-class arrester UltraQUIK catalog numbering system

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
M	**H**	**D**												

Catalog number digits

1 = Molded polymer-housed arrester, **M**

2 & 3 = Arrester class: **HD** = Heavy-duty

4 & 5 = Arrester rating (MCOV):

03 = 3 kV (2.55 kV)
06 = 6 kV (5.1 kV)
09 = 9 kV (7.65 kV)
10 = 10 kV (8.4 kV)
12 = 12 kV (10.2 kV)
15 = 15 kV (12.7 kV)
18 = 18 kV (15.3 kV)
21 = 21 kV (17.0 kV)
24 = 24 kV (19.5 kV)
27 = 27 kV (22.0 kV)
30 = 30 kV (24.4 kV)
33 = 33 kV (27.0 kV)
36 = 36 kV (29.0 kV)

6 & 7 = Housing code per arrester rating (select from table below):

★ = Standard creepage housing **O** = Optional creepage housings

Digits 6 & 7	H1	H2	H3	H4	H5	H6	H7
Leakage distance (inches) / Arrester rating (kV rms)	14.8	19.7	24.6	29.5	34.4	39.4	49.2
3	★	O					
6	★	O					
9		★	O				
10		★	O				
12		★	O				
15			★	O			
18			★	O			
21					★	O	
24					★	O	
27						★	O
30						★	O
33							★
36							★

8 = Line terminal wire: **0** = No line terminal wire

2 = 12 inches, #6 AWG insulated wire, 1 ring terminal /1 end stripped 1.25 inches

3 = 12 inches, #6 AWG insulated wire, 2 ring terminals

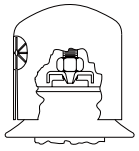
5 = 18 inches, #6 AWG insulated wire, 1 ring terminal /1 end stripped 1.25 inches

6 = 18 inches, #6 AWG insulated wire, 2 ring terminals

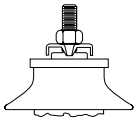
8 = 30 inches, #6 AWG insulated wire, 1 ring terminal /1 end stripped 1.25 inches

9 = 30 inches, #6 AWG insulated wire, 2 ring terminals

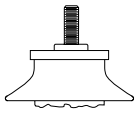
9 = Line terminal options



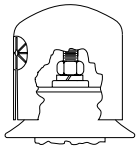
A = Stainless steel nut, stainless steel wire clamp and universal wildlife protector



B = Stainless steel nut and stainless steel wire clamp



C = No hardware



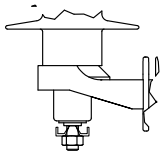
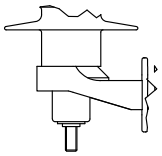
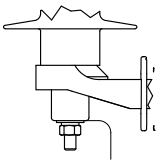
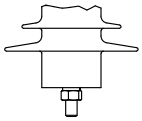
D = Stainless steel nut, lock washer, flat washer, and universal wildlife protector (for leads with ring terminals)

Table 10. Distribution-class arrester UltraQUIK catalog numbering system (continued)

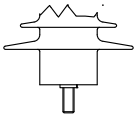
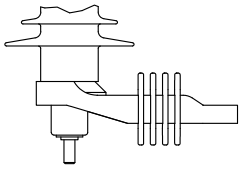
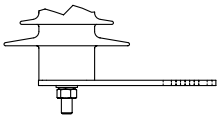
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
M	**H**	**D**												

10 = Isolator, with M10 stainless steel grounding stud
- **0** = No isolator
- **1** = Black isolator

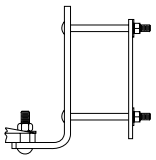
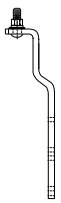
11 = Ground terminal options

			
A = Wire clamp with stainless steel nut (shown with optional isolator and insulated hanger)	**B** = No hardware (shown with optional isolator and insulated hanger)	**C** = Copper transformer grounding strap with stainless steel lock washer and stainless-steel nut (shown with optional isolator and insulated hanger)	**D** = Stainless steel washer, lock washer, stainless steel nut

12 = Base configuration options

		
O = Insulated base (base mounted arrester) **(requires "0" in digit 10)**	**1** = Insulated hanger (required with optional isolator)	**2** = Insulated base with conductive mounting bracket **(requires "0" in digit 10 and "D" in digit 11)** See **Figure 12** for dimensional information.

13 = Mounting bracket options

		
A = Without an additional mounting bracket	**B** = NEMA cross-arm bracket (arrester mounting hardware included) **(requires "1" or "2" in digit 12)** Refer to **Figure 9** for dimensional information.	**C** = Transformer bracket (arrester mounting hardware included) **(requires "1" or "2" in digit 12)** (reference **Figure 10** and **Figure 11** for bracket dimensions by rating)

14 = Nameplate information: **1** = IEEE Std C62.11-2020™ required data

15 = Packaging:

A = Individual carton (assembled terminal hardware). Each arrester is shipped in an individual high-strength cardboard carton. The top and bottom terminal hardware is assembled to the arrester. Any optional brackets or hardware are provided unassembled.

C = Bulk packed (assembled terminal hardware). Pallet sized bulk cardboard packaging for transformer mounting bracket options (digits 13 = C or D only). Each arrester is shipped fully assembled including transformer mounting bracket. Available for 3–24 kV arresters only. Full pallet quantities only: 3–10 kV = 90, 12–24 kV = 72.

Available accessories for the arrester

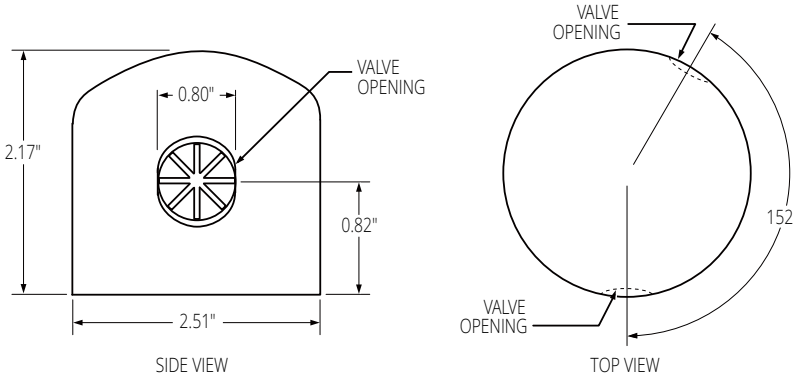


Figure 8. Universal wildlife protector (catalog number AV346X1C) (all dimensions in inches)

The universal wildlife protector has two self-adjusting valve style openings that vary from 0 to 0.75 inches in diameter, thus allowing for a large variety of conductor/insulation sizes while providing optimum wildlife protection.

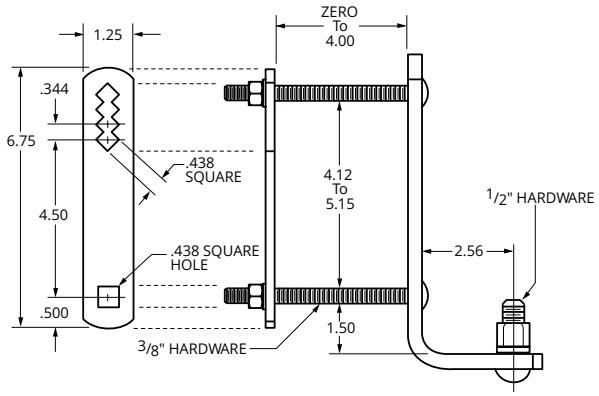


Figure 9. NEMA cross-arm bracket (catalog number AM35A1), can be specified with a "B" in digit 13 (all dimensions in inches)

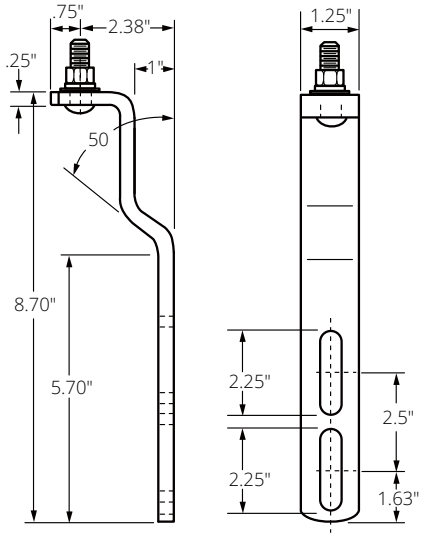


Figure 10. Standard transformer mounting bracket for 3–24 kV arrester (part number AM36A2), can be specified with a "C" in digit 13 (all dimensions in inches)

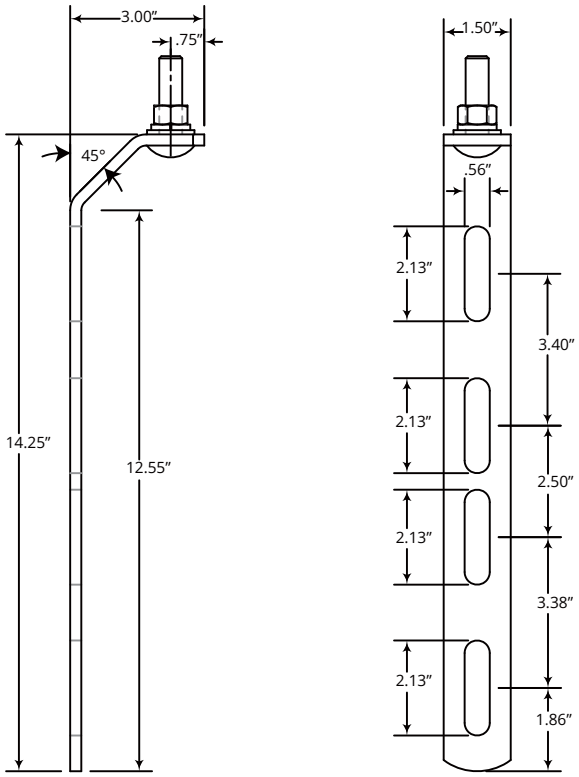


Figure 11. Standard transformer mounting bracket for 27–36 kV arrester (part number AH46A2), can be specified with a "C" in digit 13 (all dimensions in inches)

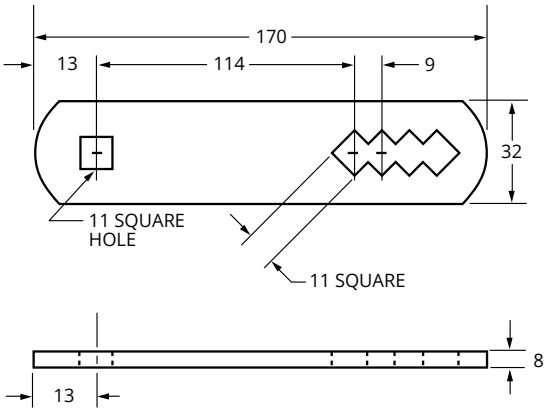


Figure 12. Conductive base mounting for use with 3/8 inch hardware, can be specified with a "2" in digit 12 (requires "0" in digit 10, "D" in digit 11) (all dimensions in inches)

Additional information

- MN235XXXEN, Molded polymer-housed IEEE heavy-duty (10 kA) distribution class surge arrester Installation Instructions
- CPXXXX, Design Test Report Summary, 10 kA, MHD

Eaton is an intelligent power management company dedicated to protecting the environment and improving the quality of life for people everywhere. We make products for the data center, utility, industrial, commercial, machine building, residential, aerospace and mobility markets. We are guided by our commitment to do business right, to operate sustainably and to help our customers manage power-today and well into the future. By capitalizing on the global growth trends of electrification and digitalization, we're accelerating the planet's transition to renewable energy sources, helping to solve the world's most urgent power management challenges, and building a more sustainable society for people today and generations to come.

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