Fusing Equipment
Catalog Data
CA132038EN

Effective September 2019
Supersedes October 2015

COOPER POWER SERIES

CMU medium voltage power fuses

General

Eaton's Cooper Power™ series CMU power fuse is a boric acid, expulsion-style fuse. Suitable for both indoor and outdoor applications, the CMU power fuse provides an economical alternative to refillable fuses. CMU expulsion power fuses are available in three maximum voltage classes: 17 kV, 27 kV, and 38 kV. The fuse unit comes in three speed variations: Standard "E", Slow "SE", and Fast "K". Amperage sizes range from 3 A through 200 A.

The CMU power fuse interrupting rating greatly exceeds that of conventional distribution cutouts that use a fuse tube and link design, and considerably reduces the hazards and noise of the violent exhaust common to cutouts under fault interrupting conditions. The CMU power fuse, employing the use of a calibrated silver element, boric acid for its interrupting media and rod mechanism for arc extension, creates low arcing voltage and mild exhaust during fault interruption.

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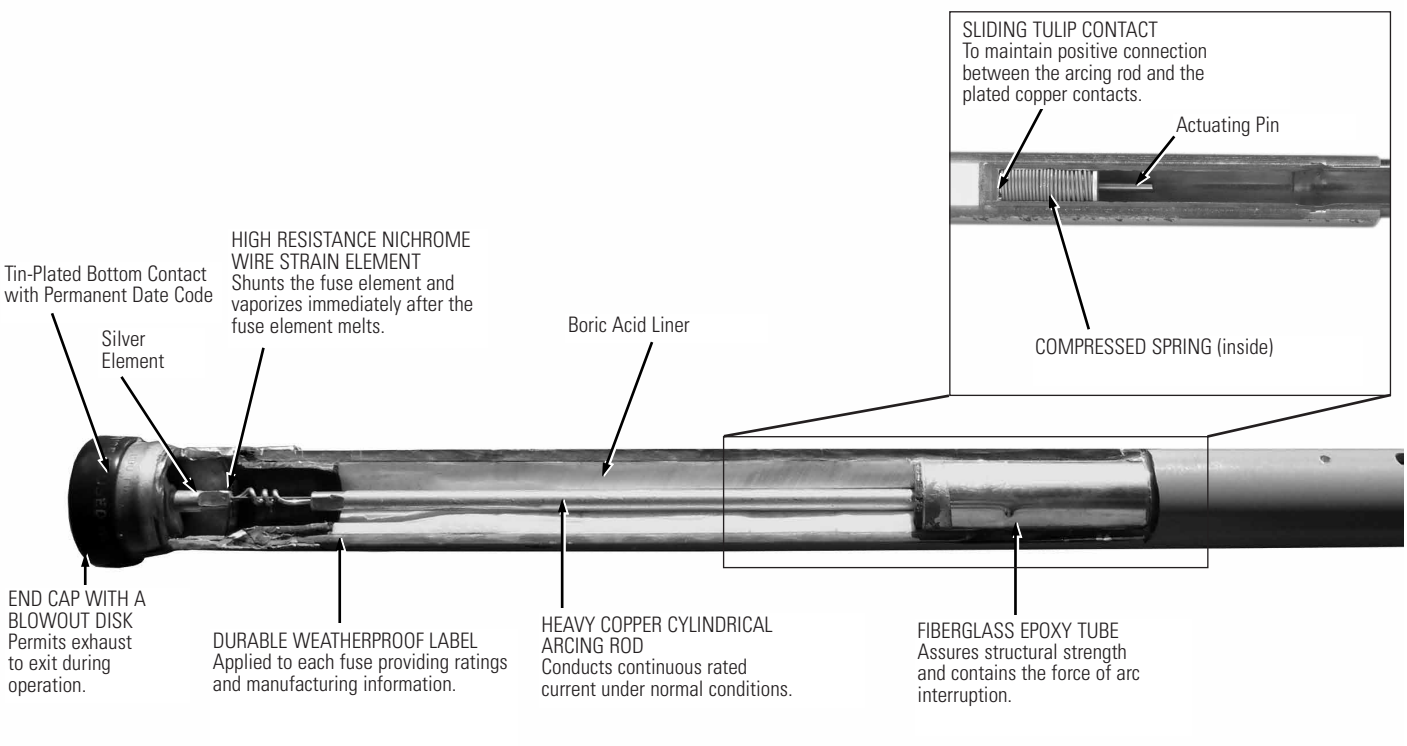


Figure 1. Fuse unit.

Application

The CMU power fuses provide effective protection for circuits and equipment which operate on system voltages up to 34,500 V. They can be used on both electric utility and industrial distribution systems. Typical applications include:

- Power Transformers
- Feeder Circuits
- Distribution Transformers
- Potential Transformers
- Station Service Transformers
- Metal-enclosed Switchgear
- Pad-Mounted Switches
- Overhead Capacitor Racks

CMU power fuses can be used in outdoor or indoor applications, and can be used to directly replace competitive equivalent units.

When used in upstream system protection, the CMU power fuse operates promptly to limit the stress on electrical systems due to short circuits. It provides isolation for the faulted circuit, limiting the size of interrupted service area.

Full protection is provided for downstream equipment, even down to minimum melt current, regardless of the nature of the fault. The CMU power fuse acts rapidly to take transformer and feeder circuits off-line before damage can become widespread. It also provides excellent isolation for capacitors in the event of a fault condition. When installed on the primary side of substation power transformers, CMU power fuses provide protection against small, medium or large faults.

Production tests

Tests are conducted in accordance with Eaton quality assurance requirements.

- Physical Inspection
- Micro-Ohm Resistance Testing
- Construction Integrity Testing

Installation

No special tools are required to install the CMU power fuse. The CMU power fuse and end fittings are designed to fit into industry standard mountings. Refer to Installation Instructions Sheet MN132032EN for details.

Electrical characteristics

- The CMU power fuse interrupts at a natural current zero in the current wave and allows a minimum of a half cycle of fault current to flow before the fault is cleared. The time-current characteristics associated with a CMU power fuse have a gradual slope, making it easier to coordinate with downstream equipment.
- The CMU power fuse is ideal for higher voltage (up to 38 kV) and high current applications (through 200 A). Proper coordination can be achieved through use of the appropriate time-current curves.
- The CMU power fuse provides effective protection for circuits and equipment which operates on voltages from 2,400 V to 34,500 V.
- The CMU power fuse has interrupting capabilities from 10,000 to 14,000 A symmetrical.
- The CMU power fuse is offered in three configuration for use with high currents: “E” (standard), “K” (fast), and “SE” (slow). The curves for the “SE” are less inverse and allow for more of a time delay at high currents.
- CMU power fuses, when used on the transformer-primary side, should be selected based on the anticipated normal transformer loading schedule, including daily or repetitive peak loads, and

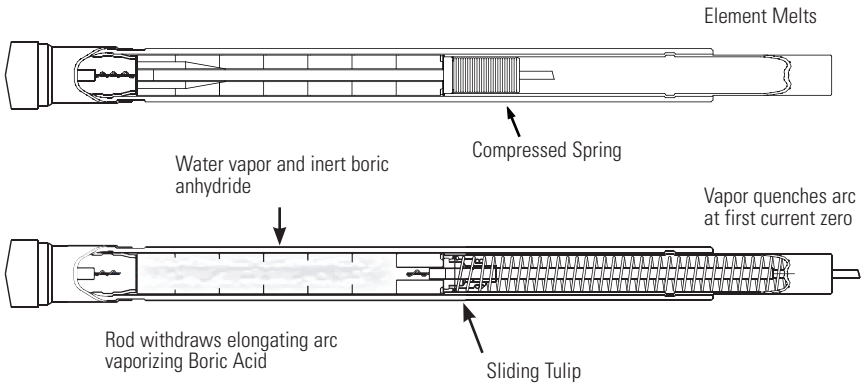


Figure 2. CMU power fuse cross section view.

must be sized with the inrush currents in mind.

The CMU power fuses have been designed and tested according to the following standards:

- IEEE Std C37.40™ standard–Service Conditions and Definitions for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories
- IEEE Std C37.41™ standard–Design Tests for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories
- IEEE Std C37.42™ standard–Specifications for High-Voltage Expulsion Type Distribution Class Fuses, Cutouts, Fuse Disconnecting Switches and Fuse links
- IEEE Std C37.46™ standard–Specifications for High-Voltage Expulsion and Current-Limiting Type Power Class Fuses and Fuse Disconnecting Switches
- IEEE Std C37.48.1™ standard–Guide for the Operation, Classification, Application, and Coordination of Current-Limiting Fuses with Rated Voltages 1–38 kV

Operation

The CMU power fuse utilizes the proven performance of boric acid to create the de-ionizing action needed to interrupt the current. A spring-loaded arcing rod carries the normal continuous current through the unit when the circuit is operational.

Under normal conditions, the fusible element's temperature is well below its melting temperature and does not melt. When a fault occurs that is large enough to melt the fuse element, an arc is initiated and elongated by the units spring, pulling the arcing rod up into the boric acid interrupting media. The heat produced decomposes the boric acid liner inside producing water vapor and boric anhydride which helps to de-ionize the arc. The by-products extinguish the arc at a natural current zero and exit out the bottom of the fuse.

The arcing rod is prevented from falling back into its original position by residual force in the compression spring, whose free length is greater than the available space within the fuse unit. When the fuse operates, the upward motion of the spring forces the top of the arcing rod to penetrate the upper seal, striking the latch mechanism. On indoor applications, this action causes the blown fuse indicator to actuate. On outdoor installations, the latch releases the fuse unit allowing the ejector spring to move the assembly outward and swing through a 180 degree arc into a dropout position. This dropout action provides immediate visual indication that the fuse has operated. When the fuse is blown and the dropout action completed, the entire unit is removed with a hotstick.

When replacing the blown fuse, the end fittings should be removed from the operated fuse unit, and if undamaged, clamped onto the new fuse unit.

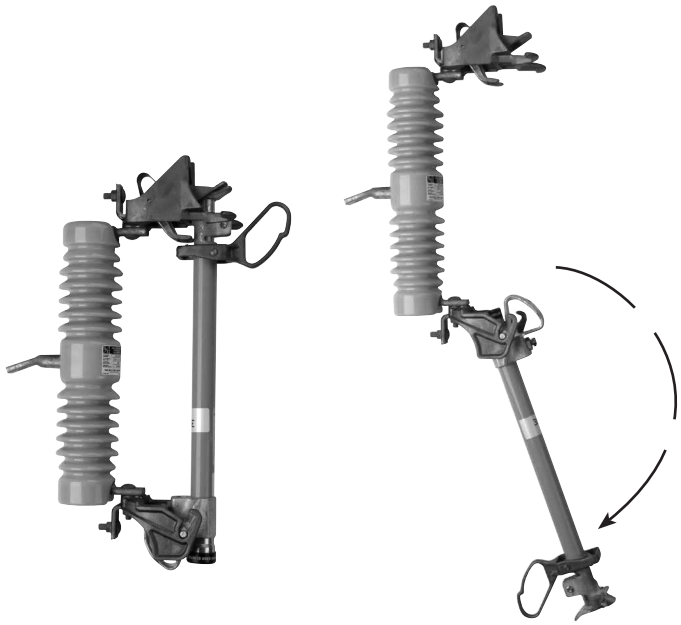


Figure 3. Outdoor application (left) and dropout action (right).

When installed indoors, the exhaust and noise produced during the interruption process are limited by the muffler attached to the lower end fitting. The CMU power fuse unit is then discarded, and replaced with a new unit, re-using the end fittings if undamaged.

During the interrupting process, current continues to flow in the circuit and in the fuse until a current zero is reached. When the arc is stopped at current zero, the voltage will attempt to re-ignite the arc. The voltage across the fuse terminals builds rapidly and is referred to as the Transient Recovery Voltage (TRV). The TRV is the most severe waveform the fuse will have to withstand. This voltage build-up puts a great deal of potentially destructive force on the fuse units and the system in total. Whether or not extinguishing of the arc is successful depends, in general, on the dielectric strength between the fuse terminals. In short, the dielectric strength between the fuse terminals must be greater than the voltage trying to re-ignite the arc for a successful interruption to occur.

When properly applied, the CMU power fuse has a dielectric withstand that is greater than the TRV, regardless of the fault current.

Table 1. CMU Catalog Numbers and Information

Voltage Rating Speed	Rating A	Catalog Numbers	Min. Melt Curve Reference R240-91-	Max. Clear Curve Reference R240-91-	Max Int. kA Sym	Approx. Shipping Wt.	Indoor End Fittings Catalog Number	Outdoor End Fittings Catalog Number
17 kV, K	3	CMU702003	153	156	14	2.1	CMU3097	CMU3095
	6	CMU702006						
	8	CMU702008						
	10	CMU702010						
	12	CMU702012						
	15	CMU702015						
	20	CMU702020						
	25	CMU702025						
	30	CMU702030						
	40	CMU702040						
	50	CMU702050						
	65	CMU702065						
	80	CMU702080						
	100	CMU702100						
	140	CMU702140						
	200	CMU702200						
17 kV, E std	5	CMU612005	152	155	14	2.1	CMU3097	CMU3095
	7	CMU612007						
	10	CMU612010						
	13	CMU612013						
	15	CMU612015						
	20	CMU612020						
	25	CMU612025						
	30	CMU612030						
	40	CMU612040						
	50	CMU612050						
	65	CMU612065						
	80	CMU612080						
	100	CMU612100						
	125	CMU612125						
	150	CMU612150						
	175	CMU612175						
	200	CMU612200						
17 kV, SE slow	15	CMU712015	151	154	14	2.1	CMU3097	CMU3095
	20	CMU712020						
	25	CMU712025						
	30	CMU712030						
	40	CMU712040						
	50	CMU712050						
	65	CMU712065						
	80	CMU712080						
	100	CMU712100						
	125	CMU712125						
	150	CMU712150						
	175	CMU712175						
	200	CMU712200						

Note: Muffler can be ordered separately. Order catalog number CMUFDA1103.

Table 1. CMU Catalog Numbers and Information (continued)

Voltage Rating Speed	Rating A	Catalog Numbers	Min. Melt Curve Reference R240-91-	Max Clear Curve Reference R240-91-	Max Int. kA Sym	Approx. Shipping Wt.	Indoor End Fittings Catalog Number	Outdoor End Fittings Catalog Number
27 kV, K	3	CMU703003	153	159	12.5	2.1	CMU3097	CMU3095
	6	CMU703006						
	8	CMU703008						
	10	CMU703010						
	12	CMU703012						
	15	CMU703015						
	20	CMU703020						
	25	CMU703025						
	30	CMU703030						
	40	CMU703040						
	50	CMU703050						
	65	CMU703065						
	80	CMU703080						
	100	CMU703100						
	140	CMU703140						
	200	CMU703200						
27 kV, std	5	CMU613005	152	158	12.5	2.1	CMU3097	CMU3095
	7	CMU613007						
	10	CMU613010						
	13	CMU613013						
	15	CMU613015						
	20	CMU613020						
	25	CMU613025						
	30	CMU613030						
	40	CMU613040						
	50	CMU613050						
	65	CMU613065						
	80	CMU613080						
	100	CMU613100						
	125	CMU613125						
	150	CMU613150						
	175	CMU613175						
	200	CMU613200						
27 kV, SE slow	15	CMU713015	151	157	12.5	2.1	CMU3097	CMU3095
	20	CMU713020						
	25	CMU713025						
	30	CMU713030						
	40	CMU713040						
	50	CMU713050						
	65	CMU713065						
	80	CMU713080						
	100	CMU713100						
	125	CMU713125						
	150	CMU713150						
	175	CMU713175						
	200	CMU713200						

Note: Muffler can be ordered separately. Order catalog number CMUFDA1103.

Table 1. CMU Catalog Numbers and Information (continued)

Voltage Rating Speed	Rating A	Catalog Numbers	Min. Melt Curve Reference R240-91-	Max Clear Curve Reference R240-91-	Max Int. kA Sym	Approx. Shipping Wt.	Indoor End Fittings Catalog Number	Outdoor End Fittings Catalog Number
38 kV, K	3	CMU704003	153	159	10	2.8	CMU3097	CMU3095
	6	CMU704006						
	8	CMU704008						
	10	CMU704010						
	12	CMU704012						
	15	CMU704015						
	20	CMU704020						
	25	CMU704025						
	30	CMU704030						
	40	CMU704040						
	50	CMU704050						
	65	CMU704065						
	80	CMU704080						
	100	CMU704100						
	140	CMU704140						
	200	CMU704200						
38 kV, E std	5	CMU614005	152	158	10	2.8	CMU3097	CMU3095
	7	CMU614007						
	10	CMU614010						
	13	CMU614013						
	15	CMU614015						
	20	CMU614020						
	25	CMU614025						
	30	CMU614030						
	40	CMU614040						
	50	CMU614050						
	65	CMU614065						
	80	CMU614080						
	100	CMU614100						
	125	CMU614125						
	150	CMU614150						
	175	CMU614175						
	200	CMU614200						
38 kV, SE slow	15	CMU714015	151	157	10	2.8	CMU3097	CMU3095
	20	CMU714020						
	25	CMU714025						
	30	CMU714030						
	40	CMU714040						
	50	CMU714050						
	65	CMU714065						
	80	CMU714080						
	100	CMU714100						
	125	CMU714125						
	150	CMU714150						
	175	CMU714175						
	200	CMU714200						

Note: Muffler can be ordered separately. Order catalog number CMUFDA1103.

Construction

The complete fuse consists of the fuse unit, end fittings, and a mounting.

CMU end fittings

End fittings are required to complete the electrical connection between the fuse unit and the mounting. End fittings are positioned on the top and bottom of the fuse unit. They can be used over again if they remain undamaged.

End fittings are available in two versions: indoor and outdoor.

Indoor fittings

The indoor end fittings are composed of high-impact plastic and high conducting copper alloy. The blown fuse indicator, located on the top end fitting, provides visual indication of an operated fuse unit. The silver-plated contact rod ensures positive conductivity between the fuse and the mounting.

The spring-loaded plastic mounting handle actuates the latch mechanism when engaged into the mounting. It readily accepts a hotstick to install or remove the assembled fuse.

A locating pin in the upper fitting assures proper alignment and engagement with the fuse. The cast bottom indoor fitting has a locating slot on the inside bore, which aligns with a locating pin on the lower section of the fuse for proper alignment. Two pivotal slots are formed into the fitting for insertion into the mount.

The bottom indoor fitting is threaded to accept a muffler attachment for limiting noise and contamination to indoor equipment. The muffler is constructed of a plated steel housing containing copper mesh screening. This copper mesh absorbs and contains the noise and exhaust materials of the fuse during a fault condition. The muffler helps prevent contamination of components and mechanisms within the switchgear. This containment action also avoids accidental flash-over from phase-to-phase or phase-to-ground by limiting airborne particles and gases.

Outdoor fittings

Outdoor end fittings are made of a cast-copper plated alloy. A large hookeye on the upper fitting allows for easy installation into pole-top mountings with a hotstick. The pivotal design of this hookeye provides for proper engagement of the upper mounting. In the event of a fault, the arcing rod will penetrate through the upper end of the fuse and cause the latch to release. Once released, the fuse will rotate down to the drop-out position to indicate a blown-fuse.

The positive locking action of the latch mechanism prevents detachment from the mounting due to shock or vibration. The lower end fitting has two cylindrical posts that insert into the lower mounting, serving as the axis to rotate the fuse into the engaged position, and to suspend the fuse during a blown, drop-out condition.

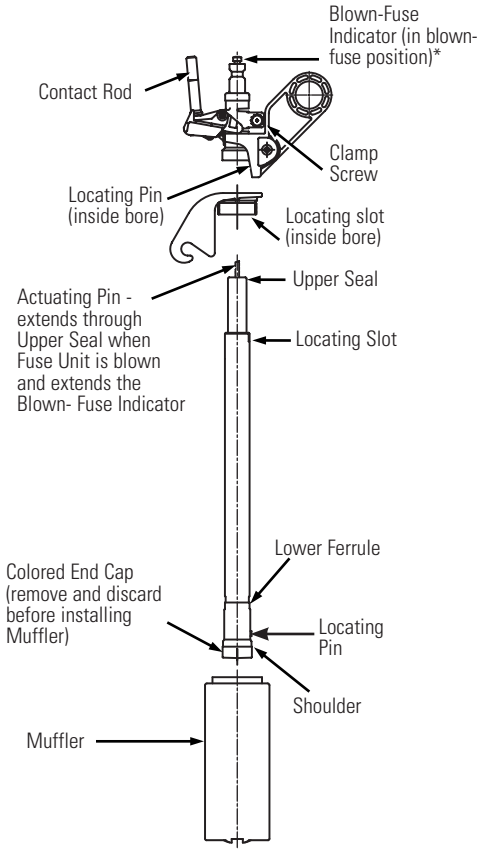


Figure 4. Indoor CMU power fuse fuse fittings.

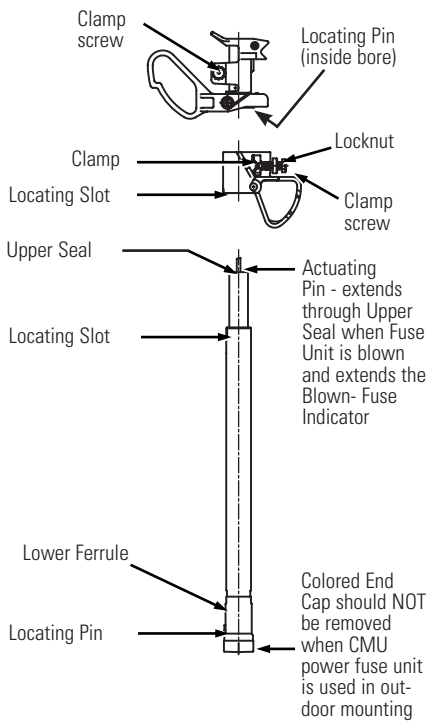
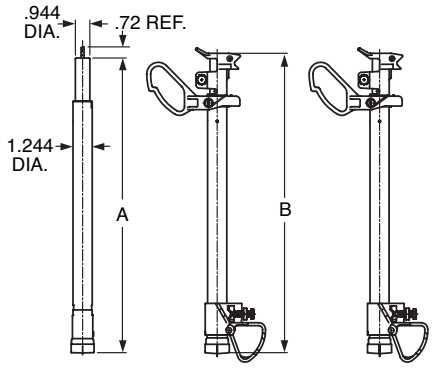
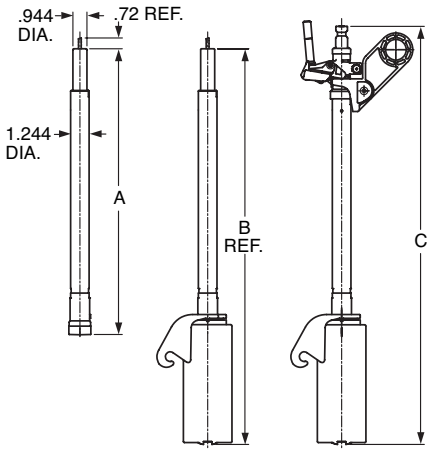


Figure 5. Outdoor CMU power fuse fittings.



	Dimensions in Inches	
Rating	**A**	**B**
17.1 kV	19.08	19.41
27.0 kV	22.58	22.91
38.0 kV	28.76	29.09



	Dimensions in Inches		
Rating	**A**	**B**	**C**
17.1 kV	19.08	27.19	28.82
27.0 kV	22.58	30.69	32.32
38.0 kV	28.76	36.87	38.50

Figure 6. Outdoor (top) and indoor (bottom) dimensions.

Table 2. TRV Characteristics

	Primary Faults			Secondary Faults		
Fuse Rating kV Normal	**Test Circuit - Normal Frequency Recovery Voltage, kV rms**	**TRV Natural Frequency, Kc**	**TRV Amplitude Factor**	**Test Circuit - Normal Frequency Recovery Voltage, kV rms**	**TRV Natural Frequency, Kc**	**TRV Amplitude Factor**
14.4	17.1	5.5	1.6	14.4	17	1.7
25	27	5.5	1.6	27	13	1.7
34.5	38	3.9	1.6	38	6.5	1.7

Table 3. CMU Power Fuse Short-Circuit Interrupting Ratings

kV, Nominal		**Amperes, Interrupting**		**MVA, Interrupting (Three-Phase Symmetrical)**
CMU	**System**	**Symmetrical based on X/R = 15**	**Asymmetrical**	**Where X/R = 15**
17	7.2	14000	22400	175
	4.8 / 8.32Y			200
	7.2 / 12.47Y			300
	7.62 / 13.2Y			320
	13.8			335
	14.4			350
	16.5			400
27	7.2 / 12.47Y	12500	20000	270
	7.62 / 13.2Y			285
	13.8			300
	14.4			310
	16.5			365
	23.0			500
	14.4 / 24.9Y			540
	20 / 34.5Y[1]			–
	23.0			–
38	14.4 / 24.9Y	10000	16000	–
	27.6			475
	20 / 34.5Y			600
	34.5			600

1 Applies to 23 kV single-insulator style only, for protection of single-phase-to-neutral circuits (line or transformers) and three-phase transformers or banks with solidly grounded neutral connections.

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