Fusing Equipment

COOPER Power Systems

Electrical Apparatus

240-94

CMU Medium Voltage Power Fuses

GENERAL

The Cooper Power Systems 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 3 maximum voltage classes: 17 kV, 27 kV, and 38 kV. The replaceable fuse unit comes in 3 speed variations: Standard “E”, Slow “E”, and “K”. Amperage sizes range from 3 A through 200 A.

The CMU Power Fuse interrupting rating greatly exceeds that of conventional distribution cutouts that uses a fiber tube and fuse 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 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.

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-Mount 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.

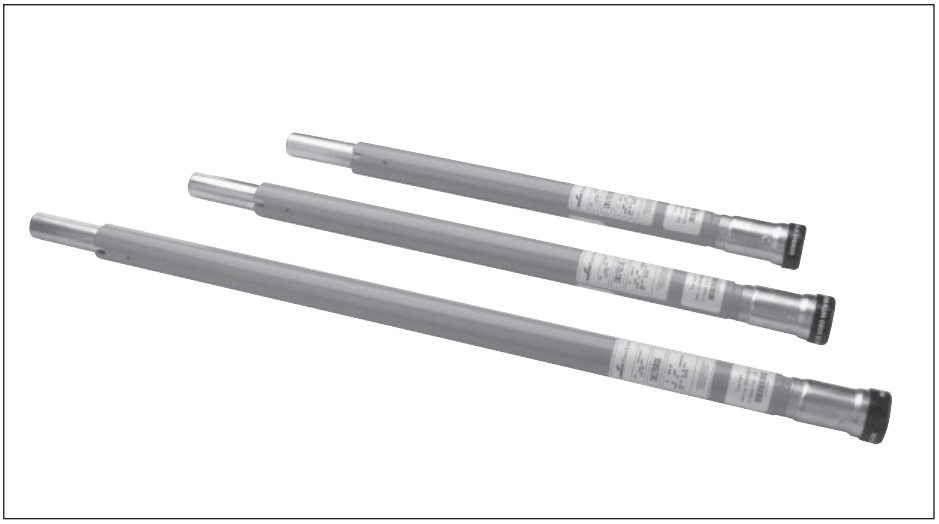


Figure 1.
CMU Power Fuse with end fittings.

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 provides excellent isolation for capacitors as well 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 Cooper Power Systems 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 S240-94-1 (5000050926) 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. (See Table 5 for correct minimum melt and maximum clear TCC curves.)
- The CMU Power Fuse provides effective protection for circuits and equipment which operates on voltages from 2,400 V to 34,500 V.

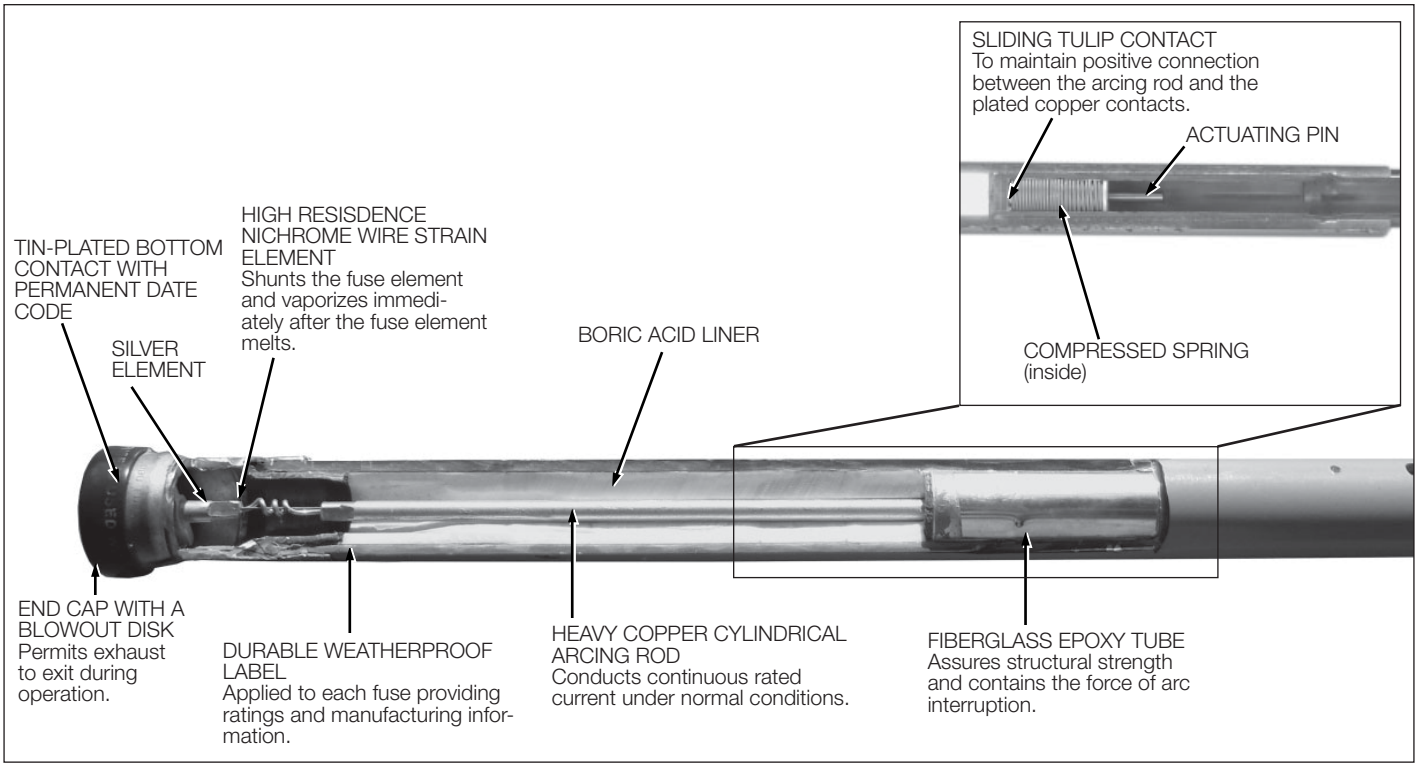


Figure 2.
Fuse unit.

- 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 must be sized with the inrush currents in mind.

The specific American National Standards Institute (**ANSI**®) standards associated with CMU Power Fuses are:

- **ANSI**® C37.40 – Service Conditions and Definitions for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories
- **ANSI**® C37.41 - Design Tests for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories
- **ANSI**® C37.42 – Specifications for High-Voltage Expulsion Type Distribution Class Fuses, Cutouts, Fuse Disconnecting Switches and Fuse links
- **ANSI**® C37.46 – Specifications for High-Voltage Expulsion and Current-Limiting Type Power Class Fuses and Fuse Disconnecting Switches
- **ANSI**® C37.48.1 – 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 by blasting through it and exiting 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 hookstick.

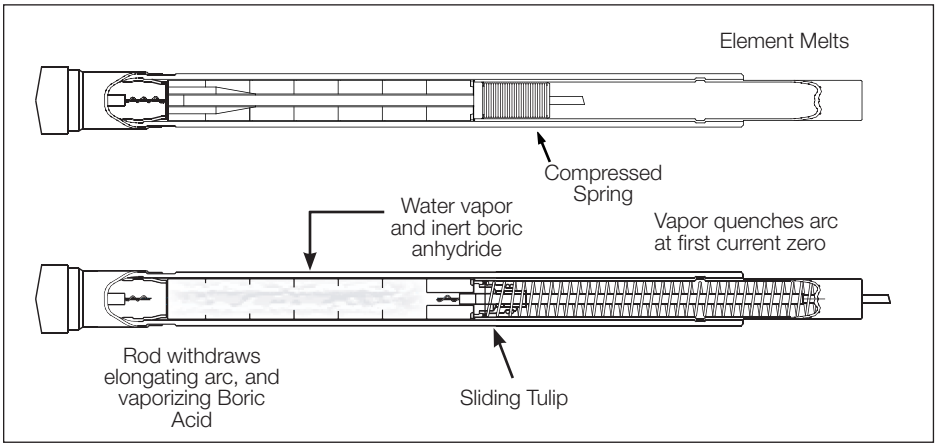


Figure 3.
CMU Power Fuse cross section view.

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.

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 hat is greater than the TRV, regardless of the fault current.

Figure 4.
Outdoor application.

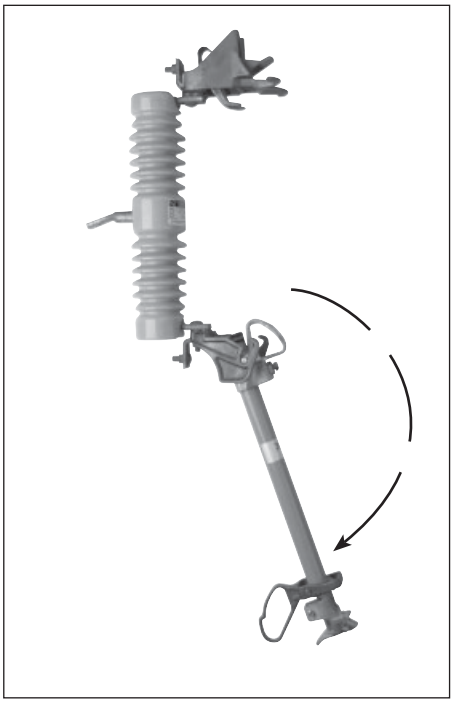


Figure 4a.
Outdoor dropout action.

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 2 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 hookstick 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.

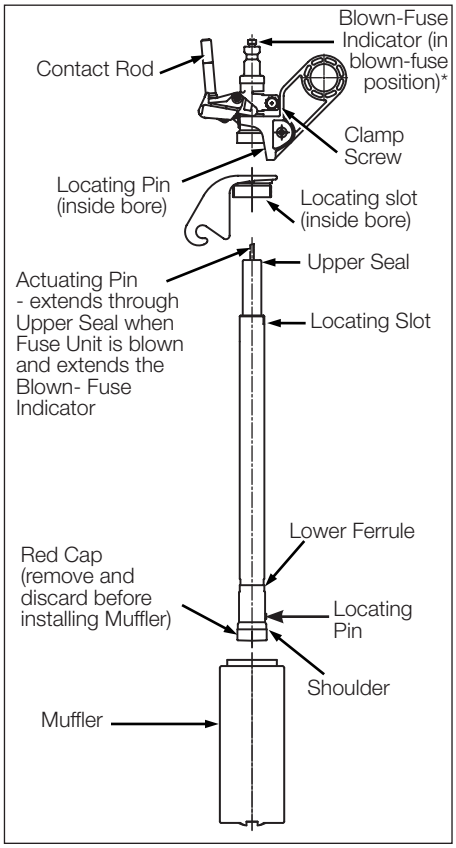
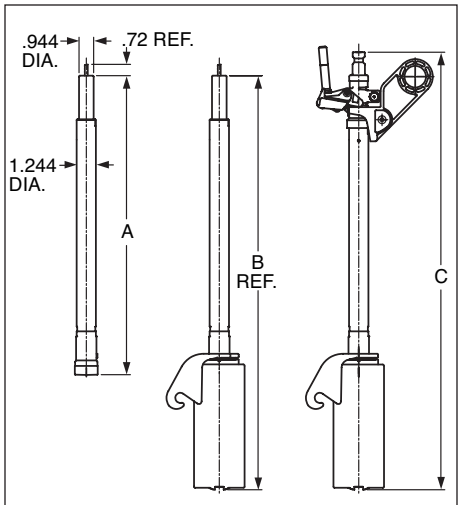


Figure 5.
Indoor CMU Power Fuse fuse fittings.



RATING	Dimensiopns in Inches 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.
Indoor dimensions.

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 hookstick. 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.

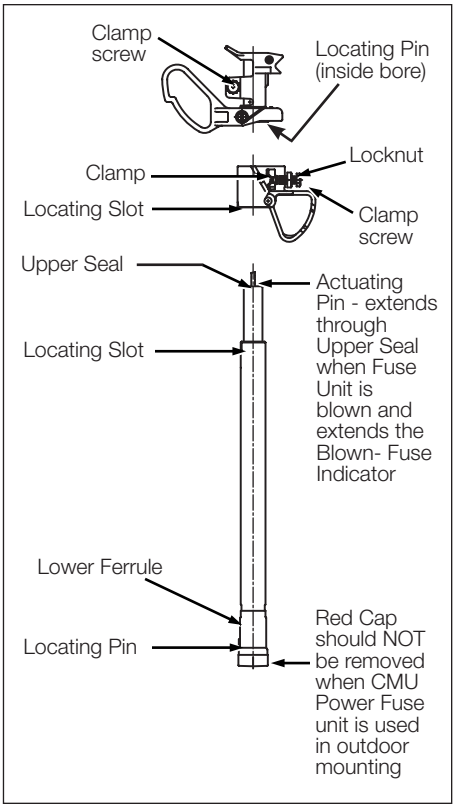
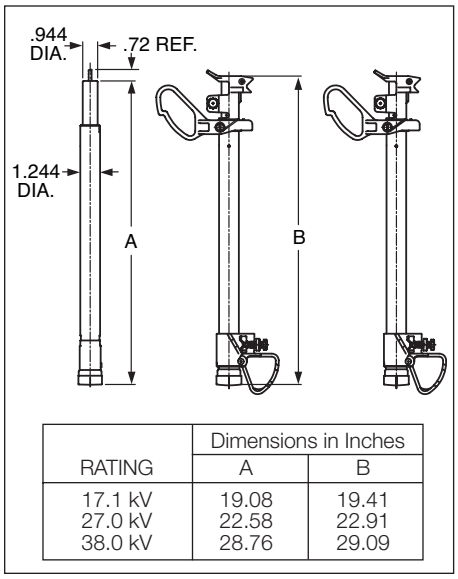


Figure 7.
Oudoor CMU Power Fuse fittings.



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

Figure 8.
Outdoor dimensions.

TABLE 1
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 2
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 tranformers) and three-phase transformers or banks with solidly grounded neutral connections.

TABLE 3
CMU Catalog Numbers and Information

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	Ampere Rating
3K	CMU702003	153	156	14	2.1	CMU3097	CMU3095	3K to 200K
6K	CMU702006							
8K	CMU702008							
10K	CMU702010							
12K	CMU702012							
15K	CMU702015							
20K	CMU702020							
25K	CMU702025							
30K	CMU702030							
40K	CMU702040							
50K	CMU702050							
65K	CMU702065							
80K	CMU702080							
100K	CMU702100							
140K	CMU702140							
200K	CMU702200							
5E	CMU612005	151	154	14	2.1	CMU3097	CMU3095	5E to 200E
7E	CMU612007							
10E	CMU612010							
13E	CMU612013							
15E	CMU612015							
20E	CMU612020							
25E	CMU612025							
30E	CMU612030							
40E	CMU612040							
50E	CMU612050							
65E	CMU612065							
80E	CMU612080							
100E	CMU612100							
125E	CMU612125							
150E	CMU612150							
175E	CMU612175							
200E	CMU612200							
15E	CMU712015	152	155	14	2.1	CMU3097	CMU3095	15SE to 200SE
20E	CMU712020							
25E	CMU712025							
30E	CMU712030							
40E	CMU712040							
50E	CMU712050							
65E	CMU712065							
80E	CMU712080							
100E	CMU712100							
125E	CMU712125							
150E	CMU712150							
175E	CMU712175							
200E	CMU712200							

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

TABLE 3 (continued)
CMU Catalog Numbers and Information

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	Ampere Rating
3K	CMU703003	153	159	12.5	2.1	CMU3097	CMU3095	3K to 200K
6K	CMU703006							
8K	CMU703008							
10K	CMU703010							
12K	CMU703012							
15K	CMU703015							
20K	CMU703020							
25K	CMU703025							
30K	CMU703030							
40K	CMU703040							
50K	CMU703050							
65K	CMU703065							
80K	CMU703080							
100K	CMU703100							
140K	CMU703140							
200K	CMU703200							
5E	CMU613005	151	157	12.5	2.1	CMU3097	CMU3095	5E to 200E
7E	CMU613007							
10E	CMU613010							
13E	CMU613013							
15E	CMU613015							
20E	CMU613020							
25E	CMU613025							
30E	CMU613030							
40E	CMU613040							
50E	CMU613050							
65E	CMU613065							
80E	CMU613080							
100E	CMU613100							
125E	CMU613125							
150E	CMU613150							
175E	CMU613175							
200E	CMU613200							
15E	CMU713015	152	158	12.5	2.1	CMU3097	CMU3095	15SE to 200SE
20E	CMU713020							
25E	CMU713025							
30E	CMU713030							
40E	CMU713040							
50E	CMU713050							
65E	CMU713065							
80E	CMU713080							
100E	CMU713100							
125E	CMU713125							
150E	CMU713150							
175E	CMU713175							
200E	CMU713200							

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

TABLE 3 (continued)
CMU Catalog Numbers and Information

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	Ampere Rating
3K	CMU704003	153	159	10	2.8	CMU3097	CMU3095	3K to 200K
6K	CMU704006							
8K	CMU704008							
10K	CMU704010							
12K	CMU704012							
15K	CMU704015							
20K	CMU704020							
25K	CMU704025							
30K	CMU704030							
40K	CMU704040							
50K	CMU704050							
65K	CMU704065							
80K	CMU704080							
100K	CMU704100							
140K	CMU704140							
200K	CMU704200							
5E	CMU614005	151	157	10	2.8	CMU3097	CMU3095	5E to 200E
7E	CMU614007							
10E	CMU614010							
13E	CMU614013							
15E	CMU614015							
20E	CMU614020							
25E	CMU614025							
30E	CMU614030							
40E	CMU614040							
50E	CMU614050							
65E	CMU614065							
80E	CMU614080							
100E	CMU614100							
125E	CMU614125							
150E	CMU614150							
175E	CMU614175							
200E	CMU614200							
15E	CMU714015	152	158	10	2.8	CMU3097	CMU3095	15SE TO 200SE
20E	CMU714020							
25E	CMU714025							
30E	CMU714030							
40E	CMU714040							
50E	CMU714050							
65E	CMU714065							
80E	CMU714080							
100E	CMU714100							
125E	CMU714125							
150E	CMU714150							
175E	CMU714175							
200E	CMU714200							

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

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