Fuses—
Medium Voltage

Contents

Fuses—Medium Voltage

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Specifications

See Eaton's *Product Specification Guide*, available on CD or on the Web.

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Current Limiting Fuses

General Description

Medium Voltage Fuses

Eaton's entry in the power fuse business began over 75 years ago under Westinghouse® Electric. In 1935, Westinghouse introduced the medium voltage boric acid expulsion fuse followed by the medium voltage current limiting fuse. Even today, medium voltage fuses continue to use the core Westinghouse technology. Eaton continues to build on the Westinghouse technology legacy by engineering higher performance, cost-effective power fuse products.

Eaton medium voltage fuses are manufactured and tested to the requirements of the ANSI C37.4X series of standards.

Eaton is the only North American manufacturer of both current limiting and expulsion medium voltage power fuses. A full range of general purpose, backup and boric acid fuses is available for distribution and power applications.

All Eaton medium voltage fuses are thoroughly tested and conform to ANSI specifications. Some motor starter fuses are UR® recognized, and both current limiting and expulsion fuses have been approved in UL® rated switchgear.

Current limiting and expulsion fuses can be used to meet any overcurrent protection need. At any point along the medium voltage electrical distribution system, Eaton has a fuse to satisfy your overcurrent protection needs.

The following fuse terminology will assist in understanding and selecting the correct fuse. The following is a brief overview of those terms.

Power vs. Distribution

The differentiation is intended to indicate the test conditions and where fuses are normally applied in a power system, based on specific requirements for generating sources, substations and distribution lines. Each class has its own unique set of voltage, current and construction requirements (see ANSI C37.42, .46 and .47).

Low vs. Medium vs. High Voltage

While fuses are defined in the ANSI standards as either low or high voltage, Eaton's Electrical Sector has elected to name their fuses to correspond with the equipment in which they are installed. Therefore, per ANSI C84, fuses are named as follows:

Low Voltage 1000V and below

Medium Voltage Greater than 1000–69,000V

High Voltage Greater than 69,000V

Expulsion vs. Current Limiting

Expulsion Fuse: An expulsion fuse is a vented fuse in which the expulsion effect of the gases produced by internal arcing, either alone or aided by other mechanisms, results in current interruption.

An expulsion fuse is not current limiting and as a result limits the duration of a fault on the electrical system, not the magnitude.

Current Limiting Fuse: A current limiting fuse is a fuse that, when its current responsive element is melted by a current within the fuse's specified current limiting range, abruptly introduces a high resistance to reduce current magnitude and duration, resulting in subsequent current interruption.

Table 9.0-1. General Fuse Comparison

Expulsion	Current Limiting
Vented	Sealed
Electromechanical	Static
Interrupts at current zero, limits fault current duration	Limits fault current magnitude and duration
Generally higher voltage ratings	Generally higher interrupting ratings
Different time/current characteristics	Different time/current characteristics

Table 9.0-2. Eaton Medium Voltage Fuse Family

Current Limiting	Expulsion
HLE: Helical configuration current limiting, E-rated CLE: Current limiting, E-rated CLS: Current limiting starter (motor starter) HCL: Current limiting, clip-mount, E-rated CX: Current limiting, C-rated CLPT: Current limiting, E-rated	RBA: Refillable, boric acid RDB: Refillable, dropout, boric acid DBU: Dropout, boric acid, indoor/outdoor S&C equivalent

Table 9.0-3. Application Guide

Type	Fuse Voltage Range (kV)	Fuse Ampere Rating	Fuse Maximum Interrupting Rating (kA Sym.)	Class Use Indoor/Outdoor	Applied in:
Current Limiting					
CLE	2.4–15.5	10E–1350A	65	General purpose indoor/outdoor	Fused switches, feeder circuit sectionalizing, power transformers, dip poles, substation capacitor banks.
CLPT	2.4–38	0.25E–10E	80	General purpose indoor	Potential transformers. BAL-1 mountings and clips are no longer available.
CLS	2.4–8.3	2R–44R	50	Backup distribution indoor	AMPGARD® and non-AMPGARD motor starters. HCLS version is the same as the CLS except hermetically sealed for hazardous locations.
CX/CXI CXN	4.3–15.5	3.5C–300C	50	General purpose distribution indoor	Pad mounted distribution transformers, Substation service transformers, and fused switches. Direct substitution for McGraw's NX fuse.
HCL	2.4–15.5	10A–900A	63	General purpose distribution indoor	Fused switches, feeder circuit sectionalizing, power transformers, dip poles, substation capacitor banks.
HLE	2.4–15.5	10E–450E	65	General purpose indoor/outdoor	Fused switches, feeder circuit sectionalizing, power transformers, dip poles, substation capacitor banks.
Expulsion Fuses					
RBA	2.4–38	0.5E–720E	37.5	Boric acid power indoor	Fused switches, feeder circuit sectionalizing, and power transformers.
RDB	2.4–38	0.5E–720E	37.5	Boric acid power outdoor	Feeder circuit sectionalizing, power transformers, substation service transformers, dip poles, potential transformers, and substation capacitor banks. Outdoor version of the RBA.
DBU	4.4–38	5E–200E, 3K–200K	50	Boric acid power indoor/outdoor	Feeder circuit sectionalizing, fused switches, power transformers, substation service transformers, dip poles, and potential transformers. Direct equivalent for S&C's SMU-20 fuse units.

Table 9.0-4. Power Fuse Ampere Characteristic Ratings

Rating	Definition
E	Fuses rated 100E or below will melt in 300 seconds at some current value between 2.0 and 2.4 times the E number.
	Fuses rated above 100E will melt in 600 seconds at some current value between 2.2 and 2.64 times the E number.
R	The fuse will melt in 15 to 35 seconds when the current equals 100 times the R number.
C	The fuse will melt in 1000 seconds at some current value between 1.7 and 2.4 times the C number.
A	Class A fuses have parameters that do not fall within the 'C', 'E', or 'R' definitions above.
X	Meet C37.40 temperature requirements, but not the E rating.

Current Limiting Fuses

Current Limiting Fuse Types

There are three current limiting fuse types: backup, general purpose and full range. It is important that the user have an understanding of these definitions to ensure proper application of the fuse (**Figure 9.0-1**).

Backup Fuse: A fuse capable of interrupting all currents from the rated maximum interrupting current down to the rated minimum interrupting current.

Backup fuses are normally used for protection of motor starters and are always used in series with another interrupting device capable of interrupting currents below the fuse's rated minimum interrupting current.

General Purpose Fuse: A fuse capable of interrupting all currents from the rated maximum interrupting current down to the current that causes melting of the fusible element in no less than one hour.

General purpose fuses are typically used to protect feeders and components such as transformers.

Full Range Fuse: A fuse capable of interrupting all currents from the rated maximum interrupting rating down to the minimum continuous current that causes melting of the fusible element, with the fuse applied at the maximum ambient temperature specified by the manufacturer.

Current limiting fuses are constructed with pure silver fuse elements, high purity silica sand filler, and a glass resin outer casing.

A high fault current melts the silver element almost instantly and loses energy to the surrounding sand. The sand melts and forms fulgurite, a glass-like substance. The arc voltage rapidly increases to nearly three times the fuse voltage rating and forces the current to zero.

Low fault current melts a solder drop on the silver fuse element that, in turn, melts the silver. The element burns back until there is a sufficient internal gap to interrupt the current. This is known as the M-effect.

Eaton offers current limiting fuses in two basic types: backup and general purpose. Backup fuses are applied in series with another circuit protective device, such as a contactor or an expulsion fuse, to interrupt high fault currents beyond the other device's range. General purpose fuses are designed to interrupt low fault currents that cause them to melt in one hour or less.

Multi-Range Fuses

CLE and HLE fuses are also available in user-selectable multi-range versions 10–40A, 50–125A and 150–200A.

Disconnect End Fittings and Disconnect Live Parts

Accessories

A wide assortment of mountings, live parts and end fittings are available to facilitate power fuse installation.

Mountings

Mountings include a base, porcelain or glass polyester insulators, and live parts. They help enable the fuse to be safely attached to the gear. Mountings can be either disconnect or non-disconnect.

Live Parts

Live parts attach the fuse to the insulators and are considered part of the mounting. All parts above the insulators are live parts.

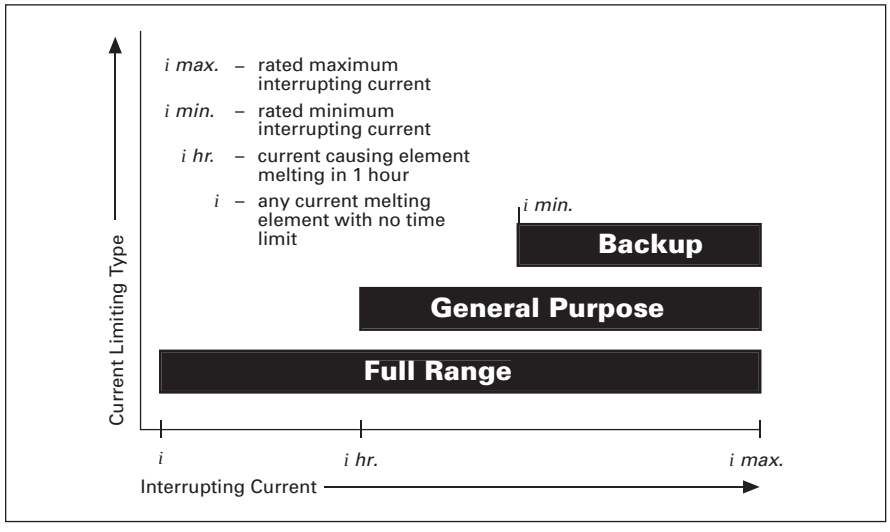

Figure 9.0-1. Current Limiting Types Protection Range

Current Limiting Fuses

Table 9.0-5. CLE, HLE, HCL and CLS Fuses

Description	Family			
	CLE	HLE	HCL	CLS
				
General				
Class	General purpose	General purpose	General purpose	Backup
Use	Power	Power	Power	Power
Maximum kV	2.75–15.5	5.5–15.5	5.5–15.5	2.4–15.5
Maximum kA	63	63	63	50
Rating	10E–1350A	10E–450A	10E–900E	2R–44R
Mounting	Clip	Clip, bolt-on, hookeye	Clip lock, bolt-on	Clip, bolt-on, hookeye
Indicator	Standard	Standard	Standard	Standard
Approvals	IEEE, ANSI	IEEE, ANSI	IEEE, ANSI	UL®, IEEE, ANSI
Applications				
Feeder circuits	■	■	■	
Motor starters				■
PTs and CTs				
LV breakers				
Substation service				
Transformers	■	■	■	
Capacitor banks	■	■	■	
Fused switches	■	■	■	

Table 9.0-6. CLPT, CX, CLT and DSL Fuses

Description	Family			
	CLPT	CX	CLT	DSL
				
General				
Class	General	General	General	Back-up
Use	Power/distribution	Distribution	Distribution	Power
Maximum kV	5.5–38	4.3–15.5	2.75–15	600V
Maximum kA	80	50	25	200
Rating	0.25E –10E	3.5C–300C	5–150	100–5000
Mounting	Clip	Clip	Stud bolt-on	Bolt-on
Indicator	Optional	None	None	None
Approvals	IEEE, ANSI	IEEE, ANSI	IEEE, ANSI	UL
Applications				
Feeder circuits				
Motor starters				
PTs and CTs	■			
LV breakers				■
Substation service		■		
Transformers		■	■	
Capacitor banks				
Fused switches				

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Expulsion Fuses

RBA
E-Rated Refillable
Boric Acid

RDB
E-Rated Refillable Outdoor
Dropout Boric Acid

DBU
Dropout Boric Acid—for Use Indoors,
Inside Switchgear or Outdoors

Eaton's expulsion fuses use boric acid as the interrupting medium. Under a fault condition, arc heat decomposes the boric acid into water vapor. The water vapor blast deionizes the arc path preventing arc re-ignition after a natural current zero.

Type RBA indoor expulsion fuses must be fitted with a discharge filter or condenser that moderates the discharge exhaust. The discharge filter limits the exhaust to a small and relatively inert amount of gas and lowers the noise level without affecting the fuse interrupting rating. Steam discharge, that can effect the interrupting, is fully restricted by the condenser.

Type RDB outdoor dropout fuses include an ejector spring that forces the arcing rod through the top of the fuse. The arcing rod strikes a latch on the mounting that forces the fuse to swing outward through a 180° arc into the dropout position.

Refill units can be field installed into RBA and RDB expulsion fuses. Once the operated unit has been removed, the separately purchased unit can be easily installed into the fuse holder.

Type DBU fuse units are designed for new and aftermarket utility applications. End fittings are available, in both indoor and outdoor versions, as well as live parts and mountings. Mufflers confine the arc within the fuse and substantially reduce the noise and exhaust when the fuse interrupts.

Accessories

The following accessories are available for expulsion fuses:

Mountings

Mountings include a base, porcelain or glass polyester insulators, and live parts. They help enable the fuse to be safely attached to the gear. Mountings can be either disconnect, non-disconnect or dropout. Non-disconnect mountings are available in either bolt-on or clamp-type arrangements. Fuses may be vertical or underhung.

Live Parts

Live parts attach the fuse to the insulators and are considered part of the mounting. All parts above the insulators are live parts.

End Fittings

End fittings are metal parts that attach to each end of the fuse at the ferrules. They are used only on disconnect fuses or when converting a non-disconnect to a disconnect fuse.

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Technical Ratings

Table 9.0-7. Transformer Primary Fuse Application

System Voltage	Fuse Type	Maximum Transformer kVA ①		Fuse Family/Characteristics			
		Self-Cooled	Forced Air	Type	Current Range	Maximum kV	Interrupting Rating Amperes (Symmetrical) ②
2400	Current limiting	742 1336 2228 4010 742 890	866 1560 2600 4676 866 1039	CLE CLE CLE-750 CLE-750 CXN CXN	10–250 300–450 600–750 1000–1350 60–250 300	5.5 8.3	63,000 63,000 40,000 31,500 50,000 50,000
	Expulsion	600 1190 2140	695 1385 2500	RBA-200 RBA-400 RBA-800 DBU-17	10–200 5–400 450–720 3–200	8.3 17.1	19,000 37,500 37,500 14,000
4160	Current limiting	1287 2317 3862 6952 1286 1545	1502 2703 4506 8111 1501 1802	CLE/HLE CLE/HLE CLE-750 CLE-750 CXN CXN	10–250 300–450 600–750 1000–1350 60–250 300	5.5 8.3	63,000 63,000 40,000 31,500 50,000 50,000
	Expulsion	1030 2055 3700	1200 2400 4320	RBA-200 RBA-400 RBA-800 DBU-17	10–200 5–400 450–720 3–200	8.3 17.1	19,000 37,500 37,500 14,000
4800	Current limiting	1483 2671 4451 8013 1483 1780	1731 3116 5193 9348 1731 2077	CLE/HLE CLE/HLE CLE-750 CLE-750 CXN CXN	10–250 300–450 600–750 1000–1350 60–250 300	5.5 8.3	63,000 63,000 40,000 31,500 50,000 50,000
	Expulsion	1190 2375 4280	1385 2775 5000	RBA-200 RBA-400 RBA-800 DBU-17	10–200 5–400 480–720 3–200	8.3	19,000 37,500 37,500 14,000
6900	Current limiting	1536 2987 2134 2560	1792 3485 2490 2987	CLE/HLE CLE CXN CXN	10–175 200–350 60–250 300	8.3	50,000 50,000 50,000 50,000
	Expulsion	1705 3415 6150	2000 3985 7170	RBA-200 RBA-400 RBA-800 DBU-17	10–200 5–400 450–720 3–200	8.3	19,000 37,500 37,500 14,000
7200	Current limiting	222 890 1603 3117 2226 2672	259 1039 1870 3637 2598 3117	CLE/HLE CLE/HLE CLE/HLE CLE CXN CXN	10–25 30–100 125–180 200–350 60–250 300	8.3	50,000 50,000 50,000 50,000 50,000 50,000
	Expulsion	1785 3565 6420	2080 4160 7500	RBA-200 RBA-400 RBA-800 DBU-17	10–200 5–400 450–720 3–200	8. 17.1	19,000 37,500 37,500 14,000

① Maximum transformer kVA ratings are based on ratios of maximum fuse current rating to transformer full load current (I_F/I_T) as listed. For a 55°C rise liquid-filled transformer, use the kVA rating for 65°C rise (55°C rating x 1.12). For suggested minimum fuse applications, see **Tables 9.0-9**, **9.0-10** and **9.0-11.**

② The type RBA interrupting ratings shown are those of the discharge filter type, in which the noise is minimized and deionization of expulsion gases is assured.

These applications are subject to modification when specific factors such as transformer characteristics, other protective devices, coordination requirements and load variations may indicate a different I_F/I_T ratio.

Caution: Primary fuses must not be relied upon for clearing secondary ground faults.

Technical Ratings (Continued)

Table 9.0-7. Transformer Primary Fuse Application (Continued)

System Voltage	Fuse Type	Maximum Transformer kVA ①		Fuse Family/Characteristics			
		Self-Cooled	Forced Air	Type	Current Range	Maximum kV	Interrupting Rating Amperes (Symmetrical) ②
12,000	Current limiting	371 1484 2226 4452 1484 2597	432 1731 2597 5195 1731 3030	CLE HLE CLE HLE CXN CXN	10–150 10–125 175–300 150–250 45–100 120–175	15.5	63,000 63,000 63,000 63,000 50,000 50,000
	Expulsion	2970 5945	3465 6930	RBA-200 RBA-400 RBA-800 DBU-17	10–200 5–400 450–720 10–200	15.5	14,400 29,400 29,400 14,000
13,200	Current limiting	408 1632 2449 4898 1632 2857	476 1905 2857 5715 1905 3333	CLE HLE CLE HLE CXN CXN	10–150 10–125 175–300 150–250 45–100 120–175	15.5	63,000 63,000 63,000 63,000 50,000 50,000
	Expulsion	3265 6530	3810 7620	RBA-200 RBA-400 RBA-800 DBU-17	10–200 5–400 450–720 7–150	15.5	14,400 29,400 29,400 14,000
13,800	Current limiting	426 1707 2560 5121 1707 5855	497 1991 2987 5975 1991 3485	CLE HLE CLE HLE CXN CXN	10–150 10–125 175–300 150–250 45–100 120–175	15.5	63,000 63,000 63,000 63,000 50,000 50,000
	Expulsion	3415 6830 3415	3985 7970 3985	RBA-200 RBA-400 RBA-800 DBU-17	10–200 5–400 450–720 7–150	15.5 17.1	14,400 29,400 29,400 14,000
23,000	Expulsion	5690 8535 5690	6635 9950 6635	RBA-200 RBA-400 RBA-800 DBU-27	10–200 5–300 450–540 3–200	25.5 27.0	10,500 21,000 21,000 12,500
34,500	Expulsion	8535 12800 8535	9950 14925 9950	RBA-200 RBA-400 RBA-800 DBU-38	10–200 5–300 450–540 3–200	38.0	6,900 16,800 16,800 10,000

① Maximum transformer kVA ratings are based on ratios of maximum fuse current rating to transformer full load current (I_F/I_T) as listed. For a 55°C rise liquid-filled transformer, use the kVA rating for 65°C rise (55°C rating x 1.12). For suggested minimum fuse applications, see **Tables 9.0-9**, **9.0-10** and **9.0-11.**

② The type RBA interrupting ratings shown are those of the discharge filter type, in which the noise is minimized and deionization of expulsion gases is ensured.

These applications are subject to modification when specific factors such as transformer characteristics, other protective devices, coordination requirements and load variations may indicate a different I_F/I_T ratio.

Caution: Primary fuses must not be relied upon for clearing secondary ground faults.

Table 9.0-8. Selection of Minimum Primary Fuse for Transformer Protection

Instructions: Multiply the transformer primary full load current (FLA) times the multiplier shown in the table to determine suggested minimum size fuse. Use fan-cooled primary FLA with forced air transformer multiplier. See **Tables 9.0-9** thru **9.0-11** for suggested minimum fuse size.		For self-cooled transformers	For forced air transformers
Type CLE current limiting fuses Type RBA, DBU expulsion type fuses	All ratings	1.4 x FLA of XFMR	1.2 x FLA of XFMR

Interrupting Ratings of Fuses

Modern fuses are rated in amperes rms symmetrical. They also have a listed asymmetrical rms rating, which is 1.6 x the symmetrical rating.

Refer to ANSI/IEEE C37.48 for fuse interrupting duty guidelines.

Calculation of the fuse required interrupting rating:

Step 1—Convert the fault from the utility to percent or per unit on a convenient voltage and kVA base.

Step 2—Collect the X and R data of all the other circuit elements and convert to percent or per unit on a convenient kVA and voltage base same as that used in **Step 1**. Use the substransient X and R for all generators and motors.

Step 3—Construct the sequence networks using reactances and connect properly for the type of fault under consideration and reduce to a single equivalent reactance.

Step 4—Same as above except using resistances (omit if a symmetrically rated fuse is to be selected).

Step 5—Calculate the E/X_I value, where E is the prefault value of the voltage at the point of fault normally assumed 1.0 in pu. For three-phase faults E/X_I is the fault current to be used in determining the required interrupting capability of the fuse.

Note: It is not necessary to calculate a single phase-to-phase fault current. This current is very nearly $\sqrt{3}/2$ x three-phase fault. The line-to-ground fault may exceed the three-phase fault for fuses located in generating stations with solidly grounded neutral generators, or in delta-wye transformers with the wye solidly grounded, where the sum of the positive and negative sequence impedances on the high voltage side (delta) is smaller than the impedance of the transformer.

For single line-to-ground fault;

$$X_I = X_I(+) + X_I(-) + X_I(0)$$

$$I_f = \frac{E}{X_I} \times 3$$

Step 6—Select a fuse with a published interrupting rating exceeding the calculated fault current.

Table 9.0-10 should be used where older asymmetrically rated fuses are involved.

The voltage rating of power fuses used on three-phase systems should equal or exceed the maximum line-to-line voltage rating of the system. Current limiting fuses for three-phase systems should normally be applied so that the fuse voltage rating is equal to or less than 1.41 x nominal system voltage. However, the insulation levels on 2.4 kV systems normally allow 4.3 or 5.5 kV rated fuses to be used.

Table 9.0-9. Suggested Minimum Current Limiting Fuse Current Ratings for Self-Cooled 2.4–15.5 kV Transformer Applications—E-Rated Fuses

System Nominal kV	2.4		4.16		4.8		7.2		12.0		13.2		13.8		14.4	
Fuses Maximum kV	2.75		5.5		5.5		8.3		15.5		15.5		15.5		15.5	
Transformer kVA Rating Self-Cooled	Full Load Current Amps	Fuse Rating Amps E	Full Load Current Amps	Fuse Rating Amps E	Full Load Current Amps	Fuse Rating Amps E	Full Load Current Amps	Fuse Rating Amps E	Full Load Current Amps	Fuse Rating Amps E	Full Load Current Amps	Fuse Rating Amps E	Full Load Current Amps	Fuse Rating Amps E	Full Load Current Amps	Fuse Rating Amps E
112.5	27.1	50E	15.6	25E	13.5	20E	9.0	15E	5.4	10E	4.9	10E	4.7	10E	4.5	10E
150	36.1	65E	20.8	30E	18.0	25E	12.0	20E	7.2	15E	6.6	10E	6.3	10E	6.0	10E
225	54.1	80E	31.2	50E	27.1	50E	18.0	25E	10.8	15E	9.8	15E	9.4	15E	9.0	15E
300	72.2	125E	41.6	80E	36.1	65E	24.1	40E	14.4	20E	13.1	20E	12.6	20E	12.0	20E
500	120.3	200E	69.4	125E	60.1	100E	40.1	65E	24.1	50E	21.9	30E	20.9	30E	20.0	30E
750	180.4	300E	104.1	150E	90.2	150E	60.1	100E	36.1	65E	32.8	65E	31.4	65E	30.1	65E
1000	240.6	350E	138.8	200E	120.3	175E	80.2	125E	48.1	80E	43.7	80E	41.8	80E	40.1	80E
1500	360.8	600E	208.2	300E	180.4	250E	120.3	175E	72.2	100E	65.6	100E	62.8	100E	60.1	100E
2000	481.1	750E	277.6	400E	240.6	350E	160.4	250E	96.2	150E	87.5	125E	83.7	150E	80.2	125E
2500	601.4	1100E	347.0	600E	300.7	450E	200.5	300E	120.3	200E	109.3	175E	104.6	175E	100.2	175E
3000	721.7	1100E	416.4	600E	360.8	600E	240.6	350E	144.3	250E	131.2	200E	125.5	200E	120.3	200E
3750	902.1	1350E	520.4	750E	451.1	750E	300.7	—	180.4	250E	164.0	250E	156.9	250E	150.4	250E
5000	1202.8	—	693.9	1100E	601.4	1100E	400.9	—	240.6	—	218.7	300E	209.2	300E	200.5	300E
7500	1804.2	—	1040.9	—	902.1	1350E	601.4	—	360.8	—	328.0	—	313.8	—	300.7	—
10,000	2405.6	—	1387.9	—	1202.8	—	801.9	—	481.1	—	437.4	—	418.4	—	400.9	—

Note: Fuse ratings represent the fuse that will withstand transformer inrush (12 x FLC for 0.1 second and 25 x FLC for 0.01 second) and be able to handle temporary overloads (133% of FLC, 150% for 15.5 kV).

Table 9.0-10. Suggested Minimum RBA Expulsion Fuse Ratings for Self-Cooled 2.4–15.5 kV Transformer Applications—E-Rated Fuses

System Nominal kV	2.4		4.16		4.8		7.2		12.0		13.2		13.8		14.4	
Fuses Maximum kV	2.75		5.5		5.5		8.3		15.5		15.5		15.5		15.5	
Transformer kVA Rating Self-Cooled	Full Load Current Amps	Fuse Rating Amps E	Full Load Current Amps	Fuse Rating Amps E	Full Load Current Amps	Fuse Rating Amps E	Full Load Current Amps	Fuse Rating Amps E	Full Load Current Amps	Fuse Rating Amps E	Full Load Current Amps	Fuse Rating Amps E	Full Load Current Amps	Fuse Rating Amps E	Full Load Current Amps	Fuse Rating Amps E
112.5	27.1	40E	15.6	25E	13.5	20E	9.0	15E	5.4	10E	4.9	10E	4.7	10E	4.5	10E
150	36.1	50E	20.8	30E	18.0	25E	12.0	20E	7.2	10E	6.6	10E	6.3	10E	6.0	10E
225	54.1	80E	31.2	50E	27.1	40E	18.0	25E	10.8	15E	9.8	15E	9.4	15E	9.0	15E
300	72.2	100E	41.6	65E	36.1	50E	24.1	40E	14.4	20E	13.1	20E	12.6	20E	12.0	20E
500	120.3	175E	69.4	100E	60.1	80E	40.1	65E	24.1	40E	21.9	30E	20.9	30E	20.0	30E
750	180.4	250E	104.1	150E	90.2	125E	60.1	80E	36.1	50E	32.8	50E	31.4	50E	30.1	50E
1000	240.6	400E	138.8	200E	120.3	175E	80.2	125E	48.1	65E	43.7	65E	41.8	65E	40.1	65E
1500	360.8	450E ①	208.2	300E	180.4	250E	120.3	175E	72.2	100E	65.6	100E	62.8	100E	60.1	80E
2000	481.1	720E ②	277.6	400E	240.6	350E	160.4	250E	96.2	150E	87.5	125E	83.7	125E	80.2	125E
2500	601.4	—	347.0	540E ①	300.7	400E	200.5	300E	120.3	175E	109.3	150E	104.6	150E	100.2	150E
3000	721.7	—	416.4	720E ②	360.8	540E ①	240.6	350E	144.3	200E	131.2	175E	125.5	175E	120.3	175E
3750	902.1	—	520.4	720E ②	451.1	720E ②	300.7	400E	180.4	250E	164.0	250E	156.9	250E	150.4	200E
5000	1202.8	—	693.9	—	601.4	—	400.9	540E ①	240.6	400E	218.7	300E	209.2	300E	200.5	300E
7500	1804.2	—	1040.9	—	902.1	—	601.4	—	360.8	540E ①	328.0	450E ③	313.8	450E ③	300.7	450E ③
10,000	2405.6	—	1387.9	—	1202.8	—	801.9	—	481.1	720E ②	437.4	720E ②	418.4	720E ②	400.9	540E ①

① Two 300E-ampere fuse refill units in parallel with 10% derating.
② Two 400E-ampere fuse refill units in parallel with 10% derating.
③ Two 250E-ampere fuse refill units in parallel with 10% derating.

Note: Fuse ratings represent the fuse that will withstand transformer inrush (12 x FLC for 0.1 second and 25 x FLC for 0.01 second) and be able to handle temporary overloads (133% of FLC, 150% for 15.5 kV).

Table 9.0-11. Suggested Minimum RBA Expulsion Fuse Ratings for Self-Cooled 25.8–38 kV Transformer Applications

System Nominal kV	22.9		23.9		24.9		34.5	
Fuses Maximum kV	25.8		25.8		24.8		—	
Transformer kVA Rating Self-Cooled	Full Load Current Amps	Fuse Rating Amps E	Full Load Current Amps	Fuse Rating Amps E	Full Load Current Amps	Fuse Rating Amps E	Full Load Current Amps	Fuse Rating Amps E
750	18.9	30E	18.1	25E	17.4	25E	12.6	20E
1000	25.2	40E	24.2	40E	23.2	40E	16.7	25E
1500	37.8	65E	36.2	50E	34.8	50E	25.1	40E
2000	50.4	80E	48.3	65E	46.4	65E	33.5	50E
2500	63.0	100E	60.4	100E	58.0	80E	41.8	65E
3000	75.6	125E	72.5	100E	69.6	100E	50.2	80E
3750	94.5	150E	90.6	125E	87.0	125E	62.8	100E
5000	126.1	175E	120.8	175E	115.9	175E	83.7	125E
7500	189.1	300E	181.2	250E	173.9	250E	125.5	175E
10,000	252.1	450E ④	241.6	450E ④	231.9	450E ④	167.3	250E

④ Two 250E-ampere fuse refill units in parallel with 10% derating.

Note: Fuse ratings represent the fuse that will withstand transformer inrush (12 x FLC for 0.1 second and 25 x FLC for 0.01 second) and be able to handle temporary overloads (133% of FLC, 150% for 15.5 kV).

Table 9.0-12. Suggested Minimum DBU Expulsion Fuse Current Ratings for Self-Cooled 2.4–15.5 kV Power Transformer Applications

System Nominal kV	2.4		4.2		4.8		7.2		12.0		13.2		13.8		14.4	
Fuses Maximum kV	17.1		17.1		17.1		17.1		17.1		17.1		17.1		17.1	
Transformer kVA Rating Self-Cooled	Full Load Current Amps	Fuse Rating Amps E	Full Load Current Amps	Fuse Rating Amps E	Full Load Current Amps	Fuse Rating Amps E	Full Load Current Amps	Fuse Rating Amps E	Full Load Current Amps	Fuse Rating Amps E	Full Load Current Amps	Fuse Rating Amps E	Full Load Current Amps	Fuse Rating Amps E	Full Load Current Amps	Fuse Rating Amps E
Three-Phase Transformers																
112.5	27	40E	16	25E	14	20E	9	15E	5	10E	5	7E	5	7E	5	7E
150	36	50E	21	30E	18	25E	12	20E	7	10E	7	10E	6	10E	6	10E
225	54	80E	31	50E	27	40E	18	25E	11	15E	10	15E	9	15E	9	15E
300	72	100E	42	65E	36	50E	24	40E	14	20E	13	20E	13	20E	12	20E
500	120	200E	69	100E	60	100E	40	65E	24	40E	22	30E	21	30E	20	30E
750	180	—	104	150E	90	125E	60	100E	36	50E	33	50E	31	50E	30	50E
1000	241	—	139	200E	120	200E	80	125E	48	80E	44	65E	42	65E	40	65E
1500	361	—	208	—	180	—	120	200E	72	100E	66	100E	63	100E	60	65E
2000	481	—	278	—	241	—	160	—	96	150E	87	125E	84	125E	80	125E
2500	601	—	347	—	301	—	200	—	120	200E	109	150E	105	150E	100	150E

Note: Fuse ratings represent the fuse that will withstand transformer inrush (12 x FLC for 0.1 second and 25 x FLC for 0.01 second) and be able to handle temporary overloads (133% of FLC, 150% for 15.5 kV).

Table 9.0-13. Suggested Minimum DBU Expulsion Fuse Current Ratings for Self-Cooled 2.4–15.5 kV Power Transformer Applications

System Nominal kV	22.9		23.9		24.9		34.5	
Fuses Maximum kV	27.0		27.0		27.0		38.0	
Transformer kVA Rating Self-Cooled	Full Load Current Amps	Fuse Rating Amps E	Full Load Current Amps	Fuse Rating Amps E	Full Load Current Amps	Fuse Rating Amps E	Full Load Current Amps	Fuse Rating Amps E
Three-Phase Transformers								
750	19	30E	18	25E	17	25E	13	20E
1000	25	40E	24	40E	23	40E	17	25E
1500	38	65E	36	50E	34	50E	25	40E
2000	50	80E	48	80E	46	65E	33	50E
2500	63	100E	60	100E	58	80E	42	65E
3750	95	150E	91	150E	87	125E	63	100E

Note: Fuse ratings represent the fuse that will withstand transformer inrush (12 x FLC for 0.1 second and 25 x FLC for 0.01 second) and be able to handle temporary overloads (133% of FLC, 150% for 15.5 kV).

Table 9.0-14. Type DBU Expulsion Fuses, Boric Acid, Indoor/Outdoor

Maximum Design kV	Current Rating Amperes	Interrupting Rating rms (kA Symmetrical)
17.1	3K, 6K, 8K, 10K, 12K, 15K, 20K, 25K, 30K, 40K, 50K, 65K, 80K, 100K, 140K, 200K, 5E, 7E, 10E, 13E, 15E, 20E, 25E, 30E, 40E, 50E, 65E, 80E, 100E, 125E, 150E, 175E, 200E, 15SE, 20SE, 25SE, 30SE, 40SE, 50SE, 65SE, 80SE, 100SE, 125SE, 150SE, 175SE, 200SE	14
27	3K, 6K, 8K, 10K, 12K, 15K, 20K, 25K, 30K, 40K, 50K, 65K, 80K, 100K, 140K, 200K, 5E, 7E, 10E, 13E, 15E, 20E, 25E, 30E, 40E, 50E, 65E, 80E, 100E, 125E, 150E, 175E, 200E, 15SE, 20SE, 25SE, 30SE, 40SE, 50SE, 65SE, 80SE, 100SE, 125SE, 150SE, 175SE, 200SE	12.5
38	3K, 6K, 8K, 10K, 12K, 15K, 20K, 25K, 30K, 40K, 50K, 65K, 80K, 100K, 140K, 200K, 5E, 7E, 10E, 13E, 15E, 20E, 25E, 30E, 40E, 50E, 65E, 80E, 100E, 125E, 150E, 175E, 200E, 15SE, 20SE, 25SE, 30SE, 40SE, 50SE, 65SE, 80SE, 100SE, 125SE, 150SE, 175SE, 200SE	10–outdoor 8.5–indoor with muffler

Note: Used on overhead distribution transformers, substation equipment, industrial transformer installations, and radial distribution circuits.

For additional information, see:
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