

Eaton Expulsion Fuses



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Eaton Expulsion Fuses



### Product Description

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 de-ionizes the arc path preventing arc re-ignition after a natural current zero.

RBA type 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.

RDB type 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.

DBU type 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.

#### 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



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### 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 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.

### Catalog Numbers

Each Eaton fuse product is identified by a unique descriptive catalog number that contains major information such as the fuse family and item, and rated maximum continuous current and rated maximum application voltage where applicable. The catalog number does not change where form, fit and function remain unchanged, although the associated Eaton internal 10 character style number may change. Fuse products should be ordered by the descriptive catalog number.

## Refillable and Replaceable Fuses

Boric acid expulsion power fuses are divided into two types, refillable and replaceable.

Refillable fuses are constructed so that the consumable refill unit can be removed and replaced after a fuse operation. Because the fuse holder and spring and shunt assembly components are reused, they can be constructed with a heavy duty design that also allows the unit to have a high interrupting capacity. Because these components are reused it is easy to change fuse current rating by simply changing the refill unit.

The indoor refillable fuse is the RBA (Refillable Boric Acid) fuse. It is designed to be used indoor or in an enclosure with an exhaust control device that limits the discharge given off by the fuse during operation. Three types of exhaust control devices are available to limit the discharge. A condenser may be used that fully restricts the discharge but reduces the interrupting

rating. A discharge filter is available that restricts discharge but not to a level that causes a reduction in the interrupting rating. A high capacity discharge filter is also available, but its use is restricted to certain applications on 15.5 kV equipment at maximum voltages below 14.4 kV. This device allows a higher interrupting rating, but allows more discharge.

The outdoor refillable fuse is the RDB (Refillable Dropout Boric acid) fuse. RDB fuses cannot be equipped with exhaust control devices.

The construction of the RDA and RDB is similar. They both utilize RBA refill units. The main difference in the internal construction is the ballistic kick-out pin that initiates the dropout action. Externally the RBD outdoor fuse holder tube has a protective coating of tough epoxy paint that provides ultraviolet protection. The fuse holder has a sealed weatherproof design.

A complete fuse consists of a fuse mounting, a fuse holder that includes the spring and shunt assembly, a refill unit, and an exhaust control device for indoor applications. These parts are shown in the RBA/RDB section.

Both disconnect and non-disconnect mountings are available for RBA fuses. Each of these mountings has front connected terminals. Indoor non-disconnect fuse holders have translucent tubes, and the lower end of the spring and shunt assembly is equipped with a bright orange cap to give a visual indication of fuse operation. RDB outdoor mountings must be disconnecting because of the dropout requirement to provide dielectric isolation and visible indication.

BA type installations were made obsolete several years ago, but BA refill units are still available to enable re-fusing in existing applications. BA and RBA installations use the same exhaust control devices. RBA filters or condensers can be used to replace BA filters or condensers if required. Replacement BA mountings and fuse holders are not normally available.

Replaceable fuses have a lower initial installed cost by providing a more cost effective construction. Replaceable fuses generally offer faster reconnection, but with higher replacement cost and lower interrupting ratings.

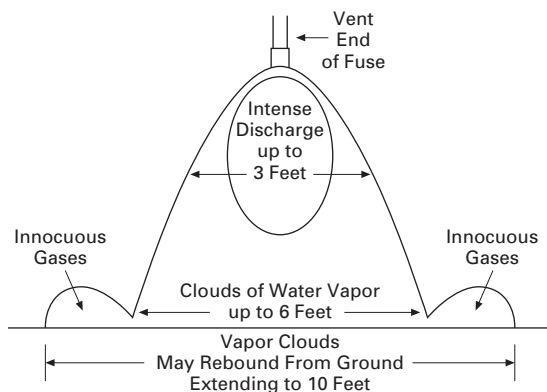
Eaton offers a replaceable style DBU fuse for either indoor or outdoor applications. DBU fuses are lighter, less expensive fuses than the higher rated RBA/RBD fuses. DBA fuse units are offered as replacement fuses, but DBA mountings are no longer available.

## Outdoor Applications

For outdoor application of the RDB, DBU and DBA fuses, it is important that fuses that have not operated are not left hanging in the disconnected position for extended periods. If the weather seals on these fuses are broken or damaged, it is possible for water to enter and damage the fuse unit or fuse refill unit. The integrity of these seals is directly related to the integrity of the fuse unit or fuse refill unit. Seals should be checked periodically and an affected fuse unit or fuse refill unit replaced. The condition of the paint on the fuse unit should also be checked periodically.

Eaton expulsion fuses use boric acid for the interrupting medium. When the fuse element melts, the heat of the arc decomposes the boric acid, releasing water vapor that cools and extinguishes the arc by blasting through it and exiting the bottom of the fuse. The interruption process produces both a flow of exhaust gas and a good deal of noise. To moderate the pressure wave and noise, an exhaust control device is added to indoor fuses. Exhaust control devices limit the exhaust to a small and relatively inert amount of gas while lowering the noise level, but have little or no effect on the interrupting rating of the fuse. Mufflers and condensers absorb and contain the exhaust while drastically reducing the noise level; however, a condenser or muffler may cause a reduction of the interrupting rating of the fuse.

### Typical Discharge Pattern from an Eaton Outdoor Boric Acid Power Fuse



DBU Outdoor Mounting

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### Fuse Selection

There are four factors involved in the selection of a boric acid expulsion fuse.

The first three considerations are the rated maximum voltage, the rated maximum interrupting current including the rate of rise of the transient recovery voltage, and the rated continuous current of the fuse. Proper attention must be given to each of these as improper application in any one of these areas may result in the fuse failing to perform its intended function. The fourth consideration is coordination with line and load side protective equipment that is needed to give selectivity of outage and to prevent premature operation.

Each of these four areas is discussed in detail.

### Voltage Rating

The first consideration regarding fuse application is that the fuse selected must have a rated maximum voltage equal to or greater than the maximum power frequency voltage that could be impressed across the fuse under any possible conditions. In most cases, this means that the rated maximum voltage of the fuse must equal or exceed the system maximum line-to-line voltage. The only exception to this rule occurs when fusing single-phase loads connected from line-to-neutral on an effectively grounded four-wire system. Here, the fuse rated maximum voltage need only exceed the system maximum line-to-neutral voltage, providing it is impossible for the fuse to experience the full

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line-to-line voltage under any fault condition. A good rule of thumb is that if more than one phase of the system is extended beyond the fuse location, the fuse rated maximum voltage must equal or exceed the system maximum line-to-line voltage, regardless of how the three-phase system is grounded on the source side of the fuse or how the transformers or loads are connected on the load side of the fuse. It is a fairly common practice to fuse wye grounded wye transformers with fuses that have a rated maximum voltage that only exceeds then system line-to-neutral voltage. In most cases, this presents no problem, but the user should be aware of the remote possibility of a

secondary phase-to-phase fault that could impose full line-to-line voltage across a single fuse. When only one phase of a four-wire effectively grounded system is extended beyond the fuse location to supply a load connected from phase-to-neutral, it is usually acceptable to have the fuse rated maximum voltage equal or exceed the maximum line-to neutral voltage.

It is permissible for expulsion fuse rated voltage to exceed the system voltage by any desired amount but under no circumstances may the system maximum voltage exceed the fuse rated maximum voltage.

### Interrupting Rating

Under no circumstance should a fuse be applied in a situation where the available fault current exceeds the interrupting rating of the fuse.

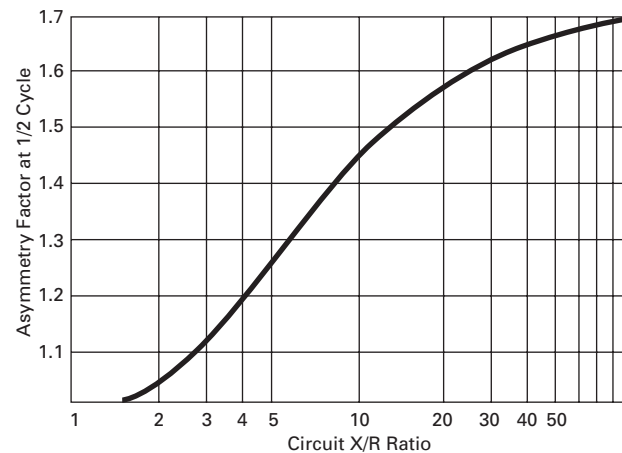
The rated maximum interrupting current of a boric acid expulsion fuse is the rms value of the symmetrical AC component of the highest current that the fuse has been demonstrated to be able to interrupt under any conditions of asymmetry with specified circuit conditions. In other words, the rated maximum interrupting current denotes the maximum symmetrical fault current permitted at the fuse location. Historically, boric acid expulsion fuses have alternately been rated in terms of asymmetrical fault current. Asymmetrical currents are related to symmetrical currents by the asymmetry factor, which is the ratio of the rms values of the asymmetrical and symmetrical currents. The asymmetrical current includes the decaying DC component of the fault current. Asymmetry factors are a function of the circuit X/R ratio, and this relationship is shown below. Theoretically, the maximum asymmetry factor in a purely inductive circuit 1.732; however, with X/R ratios encountered in power circuits, it is rarely ever more than 1.6. Fuse standards suggest an asymmetry factor of 1.56 to 1.6. The minimum

asymmetry factor at which Eaton boric acid expulsion fuses are tested to determine their rated maximum interrupting current is 1.6. In general, historically stated asymmetrical rms rated maximum interrupting currents can be converted to their rms symmetrical rated maximum counterparts by dividing the asymmetrical value by 1.6.

Historically, a third way to state the interrupting rating of a boric acid expulsion fuse was with nominal three-phase kVA ratings. Three-phase kVA ratings are calculated by the formula  $kVA = I \times kV \times 1.732$ , where I is the rated maximum interrupting current in symmetrical rms amperes and kV is the fuse nominal voltage rating. With this method, it must be kept in mind that fuses are not constant kVA devices, that is, if the voltage is half the fuse rating, the interrupting current does not double but remains the same. The fuse will interrupt any current up to the rated maximum interrupting current as long as the power frequency voltage does not exceed the rated maximum voltage of the fuse.

Interrupting ratings for each type of Eaton expulsion fuse are listed in the detailed sections for each fuse type.

### Asymmetry Factors



When the fusible element in an expulsion fuse melts as the result of a fault, an arc is established within the fuse. Normal operation of an expulsion fuse causes elongation of the arc due to spring tension. The current continues to flow in the circuit and within the fuse until a natural current zero of the circuit is reached. When the arc is extinguished at a current zero, the voltage across the fuse terminals changes abruptly from a relatively low value of arc voltage to the power frequency recovery voltage. The rapid voltage change, in association with the inherent capacitance in the circuit, causes a short duration high frequency voltage oscillation to be superimposed on the power frequency recovery

voltage. This combination of power frequency voltage and high frequency oscillatory voltage is known as the Transient recovery voltage. Transient recovery voltages produce high voltage stresses across the fuse terminals. The dielectric strength between the fuse terminals must rise faster than the transient recovery voltage if a successful interruption is to occur. The natural frequency of the transient recovery voltage is determined by the circuit inductance and capacitance, and the amplitude and decay rate are determined by the circuit resistance. The peak factor is the ratio of the highest (first) peak of the transient recovery voltage to the power frequency recovery voltage.

# 2.2

## Expulsion Fuses

### Fuse Selection

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Primary faults, or faults on the primary side of a transformer, will generally produce higher short-circuit currents and less severe transient recovery voltages. Secondary faults produce lower fault currents and more severe transient recovery voltages. This is due to the insertion of the transformer impedance in the circuit. Eaton recognizes the effects of the different parameters involved in primary and secondary fault phenomena. These various conditions are

also reflected in the test parameters called for in IEEE Std. C37.41-2000™. Eaton's line of expulsion fuses have proven their ability to successfully withstand the transient recovery voltage associated with both types of faults. The table on **Page V14-T2-6** lists the frequency of the transient recovery voltage and amplitude factors at which these fuses were tested. These conditions meet or exceed the requirements of the ANSI Standards.

Another consideration when applying power fuses is the altitude at which they are installed. The dielectric strength of air decreases with increasing altitude. De-rating is required for applications at altitudes above 1000 meters (3300 feet). Correction factors for various altitudes are listed in IEEE Std. C37.40™.

Fuses are fault protective devices, and are overload tolerant not overload protective devices. By design, power type expulsion

fuses are not intended to operate on fault currents below the secondary terminal fault of the associated transformer. Distribution type expulsion fuses can be used where the protection requirements call for a greater degree of overload protection. However, E-rated and K-rated fuses do not provide protection for fault currents less than two times the continuous current rating of the fuse.

#### Transient Recovery Voltage Values for RBA, RDB and DBU Fuses

Voltage kV	Transient Recovery Voltage Values				
	Nominal	Maximum Design	Primary Fault Recovery		Secondary Fault Recovery
Frequency in kHz			Amplitude Factor	Frequency in kHz	Amplitude Factor
2.40	2.75	9.0	1.6	26.0	1.6
4.16	4.80	9.0	1.6	26.0	1.6
4.80	5.50	9.0	1.6	26.0	1.6
7.20	8.25	9.0	1.6	26.0	1.6
13.80	14.40	5.5	1.6	17.4	1.6
14.40	15.50	5.5	1.6	17.4	1.6
23.00	25.50	4.2	1.6	13.0	1.6
34.50	38.00	3.9	1.6	8.5	1.6

### Continuous Current Rating

Eaton's expulsion fuses are designed to carry rated current continuously without exceeding the temperature and temperature rise limits permitted by IEEE Std. C37.40™-2003 when tested as specified in IEEE Std. C37.41™-2000. The ranges of continuous current ratings available in Eaton's fuses are shown in the table below. These current ratings carry either an E or a K designation as defined in ANSI C37.42-1996 or ANSI C37.46-2000.

The current responsive element of a power fuse with a continuous current rating of 100E or below shall melt in 300 seconds at an rms current between 200% and 240% of the continuous current rating.

The current responsive element of a power fuse with a continuous current rating of above 100E shall melt in 600 seconds at an rms current between 220% and 264% of the continuous current rating.

The current responsive element of a distribution fuse with a K designation on the current rating shall melt within the required time ranges specified for various current levels in Table 8 of ANSI C37.42-1996.

Although the E and K ratings do not make time current curves identical, they do produce a similarity among different manufacturer's fuses, as they all must satisfy the same requirements. The E and K ratings also reflect the 2:1 minimum melting current versus continuous current rating that is a design feature of these fuses.

Note that this similarity between the time current curves of E-rated expulsion fuses from various manufacturers does not imply that the time current curves of E-rated expulsion and current limiting fuses are similar even from the same manufacturer—there are in fact, considerable differences, and this must be considered when comparing expulsion and current-limiting fuses.

Power fuses are designed to continuously carry their rated current without exceeding temperature rise restrictions. If rated current is exceeded enough to cause the temperature or temperature rise limits to be exceeded, but the current is still below the 300 or 600 second melting current for a considerable length of time, a large amount of heat will be generated that may cause permanent damage to the fuse. Even though the DBU and RBA/RDB standard fuses employ silver elements that are not subject to thermal degradation unless the element temperature nearly reaches the melting temperature, caution should still be exercised when overloading the fuse as prolonged overheating will cause deterioration of the boric acid interrupting medium and charring of the fuse wall before the fuse element melts. The following curve shows the overload characteristics of Eaton's expulsion fuses. Do not exceed these overload restrictions under any circumstances.

In practice, expulsion power fuses are used to protect transformers and other equipment where overloads and inrush currents are common. As boric acid expulsion fuses have a rather low thermal capacity and cannot carry overloads of the same magnitude and duration as motors and transformers of equal continuous currents, general fuse application ratio of 1.4:1 fuse continuous current rating to full load current is suggested to prevent nuisance fuse operations on acceptable overloads and inrush conditions. Remember that this is only a general ratio for typical applications, and that ratios as low as 1:1 or as high as 2:1 can be used for specific applications. More specific application information can be found in the individual equipment applications sections that follow.

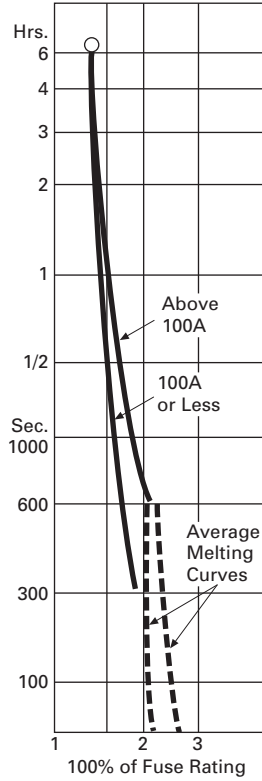
### Continuous Current Ratings Available in Eaton Expulsion Fuses

Maximum Design kV	RBA-RDB-200 Standard	RBT-200 Time Lag	RBA-RDB-400 Standard ①	RBT-400 Time Lag	DBU Standard	DBU Slow	DBU K-Rated	DBA-1, 2 Standard
2.75	10E to 200E	20E to 200E	0.5E to 400E1	20E to 400E1	—	—	—	—
5.50	10E to 200E	20E to 200E	0.5E to 400E1	20E to 400E1	—	—	—	—
8.25	10E to 200E	20E to 200E	0.5E to 400E1	20E to 400E1	—	—	—	0.5E to 200E
14.40	10E to 200E	20E to 200E	0.5E to 400E1	20E to 400E1	5E to 200E	15E to 200E	3K to 200L	0.5E to 200E
15.50	10E to 200E	20E to 200E	0.5E to 400E1	20E to 400E1	5E to 200E	15E to 200E	3K to 200L	0.5E to 200E
25.50	10E to 200E	20E to 200E	0.5E to 300E2	20E to 300E2	5E to 200E	15E to 200E	3K to 200L	0.5E to 200E
38.00	10E to 200E	20E to 200E	0.5E to 300E2	20E to 300E2	5E to 200E	15E to 200E	3K to 200L	0.5E to 200E

#### Note

① Using the two paralleled 800 fuse design, which has a 10% derating factor, ratings of 450, 540 and 720 are available.

#### Overload Characteristics for Eaton Expulsion Fuses



**Eaton's expulsion type fuses must not be paralleled to obtain continuous current ratings greater than those indicated, with the exceptions stated below. Satisfactory operation of untested parallel arrangements cannot be predicted.**

**RBA-8, RDB-8 and BA-8 assemblies have been specifically tested to demonstrate their correct operation throughout the rated range of interrupting currents, with the specific physical arrangements shown.**

Corrections for applying expulsion fuses above 3300 feet also apply to the continuous current ratings as well as the interrupting rating. De-rating is required for applications at altitudes above 1000 meters (3300 feet). Correction factors for various altitudes are listed in IEEE Std. C47.40™.

Remember that:

- Under no circumstances must the continuous rating of the fuse be less than the continuous load current
- E-rated fuses do not provide protection for currents below two times the continuous current rating



### Coordination

In addition to selecting a fuse that meets the voltage, interrupting and continuous current ratings, it is important to examine the time-current curves of the fuse. These curves are designated as minimum melt and total clearing curves. The minimum melt curve gives the minimum amount of time in seconds required to melt the fuse elements at a particular value of rms symmetrical current under specified conditions. The total clearing curve gives the maximum amount of time in seconds to complete interruption of the circuit at a particular value of rms symmetrical current under conditions specified in ANSI C37.42-1996 or ANSI C36.46-2000.

The time-current curves for Eaton fuses are derived from tests on fuses at an ambient temperature of 25 degrees C and no initial loading as specified in IEEE Std. C37.46™.

Arcing time is defined as the amount of time in seconds elapsing from the melting of the fusible element to the final interruption of the circuit. It is important to examine these characteristics to assure proper protection and selectivity with other overcurrent protective devices. These curves are located in each fuse section of the catalog.

The melting curves of all E-rated fuses must lie within the range defined in IEEE Std. C37.46™ at either the 300 or 600 second point, but there are no limitations placed on the melting time at high currents. To take advantage of this, Eaton increases the applicability of their fuses by producing fast or standard fuses and slow or time-lag fuses. The curves for time-lag fuses are less inverse and allow for more of a time delay at high currents.

The melting curves of all K-rated DBU fuses must lie within the ranges defined in IEEE Std. C37.42™.

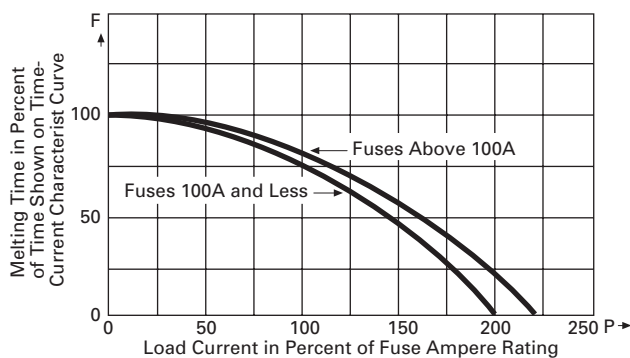
Proper coordination of power fuses requires keeping the minimum melting current time-current curve above the total clearing time-current curve of any downstream protective device, and keeping the total clearing time-current curve beneath the minimum melting time-current curve of any upstream protective device. Manufacturers publish time-current curves based on standard conditions that do not allow for variables such as pre-loading or ambient temperature. Fuses subject to conditions other than the above will experience shifts in the time-current curves.

For this reason, it is recommended that a safety zone be used to ensure that proper coordination is maintained allowing for these variables. Eaton recommends the use of a 10% safety zone on current for a particular value of time as it allows the safety band to be published on the left-hand side of all the time-current curves. Coordination is then achieved by overlaying curves and shifting one by the width of the published safety zone.

Although the relevant ANSI and IEEE standards allow a 20% tolerance band on current between minimum and maximum melting characteristics, Eaton published characteristics in general only show a 10% tolerance band that can be seen for times greater than 0.5 second. Note that the published upper limit time-current curve is for total clearing, and not maximum melting. The total clearing time-current curve gives the maximum melting time plus the arcing time of the fuse.

If desired or if unusual conditions exist, shifts in the time-current curve due to pre-loading may be examined individually. The following illustration gives the adjusting factor for preloaded fuses. These adjusting factors are valid only for Eaton power fuses.

### Preloading Adjustment Factor for Eaton Expulsion Fuses



RBA Fuses

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### Application

Use of the current generation of protection and coordination computer programs has taken much of the hard work out of checking coordination between medium voltage fuses and the upstream and downstream devices and protective equipment in the circuit. In addition, they allow detailed analysis of potential arc flash that could occur due to faults at particular circuit locations. Additional considerations such as the effects of cable run lengths can also be included in the fault current calculations to increase the accuracy of coordination and arc flash studies. However, a basic understanding of the coordination principles behind such studies is necessary for correct interpretation of the results.

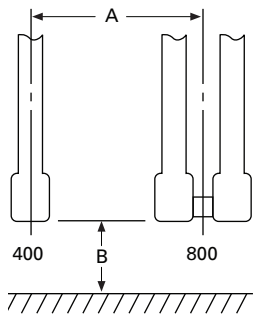
When applying expulsion fuses, physical as well as electrical properties must be considered. Expulsion fuses emit gases from the bottom of the fuse and as a result, care should also be taken to maintain minimum phase-to-phase and phase-to-ground clearances when mounting fuses. Indoor fuses employ an exhaust control device, a discharge filter, a muffler or a condenser to absorb some or most of the exhaust from the fuse but specified clearances must still be maintained.

Outdoor fuses are vented and thus have a high noise level and expel a greater amount of gas making clearance from ground an important consideration. However, the noise level of outdoor power fuses that employ boric acid solid material to control the arcing process is generally much lower, and the exhaust column is less violent than that associated with fuses employing links and cutouts, even at higher levels of interrupting current. When applying outdoor fuses, clearance must also be allowed for the arc that the fuse swings through during dropout. The tables on **Page V14-T2-11** give the minimum clearance to ground and the minimum phase spacing.

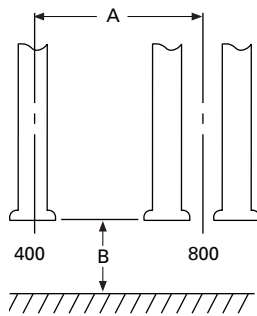
Outdoor fuses are vented, and the venting of the hot gases resembles a cylindrical or narrowly conical column height above the minimum ground clearance. It is not really a factor except as related to rebounding from the ground of hot particles and gases. The illustration on **Page V14-T2-3** shows the nature of the discharge and allows the user to suggest specific safety zones for each particular application.

**Recommended Spacings—Typical Single Fuse Unit**

**Typical Filter or Condenser**



**Typical Vented**



Typical paralleled fuse unit with standard Eaton mounting.

**Legend**

- A** = Recommended phase-to-phase centerline spacing without barriers
- B** = Minimum clearance to ground

**(A) Recommended Phase-to-Phase Centerline Spacing without Barriers in Inches**

Maximum Design kV	RBA Disconnect		RBA Non-Disconnect		RDB		DBU	DBA
	200/400	800	200/400	800	200/400	800		
2.75	11.75	27.51	11.16	19.92	19.0	26.76	17.0	17.0
4.80	11.75	27.51	11.16	19.92	18.0	26.75	17.0	17.0
5.50	11.75	27.51	11.16	19.92	18.0	26.75	17.0	17.0
8.25	13.25	29.01	12.56	21.32	18.0	26.76	17.0	17.0
14.40	14.75	30.51	13.06	21.82	24.0	32.76	19.0	19.0
15.50	16.25	32.01	15.56	24.32	24.0	32.76	19.0	19.0
25.50	20.25	—	19.56	—	30.0	38.76	23.0	23.0
38.00	25.25	—	24.56	—	36.0	44.76	30.0	30.0
48.30	—	—	—	—	—	—	—	33.0
72.50	—	—	—	—	—	—	—	44.0

**(B) Minimum Clearance to Ground in Inches**

Maximum Design kV	RBA Filter	RBA Condenser	RDB-200, DBU and DBA-1 Vented	RDB-400, 800 and DBA-2 Vented
	2.75	7.5	3.0	17.5
4.80	7.5	3.0	17.5	22.0
5.50	8.5	4.0	17.5	22.0
8.25	8.5	4.0	17.5	22.0
14.40	11.5	6.0	21.0	26.0
15.40	11.5	6.0	21.0	26.0
25.50	15.0	8.5	26.0	32.0
38.00	19.5	12.0	33.0	42.0
48.30 (DBA only)	—	—	40.0	54.0
72.50 (DBA only)	—	—	54.0	84.0

### Transformer Application

Fuses are installed on the primary side of a transformer to:

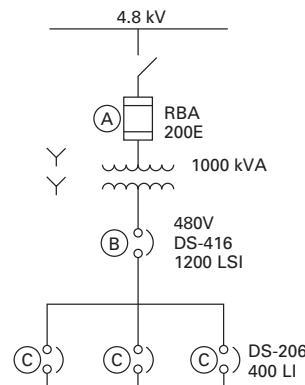
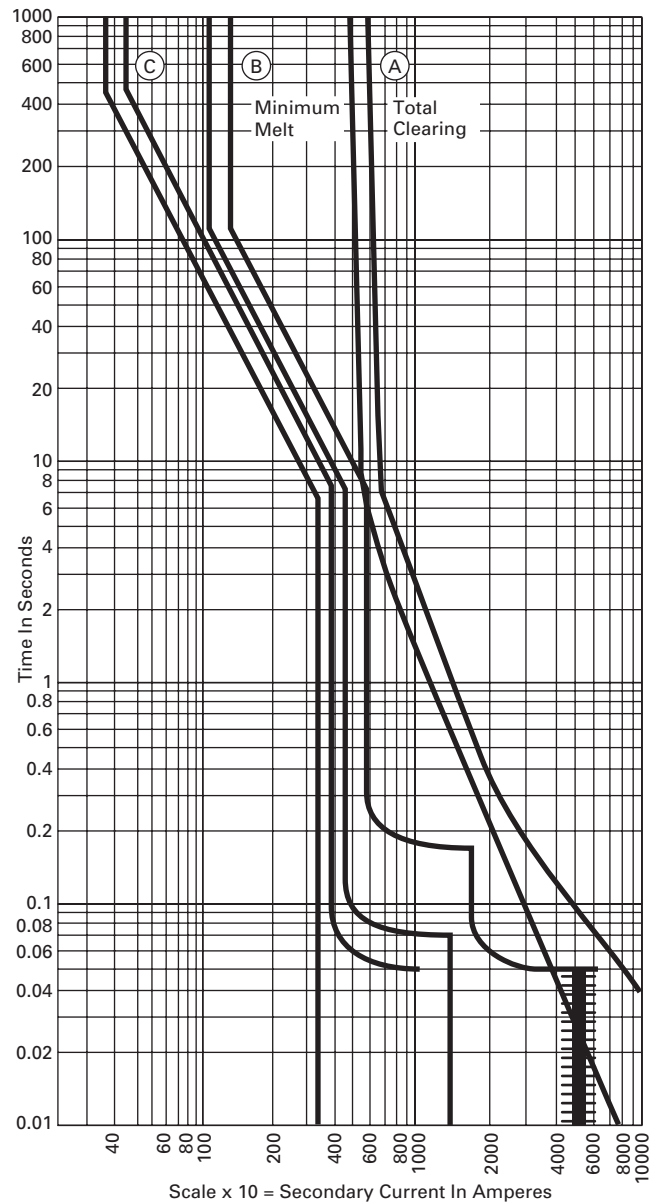
- Protect the system on the source side of the fuses from an outage due to faults in or beyond the transformer (isolate a faulted transformer from an otherwise healthy distribution system to prevent further disturbance)—in the case of an internal winding fault in the transformer, the fuse should prevent further collateral damage to the transformer and its surroundings (although the primary fuses will isolate a transformer with an internal fault from the primary system, expulsion fuses generally are not fast enough to prevent extensive damage to the transformer)
- Coordinate with protection on the low-voltage side of the transformer (transformer primary protection must be overload tolerant, allowing the secondary protection to clear faults occurring downstream of the secondary protection)
- Protect the transformer against bolted secondary faults (the fuse should operate on any bolted secondary faults, between the transformer secondary terminals and the secondary protection before the transformer is damaged—usually thru-fault protection is provided to the transformer by a main secondary breaker or breakers and the main purpose of the primary fuses is to isolate a faulted transformer from the primary system)
- Protect the transformer against higher impedance secondary faults to whatever extent is possible (the fuse should limit damage to the transformer windings to the best extent possible)

Selecting the proper voltage, interrupting and continuous current ratings for the fuse is straightforward and has been sufficiently covered in their respective sections.

There are two sometimes conflicting factors when selecting a fuse to protect a transformer circuit. The continuous current rating must be large enough to prevent premature fuse interruption from magnetizing or inrush currents and it must also be large enough to prevent fuse deterioration or fuse interruption during normal or emergency overload situations. The fuse rating must also be small enough to provide the protection listed in the purpose hierarchy.

Fuses on the primary side of transformers should not operate on transformer magnetizing or inrush current. The magnitude of the first loop of inrush current and the rate at which the peaks of subsequent loops decay is a function of many factors. Some of these are transformer design, residual flux in the core at the instant of energization, the point on the voltage wave at which the transformer is energized and the characteristics of the source supplying the transformer. When energizing, the heating effect of the inrush current can be considered equal to 12 times the transformer full load current for 1/10 of a second. Thus, when selecting the current rating for fuses used at the primary side of a transformer, the fuse minimum melting curve must lie above and to the right of the point on the time-current curve representing 12 times full load current and 0.1 seconds. The fuse whose minimum melting curve lies just above and to the right of this point is the lowest rated fuse that can be used at the primary terminals to satisfy the inrush requirements. This criterion is normally satisfied for all Eaton expulsion fuses if the fuse current rating is equal to or greater than the transformer self-cooled full load current. Thus, a fusing ratio as low as 1:1 could be used in selecting primary side fuses if inrush or magnetizing current were the only concern.

### Typical Fuse—Transformer Coordination



Breaker	LD Amps	LD PU	SD T		SD I	
			sec	sec	PU	PU
BDS-416	1200	IX	4	4X	0.18	12X
CCDS-206	400	IX	20	—	—	9X

System operators frequently overload their transformers for short periods of time during normal and emergency situations. To allow this flexibility, it is necessary to select a fuse that can carry the overload without deteriorating. To accommodate these overloads, a fusing ratio higher than 1:1 is almost always required when applying fuses for transformer protection. The fuse emergency overload curve on **Page V14-T2-8** along with the required extent of overloading is used to determine the smallest fuse that can be applied. Determine the minimum fuse rating by using the duration (ordinate) of the transformer overload on the fuse overload curve on **Page V14-T2-8** to obtain the multiple of the current rating that should not be exceeded.

Divide the transformer overload current by the multiple obtained from the overload curve. The result is the minimum fuse current rating. Select the fuse rating that equals or is just larger than this value. The allowable time duration of the current in the primary side fuses during transformer overload should never exceed the values shown by the fuse overload curve on **Page V14-T2-8**.

**Note:** Short term and long term overloading of transformers will adversely affect the service life of the transformer. Also, increasing the primary fuse size to allow for higher overloads decreases the protection afforded the transformer. The extent to that transformers are overloaded and the implications for system security are economic decisions that are made by the system operator.

Suggested minimum fuse sizes for protection of self-cooled transformers are given in the tables on **Pages V14-T2-14** and **V14-T2-15**. These tables are based on the premise that the maximum 1.5 hour overload on the transformer would not exceed 200 percent of the transformer rating. This overload condition requires that the minimum ratio of fuse current rating to transformer full load current is 1.4:1. Fuse sizes listed in the tables on **Pages V14-T2-14** and **V14-T2-15** are those that are just higher than 1.4 times the transformer full load current. If higher or longer duration transformer overloads are to be permitted, a fuse with a higher continuous current rating may be required. The procedure described above should then be used to find the smallest permissible fuse size.

**Suggested Minimum Expulsion Fuse Current Ratings**

2

**Self-Cooled 2.4 to 12.0 kV Power Transformer Applications**

Nominal kV	2.4	2.4	4.16	4.16	4.8	4.8	7.2	7.2	12.0	12.0
Fuse Maximum kV	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	15.5	15.5
Transformer Full kVA Rating Self-Cooled	Full Load Current Amps	Fuse E-Ampere Rating	Full Load Current Amps	Fuse E-Ampere Rating	Full Load Current Amps	Fuse E-Ampere Rating	Full Load Current Amps	Fuse E-Ampere Rating	Full Load Current Amps	Fuse E-Ampere Rating
<b>Three-Phase Transformers</b>										
9	2.16	3E	1.25	3E	1.10	3E	0.72	3E	0.43	3E
15	3.60	5E	2.08	3E	1.80	3E	1.20	3E	0.72	3E
30	7.20	10E	4.20	7E	3.60	5E	2.40	5E	1.44	3E
45	10.80	15E	6.20	10E	5.40	10E	3.60	5E	2.16	3E
75	18.00	25E	10.40	15E	9.00	15E	6.00	10E	3.60	5E
112	27.00	40E	15.60	25E	13.60	20E	9.00	15E	5.40	10E
150	36.00	50E	20.80	30E	18.00	25E	12.00	20E	7.20	10E
225	54.00	80E	31.30	50E	27.20	40E	18.00	25E	10.80	15E
300	72.00	100E	41.60	65E	36.00	50E	24.00	40E	14.40	20E
500	120.00	200E	69.40	100E	60.00	100E	40.00	65E	24.10	40E
750	180.00	250E	104.00	150E	90.00	125E	60.00	100E	36.10	50E
1000	241.00	400E	140.00	200E	120.00	200E	80.00	125E	48.10	80E
1500	360.00	540E <sup>①</sup>	208.00	300E	180.00	250E	120.00	200E	72.00	100E
2000	481.00	720E <sup>②</sup>	278.00	400E	241.00	400E	160.00	250E	496.20	150E
2500	600.00	—	346.00	540E <sup>①</sup>	301.00	450E <sup>③</sup>	200.00	300E	120.00	200E
3750	—	—	—	—	—	...	—	—	180.00	250E
5000	—	—	—	—	—	...	—	—	241.00	400E
<b>Single-Phase Transformers</b>										
5	2.08	3E	1.20	3E	1.04	3E	0.69	3E	0.416	3E
10	4.17	7E	2.40	5E	2.08	3E	1.39	3E	0.832	3E
15	6.25	10E	3.60	5E	3.13	5E	2.08	3E	1.25	3E
25	10.40	15E	6.00	10E	5.20	10E	3.47	5E	2.08	3E
37	15.60	25E	9.00	15E	7.80	15E	5.21	10E	3.12	5E
50	20.80	30E	12.00	20E	10.40	15E	6.95	10E	4.16	7E
75	31.30	50E	18.00	25E	15.60	25E	10.40	15E	6.25	10E
100	41.70	65E	24.00	40E	20.80	30E	13.90	20E	8.32	15E
167	70.00	100E	40.00	65E	35.00	65E	23.20	40E	13.90	20E
250	104.00	150E	60.00	100E	52.00	80E	34.80	50E	20.80	30E
333	139.00	200E	80.00	125E	69.50	100E	46.30	65E	27.70	40E
500	208.00	300E	120.00	200E	104.00	150E	69.60	100E	41.60	65E
667	278.00	400E	160.00	250E	139.00	200E	92.60	150E	55.40	80E
833	347.00	540E <sup>①</sup>	200.00	300E	173.00	250E	115.50	200E	69.40	100E
1250	521.00	720E <sup>②</sup>	300.00	540E <sup>①</sup>	260.00	400E	174.00	250E	104.00	150E

**Notes**

- ① Two (2) 300E ampere fuse refills used in parallel with 10% derating factor.  
 ② Two (2) 400E ampere fuse refills used in parallel with 10% derating factor.  
 ③ Two (2) 250E ampere fuse refills used in parallel with 10% derating factor.

## Self-Cooled 13.2 to 34.5 kV Power Transformer Applications

System Nominal kV	13.2	13.2	13.8	13.8	14.4	14.4	22.9	22.9	23.9	23.9	24.9	24.9	34.5	34.5
Fuse Maximum kV	15.5	15.5	15.5	15.5	15.5	15.5	25.5	25.5	25.5	25.5	25.5	25.5	38.0	38.0
Transformer Full kVA Rating Self-Cooled	Full Load Current Amps	Fuse E-Ampere Rating	Full Load Current Amps	Fuse E-Ampere Rating	Full Load Current Amps	Fuse E-Ampere Rating	Full Load Current Amps	Fuse E-Ampere Rating	Full Load Current Amps	Fuse E-Ampere Rating	Full Load Current Amps	Fuse E-Ampere Rating	Full Load Current Amps	Fuse E-Ampere Rating
<b>Three-Phase Transformers</b>														
9.00	0.40	3E	0.38	3E	0.36	1/2E	0.22	1/2E	0.21	1/2E	0.20	1/2E	0.15	1/2E
15.00	0.66	3E	0.62	3E	0.60	3E	0.38	3E	0.36	1/2E	0.35	1/2E	0.25	1/2E
30.00	1.32	3E	1.25	3E	1.20	3E	0.75	3E	0.72	3E	0.69	3E	0.50	3E
45.00	1.98	3E	1.88	3E	1.80	3E	1.14	3E	1.09	3E	1.04	3E	0.75	3E
75.00	3.30	5E	3.10	5E	3.00	5E	1.89	3E	1.81	3E	1.74	3E	1.25	3E
112.50	4.95	7E	4.70	7E	4.51	7E	2.84	5E	2.72	5E	2.60	5E	1.88	3E
150.00	6.56	10E	6.20	10E	6.01	10E	3.78	7E	3.62	5E	3.47	5E	2.51	5E
225.00	9.90	15E	9.40	15E	9.02	15E	5.68	10E	5.44	10E	5.21	10E	3.77	7E
300.00	13.10	20E	12.50	20E	12.00	20E	7.58	15E	7.25	10E	6.94	10E	5.02	7E
500.00	21.90	30E	21.00	30E	20.10	30E	12.60	20E	12.10	20E	11.60	20E	8.37	15E
750.00	32.80	50E	31.00	50E	30.10	50E	18.90	30E	18.10	25E	17.40	25E	12.60	20E
1000.00	43.70	65E	42.00	65E	40.10	65E	25.30	40E	24.20	40E	23.10	40E	16.70	25E
1500.00	65.60	100E	62.00	100E	60.10	65E	37.90	65E	36.20	50E	34.70	50E	25.10	40E
2000.00	87.50	125E	84.00	125E	80.20	125E	50.50	80E	48.30	80E	46.30	65E	33.50	50E
2500.00	109.00	150E	104.00	150E	100.00	150E	63.10	100E	60.40	100E	57.90	80E	41.80	65E
3750.00	165.00	250E	156.00	250E	150.00	250E	94.70	150E	90.60	150E	86.60	125E	62.80	100E
5000.00	218.00	300E	210.00	300E	200.00	300E	126.00	200E	121.00	200E	116.00	200E	83.70	125E
<b>Single-Phase Transformers</b>														
5.00	0.38	3E	0.36	3E	0.35	1/2E	0.22	1/2E	0.21	1/2E	0.20	1/2E	0.14	1/2E
10.00	0.76	3E	0.72	3E	0.69	3E	0.44	3E	0.42	3E	0.40	3E	0.29	1/2E
15.00	1.14	3E	1.09	3E	1.64	3E	0.66	3E	0.63	3E	0.60	3E	0.43	3E
25.00	1.90	3E	1.81	3E	1.74	3E	1.09	3E	1.05	3E	1.00	3E	0.72	3E
37.50	2.84	5E	2.71	5E	2.60	5E	1.64	3E	1.57	3E	1.50	3E	1.09	3E
50.00	3.80	7E	3.62	5E	3.47	5E	2.19	3E	2.09	3E	2.00	3E	1.45	3E
75.00	5.70	10E	5.43	10E	5.21	10E	3.28	5E	3.14	5E	3.01	5E	2.17	3E
100.00	7.60	15E	7.24	10E	6.94	10E	4.37	7E	4.18	7E	4.01	7E	2.90	5E
167.00	12.70	20E	12.10	20E	11.60	20E	7.31	10E	6.99	10E	6.70	10E	4.84	7E
250.00	19.00	30E	18.10	25E	17.40	25E	10.90	15E	10.50	15E	10.00	15E	7.25	10E
333.00	27.70	40E	25.20	40E	23.10	40E	14.60	20E	13.90	20E	13.40	20E	9.65	15E
500.00	38.00	65E	36.20	50E	34.70	50E	21.90	30E	20.90	30E	20.10	30E	14.50	20E
667.00	50.50	80E	48.20	80E	46.30	65E	29.20	40E	27.90	40E	26.80	40E	19.30	30E
833.00	63.50	100E	60.40	100E	57.90	80E	36.40	50E	34.90	50E	33.40	50E	24.10	40E
1250.00	95.00	150E	90.60	125E	86.80	125E	54.70	80E	52.30	80E	50.10	80E	36.20	50E

If provisions are made to limit transformer overloads to a lower range, by thermal or other protective devices, the ratio of fuse current to transformer full load current can be less than 1.4:1. To find the amount of reduction permissible without damage to the fuse, the procedure using the overload curve should be employed.

When the transformer has forced cooling, the minimum fuse size that can be applied should be based on the transformer top rating and the extent to which the transformer will be overloaded beyond the top rating.

It should be remembered that E- or K-rated expulsion fuses applied at the primary terminals of a transformer do not provide protection for currents below two times the continuous current rating of the fuse. That is, for currents that exceed the time limits shown by the fuse overload curve on **Page V14-T2-5**, the fuse may have deteriorated before the fusible element melts. In order to provide dependable overload protection for the transformer, protection must be applied on the secondary side of the transformer.

Equal concern should be given to the upper limit of continuous current rating that will provide protection for the transformer. The extent to which the fuses are to protect the transformer against secondary faults is one of several factors that determines the upper limit.

When a main secondary breaker is not used, the primary fuses may be the only devices that provide thru-fault protection for the transformer. In these circumstances the fuse should operate before the transformer windings are damaged due to heavy currents. The capability of transformer windings to carry these thru-fault or heavy currents varies from one transformer design to another. When specific information applicable to individual transformers is not available, the transformer heat curves shown on **Page V14-T2-18** can be used to evaluate the thru-fault protection offered the transformer by the fuses. The curve labeled  $N=1$  is drawn through the points defined in IEEE Std. C57.92™, such that the curve has the same shape as shown in Figure 1 of IEEE publication 273 titled, "Guide to Protective Relay Application to Power Transformers". This curve applies to single-phase transformers and to three-phase faults on three-phase

transformer banks. Curves for values of  $N$  other than 1 apply to unsymmetrical faults on three-phase transformers and three-phase transformer banks that have at least one delta connected winding. Ideally, the total clearing time-current of the primary fuse would lie below the heat curve for all values of current up to 25 times the transformer rated current. However this is not usually possible as the fuse has minimum limitations placed on the rating due to long time overload impressed on the transformer and the fact that E-rated expulsion fuses do not provide protection for currents below two times their continuous current rating. In spite of these lower limitations, primary side fuses should protect the transformer for bolted secondary faults and higher impedance secondary faults to whatever extent is possible.

Wye connected transformers, regardless of whether or not the neutral is grounded, tied to the system neutral or floating have line currents that are equal to the winding currents for faults external to the transformer. Thus a fuse connected to the terminal of a wye connected winding will see the same current that is in the winding for all faults external to the transformer. Also, there is a simple relation between the primary and secondary amperes, whether or not load of fault currents are being considered.

This is not the case when the transformer has a delta connected winding, either on the primary or the secondary side of the transformer. With delta connected primary windings the current in the lines (fuses) supplying the delta winding and currents in the primary delta windings generally are not equal, and of greater importance, the ratio of line (fuse) current to the winding current varies with the type of fault on the external system. With delta connected secondary windings, the current in the transformer secondary windings is generally not equal to the secondary line current, and the ratio of primary line current to the secondary line current varies with the type of fault on the secondary system.



The relationship between rated line (fuse) current and rated winding current (referred to as the base current of the winding in IEEE/ANSI Std. C57.12.00™) is 1 for wye connected primaries and is  $1/\sqrt{3}$  for delta connected primaries. IEEE/ANSI Std. C57.12.00™ also indicates that the transformer winding shall be capable of withstanding 25 times rated winding current for two seconds and smaller multiples of rated winding current for longer periods of time. However, transformer overloads and faults are generally expressed in terms of line and not winding current. This could present a problem for fault conditions where the type of fault changes the relationship between the line and the winding current. The table below gives a multiplier that will translate the line current in multiples of the winding current for different type faults for various transformer windings. These tables lead us back to the transformer heat curves shown where it can be verified that the curve N=1 passes through the point 25 times full load line current at two seconds. The curves for other than N=1 are for unsymmetrical faults as can be seen from the table below.

Coordination diagrams employ the transformer heat curves and fuse time current curves to determine which fuse rating may be safely applied. These diagrams are the tools used to apply the information previously cited. The most straightforward diagram involves fuses applied at the terminals of transformers with wye primary windings. The table below shows that the fuse current is the same as the winding current for all faults external to the transformer. This means the coordination diagram consists simply of the direct reading of the fuse time-current curves and the transformer heat curve N=1 for coordination diagrams where the abscissa is labeled in amperes in the primary system. To coordinate with the abscissa labeled in secondary amperes, the same two curves are shifted to allow for the ratio between the primary and secondary amperes.

When fuses are employed at the terminals of a delta-wye transformer, the coordination diagram becomes a bit more involved. In this instance, the table below shows that the fuse current varies in relation to the winding current depending on the nature of the fault. Thus, when the coordination is with respect to primary amperes, the diagram consists of one direct reading fuse time-current curve and one or more transformer heat curves. The number of heat curves included would be determined by the types of secondary faults considered. The table below gives the N curve to be used for the different faults to be considered. When the coordination is with respect to secondary amperes the diagram consists of one transformer heating curve (N=1) and up to three fuse time-current curves. The three time-current curves are again dependent on the possible faults to be considered. The table below shows that to obtain proper coordination after the curve is translated to secondary amperes, it must be shifted  $1/\sqrt{3}$  when phase-to-ground faults are considered and  $2/\sqrt{3}$  when phase-to-phase faults are considered.

Regardless of whether a primary or secondary current abscissa is employed, a coordination diagram for a delta-wye transformer shows that the primary side fuses do not protect the transformer for high impedance secondary faults and overloads. This type of protection can be obtained through the application of secondary side breakers. If a secondary breaker were used, it would be added to the coordination diagram by plotting the breaker phase and ground trip characteristics. Selective coordination would exist if the breaker phase trip characteristic curve lies below the fuse characteristic for a phase-to-phase fault and the heating curve, and breaker ground trip characteristic for a single line-to-ground fault and the heat curve.

### Multiples of Primary Line Current for Fixed Secondary Winding Current

Transformer Connection All Neutrals Grounded		N (N Times Secondary Winding Current Gives Multiples of Primary Line Current)		
Primary	Secondary	Three-Phase Fault	Phase-to-Ground Fault	Phase-to-Phase Fault
Y	Y	1	1	1
Y	D	1	—	1
D	Y	1	$1/\sqrt{3}$	$2/\sqrt{3}$
D	D	1	—	$\sqrt{3}/2$

The preceding pertains to diagrams using secondary amperes. If the breaker characteristic is to be translated to primary amperes, its characteristics must lie beneath the fuse characteristic and the heating curve for  $N=1$ . For unsymmetrical faults the breaker characteristic will shift by the same multiple as the heating curve. If further secondary protection is translated to the primary, the characteristic must lie beneath the secondary breaker characteristic for the different types of faults considered.

Fuses used at the terminals of a delta-delta transformer require:

1. fuse time-current curves and
2. heat curves

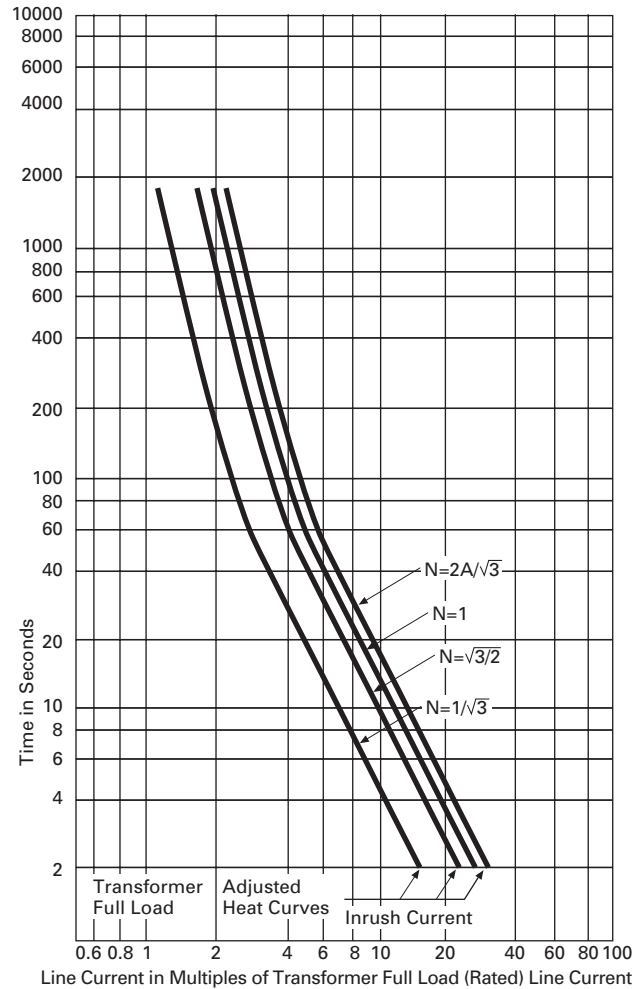
if both three-phase and phase-to-phase faults are to be considered. This agrees with the information presented in the table on **Page V14-T2-17**. When the abscissa is in primary amperes the curves are read directly. An abscissa in secondary amperes uses the same curves but shifts them from primary to secondary amperes.

When using the current generation of protection and coordination computer programs, all the factors such as the ratios of line to winding ratios and transformation ratios should be accounted for by the software if the transformer details are correctly entered into the program, and it should only be necessary to correctly interpret the program plots to evaluate the levels of secondary to primary protection, and the level of transformer overload protection afforded by a selected fuse rating.

For all the coordination diagrams discussed above, the vertical distance between the total clearing curve and the safe heat curve indicates the margin of protection offered for different types of faults. It should be remembered, however, that the transformer heat curves illustrated in this application data are drawn from the reference previously cited and they may not apply to all transformer designs.

In practice, it is not always possible to select a fuse large enough to allow for all the over-loading required and still provide complete protection for the transformer. In these cases, the user should decide where his priorities lie and trade off overloading ability for transformer protection.

#### Typical Transformer Heat Curves



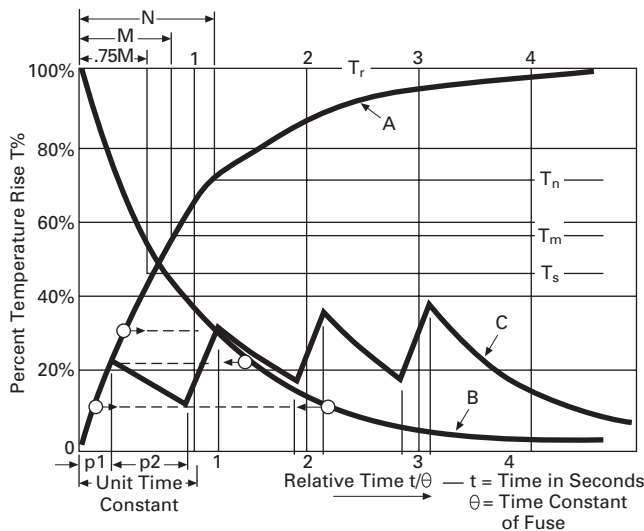
#### Capacitor Application

Another common use of power fuses is for the protection of capacitor banks. This application is unique in that the protected equipment, capacitors, are designed with a zero minus tolerance and some value positive tolerance. For this

reason a ratio of 1.65:1 fuse rating to full load current is suggested for all single bank protection. If two or more banks are paralleled with automatic switching, refer to Eaton Technical Support for fusing information.

**Repetitive Faults**

**Temperature Cycle of a Fuse During Reclosing Operation**



Curve A—Basic fuse heating curve:  $T_f (1 - e^{-t/\theta})$   
 Curve B—Basic fuse cooling curve:  $T_f \times e^{-t/\theta}$   
 Curve C—Temperature rise curve of fuse subjected to reclosing cycle  
 M—Melting time of fuse at a given fault current  
 N—Total clearing time of fuse at same fault current  
 $T_m, T_n$ —Levels of melting temperature of fastest and of slowest fuse (See note below)  
 $T_s$ —Safe temperature level, considering service variables  
 $T_r$ —Hypothetical steady-state temperature level (100%) attained if the fuse element did not open when melting temperature was reached but continued to be a resistance of constant value

**Note:** The absolute temperature at which the elements of the fastest and of the slowest fuse melt is the same since both fuses are made of the same material, However,  $T_n$  and  $T_m$  are different if measured by the final temperature level if reached at a given current.

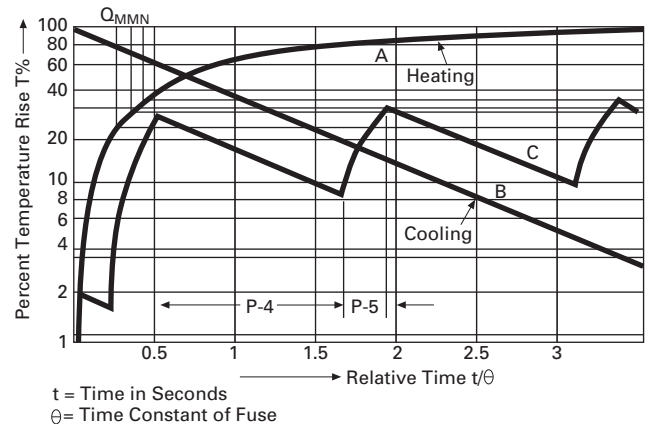
It is often desirable to determine the performance of fuses under repetitive faults such as produced by the operation of reclosing circuit breakers. This performance is determined by graphically simulating the heating and cooling characteristics of the fuse, which are found and expressed by the melting time-current curves. The theory behind the above implications is available upon request, but in this section only the practical use of those implications will be discussed.

Conventional E-rated fuses can with good approximation be regarded as bodies whose heating and cooling properties are described by the basic exponential curves A and B as shown above. Except for being inverted, the cooling curve is the same as the heating curve as both have the same time constant. Each fuse has a specific time constant that can be calculated with sufficient accuracy by the formula  $\theta = 0.1S^2$  where S is the fuse speed ratio, that is, the melting current at 0.1 seconds divided by the melting current at 300 or 600 seconds. The 300 seconds applies to fuses rated 100A or less and the 600 seconds for fuses rated above 100A.

The time constant of a specific fuse, having been obtained in terms of seconds, gives to the general heating and cooling curves shown below a specific time scale. In enables us to plot the course of the fuse

temperature (in percent values) if we know the sequence and duration of the open and closed periods of the recloser. This is illustrated by curve C that is formed by piecing together the proper sections of curves A and B.

**Reclosing Circuit Breaker Fuse Coordination**



$t$  = Time in Seconds  
 $\theta$  = Time Constant of Fuse  
**Notes:** Recloser data: 400PR (cycling code A1-3CH3).  
 Fuse type and rating: CLT (drawout) 8.3 kV 150°C.  
 Fuse speed ratio,  $S = 2150/420 = 5.11$ .  
 Thermal time constant,  $\theta = 0.10 S^2, 2.61$  seconds.  
 Fault current 1350A.

Next we must determine the temperature at which the fuse element will melt. Here we refer to the standard time-current curves and find the melting time M for specific value of fault current. The melting temperature  $T_m$  lies where the ordinate to the time M intersects curve A. It is not necessary to know the absolute value of this temperature, as it is sufficient to know its relation to the peaks. A similar temperature  $T_n$  can be found using the total clearing time for the specific fault current. What we have then are two temperatures where we can state that any time the curve C intersects the line  $T_m$ , the fuse could operate and any time it intersects line  $T_n$  the fuse will definitely operate. The gap between  $T_m$  and  $T_n$  indicates the tolerance range as set forth in ANSI and NEMA® standards where E-rated fuses are defined.

If the fuse is not to operate, curve C must remain below the level  $T_m$  by a safe margin. It is common practice to provide such a safety margin by coordinating the breaker with a fuse curve whose time ordinates are 75 percent of those of the melting curve. Line  $T_s$  represents this temperature in illustration above.

Although the construction of the temperature diagram as outlined above basically offers no difficulties, the manipulation is made easier and more accurate by putting the graph on semi-log coordinates as shown. On these coordinates, the cooling curve B becomes a straight line.

BA Fuseholder

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## BA Type Fuses

### Product Description

The refillable BA type (boric acid) high voltage expulsion fuse is an E-rated fuse that can be vented (outdoor) or enclosed (indoor). These fuses are designed for power applications and were introduced by the Westinghouse Electric Company in the middle 1930s. The refill units have been in continuous production since that time and are still available for use in existing installations.

Mountings are no longer available for use with BA refill units, but a limited range of replacement fuse holders is still available.

New and replacement applications should use RBA fuses that superseded BA fuses a number of years ago.

### Introduction

BA power fuses provide protection for circuits and equipment that operate on voltages from 7.2 to 38 kV. When the calibrated current responsive element melts, the fuse reacts rapidly to de-ionize the arc and interrupt the circuit. On outdoor vented installations, a mechanical dropout action gives a 180° air break. On indoor applications, the arc exhaust is absorbed by the attached exhaust control device (filter or condenser). The fuse refill unit is of the replaceable type rather than the renewable type, resulting in light weight for ease in handling.

### Construction

DE-ION® arc interruption permits application of the BA type power fuse over a range of system voltages. This line of dropout fuses carries the boric acid principle of circuit protection to higher voltage ratings, and at the same time provides short-circuit protection for systems of moderate capacity at a lower cost.

Main operating parts are the fusible element, arcing rod, helical spring, and dry boric acid cylinder. To prevent warping under outdoor conditions, a heavy glass-epoxy or ceramic tube encloses the entire assembly. This glass-epoxy tube also assures adequate strength to contain the force of the arc interruption.

Within the fuse, the current path is maintained by tight electrical connections. From the top ferrule, the path is through the extended spring and shunt assembly; then to the arcing rod, on through the fusible element that is bridged by the mechanical strain element, and into the bottom ferrule. When the fuse element melts, the arcing rod is pulled upward drawing the arc into the boric acid cylinder. As it strikes, intense heat from the arc decomposes the compressed boric acid powder.

Decomposition of the dry boric acid forms water vapor and boric acid anhydride. The electrical interruption is caused by the steam cooling and de-ionizing the arc as it is drawn through the cylinder by the action of the spring and rod.

### Operation

BA type fuses are of the refillable type. When a fuse operates due to a fault blown, the fuse holder is removed with from the mounting. After replacement of the refill unit, the fuse holder can be reinserted into the fuse mounting.

### Application

BA fuses are applied in utility and industrial high voltage power systems for protecting:

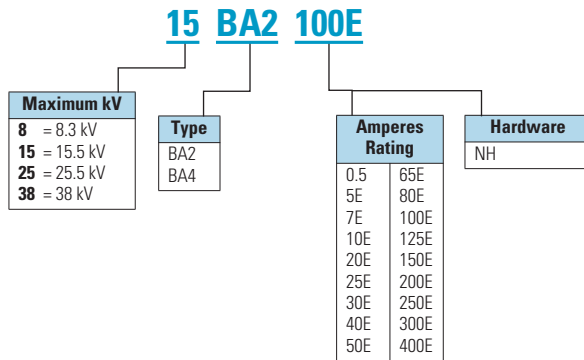
- Power transformers
- Feeder circuit sectionalizing
- Distribution transformers
- Potential transformers

### Ratings

- 8.3 to 38 kV
- 0.5E to 400E Amperes

**Catalog Number Selection**

**BA Fuse Units**



**Interrupting Ratings**

**BA Fuse Interrupting Ratings**

Refill Maximum Rated Voltage Rating kV	Maximum System Voltage kV	Vented or with Filter rms Symmetrical kA	With Condenser rms Symmetrical kA
8.3	2.75	17.5	10.0
—	5.5	17.5	10.0
—	8.3	16.0	10.0
15.5	15.5	12.5	8.0
25.8	25.8	10.0	6.3
38	38	6.3	5.0

## Product Selection

## 2

## BA2 Type Expulsion Fuse Refill Units

Voltage (kV)

Performance Curves

Nominal	Maximum	Ampere Rating	Catalog Number	Approximate Shipping Weight Lbs (kg)	Minimum Melting	Total Clearing
7.2	8.3	0.5	8BA2-5	1.0 (0.45)	TC28115801	TC28021601
7.2	8.3	5E	8BA2-5E	1.0 (0.45)	TC28115801	TC28021601
7.2	8.3	7E	8BA2-7E	1.0 (0.45)	TC28115801	TC28021601
7.2	8.3	10E	8BA2-10E	1.0 (0.45)	TC28115801	TC28021601
7.2	8.3	15E	8BA2-15E	1.0 (0.45)	TC28115801	TC28021601
7.2	8.3	20E	8BA2-20E	1.0 (0.45)	TC28115801	TC28021601
7.2	8.3	25E	8BA2-25E	1.0 (0.45)	TC28115801	TC28021601
7.2	8.3	30E	8BA2-30E	1.0 (0.45)	TC28115801	TC28021601
7.2	8.3	40E	8BA2-40E	1.0 (0.45)	TC28115801	TC28021601
7.2	8.3	50E	8BA2-50E	1.0 (0.45)	TC28115801	TC28021601
7.2	8.3	65E	8BA2-65E	1.0 (0.45)	TC28115801	TC28021601
7.2	8.3	80E	8BA2-80E	1.0 (0.45)	TC28115801	TC28021601
7.2	8.3	100E	8BA2-100E	1.0 (0.45)	TC28115801	TC28021601
7.2	8.3	125E	8BA2-125E	1.0 (0.45)	TC28115801	TC28021601
7.2	8.3	150E	8BA2-150E	1.0 (0.45)	TC28115801	TC28021601
7.2	8.3	200E	8BA2-200E	1.0 (0.45)	TC28115801	TC28021601
14.4	15.5	0.5	15BA2-5	1.2 (0.55)	TC28115801	TC28021601
14.4	15.5	5E	15BA2-5E	1.2 (0.55)	TC28115801	TC28021601
14.4	15.5	7E	15BA2-7E	1.2 (0.55)	TC28115801	TC28021601
14.4	15.5	10E	15BA2-10E	1.2 (0.55)	TC28115801	TC28021601
14.4	15.5	15E	15BA2-15E	1.2 (0.55)	TC28115801	TC28021601
14.4	15.5	20E	15BA2-20E	1.2 (0.55)	TC28115801	TC28021601
14.4	15.5	25E	15BA2-25E	1.2 (0.55)	TC28115801	TC28021601
14.4	15.5	30E	15BA2-30E	1.2 (0.55)	TC28115801	TC28021601
14.4	15.5	40E	15BA2-40E	1.2 (0.55)	TC28115801	TC28021601
14.4	15.5	50E	15BA2-50E	1.2 (0.55)	TC28115801	TC28021601
14.4	15.5	65E	15BA2-65E	1.2 (0.55)	TC28115801	TC28021601
14.4	15.5	80E	15BA2-80E	1.2 (0.55)	TC28115801	TC28021601
14.4	15.5	100E	15BA2-100E	1.2 (0.55)	TC28115801	TC28021601
14.4	15.5	125E	15BA2-125E	1.2 (0.55)	TC28115801	TC28021601
14.4	15.5	150E	15BA2-150E	1.2 (0.55)	TC28115801	TC28021601
14.4	15.5	200E	15BA2-200E	1.2 (0.55)	TC28115801	TC28021601

## BA2 Type Expulsion Fuse Refill Units, continued

Voltage (kV)

Performance Curves

Nominal	Maximum	Ampere Rating	Catalog Number	Approximate Shipping Weight Lbs (kg)	Minimum Melting	Total Clearing
23	25.5	0.5	25BA2-.5	1.5 (0.7)	TC28115801	TC28021601
23	25.5	5E	25BA2-5E	1.5 (0.7)	TC28115801	TC28021601
23	25.5	7E	25BA2-7E	1.5 (0.7)	TC28115801	TC28021601
23	25.5	10E	25BA2-10E	1.5 (0.7)	TC28115801	TC28021601
23	25.5	15E	25BA2-15E	1.5 (0.7)	TC28115801	TC28021601
23	25.5	20E	25BA2-20E	1.5 (0.7)	TC28115801	TC28021601
23	25.5	25E	25BA2-25E	1.5 (0.7)	TC28115801	TC28021601
23	25.5	30E	25BA2-30E	1.5 (0.7)	TC28115801	TC28021601
23	25.5	40E	25BA2-40E	1.5 (0.7)	TC28115801	TC28021601
23	25.5	50E	25BA2-50E	1.5 (0.7)	TC28115801	TC28021601
23	25.5	65E	25BA2-65E	1.5 (0.7)	TC28115801	TC28021601
23	25.5	80E	25BA2-80E	1.5 (0.7)	TC28115801	TC28021601
23	25.5	100E	25BA2-100E	1.5 (0.7)	TC28115801	TC28021601
23	25.5	125E	25BA2-125E	1.5 (0.7)	TC28115801	TC28021601
23	25.5	150E	25BA2-150E	1.5 (0.7)	TC28115801	TC28021601
23	25.5	200E	25BA2-200E	1.5 (0.7)	TC28115801	TC28021601
34.5	38	0.5	38BA2-.5	1.8 (0.82)	TC28115801	TC28021601
34.5	38	5E	38BA2-5E	1.8 (0.82)	TC28115801	TC28021601
34.5	38	7E	38BA2-7E	1.8 (0.82)	TC28115801	TC28021601
34.5	38	10E	38BA2-10E	1.8 (0.82)	TC28115801	TC28021601
34.5	38	15E	38BA2-15E	1.8 (0.82)	TC28115801	TC28021601
34.5	38	20E	38BA2-20E	1.8 (0.82)	TC28115801	TC28021601
34.5	38	25E	38BA2-25E	1.8 (0.82)	TC28115801	TC28021601
34.5	38	30E	38BA2-30E	1.8 (0.82)	TC28115801	TC28021601
34.5	38	40E	38BA2-40E	1.8 (0.82)	TC28115801	TC28021601
34.5	38	50E	38BA2-50E	1.8 (0.82)	TC28115801	TC28021601
34.5	38	65E	38BA2-65E	1.8 (0.82)	TC28115801	TC28021601
34.5	38	80E	38BA2-80E	1.8 (0.82)	TC28115801	TC28021601
34.5	38	100E	38BA2-100E	1.8 (0.82)	TC28115801	TC28021601
34.5	38	125E	38BA2-125E	1.8 (0.82)	TC28115801	TC28021601
34.5	38	150E	38BA2-150E	1.8 (0.82)	TC28115801	TC28021601
34.5	38	200E	38BA2-200E	1.8 (0.82)	TC28115801	TC28021601

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## Expulsion Fuses

### BA Type Fuses

#### BA4 Type Expulsion Fuse Refill Units

Voltage (kV)

Performance Curves

2

Nominal	Maximum	Ampere Rating	Catalog Number	Approximate Shipping Weight Lbs (kg)	Minimum Melting	Total Clearing
7.2	8.3	0.5	8BA4-5	2 (0.9)	TC28021201	TC28021401
7.2	8.3	5E	8BA4-5E	2 (0.9)	TC28021201	TC28021401
7.2	8.3	7E	8BA4-7E	2 (0.9)	TC28021201	TC28021401
7.2	8.3	10E	8BA4-10E	2 (0.9)	TC28021201	TC28021401
7.2	8.3	15E	8BA4-15E	2 (0.9)	TC28021201	TC28021401
7.2	8.3	20E	8BA4-20E	2 (0.9)	TC28021201	TC28021401
7.2	8.3	25E	8BA4-25E	2 (0.9)	TC28021201	TC28021401
7.2	8.3	30E	8BA4-30E	2 (0.9)	TC28021201	TC28021401
7.2	8.3	40E	8BA4-40E	2 (0.9)	TC28021201	TC28021401
7.2	8.3	50E	8BA4-50E	2 (0.9)	TC28021201	TC28021401
7.2	8.3	65E	8BA4-65E	2 (0.9)	TC28021201	TC28021401
7.2	8.3	80E	8BA4-80E	2 (0.9)	TC28021201	TC28021401
7.2	8.3	100E	8BA4-100E	2 (0.9)	TC28021201	TC28021401
7.2	8.3	125E	8BA4-125E	2 (0.9)	TC28021201	TC28021401
7.2	8.3	150E	8BA4-150E	2 (0.9)	TC28021201	TC28021401
7.2	8.3	200E	8BA4-200E	2 (0.9)	TC28021201	TC28021401
7.2	8.3	250E	8BA4-250E	2 (0.9)	TC28021201	TC28021401
7.2	8.3	300E	8BA4-300E	2 (0.9)	TC28021201	TC28021401
7.2	8.3	400E	8BA4-400E	2 (0.9)	TC28021201	TC28021401
14.4	15.5	0.5	15BA4-5	2.5 (1.15)	TC28021201	TC28021401
14.4	15.5	5E	15BA4-5E	2.5 (1.15)	TC28021201	TC28021401
14.4	15.5	7E	15BA4-7E	2.5 (1.15)	TC28021201	TC28021401
14.4	15.5	10E	15BA4-10E	2.5 (1.15)	TC28021201	TC28021401
14.4	15.5	15E	15BA4-15E	2.5 (1.15)	TC28021201	TC28021401
14.4	15.5	20E	15BA4-20E	2.5 (1.15)	TC28021201	TC28021401
14.4	15.5	25E	15BA4-25E	2.5 (1.15)	TC28021201	TC28021401
14.4	15.5	30E	15BA4-30E	2.5 (1.15)	TC28021201	TC28021401
14.4	15.5	40E	15BA4-40E	2.5 (1.15)	TC28021201	TC28021401
14.4	15.5	50E	15BA4-50E	2.5 (1.15)	TC28021201	TC28021401
14.4	15.5	65E	15BA4-65E	2.5 (1.15)	TC28021201	TC28021401
14.4	15.5	80E	15BA4-80E	2.5 (1.15)	TC28021201	TC28021401
14.4	15.5	100E	15BA4-100E	2.5 (1.15)	TC28021201	TC28021401
14.4	15.5	125E	15BA4-125E	2.5 (1.15)	TC28021201	TC28021401
14.4	15.5	150E	15BA4-150E	2.5 (1.15)	TC28021201	TC28021401
14.4	15.5	200E	15BA4-200E	2.5 (1.15)	TC28021201	TC28021401
14.4	15.5	250E	15BA4-250E	2.5 (1.15)	TC28021201	TC28021401
14.4	15.5	300E	15BA4-300E	2.5 (1.15)	TC28021201	TC28021401
14.4	15.5	400E	15BA4-400E	2.5 (1.15)	TC28021201	TC28021401



## BA4 Type Expulsion Fuse Refill Units, continued

Voltage (kV)

Performance Curves

Nominal	Maximum	Ampere Rating	Catalog Number	Approximate Shipping Weight Lbs (kg)	Minimum Melting	Total Clearing
23	25.5	0.5	25BA4-5	3.5 (1.6)	TC28021201	TC28021401
23	25.5	5E	25BA4-5E	3.5 (1.6)	TC28021201	TC28021401
23	25.5	7E	25BA4-7E	3.5 (1.6)	TC28021201	TC28021401
23	25.5	10E	25BA4-10E	3.5 (1.6)	TC28021201	TC28021401
23	25.5	15E	25BA4-15E	3.5 (1.6)	TC28021201	TC28021401
23	25.5	20E	25BA4-20E	3.5 (1.6)	TC28021201	TC28021401
23	25.5	25E	25BA4-25E	3.5 (1.6)	TC28021201	TC28021401
23	25.5	30E	25BA4-30E	3.5 (1.6)	TC28021201	TC28021401
23	25.5	40E	25BA4-40E	3.5 (1.6)	TC28021201	TC28021401
23	25.5	50E	25BA4-50E	3.5 (1.6)	TC28021201	TC28021401
23	25.5	65E	25BA4-65E	3.5 (1.6)	TC28021201	TC28021401
23	25.5	80E	25BA4-80E	3.5 (1.6)	TC28021201	TC28021401
23	25.5	100E	25BA4-100E	3.5 (1.6)	TC28021201	TC28021401
23	25.5	125E	25BA4-125E	3.5 (1.6)	TC28021201	TC28021401
23	25.5	150E	25BA4-150E	3.5 (1.6)	TC28021201	TC28021401
23	25.5	200E	25BA4-200E	3.5 (1.6)	TC28021201	TC28021401
23	25.5	250E	25BA4-250E	3.5 (1.6)	TC28021201	TC28021401
23	25.5	300E	25BA4-300E	3.5 (1.6)	TC28021201	TC28021401
34.5	38	0.5	38BA4-5	4 (1.8)	TC28021201	TC28021401
34.5	38	5E	38BA4-5E	4 (1.8)	TC28021201	TC28021401
34.5	38	7E	38BA4-7E	4 (1.8)	TC28021201	TC28021401
34.5	38	10E	38BA4-10E	4 (1.8)	TC28021201	TC28021401
34.5	38	15E	38BA4-15E	4 (1.8)	TC28021201	TC28021401
34.5	38	20E	38BA4-20E	4 (1.8)	TC28021201	TC28021401
34.5	38	25E	38BA4-25E	4 (1.8)	TC28021201	TC28021401
34.5	38	30E	38BA4-30E	4 (1.8)	TC28021201	TC28021401
34.5	38	40E	38BA4-40E	4 (1.8)	TC28021201	TC28021401
34.5	38	50E	38BA4-50E	4 (1.8)	TC28021201	TC28021401
34.5	38	65E	38BA4-65E	4 (1.8)	TC28021201	TC28021401
34.5	38	80E	38BA4-80E	4 (1.8)	TC28021201	TC28021401
34.5	38	100E	38BA4-100E	4 (1.8)	TC28021201	TC28021401
34.5	38	125E	38BA4-125E	4 (1.8)	TC28021201	TC28021401
34.5	38	150E	38BA4-150E	4 (1.8)	TC28021201	TC28021401
34.5	38	200E	38BA4-200E	4 (1.8)	TC28021201	TC28021401
34.5	38	250E	38BA4-250E	4 (1.8)	TC28021201	TC28021401
34.5	38	300E	38BA4-300E	4 (1.8)	TC28021201	TC28021401

# 2.4

## Expulsion Fuses

### BA Type Fuses

2

#### BA2 Type Expulsion Fuse Fuse Holders and Exhaust Control Devices <sup>①②</sup>

Voltage (kV)			Non-Disconnect Fuse Holder Catalog Number	Exhaust Control Device	
Nominal	Maximum	Ampere Rating		Filter Catalog Number	Condenser Catalog Number
7.2	8.3	0.5–200E	<b>8BA2-NH</b>	<b>RBA2-FLTR</b>	<b>RBA2-COND</b>
14.4	15.5	0.5–200E	<b>15BA2-NH</b>	<b>RBA2-FLTR</b>	<b>RBA2-COND</b>
23	25.5	0.5–200E	—	<b>RBA2-FLTR</b>	<b>RBA2-COND</b>
34.5	38	0.5–200E	—	<b>RBA2-FLTR</b>	<b>RBA2-COND</b>

#### BA4 Type Expulsion Fuse Fuse Holders and Exhaust Control Devices <sup>①②</sup>

Voltage (kV)			Non-Disconnect Fuse Holder Catalog Number	Exhaust Control Device	
Nominal	Maximum	Ampere Rating		Filter Catalog Number	Condenser Catalog Number
7.2	8.3	0.5–400E	<b>8BA4-NH</b>	<b>RBA4-FLTR</b>	<b>RBA4-COND</b>
14.4	15.5	0.5–400E	<b>15BA4-NH</b>	<b>RBA4-FLTR</b>	<b>RBA4-COND</b>
23	25.5	0.5–300E	—	<b>RBA4-FLTR</b>	<b>RBA4-COND</b>
34.5	38	0.5–300E	—	<b>RBA4-FLTR</b>	<b>RBA4-COND</b>

#### Notes

- ① Available as replacements in exiting installations. For new installations, use RBA fuse assemblies.
- ② Mounting no longer available. If mounting is required, convert installation to RBA fuse assemblies.

## DBA Fuse



## DBA Type Fuses

### Product Description

The DBA type (dropout, boric acid) high voltage expulsion fuse is an E-rated, vented device designed for power applications.

### Introduction

The DBA power fuse provides double protection for circuits and equipment that operate on voltages from 7.2 to 145 kV. The fuse has instant acting DE-ION circuit interruption and almost simultaneously, a mechanical dropout action gives a 180° air break. The fuse unit is of the replaceable type rather than the renewable type, resulting in light weight for ease in handling.

### Construction

DE-ION arc interruption permits application of the DBA type power fuse over a wide range of system voltages. This line of dropout fuses carries the boric acid principle of circuit protection to higher voltage ratings, and at the same time provides at lower cost short-circuit protection for systems of moderate capacity.

Principle parts of the DBA fuse unit are shown in the cross section illustration on this page. Main operating parts are the fusible element, arcing rod, helical spring, and dry boric acid cylinder. To prevent warping under outdoor conditions, a heavy Micarta tube encloses the entire assembly. This Micarta tube also assures adequate strength to contain the force of the arc interruption.

## Contents

### Description

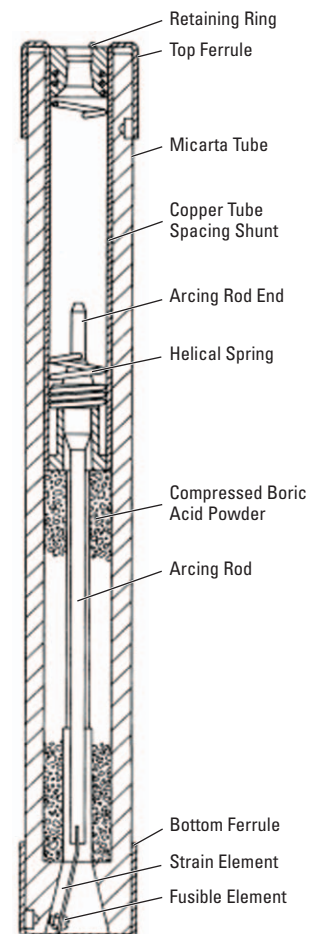
Description	Page
DBA Type Fuses . . . . .	V14-T2-27
Catalog Number Selection . . . . .	V14-T2-32
Interrupting Ratings . . . . .	V14-T2-32
Product Selection . . . . .	V14-T2-33

Within the fuse unit, the current path is maintained by tight electrical connections. From the top ferrule, the path is to the copper tube spring shunt; then to the arcing rod collar and the arcing rod, on through the fusible element that is bridged by the strain element, and into the bottom ferrule. The copper spring shunt and the arcing rod collar are firmly held together by the contact finger spring. When the fuse element is blown, the arcing rod is pulled upward drawing the arc into the boric acid cylinder. The spring shunt contact fingers close in on the rod to maintain the electrical path. Intense heat from the arc, as it strikes, decomposes the compressed boric acid powder.

Decomposition of the dry boric acid forms water vapor and boric acid anhydride. The electrical interruption is caused by the steam de-ionizing the arc as it is drawn through the cylinder by action of the spring and rod.

The arcing rod is prevented from falling back into the fuse until after interruption by a friction stop just inside the top ferrule.

### DBA Fuse Construction



**Operation**

The DBA type fuse unit is of the replaceable type rather than the renewable type. When the fuse has blown and drop-out completed, the entire unit is removed with a switch stick. After replacement of the blown unit, it is closed back into place with the switch stick.

In replacing the blown fuse, the end fittings are removed and clamped on a new fuse. End fittings consist of an operating eye at the top and hinge lifting eye at the bottom. The two fittings have different shapes and are keyed with different projections. Fittings are simple to remove or replace, and cannot be reversed since the keys insure quick, correct alignment.

DE-ION circuit interruption by action of the boric acid fuse unit is followed simultaneously by a mechanical drop-out action. When closing the fuse unit with the switch stick, the ejector casting located under the sleet hood, compresses the ejector spring. Under fault conditions the fuse element melts, the helical spring pulls the arcing rod and arc through the cylinder. The upper end of the arcing rod drives through a small hole in the top of the ferrule of the fuse unit and strikes the trigger-releasing ejector. The trigger operates and causes the ejector spring

to force the ejector casting against the fuse assembly forcing it outward to swing through a 180° arc into a drop-out position. Drop-out action provides immediate visual indication that the particular circuit in which the fuse is connected has been interrupted. The additional drop-out break insulates the fault from the feeders with an air gap of at least one foot on lower voltage system and up to six feet on higher voltage systems.

This air break eliminates any possibility of carbonized fuse parts breaking down to allow leakage or another fault. Since drop-out action takes place after current interruption within the boric acid cylinder, burning or arcing at the contact surfaces is eliminated.

**Application**

The DBA fuse is applicable in utility and industrial high voltage power systems for protecting:

- Power transformers
- Feeder circuit sectionalizing
- Distribution transformers
- Potential transformers

**Ratings**

- 8.3 to 145 kV
- 0.5E to 200E Amperes

The power fuse is an inherently fast circuit-interrupting device. This must be taken into account when determining the required short-circuit interrupting rating of a fuse.

The boric acid power fuse will interrupt currents of short-circuit magnitude in approximately 1/2 cycle measured from the instant of short-circuit. During this 1/2 cycle, the short-circuit current may be much higher than the sustained rms short-circuit current of the system at that point. The fuse must be capable of safely interrupting this transient current that might exist at the instant the fuse operates.

In an alternating current circuit containing inductance, a sudden change in the AC current is accompanied by a transient DC component that is a function of the AC current before and after the change and the point on the cycle at that the change occurs. The decrement of the transient is a function of the inductance and resistance or losses of the circuit.

If a short is suddenly established on a circuit, the DC component can have a maximum peak value equal to the crest of the 60 cycle short-circuit current of the system.

This maximum transient is obtained if the fault occurs at voltage zero. Due to the system losses, this DC component will die out to a low value in a few cycles. However, a fuse normally interrupts a short-circuit in 1/2 cycle, and this DC component of current must be taken into consideration in rating the fuse. If the decrement of DC component in this half cycle is neglected, the rms value of current for the totally asymmetrical condition would be 1.73 times the rms symmetrical value of the 60 cycle component.

Experience has shown that there is some decrement in this first half cycle and also that the current is limited somewhat by the arc drop in the fuse. For this reason, a ratio of 1.6 has been selected between the rms asymmetrical current the fuse must be designed to interrupt, and the rms short-circuit of the system on which the fuse is to be used. This instantaneous rms asymmetrical value of short-circuit current, which the fuse must be designed to interrupt, is often referred to as the rms symmetrical value including the DC component. The asymmetrical value is obtained by multiplying the symmetrical value by 1.6. The symmetrical value of short-circuit current on a three-phase system is determined by dividing the available three-phase, short-circuit kVA by the product of the system voltage and  $1/\sqrt{3}$ .

**Instructions for DBA Type Fuse Units 8.3 kV to 145 kV****Installation of Replacement Fuses**

DBA fuse units are available in two classifications, DBA-1 and DBA-2 and are used for utility-type applications from 8.3 kV through 145 kV.

Remove fuses from all three phases and replace with new or tested units. Fuses having been involved in a fault but not blown should be tested by resistance measurements to ascertain that they are suitable for continued service. Resistance limits are available on request.

Prior to installation, it is advisable to check the functioning of the mounting as follows:

1. Remove fuse fittings from hinge casting (see the figures on **Pages V14-T2-30** and **V14-T2-31**) and mount on a suitable fuse unit as shown in the figure on this page.
2. Check gauging distance "S" between center of guide pin in latch housing and bottom of socket in hinge casting as illustrated in the figures on **Pages V14-T2-30** and **V14-T2-31**. Dimension "S" must measure the same on both sides of the mounting. If dimension "S" is found to be incorrect, adjust it by using the clearances provided in the bolt holes (see the figures on **Pages V14-T2-30** and **V14-T2-31**).

3. Put the suitable fuse unit equipped with fittings in the mounting. Check operation of latch assembly by closing and opening the fuse as shown in the figures on **Pages V14-T2-30** and **V14-T2-31**.

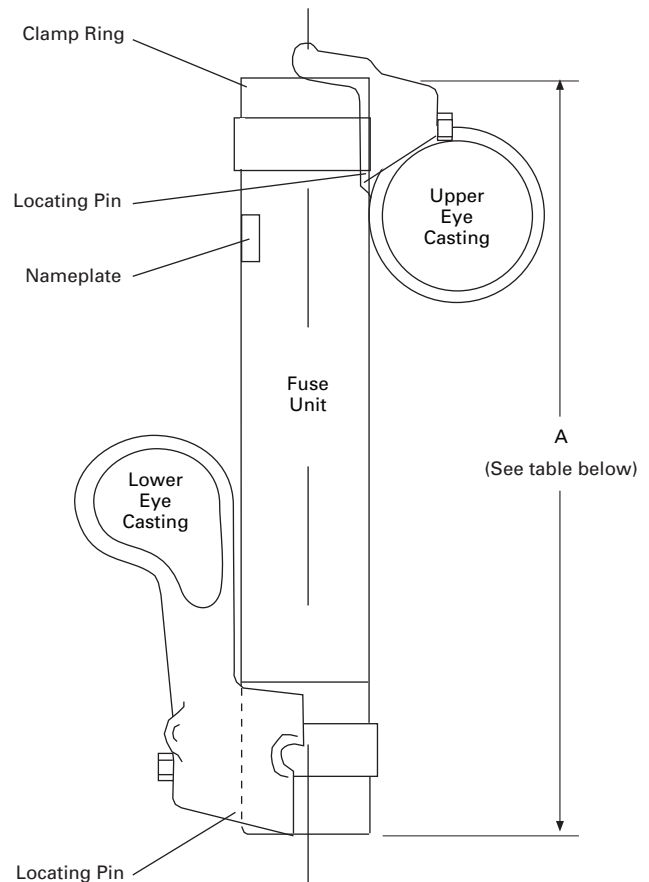
DBA-1 fuses up to 69 kV as well as DBA-2 fuses up to 46 kV can be lifted into the hinge casting by means of conventional all-purpose switch sticks. For lifting heavier fuses into the hinge, a switch stick about one foot shorter than the distance from ground level to the fuse hinge is recommended. This switch stick should be held approximately vertical as shown in the figures on **Pages V14-T2-30** and **V14-T2-31**.

For the closing-in or disconnecting operation, a switch stick of at least four foot greater length should be employed. Insert the switch stick pin into the eye of the fuse fitting from the right-hand side and have it form an angle of at least 35° with the fuse.

Fuse should be closed in with a sharp thrust. A similar impact-like pull is required to open the fuse. After the latch contacts have parted, the fuse may be allowed to disengage itself from the switch stick and drop out in a normal manner.

**Maintenance**

General maintenance instructions are published in the IEEE Std. C-37.48™-1973. Inspection of the fuse mounting should include checking the gauge distance "S" (see the figures on **Pages V14-T2-30** and **V14-T2-31**) and the operation of the latch mechanism.

**Fuse Unit With Fittings****Dimensions in Inches (mm)**

kV	DBA-1	DBA-2
8.3	13.5 (342.9)	—
15.5	17.0 (431.8)	—
25.5	21.5 (546.1)	—
38	28.5 (723.9)	28.13 (714.5)
48.3	34.0 (863.6)	33.63 (854.2)
69	43.88 (1,114.6)	43.63 (1,108.2)
92	—	52.0 (1,320.8)
121	—	62.0 (1,574.8)
145	—	72.0 (1,828.8)

# 2.5

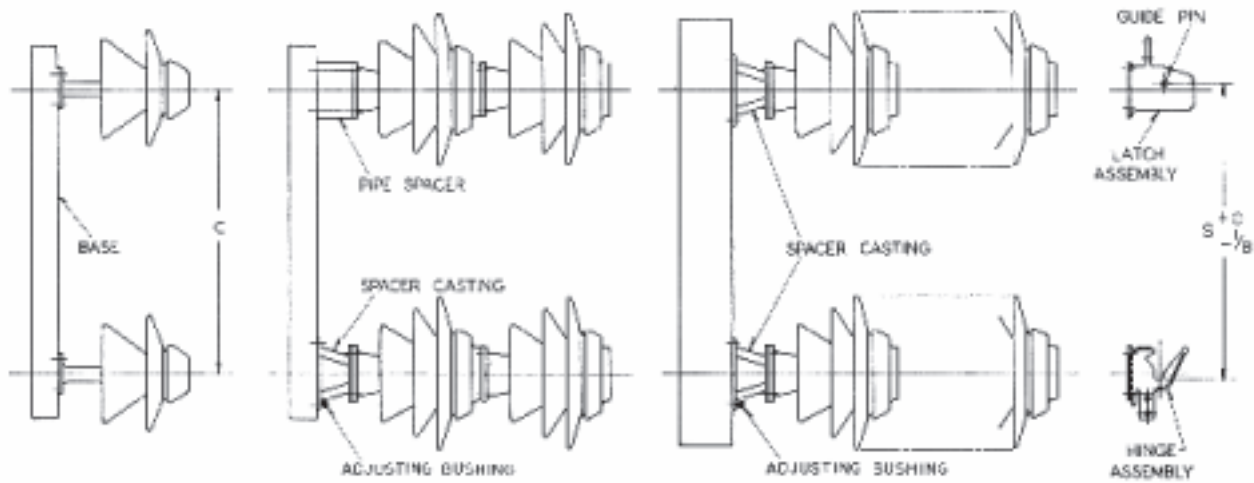
## Expulsion Fuses

### DBA Type Fuses

#### Insulator Spacing

Approximate Dimensions in Inches (mm)

2



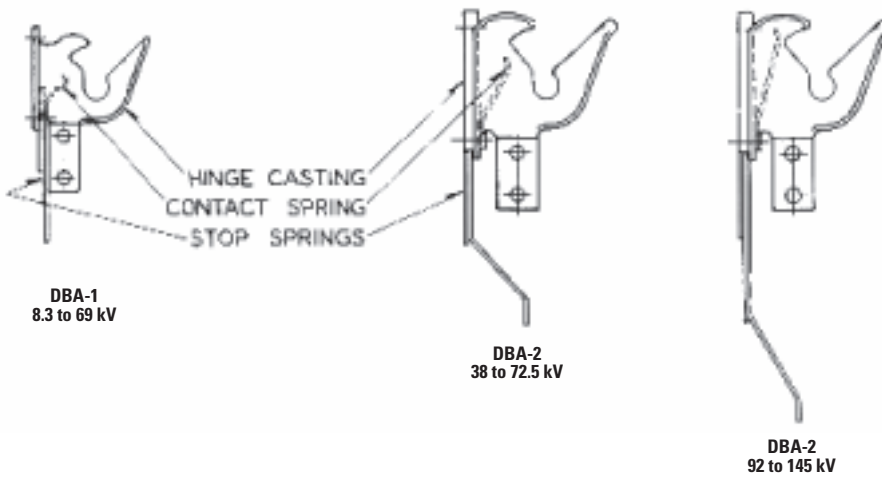
7.2 to 46 kV

69 kV

92 to 138 kV

kV	Dimension C		Dimension S	
	DBA-1	DBA-2	DBA-1	DBA-2
7.2	13.63 (346.2)	—	15.25 (387.4)	—
15	17.13 (435.1)	—	18.75 (476.3)	—
23	21.63 (549.4)	—	23.25 (590.6)	—
34.5	28.63 (727.2)	27.88 (708.2)	30.25 (768.4)	—
46	34.13 (866.9)	33.38 (847.9)	35.75 (908.1)	—
69	44.00 (1117.6)	43.38 (1101.9)	45.63 (1159.0)	—
92	—	51.75 (1314.5)	—	—
115	—	61.75 (1568.5)	—	—
138	—	71.75 (1822.5)	—	—

#### Hinge Assembly

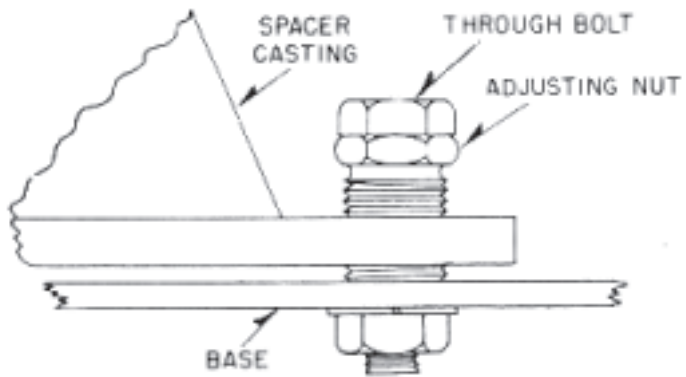


DBA-1  
8.3 to 69 kV

DBA-2  
38 to 72.5 kV

DBA-2  
92 to 145 kV

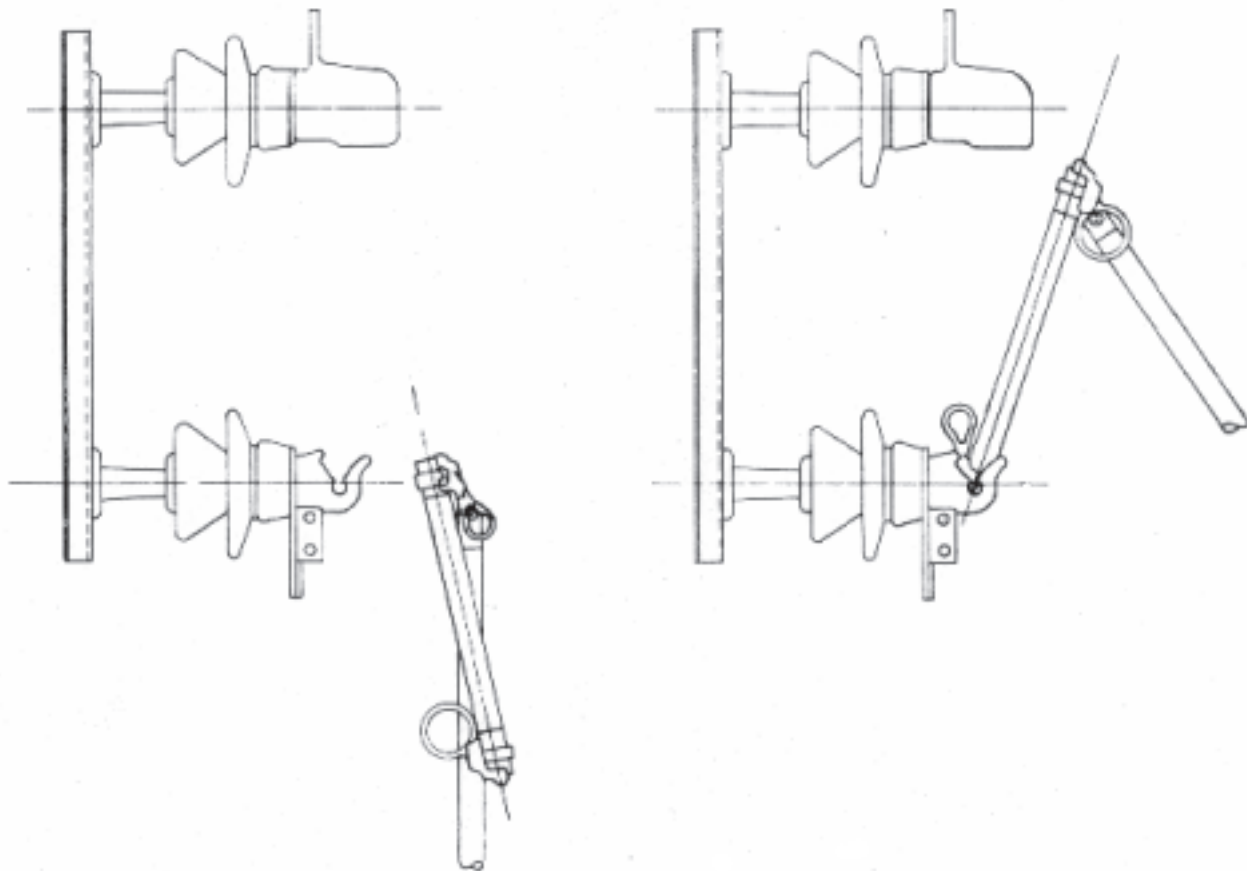
### Spacer Adjustment



### Procedure

1. Loosen all four through bolts.
2. Turn adjusting nut the desired amount.
3. Retighten all four through bolts.

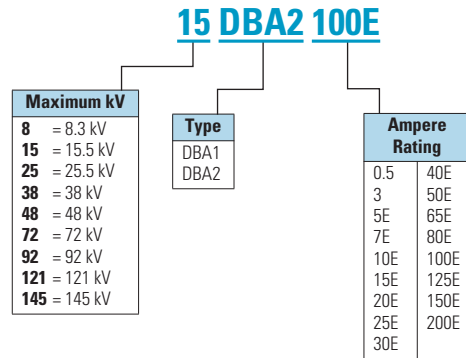
### Switch Stick Operation



#### Catalog Number Selection

#### DBA Fuse Units

2



#### Interrupting Ratings

#### DBA Fuse Interrupting Ratings

Fuse Unit Maximum Voltage Rating kV	Maximum System Voltage kV	DBA-1 rms Symmetrical kA	DBA-2 rms Symmetrical kA
8.3	2.75	6.3	—
—	5.5	6.3	—
—	8.3	6.3	—
15.5	15.5	6.3	—
25.8	25.8	6.3	12.5
38	38	5.0	12.5
48	48	4.0	12.5
72	72	—	10.0
92	92	—	6.3
121	121	—	5.0
145	145	—	4.0



## Product Selection

## DBA-1 Type Expulsion Fuse Units

Voltage (kV)

Performance Curves

Nominal	Maximum	Ampere Rating	Catalog Number	Approximate Shipping Weight Lbs (kg)	Minimum Melting	Total Clearing
7.2	8.3	0.5	8DBA1-0.5	1.5 (0.7)	TC45935101	TC45935201
7.2	8.3	3	8DBA1-3	1.5 (0.7)	TC45935101	TC45935201
7.2	8.3	5E	8DBA1-5E	1.5 (0.7)	TC45935101	TC45935201
7.2	8.3	7E	8DBA1-7E	1.5 (0.7)	TC45935101	TC45935201
7.2	8.3	10E	8DBA1-10E	1.5 (0.7)	TC45935101	TC45935201
7.2	8.3	15E	8DBA1-15E	1.5 (0.7)	TC45935101	TC45935201
7.2	8.3	20E	8DBA1-20E	1.5 (0.7)	TC45935101	TC45935201
7.2	8.3	25E	8DBA1-25E	1.5 (0.7)	TC45935101	TC45935201
7.2	8.3	30E	8DBA1-30E	1.5 (0.7)	TC45935101	TC45935201
7.2	8.3	40E	8DBA1-40E	1.5 (0.7)	TC45935101	TC45935201
7.2	8.3	50E	8DBA1-50E	1.5 (0.7)	TC45935101	TC45935201
7.2	8.3	65E	8DBA1-65E	1.5 (0.7)	TC45935101	TC45935201
7.2	8.3	80E	8DBA1-80E	1.5 (0.7)	TC45935101	TC45935201
7.2	8.3	100E	8DBA1-100E	1.5 (0.7)	TC45935101	TC45935201
7.2	8.3	125E	8DBA1-125E	1.5 (0.7)	TC45935101	TC45935201
7.2	8.3	150E	8DBA1-150E	1.5 (0.7)	TC45935101	TC45935201
7.2	8.3	200E	8DBA1-200E	1.5 (0.7)	TC45935101	TC45935201
14.4	15.5	0.5	15DBA1-0.5	2.1 (1.0)	TC45935101	TC45935201
14.4	15.5	3	15DBA1-3	2.1 (1.0)	TC45935101	TC45935201
14.4	15.5	5E	15DBA1-5E	2.1 (1.0)	TC45935101	TC45935201
14.4	15.5	7E	15DBA1-7E	2.1 (1.0)	TC45935101	TC45935201
14.4	15.5	10E	15DBA1-10E	2.1 (1.0)	TC45935101	TC45935201
14.4	15.5	15E	15DBA1-15E	2.1 (1.0)	TC45935101	TC45935201
14.4	15.5	20E	15DBA1-20E	2.1 (1.0)	TC45935101	TC45935201
14.4	15.5	25E	15DBA1-25E	2.1 (1.0)	TC45935101	TC45935201
14.4	15.5	30E	15DBA1-30E	2.1 (1.0)	TC45935101	TC45935201
14.4	15.5	40E	15DBA1-40E	2.1 (1.0)	TC45935101	TC45935201
14.4	15.5	50E	15DBA1-50E	2.1 (1.0)	TC45935101	TC45935201
14.4	15.5	65E	15DBA1-65E	2.1 (1.0)	TC45935101	TC45935201
14.4	15.5	80E	15DBA1-80E	2.1 (1.0)	TC45935101	TC45935201
14.4	15.5	100E	15DBA1-100E	2.1 (1.0)	TC45935101	TC45935201
14.4	15.5	125E	15DBA1-125E	2.1 (1.0)	TC45935101	TC45935201
14.4	15.5	150E	15DBA1-150E	2.1 (1.0)	TC45935101	TC45935201
14.4	15.5	200E	15DBA1-200E	2.1 (1.0)	TC45935101	TC45935201

## DBA-1 Type Expulsion Fuse Units, continued

Voltage (kV)

Performance Curves

Nominal	Maximum	Ampere Rating	Catalog Number	Approximate Shipping Weight Lbs (kg)	Performance Curves	
					Minimum Melting	Total Clearing
23	25.5	0.5	25DBA1-0.5	3.1 (1.4)	TC45935101	TC45935201
23	25.5	3	25DBA1-3	3.1 (1.4)	TC45935101	TC45935201
23	25.5	5E	25DBA1-5E	3.1 (1.4)	TC45935101	TC45935201
23	25.5	7E	25DBA1-7E	3.1 (1.4)	TC45935101	TC45935201
23	25.5	10E	25DBA1-10E	3.1 (1.4)	TC45935101	TC45935201
23	25.5	15E	25DBA1-15E	3.1 (1.4)	TC45935101	TC45935201
23	25.5	20E	25DBA1-20E	3.1 (1.4)	TC45935101	TC45935201
23	25.5	25E	25DBA1-25E	3.1 (1.4)	TC45935101	TC45935201
23	25.5	30E	25DBA1-30E	3.1 (1.4)	TC45935101	TC45935201
23	25.5	40E	25DBA1-40E	3.1 (1.4)	TC45935101	TC45935201
23	25.5	50E	25DBA1-50E	3.1 (1.4)	TC45935101	TC45935201
23	25.5	65E	25DBA1-65E	3.1 (1.4)	TC45935101	TC45935201
23	25.5	80E	25DBA1-80E	3.1 (1.4)	TC45935101	TC45935201
23	25.5	100E	25DBA1-100E	3.1 (1.4)	TC45935101	TC45935201
23	25.5	125E	25DBA1-125E	3.1 (1.4)	TC45935101	TC45935201
23	25.5	150E	25DBA1-150E	3.1 (1.4)	TC45935101	TC45935201
23	25.5	200E	25DBA1-200E	3.1 (1.4)	TC45935101	TC45935201
34.5	38	0.5	38DBA1-0.5	4.2 (1.9)	TC45935101	TC45935201
34.5	38	3	38DBA1-3	4.2 (1.9)	TC45935101	TC45935201
34.5	38	5E	38DBA1-5E	4.2 (1.9)	TC45935101	TC45935201
34.5	38	7E	38DBA1-7E	4.2 (1.9)	TC45935101	TC45935201
34.5	38	10E	38DBA1-10E	4.2 (1.9)	TC45935101	TC45935201
34.5	38	15E	38DBA1-15E	4.2 (1.9)	TC45935101	TC45935201
34.5	38	20E	38DBA1-20E	4.2 (1.9)	TC45935101	TC45935201
34.5	38	25E	38DBA1-25E	4.2 (1.9)	TC45935101	TC45935201
34.5	38	30E	38DBA1-30E	4.2 (1.9)	TC45935101	TC45935201
34.5	38	40E	38DBA1-40E	4.2 (1.9)	TC45935101	TC45935201
34.5	38	50E	38DBA1-50E	4.2 (1.9)	TC45935101	TC45935201
34.5	38	65E	38DBA1-65E	4.2 (1.9)	TC45935101	TC45935201
34.5	38	80E	38DBA1-80E	4.2 (1.9)	TC45935101	TC45935201
34.5	38	100E	38DBA1-100E	4.2 (1.9)	TC45935101	TC45935201
34.5	38	125E	38DBA1-125E	4.2 (1.9)	TC45935101	TC45935201
34.5	38	150E	38DBA1-150E	4.2 (1.9)	TC45935101	TC45935201
34.5	38	200E	38DBA1-200E	4.2 (1.9)	TC45935101	TC45935201

## DBA-1 Type Expulsion Fuse Units, continued

Voltage (kV)

Performance Curves

Nominal	Maximum	Ampere Rating	Catalog Number	Approximate Shipping Weight Lbs (kg)	Performance Curves	
					Minimum Melting	Total Clearing
46	48	0.5	48DBA1-0.5	6.5 (3.0)	TC45935101	TC45935301
46	48	3	48DBA1-3	6.5 (3.0)	TC45935101	TC45935301
46	48	5E	48DBA1-5E	6.5 (3.0)	TC45935101	TC45935301
46	48	7E	48DBA1-7E	6.5 (3.0)	TC45935101	TC45935301
46	48	10E	48DBA1-10E	6.5 (3.0)	TC45935101	TC45935301
46	48	15E	48DBA1-15E	6.5 (3.0)	TC45935101	TC45935301
46	48	20E	48DBA1-20E	6.5 (3.0)	TC45935101	TC45935301
46	48	25E	48DBA1-25E	6.5 (3.0)	TC45935101	TC45935301
46	48	30E	48DBA1-30E	6.5 (3.0)	TC45935101	TC45935301
46	48	40E	48DBA1-40E	6.5 (3.0)	TC45935101	TC45935301
46	48	50E	48DBA1-50E	6.5 (3.0)	TC45935101	TC45935301
46	48	65E	48DBA1-65E	6.5 (3.0)	TC45935101	TC45935301
46	48	80E	48DBA1-80E	6.5 (3.0)	TC45935101	TC45935301
46	48	100E	48DBA1-100E	6.5 (3.0)	TC45935101	TC45935301
46	48	125E	48DBA1-125E	6.5 (3.0)	TC45935101	TC45935301
46	48	150E	48DBA1-150E	6.5 (3.0)	TC45935101	TC45935301
46	48	200E	48DBA1-200E	6.5 (3.0)	TC45935101	TC45935301
69	72	0.5	72DBA1-0.5	7.1 (3.25)	TC45935101	TC45935301
69	72	3	72DBA1-3	7.1 (3.25)	TC45935101	TC45935301
69	72	5E	72DBA1-5E	7.1 (3.25)	TC45935101	TC45935301
69	72	7E	72DBA1-7E	7.1 (3.25)	TC45935101	TC45935301
69	72	10E	72DBA1-10E	7.1 (3.25)	TC45935101	TC45935301
69	72	15E	72DBA1-15E	7.1 (3.25)	TC45935101	TC45935301
69	72	20E	72DBA1-20E	7.1 (3.25)	TC45935101	TC45935301
69	72	25E	72DBA1-25E	7.1 (3.25)	TC45935101	TC45935301
69	72	30E	72DBA1-30E	7.1 (3.25)	TC45935101	TC45935301
69	72	40E	72DBA1-40E	7.1 (3.25)	TC45935101	TC45935301
69	72	50E	72DBA1-50E	7.1 (3.25)	TC45935101	TC45935301
69	72	65E	72DBA1-65E	7.1 (3.25)	TC45935101	TC45935301
69	72	80E	72DBA1-80E	7.1 (3.25)	TC45935101	TC45935301
69	72	100E	72DBA1-100E	7.1 (3.25)	TC45935101	TC45935301
69	72	125E	72DBA1-125E	7.1 (3.25)	TC45935101	TC45935301
69	72	150E	72DBA1-150E	7.1 (3.25)	TC45935101	TC45935301
69	72	200E	72DBA1-200E	7.1 (3.25)	TC45935101	TC45935301

## DBA-2 Type Expulsion Fuse Units

Voltage (kV)

Performance Curves

2

Nominal	Maximum	Ampere Rating	Catalog Number	Approximate Shipping Weight Lbs (kg)	Minimum Melting	Total Clearing
34.5	38	0.5	38DBA2-5	10 (4.6)	TC45935101	TC45935301
34.5	38	3	38DBA2-3	10 (4.6)	TC45935101	TC45935301
34.5	38	5E	38DBA2-5E	10 (4.6)	TC45935101	TC45935301
34.5	38	7E	38DBA2-7E	10 (4.6)	TC45935101	TC45935301
34.5	38	10E	38DBA2-10E	10 (4.6)	TC45935101	TC45935301
34.5	38	15E	38DBA2-15E	10 (4.6)	TC45935101	TC45935301
34.5	38	20E	38DBA2-20E	10 (4.6)	TC45935101	TC45935301
34.5	38	25E	38DBA2-25E	10 (4.6)	TC45935101	TC45935301
34.5	38	30E	38DBA2-30E	10 (4.6)	TC45935101	TC45935301
34.5	38	40E	38DBA2-40E	10 (4.6)	TC45935101	TC45935301
34.5	38	50E	38DBA2-50E	10 (4.6)	TC45935101	TC45935301
34.5	38	65E	38DBA2-65E	10 (4.6)	TC45935101	TC45935301
34.5	38	80E	38DBA2-780E	10 (4.6)	TC45935101	TC45935301
34.5	38	100E	38DBA2-100E	10 (4.6)	TC45935101	TC45935301
34.5	38	125E	38DBA2-125E	10 (4.6)	TC45935101	TC45935301
34.5	38	150E	38DBA2-150E	10 (4.6)	TC45935101	TC45935301
34.5	38	200E	38DBA2-200E	10 (4.6)	TC45935101	TC45935301
46	48	0.5	48DBA2-5	12 (5.5)	TC45935101	TC45935301
46	48	3	48DBA2-3	12 (5.5)	TC45935101	TC45935301
46	48	5E	48DBA2-5E	12 (5.5)	TC45935101	TC45935301
46	48	7E	48DBA2-7E	12 (5.5)	TC45935101	TC45935301
46	48	10E	48DBA2-10E	12 (5.5)	TC45935101	TC45935301
46	48	15E	48DBA2-15E	12 (5.5)	TC45935101	TC45935301
46	48	20E	48DBA2-20E	12 (5.5)	TC45935101	TC45935301
46	48	25E	48DBA2-25E	12 (5.5)	TC45935101	TC45935301
46	48	30E	48DBA2-30E	12 (5.5)	TC45935101	TC45935301
46	48	40E	48DBA2-40E	12 (5.5)	TC45935101	TC45935301
46	48	50E	48DBA2-50E	12 (5.5)	TC45935101	TC45935301
46	48	65E	48DBA2-65E	12 (5.5)	TC45935101	TC45935301
46	48	80E	48DBA2-780E	12 (5.5)	TC45935101	TC45935301
46	48	100E	48DBA2-100E	12 (5.5)	TC45935101	TC45935301
46	48	125E	48DBA2-125E	12 (5.5)	TC45935101	TC45935301
46	48	150E	48DBA2-150E	12 (5.5)	TC45935101	TC45935301
46	48	200E	48DBA2-200E	12 (5.5)	TC45935101	TC45935301

## DBA-2 Type Expulsion Fuse Units, continued

Voltage (kV)

Performance Curves

Nominal	Maximum	Ampere Rating	Catalog Number	Approximate Shipping Weight Lbs (kg)	Minimum Melting	Total Clearing
69	72	0.5	72DBA2-5	15 (6.8)	TC45935101	TC45935301
69	72	3	72DBA2-3	15 (6.8)	TC45935101	TC45935301
69	72	5E	72DBA2-5E	15 (6.8)	TC45935101	TC45935301
69	72	7E	72DBA2-7E	15 (6.8)	TC45935101	TC45935301
69	72	10E	72DBA2-10E	15 (6.8)	TC45935101	TC45935301
69	72	15E	72DBA2-15E	15 (6.8)	TC45935101	TC45935301
69	72	20E	72DBA2-20E	15 (6.8)	TC45935101	TC45935301
69	72	25E	72DBA2-25E	15 (6.8)	TC45935101	TC45935301
69	72	30E	72DBA2-30E	15 (6.8)	TC45935101	TC45935301
69	72	40E	72DBA2-40E	15 (6.8)	TC45935101	TC45935301
69	72	50E	72DBA2-50E	15 (6.8)	TC45935101	TC45935301
69	72	65E	72DBA2-65E	15 (6.8)	TC45935101	TC45935301
69	72	80E	72DBA2-780E	15 (6.8)	TC45935101	TC45935301
69	72	100E	72DBA2-100E	15 (6.8)	TC45935101	TC45935301
69	72	125E	72DBA2-125E	15 (6.8)	TC45935101	TC45935301
69	72	150E	72DBA2-150E	15 (6.8)	TC45935101	TC45935301
69	72	200E	72DBA2-200E	15 (6.8)	TC45935101	TC45935301
92	92	3	92DBA2-3	19 (8.7)	TC45935101	TC45935401
92	92	5E	92DBA2-5E	19 (8.7)	TC45935101	TC45935401
92	92	7E	92DBA2-7E	19 (8.7)	TC45935101	TC45935401
92	92	10E	92DBA2-10E	19 (8.7)	TC45935101	TC45935401
92	92	15E	92DBA2-15E	19 (8.7)	TC45935101	TC45935401
92	92	20E	92DBA2-20E	19 (8.7)	TC45935101	TC45935401
92	92	25E	92DBA2-25E	19 (8.7)	TC45935101	TC45935401
92	92	30E	92DBA2-30E	19 (8.7)	TC45935101	TC45935401
92	92	40E	92DBA2-40E	19 (8.7)	TC45935101	TC45935401
92	92	50E	92DBA2-50E	19 (8.7)	TC45935101	TC45935401
92	92	65E	92DBA2-65E	19 (8.7)	TC45935101	TC45935401
92	92	80E	92DBA2-780E	19 (8.7)	TC45935101	TC45935401
92	92	100E	92DBA2-100E	19 (8.7)	TC45935101	TC45935401
92	92	125E	92DBA2-125E	19 (8.7)	TC45935101	TC45935401
92	92	150E	92DBA2-150E	19 (8.7)	TC45935101	TC45935401
92	92	200E	92DBA2-200E	19 (8.7)	TC45935101	TC45935401

## DBA-2 Type Expulsion Fuse Units, continued

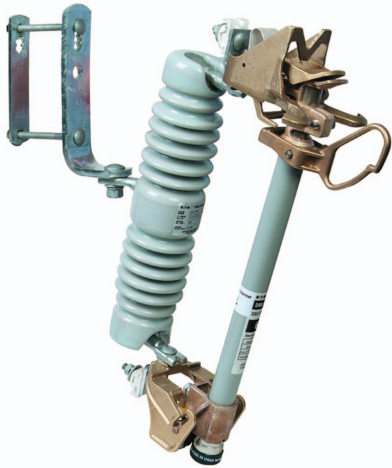
Voltage (kV)

Performance Curves

2

Nominal	Maximum	Ampere Rating	Catalog Number	Approximate Shipping Weight Lbs (kg)	Minimum Melting	Total Clearing
115	121	3	121DBA2-3	22 (10)	TC45935101	TC45935401
115	121	5E	121DBA2-5E	22 (10)	TC45935101	TC45935401
115	121	7E	121DBA2-7E	22 (10)	TC45935101	TC45935401
115	121	10E	121DBA2-10E	22 (10)	TC45935101	TC45935401
115	121	15E	121DBA2-15E	22 (10)	TC45935101	TC45935401
115	121	20E	121DBA2-20E	22 (10)	TC45935101	TC45935401
115	121	25E	121DBA2-25E	22 (10)	TC45935101	TC45935401
115	121	30E	121DBA2-30E	22 (10)	TC45935101	TC45935401
115	121	40E	121DBA2-40E	22 (10)	TC45935101	TC45935401
115	121	50E	121DBA2-50E	22 (10)	TC45935101	TC45935401
115	121	65E	121DBA2-65E	22 (10)	TC45935101	TC45935401
115	121	80E	121DBA2-780E	22 (10)	TC45935101	TC45935401
115	121	100E	121DBA2-100E	22 (10)	TC45935101	TC45935401
115	121	125E	121DBA2-125E	22 (10)	TC45935101	TC45935401
115	121	150E	121DBA2-150E	22 (10)	TC45935101	TC45935401
115	121	200E	121DBA2-200E	22 (10)	TC45935101	TC45935401
138	145	3	145DBA2-3	25 (11.4)	TC45935101	TC45935401
138	145	5E	145DBA2-5E	25 (11.4)	TC45935101	TC45935401
138	145	7E	145DBA2-7E	25 (11.4)	TC45935101	TC45935401
138	145	10E	145DBA2-10E	25 (11.4)	TC45935101	TC45935401
138	145	15E	145DBA2-15E	25 (11.4)	TC45935101	TC45935401
138	145	20E	145DBA2-20E	25 (11.4)	TC45935101	TC45935401
138	145	25E	145DBA2-25E	25 (11.4)	TC45935101	TC45935401
138	145	30E	145DBA2-30E	25 (11.4)	TC45935101	TC45935401
138	145	40E	145DBA2-40E	25 (11.4)	TC45935101	TC45935401
138	145	50E	145DBA2-50E	25 (11.4)	TC45935101	TC45935401
138	145	65E	145DBA2-65E	25 (11.4)	TC45935101	TC45935401
138	145	80E	145DBA2-780E	25 (11.4)	TC45935101	TC45935401
138	145	100E	145DBA2-100E	25 (11.4)	TC45935101	TC45935401
138	145	125E	145DBA2-125E	25 (11.4)	TC45935101	TC45935401
138	145	150E	145DBA2-150E	25 (11.4)	TC45935101	TC45935401
138	145	200E	145DBA2-200E	25 (11.4)	TC45935101	TC45935401

DBU Fuse Unit in Outdoor Mounting



## DBU Type Fuses

### Product Description

#### Introduction

Eaton's DBU (Distribution Boric acid fuse Unit) power and distribution fuses are expulsion-style fuse units designed for both indoor and outdoor applications. DBU fuse units provide a low initial cost alternative to refillable fuses.

Conventional distribution cutouts use a fuse link in a fiber tube within the fuse holder for fault interruption. DBU fuses far exceed the cutout in interrupting rating, and considerably reduce the hazards and noise produced by the violent exhaust of cutouts under fault interrupting conditions. DBU fuses employ calibrated silver elements with a parallel strain links, boric acid interrupting media, and a spring and rod mechanism, all housed inside a sealed rigid enclosure. The design is optimized to give a low arc voltage and mild exhaust during fault interruption. DBU expulsion fuses are available in three voltage classes: 17 kV, 27 kV, and 38 kV, and in three speed variations: Standard "E", Slow "E", and "K" with amperage sizes ranging from 3A through 200A.

### Construction

A DBU fuse comprises the fuse unit, end fittings (including a muffler when installed in an indoor mounting), and a mounting.

Principle parts of the replaceable DBU fuse unit are illustrated in the cross section view of the figure on **Page V14-T2-40**. The active parts of the fuse unit are the calibrated current responsive silver element with a parallel high strength strain wire, arcing rod, boric acid cylinder, and spring. To ensure adequate strength to contain the force of the arc interruption, the assembly is enclosed in a high strength glass-epoxy tube with plated copper end connections. The use of a calibrated pure silver element and Nichrome™ strain wire makes the DBU less prone to premature operation caused by vibration, corona corrosion, or aging of the fuse elements. It is not susceptible to damage by transient faults or overloads that may approach the minimum melt time-current curve point.

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Under normal load conditions, a positive low resistance sliding connection is maintained between the movable arcing rod and the fixed contact at the upper end of the fuse unit with a tulip contact. Durable weatherproof labels are attached to each fuse to provide rating and manufacturer information.

#### Operation

DBU expulsion fuses use the proven performance of boric acid to create the de-ionizing action needed to interrupt fault currents. Interruption is achieved by the action of the arcing rod and a charged compression spring that elongates the arc through a boric acid chamber when the arcing rod is released by the melting and arcing of the fuse element and strain wire. The high temperature of the arc separates the hydrated boric

acid producing a blast of water vapor and inert boric anhydride. This expanding mixture extinguishes the arc by blasting through and de-ionizing it. At high levels of fault current, the exhaust caused by the interruption ruptures the vent disc and exits from the bottom of the fuse. At lower values of fault current, the interruption is confined within the fuse unit, and there is no exhaust from the fuse. The de-ionizing action prevents the arc from restriking after a current zero.

DBU fuses are designed to interrupt short-circuit currents within 1/2 cycle at the next current zero. The relative details of the boric acid cylinder and the arcing rod and element assemblies are tuned to limit any noise and hazard produced by a fuse operation at all levels of fault current.

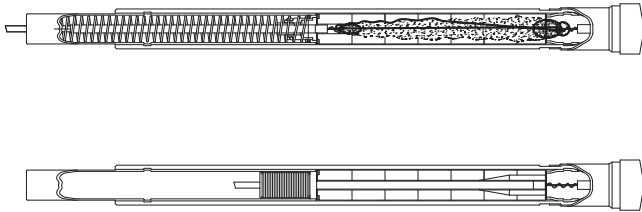
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## Expulsion Fuses

### DBU Type Fuses

2

#### DBU Sectioned View



When the fuse operates, the spring forces the top of the arcing rod to penetrate the upper seal. On indoor applications, this action causes the visible 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 into the vertical down dropout position. This dropout action provides immediate visual indication that the fuse has interrupted a fault. When a fuse has operated and the dropout action is complete, the fuse unit complete with end fittings can be removed with a switch stick. Refer to I.L.36-642-E for Installation Instructions.

#### Applications

DBU fuses provide effective protection for circuits and equipment that operate on systems with voltage ratings up to 34,500V. They can be used on both electric utility and industrial distribution systems and are suitable for use on the following:

- Power transformers
- Feeder circuits
- Distribution transformers
- Potential transformers
- Station service transformers
- Metal-enclosed switchgear
- Pad mount switches

DBU fuse units are sealed and can be used in outdoor or indoor applications. They can be used to directly replace competitive equivalent units.

#### DBU Fuse Unit

A DBU fuse unit is comprised of a compression spring, an arcing rod, a calibrated

DBU fuse units have reliable performance in compliance with industry-standard time-current characteristics which allow close coordination that other DBU fuses, as well as other fuses and a wide variety of other protective devices.

DBU fuses operate promptly to limit the stress on electrical systems due to short-circuits. They isolate the faulted circuit, limiting service interruptions. They act rapidly to take transformers off-line, preventing tank rupture, and feeder circuits off-line before damage can become widespread. They also provide excellent isolation for capacitors, preventing case failure in the event of a fault condition.

When installed on the primary side of substation power transformers, DBU fuses provide protection against small, medium or large faults. Regardless of the nature of the fault, full protection is provided even down to minimum melt current.

#### DBU Details

Eaton's DBU fuses provide superior performance and are applicable for distribution system protection up to an operational voltage of 34.5KV. Because DBU fuses are available in a range of current and speed ratings, close fusing can be achieved to maximize protection and overall coordination. The quality of the DBU design and manufacturing process ensures repeatable accuracy and ongoing time-current protection.

current responsive silver element with a parallel mechanical strain wire that isolates the silver element from the spring tension, and a

solid boric acid liner that assists with the interruption. All of these components are contained within a high strength glass-epoxy tube sealed with high conductivity copper end contacts that are compatible with industry standard end fittings for indoor or outdoor application. The calibrated fuse element determines the operational fault response characteristics of the fuse unit, which are indicated on the specific time-current characteristic curve.

The heavy copper cylindrical arcing rod is contained within the boric acid liner and performs two functions. Under normal conditions, it conducts the continuous rated current of the fuse. When the fuse element and strain wire melt during a fault condition, the arcing rod draws and lengthens the arc as it moves up through the boric acid liner. This movement is caused by spring tension accelerating the arcing rod after release by the melted strain link.

Intense heat from the arc separates the hydrated boric acid producing water vapor and inert boric anhydride that extinguishes and de-ionizes the arc.

On low current interruptions, the vent diaphragm is not ruptured, and the pressure retained within the fuse unit helps to extinguish the low intensity arc. On high current interruptions, the vent diaphragm is ruptured and the exhaust exits from the bottom of the fuse.

In either case, the resulting dielectric strength generated in the fuse unit prevents reignition of the arc after a current zero.

DBU fuse units are discarded after fault interruption, and do not present any environmental hazard if discarded in a landfill.

#### DBU End Fittings

End fittings that are positioned on the top and bottom of the fuse unit and are required to complete the electrical connection between the fuse unit and mounting, can be reused if they remain undamaged. They are completely interchangeable with other comparable industry standard end fittings.

#### Outdoor End Fittings

Reusable outdoor end fittings are silver plated and made of a cast high conductivity copper alloy. The hookeye in the lower end fitting allows the fuse unit to be easily lifted in or out of the lower hinge contact of the mounting. A large hookeye on the upper fitting allows for easy operation in pole-top mountings with a switch stick. The design of the upper end fitting provides for proper engagement in the upper contact assembly of the mounting. 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 contact assembly of the mounting. These posts allow the fuse to rotate into the proper engaged position, and suspend the fuse in the operated, drop-out position. If a fault occurs, the arcing rod will pierce the seal at the upper end of the fuse unit, and cause the latch to release. Once released, the fuse will rotate down into the drop-out position to indicate that the fuse has operated.



### Indoor End Fittings

Reusable indoor end fittings are composed of high-impact plastic and high conductivity copper alloy. The visual indicator located on the top end fitting, provides clear indication of a fuse unit that has operated. The silver-plated contact rod insures positive conductivity between the fuse unit and the upper contact assembly of the mounting.

The spring-biased plastic latch hookkey actuates the latch mechanism when engaged into the mounting. It readily accepts a switch stick to insert or remove the assembled fuse unit. A locating pin in the upper end fitting assembly ensures proper alignment and engagement with the fuse unit. The cast bottom indoor end fitting has a locating slot on the inside bore that aligns with a locating pin on the lower section of the fuse unit to provide proper alignment with the mounting.

The bottom indoor end fitting is attached to the fuse unit by threading a muffler into the end fitting, and so clamping the fitting to the fuse unit. Projections on the bottom of the muffler allow sufficient torque to be applied to seal the muffler to the fuse unit. The lower ferrule of the fuse unit directly contacts the lower contacts of the mounting. The muffler absorbs noise and contamination from arcing products to prevent contamination of indoor equipment. The muffler is constructed of a plated steel housing, containing copper mesh screening. This copper mesh acts to absorb and contain the noise, and de-ionize exhaust materials of the fuse during a fault interruption. De-ionizing the exhaust gases prevents accidental flashover from phase-to-phase or phase-to-ground by limiting foreign airborne particles and gases.

### Mountings and Live Parts

Eaton offers a full line of outdoor mountings <sup>Ⓞ</sup> and indoor loadbreak and non-loadbreak mountings and live parts for the DBU fuse family. Mountings are available in 17 kV, 27 kV, and 38 kV class designs, and these mountings will readily accommodate DBU fuses and other equivalent industry standard fuses. DBU mountings have a rated maximum continuous current of 200A, with a rated maximum interrupting current up to 14 kA. The following lists the LIWV rated lightning impulse withstand voltage rating of each voltage class (BIL):

- 17 kV–95 kV
- 27 kV–125 kV
- 38 kV–150 kV

Indoor loadbreak units have a maximum three-time fault close ASYM of 22,400A rms. Refer to the catalog number section for exact ratings per unit. Indoor mountings are constructed with rigid steel bases that are powder coated and baked. Bases are supplied with preformed mounting holes for easy installation.

Insulators are molded of high strength epoxy material for superior insulating characteristics. Live parts are rigidly secured to the insulators with standard mounting hardware.

Both left and right side cable terminations are available for indoor mountings for proper installation spacing. All bus connections are plated copper for improved conductivity and endurance.

All loadbreak units have a three-time fault close rating. These fuse mountings can withstand a fuse assembly being closed into a fault of the magnitude specified three times when closed briskly without hesitation, and remain operable and able to carry and interrupt the

continuous current. All live parts are constructed of silver-plated copper to ensure maximum and sustained conductivity.

Live parts can be purchased as separate kits without mountings.

### Interruption and Protection

DBU fuses provide effective protection for circuits and equipment operating on voltages from 2400V through 34,500V. They are designed to carry their rated continuous current without exceeding the temperature rise limits specified in IEEE and ANSI standards.

Under normal conditions, the temperature of the fusible element is well below the melting temperature and does not melt.

Under overload conditions, when the current is above any allowable overload condition for an extended period of time, but below the minimum level of current indicated on the total clearing time-current curve, the element temperature is below the melting temperature, but the heat generated within the fuse unit may be sufficient to cause permanent degradation of the structure of the fuse unit, sufficient to interfere with the ability of the fuse unit to perform as designed.

Under fault conditions, when a fault occurs that is large enough to melt the fuse element, an arc is initiated and elongated by the spring, pulling the arcing rod up into the boric acid interrupting media. The heat produced separates the material of the boric acid liner producing water vapor and boric anhydride that de-ionize the arc. At low fault current levels the pressure in the arcing chamber along with the elongation of the arc gives sufficient dielectric strength to extinguish the arc at a natural current zero without

bursting the pressure diaphragm. At higher fault current levels, the by-products extinguish the arc at a natural current zero by bursting the pressure diaphragm and forcing the arc products out of the bottom of the 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. When installed outdoors, the arc products are exhausted.

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 extinguished at current zero, the voltage across the fuse will attempt to re-ignite the arc. The voltage across the fuse immediately after the voltage zero is the sum of the circuit power frequency recovery voltage and a high frequency oscillatory voltage controlled by the circuit inductance and stray capacitance. This high frequency oscillatory voltage is called the Transient Recovery Voltage (TRV). After the fuse has interrupted a fault current at a natural circuit current zero, the dielectric gap must withstand this combined voltage to prevent re-ignition of the arc for a successful interruption to occur.

The rated maximum voltage of a DBU fuse is the highest rms voltage at which the fuse is designed to operate. The dielectric withstand level corresponds to insulation levels of power class and distribution class equipment, as DBU fuses can be used in either environment. Maximum voltage ratings for DBU fuses are: 17 kV, 27 kV, and 38 kV.

### Note

- Ⓞ Outdoor mountings available for 17 kV and 27 kV.

Fuses should never be applied where the available fault current exceeds the rated maximum interrupting current of the fuse, or the maximum value of the power frequency system voltage exceeds the rated maximum voltage of the fuse.

The rated maximum interrupting current values for DBU fuses are listed on **Page V14-T2-44**.

The continuous current rating of a DBU power fuse should equal or exceed the maximum load current where the fuse is applied.

DBU fuse units are available with continuous current ratings up to 200A and are designated as either E- or K-rated. These designations are defined in ANSI/IEEE Std. C37.42™ and C37.46™.

#### Coordination Consideration

Coordination considerations must be made to help determine what type of fuse is applied. The DBU power fuse interrupts at a natural current zero in the current wave and allows a minimum to flow before the fault is cleared. The time-current characteristics associated with a DBU has a rather gradual slope making it easier to coordinate with downstream equipment. In addition, the DBU is ideal for higher voltage (up to 38 kV) and high current applications (through 200A). It is important to examine the minimum melting and total clearing time-current characteristics of this particular fuse.

The melting time is the time in seconds required to melt the fuse element. This curve indicates when or even if the element of the fuse will melt for different symmetrical current magnitudes.

The total clearing time is the total amount of time it takes to clear a fault once the element has melted. The total clearing time is really the sum of the melting time and the time the fuse arcs during the clearing process. The DBU power fuse is offered in three configurations 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.

Finally, low currents, usually referred to as overload currents, must also be considered. The DBU and other expulsion fuses have a rather low thermal capacity and cannot carry overloads of the same magnitude and duration as motors and transformers of equal continuous currents. For this reason, the fuse must be sized with the full load current in mind. This consideration should be made so the fuse does not blow on otherwise acceptable overloads and inrush conditions.

The Eaton DBU family of power fuses is broad and comprehensive. Refer to the table below to review the ratings available for most application requirements. The final selection process for new applications will include the fuse unit, end fittings, and a mounting.

#### DBU Power Fuse Short-Circuit Interrupting Ratings

Nominal kV	System	Interrupting Amperes		Interrupting mVA
		Symmetrical Based on X/R = 16	Asymmetrical	(Three-Phase Symmetrical) Where X/R = 16
17	7.2	14,000	22,400	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	12,500	20,000	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			—
38	23.0	10,000	16,000	—
	14.4/24.9Y			—
	27.6			475
	20/34.5Y			600
	34.5			600

**Note**

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

### Testing and Performance

- Standards
- Testing
- Quality standards

Eaton does not compromise when performance, quality and safety are involved. Exacting standards have been established relative to the design, testing and application of expulsion type power fuses. Compliance with these standards ensures the best selection and performance. DBU type power fuses are designed and tested to applicable portions of ANSI standards as well as other industry standards. The ANSI standards are Consensus Standards jointly formulated by IEEE and NEMA.

IEEE (Institute of Electrical and Electronic Engineers) is an objective technical organization made up of manufacturers, users and other general interest parties. NEMA (National Electrical Manufacturers Association) is an electrical equipment manufacturer only organization with members like Eaton. ANSI (American National Standards Institute) is a nonprofit, privately funded membership organization that coordinates the development of U.S. voluntary national standards. It is also the U.S. member body to the non-treaty international standards

bodies, such as International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC).

The specific standards associated with DBU power fuses are:

- ANSI C37.40—Service Conditions and Definitions
- ANSI C37.41—Power Fuse Design and Testing
- ANSI C37.42—Distribution Fuse Ratings and Specification
- ANSI C37.46—Power Fuse Ratings and Specifications
- ANSI ~37.48—Power Fuse Application, Operation and Maintenance

### Testing

DBU power fuse unit design testing was performed on standard production fuses, holders, mountings and accessories. Demanding tests were performed by Eaton Technical Support and also at recognized independent power testing laboratories. Thermal and interrupting testing was conducted at 17, 27, and 38 kV levels. The entire series of tests was conducted in a specific sequence as stipulated by governing standards without any maintenance being performed.

All test results are verified by laboratory tabulations and oscillogram plots.

### Quality

Every effort is made to ensure the delivery of quality fuse units and customer satisfaction. All Eaton fuses are completely inspected at each manufacturing stage. In addition to ongoing quality control inspections, testing is performed prior to shipment. A Micro-Ohm Resistance Test is performed on each fuse to assure proper element construction, alignment and tightness of electrical connections. Construction integrity testing is also performed on every unit.

Each DBU fuse unit is checked to ensure that all items are supplied in keeping with manufacturing drawings. Individual fuses are packed in a plastic bag and then put into individual cartons. In addition, fuses are overpacked in a shipping carton to prevent shipping damage. Finally, mountings are packaged in heavy cardboard containers with reinforced wooden bases.

### Installation

Installation instructions are contained within I.L. 36-642.

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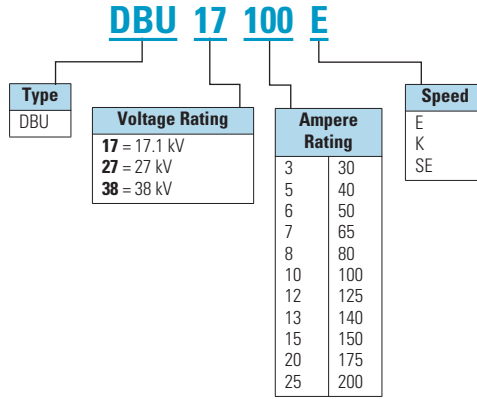
## Expulsion Fuses

### DBU Type Fuses

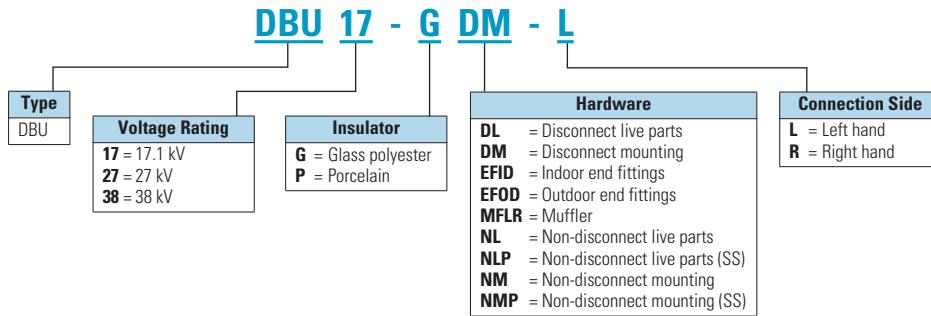
#### Catalog Number Selection

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#### DBU Fuse Units



#### DBU Mounting Catalog Numbers



#### Interrupting Ratings

##### DBU Fuse Interrupting Ratings

Fuse Unit	Maximum Rated Voltage kV	Maximum System Voltage kV	Outdoor Vented rms Symmetrical kA	Indoor with Muffler rms Symmetrical kA
17.1	17.1	17.1	14.0	14.0
27	27	27	12.5	12.5
38	38	38	10.0	8.5

## Product Selection

## DBU17 Type Standard E Speed Expulsion Fuse Units

Voltage (kV)					Performance Curves	
Nominal	Maximum	Ampere Rating	Catalog Number	Approximate Shipping Weight Lbs (kg)	Minimum Melting	Total Clearing
14.4	17.1	5	DBU17-5E	2.1 (1.0)	TC66702701	TC66703001
14.4	17.1	7	DBU17-7E	2.1 (1.0)	TC66702701	TC66703001
14.4	17.1	10	DBU17-10E	2.1 (1.0)	TC66702701	TC66703001
14.4	17.1	13	DBU17-13E	2.1 (1.0)	TC66702701	TC66703001
14.4	17.1	15	DBU17-15E	2.1 (1.0)	TC66702701	TC66703001
14.4	17.1	20	DBU17-20E	2.1 (1.0)	TC66702701	TC66703001
14.4	17.1	25	DBU17-25E	2.1 (1.0)	TC66702701	TC66703001
14.4	17.1	30	DBU17-30E	2.1 (1.0)	TC66702701	TC66703001
14.4	17.1	40	DBU17-40E	2.1 (1.0)	TC66702701	TC66703001
14.4	17.1	50	DBU17-50E	2.1 (1.0)	TC66702701	TC66703001
14.4	17.1	65	DBU17-65E	2.1 (1.0)	TC66702701	TC66703001
14.4	17.1	80	DBU17-80E	2.1 (1.0)	TC66702701	TC66703001
14.4	17.1	100	DBU17-100E	2.1 (1.0)	TC66702701	TC66703001
14.4	17.1	125	DBU17-125E	2.1 (1.0)	TC66702701	TC66703001
14.4	17.1	150	DBU17-150E	2.1 (1.0)	TC66702701	TC66703001
14.4	17.1	175	DBU17-175E	2.1 (1.0)	TC66702701	TC66703001
14.4	17.1	200	DBU17-200E	2.1 (1.0)	TC66702701	TC66703001

## DBU17 Type K Speed Expulsion Fuse Units

Voltage (kV)					Performance Curves	
Nominal	Maximum	Ampere Rating	Catalog Number	Approximate Shipping Weight Lbs (kg)	Minimum Melting	Total Clearing
14.4	17.1	3	DBU17-3K	2.1 (1.0)	TC66702801	TC66703101
14.4	17.1	6	DBU17-6K	2.1 (1.0)	TC66702801	TC66703101
14.4	17.1	8	DBU1780K	2.1 (1.0)	TC66702801	TC66703101
14.4	17.1	10	DBU17-10K	2.1 (1.0)	TC66702801	TC66703101
14.4	17.1	12	DBU17-12K	2.1 (1.0)	TC66702801	TC66703101
14.4	17.1	15	DBU17-15K	2.1 (1.0)	TC66702801	TC66703101
14.4	17.1	20	DBU17-20K	2.1 (1.0)	TC66702801	TC66703101
14.4	17.1	25	DBU17-25K	2.1 (1.0)	TC66702801	TC66703101
14.4	17.1	30	DBU17-30K	2.1 (1.0)	TC66702801	TC66703101
14.4	17.1	40	DBU17-40K	2.1 (1.0)	TC66702801	TC66703101
14.4	17.1	50	DBU17-50K	2.1 (1.0)	TC66702801	TC66703101
14.4	17.1	65	DBU17-65K	2.1 (1.0)	TC66702801	TC66703101
14.4	17.1	80	DBU17-80K	2.1 (1.0)	TC66702801	TC66703101
14.4	17.1	100	DBU17-100K	2.1 (1.0)	TC66702801	TC66703101
14.4	17.1	140	DBU17-140K	2.1 (1.0)	TC66702801	TC66703101
14.4	17.1	200	DBU17-200K	2.1 (1.0)	TC66702801	TC66703101

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## Expulsion Fuses

### DBU Type Fuses

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#### DBU17 Type Slow E Speed Expulsion Fuse Units

Voltage (kV)

Performance Curves

Nominal	Maximum	Ampere Rating	Catalog Number	Approximate Shipping Weight Lbs (kg)	Minimum Melting	Total Clearing
14.4	17.1	15	DBU17-15SE	2.1 (1.0)	TC66702601	TC66702901
14.4	17.1	20	DBU17-20SE	2.1 (1.0)	TC66702601	TC66702901
14.4	17.1	25	DBU17-25SE	2.1 (1.0)	TC66702601	TC66702901
14.4	17.1	30	DBU17-30SE	2.1 (1.0)	TC66702601	TC66702901
14.4	17.1	40	DBU17-40SE	2.1 (1.0)	TC66702601	TC66702901
14.4	17.1	50	DBU17-50SE	2.1 (1.0)	TC66702601	TC66702901
14.4	17.1	65	DBU17-65SE	2.1 (1.0)	TC66702601	TC66702901
14.4	17.1	80	DBU17-80SE	2.1 (1.0)	TC66702601	TC66702901
14.4	17.1	100	DBU17-100SE	2.1 (1.0)	TC66702601	TC66702901
14.4	17.1	125	DBU17-125SE	2.1 (1.0)	TC66702601	TC66702901
14.4	17.1	150	DBU17-150SE	2.1 (1.0)	TC66702601	TC66702901
14.4	17.1	175	DBU17-175SE	2.1 (1.0)	TC66702601	TC66702901
14.4	17.1	200	DBU17-200SE	2.1 (1.0)	TC66702601	TC66702901

#### DBU27 Type Standard E Speed Expulsion Fuse Units

Voltage (kV)

Performance Curves

Nominal	Maximum	Ampere Rating	Catalog Number	Approximate Shipping Weight Lbs (kg)	Minimum Melting	Total Clearing
23	27	5	DBU27-5E	2.5 (1.15)	TC66702701	TC66703901
23	27	7	DBU27-7E	2.5 (1.15)	TC66702701	TC66703901
23	27	10	DBU27-10E	2.5 (1.15)	TC66702701	TC66703901
23	27	13	DBU27-13E	2.5 (1.15)	TC66702701	TC66703901
23	27	15	DBU27-15E	2.5 (1.15)	TC66702701	TC66703901
23	27	20	DBU27-20E	2.5 (1.15)	TC66702701	TC66703901
23	27	25	DBU27-25E	2.5 (1.15)	TC66702701	TC66703901
23	27	30	DBU27-30E	2.5 (1.15)	TC66702701	TC66703901
23	27	40	DBU27-40E	2.5 (1.15)	TC66702701	TC66703901
23	27	50	DBU27-50E	2.5 (1.15)	TC66702701	TC66703901
23	27	65	DBU27-65E	2.5 (1.15)	TC66702701	TC66703901
23	27	80	DBU27-80E	2.5 (1.15)	TC66702701	TC66703901
23	27	100	DBU27-100E	2.5 (1.15)	TC66702701	TC66703901
23	27	125	DBU27-125E	2.5 (1.15)	TC66702701	TC66703901
23	27	150	DBU27-150E	2.5 (1.15)	TC66702701	TC66703901
23	27	175	DBU27-175E	2.5 (1.15)	TC66702701	TC66703901
23	27	200	DBU27-200E	2.5 (1.15)	TC66702701	TC66703901

**DBU27 Type K Speed Expulsion Fuse Units**

Voltage (kV)

Performance Curves

Nominal	Maximum	Ampere Rating	Catalog Number	Approximate Shipping Weight Lbs (kg)	Minimum Melting	Total Clearing
23	27	3	DBU27-3K	2.5 (1.15)	TC66702801	TC66704001
23	27	6	DBU27-6K	2.5 (1.15)	TC66702801	TC66704001
23	27	8	DBU27-8K	2.5 (1.15)	TC66702801	TC66704001
23	27	10	DBU27-10K	2.5 (1.15)	TC66702801	TC66704001
23	27	12	DBU27-12K	2.5 (1.15)	TC66702801	TC66704001
23	27	15	DBU27-15K	2.5 (1.15)	TC66702801	TC66704001
23	27	20	DBU27-20K	2.5 (1.15)	TC66702801	TC66704001
23	27	25	DBU27-25K	2.5 (1.15)	TC66702801	TC66704001
23	27	30	DBU27-30K	2.5 (1.15)	TC66702801	TC66704001
23	27	40	DBU27-40K	2.5 (1.15)	TC66702801	TC66704001
23	27	50	DBU27-50K	2.5 (1.15)	TC66702801	TC66704001
23	27	65	DBU27-65K	2.5 (1.15)	TC66702801	TC66704001
23	27	80	DBU27-80K	2.5 (1.15)	TC66702801	TC66704001
23	27	100	DBU27-100K	2.5 (1.15)	TC66702801	TC66704001
23	27	140	DBU27-140K	2.5 (1.15)	TC66702801	TC66704001
23	27	200	DBU27-200K	2.5 (1.15)	TC66702801	TC66704001

**DBU27 Type Slow E Speed Expulsion Fuse Units**

Voltage (kV)

Performance Curves

Nominal	Maximum	Ampere Rating	Catalog Number	Approximate Shipping Weight Lbs (kg)	Minimum Melting	Total Clearing
23	27	15	DBU27-15SE	2.5 (1.15)	TC66702601	TC66703801
23	27	20	DBU27-20SE	2.5 (1.15)	TC66702601	TC66703801
23	27	25	DBU27-25SE	2.5 (1.15)	TC66702601	TC66703801
23	27	30	DBU27-30SE	2.5 (1.15)	TC66702601	TC66703801
23	27	40	DBU27-40SE	2.5 (1.15)	TC66702601	TC66703801
23	27	50	DBU27-50SE	2.5 (1.15)	TC66702601	TC66703801
23	27	65	DBU27-65SE	2.5 (1.15)	TC66702601	TC66703801
23	27	80	DBU27-80SE	2.5 (1.15)	TC66702601	TC66703801
23	27	100	DBU27-100SE	2.5 (1.15)	TC66702601	TC66703801
23	27	125	DBU27-125SE	2.5 (1.15)	TC66702601	TC66703801
23	27	150	DBU27-150SE	2.5 (1.15)	TC66702601	TC66703801
23	27	175	DBU27-175SE	2.5 (1.15)	TC66702601	TC66703801
23	27	200	DBU27-200SE	2.5 (1.15)	TC66702601	TC66703801

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## Expulsion Fuses

### DBU Type Fuses

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#### DBU38 Type Standard E Speed Expulsion Fuse Units

Voltage (kV)

Nominal	Maximum	Ampere Rating	Catalog Number	Approximate Shipping Weight Lbs (kg)	Performance Curves	
					Minimum Melting	Total Clearing
34.5	38	5	DBU38-5E	2.8 (1.3)	TC66702701	TC66703901
34.5	38	7	DBU38-7E	2.8 (1.3)	TC66702701	TC66703901
34.5	38	10	DBU38-10E	2.8 (1.3)	TC66702701	TC66703901
34.5	38	13	DBU38-13E	2.8 (1.3)	TC66702701	TC66703901
34.5	38	15	DBU38-15E	2.8 (1.3)	TC66702701	TC66703901
34.5	38	20	DBU38-20E	2.8 (1.3)	TC66702701	TC66703901
34.5	38	25	DBU38-25E	2.8 (1.3)	TC66702701	TC66703901
34.5	38	30	DBU38-30E	2.8 (1.3)	TC66702701	TC66703901
34.5	38	40	DBU38-40E	2.8 (1.3)	TC66702701	TC66703901
34.5	38	50	DBU38-50E	2.8 (1.3)	TC66702701	TC66703901
34.5	38	65	DBU38-65E	2.8 (1.3)	TC66702701	TC66703901
34.5	38	80	DBU38-80E	2.8 (1.3)	TC66702701	TC66703901
34.5	38	100	DBU38-100E	2.8 (1.3)	TC66702701	TC66703901
34.5	38	125	DBU38-125E	2.8 (1.3)	TC66702701	TC66703901
34.5	38	150	DBU38-150E	2.8 (1.3)	TC66702701	TC66703901
34.5	38	175	DBU38-175E	2.8 (1.3)	TC66702701	TC66703901
34.5	38	200	DBU38-200E	2.8 (1.3)	TC66702701	TC66703901

#### DBU38 Type K Speed Expulsion Fuse Units

Voltage (kV)

Nominal	Maximum	Ampere Rating	Catalog Number	Approximate Shipping Weight Lbs (kg)	Performance Curves	
					Minimum Melting	Total Clearing
34.5	38	3	DBU38-3K	2.8 (1.3)	TC66702801	TC66704001
34.5	38	6	DBU38-6K	2.8 (1.3)	TC66702801	TC66704001
34.5	38	8	DBU38-8K	2.8 (1.3)	TC66702801	TC66704001
34.5	38	10	DBU38-10K	2.8 (1.3)	TC66702801	TC66704001
34.5	38	12	DBU38-12K	2.8 (1.3)	TC66702801	TC66704001
34.5	38	15	DBU38-15K	2.8 (1.3)	TC66702801	TC66704001
34.5	38	20	DBU38-20K	2.8 (1.3)	TC66702801	TC66704001
34.5	38	25	DBU38-25K	2.8 (1.3)	TC66702801	TC66704001
34.5	38	30	DBU38-30K	2.8 (1.3)	TC66702801	TC66704001
34.5	38	40	DBU38-40K	2.8 (1.3)	TC66702801	TC66704001
34.5	38	50	DBU38-50K	2.8 (1.3)	TC66702801	TC66704001
34.5	38	65	DBU38-65K	2.8 (1.3)	TC66702801	TC66704001
34.5	38	80	DBU38-80K	2.8 (1.3)	TC66702801	TC66704001
34.5	38	100	DBU38-100K	2.8 (1.3)	TC66702801	TC66704001
34.5	38	140	DBU38-140K	2.8 (1.3)	TC66702801	TC66704001
34.5	38	200	DBU38-200K	2.8 (1.3)	TC66702801	TC66704001



## DBU38 Type Slow E Expulsion Fuse Units

Voltage (kV)					Performance Curves	
Nominal	Maximum	Ampere Rating	Catalog Number	Approximate Shipping Weight Lbs (kg)	Minimum Melting	Total Clearing
34.5	38	15	DBU38-15SE	2.8 (1.3)	TC66702601	TC66703801
34.5	38	20	DBU38-20SE	2.8 (1.3)	TC66702601	TC66703801
34.5	38	25	DBU38-25SE	2.8 (1.3)	TC66702601	TC66703801
34.5	38	30	DBU38-30SE	2.8 (1.3)	TC66702601	TC66703801
34.5	38	40	DBU38-40SE	2.8 (1.3)	TC66702601	TC66703801
34.5	38	50	DBU38-50SE	2.8 (1.3)	TC66702601	TC66703801
34.5	38	65	DBU38-65SE	2.8 (1.3)	TC66702601	TC66703801
34.5	38	80	DBU38-80SE	2.8 (1.3)	TC66702601	TC66703801
34.5	38	100	DBU38-100SE	2.8 (1.3)	TC66702601	TC66703801
34.5	38	125	DBU38-125SE	2.8 (1.3)	TC66702601	TC66703801
34.5	38	150	DBU38-150SE	2.8 (1.3)	TC66702601	TC66703801
34.5	38	175	DBU38-175SE	2.8 (1.3)	TC66702601	TC66703801
34.5	38	200	DBU38-200SE	2.8 (1.3)	TC66702601	TC66703801

## DBU Type Fuse Mountings and Accessories Indoor Applications

Voltage (kV)			Non-Loadbreak Mountings		Live Parts		Loadbreak Mountings		Live Parts		End Fittings	Muffler	Connection
Nominal	Maximum	Ampere Rating	Catalog Number	Catalog Number	Catalog Number	Catalog Number	Catalog Number	Catalog Number	Catalog Number	Catalog Number	Catalog Number		
14.4	17.1	3-200	DBU17-GNM-L	DBU17-NL-L	DBU17-GDM-L	DBU17-DL-L	DBU-EFID	DBU-MFLR	Left hand connections				
14.4	17.1	3-200	DBU17-GNM-R	DBU17-NL-R	DBU17-GDM-R	DBU17-DL-R	DBU-EFID	DBU-MFLR	Right hand connections				
14.4	17.1	3-200	DBU17-GNMP-L	DBU17-NLP-L	—	—	DBU-EFID	DBU-MFLR	Left hand connections stainless steel hardware				
14.4	17.1	3-200	DBU17-GNMP-R	DBU17-NLP-R	—	—	DBU-EFID	DBU-MFLR	Right hand connections stainless steel hardware				
23	27	3-200	DBU27-GNM-L	DBU27-NL-L	DBU27-GDM-L	DBU27-DL-L	DBU-EFID	DBU-MFLR	Left hand connections				
23	27	3-200	DBU27-GNM-R	DBU27-NL-R	DBU27-GDM-R	DBU27-DL-R	DBU-EFID	DBU-MFLR	Right hand connections				
23	27	3-200	DBU27-GNMP-L	DBU27-NLP-L	—	—	DBU-EFID	DBU-MFLR	Left hand connections stainless steel hardware				
23	27	3-200	DBU27-GNMP-R	DBU27-NLP-R	—	—	DBU-EFID	DBU-MFLR	Right hand connections stainless steel hardware				
34.5	38	3-200	DBU38-GNM-L	DBU38-NL-L	—	—	DBU-EFID	DBU-MFLR	Left hand connections				
34.5	38	3-200	DBU38-GNM-R	DBU38-NL-R	—	—	DBU-EFID	DBU-MFLR	Right hand connections				
34.5	38	3-200	DBU38-GNMP-L	DBU38-NLP-L	—	—	DBU-EFID	DBU-MFLR	Left hand connections stainless steel hardware				
34.5	38	3-200	DBU38-GNMP-R	DBU38-NLP-R	—	—	DBU-EFID	DBU-MFLR	Right hand connections stainless steel hardware				

## DBU Type Fuse Mountings and Accessories Outdoor Applications

Voltage (kV)			Non-Loadbreak Mountings	End Fittings
Nominal	Maximum	Ampere Rating	Catalog Number	Catalog Number
14.4	17.1	3-200	DBU17-DM	DBU-EFOD
23	27	3-200	DBU27-DM	DBU-EFOD

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## Expulsion Fuses

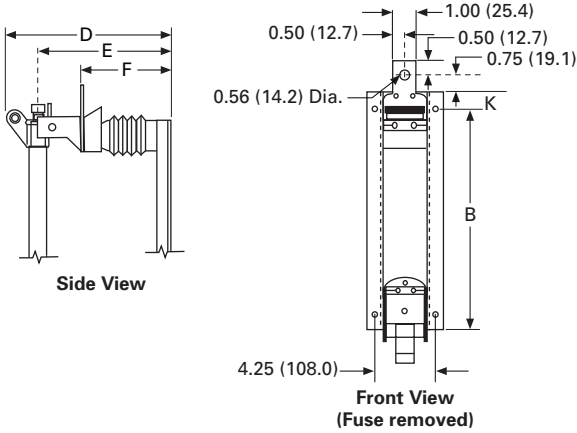
### DBU Type Fuses

#### Dimensions

Dimensions are in Inches (mm)

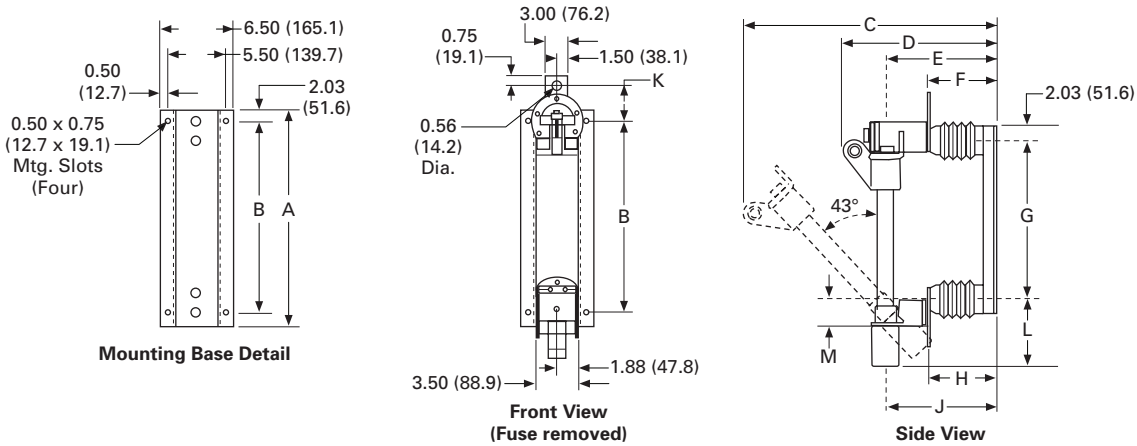
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#### Non-Loadbreak Mounting



kV Max.	Catalog Number ①	kv BIL	Dimensions				
			B	D	E	F	K
17	DBU17-GNM	95	18.00 (457.2)	16.87 (428.0)	12.12 (307.9)	8.81 (223.8)	2.25 (57.2)
27	DBU27-GNM	125	22.25 (565.2)	19.63 (498.6)	14.87 (377.7)	11.56 (293.6)	2.25 (57.2)
38	DBU38-GNM	150	28.25 (717.6)	21.33 (541.8)	16.58 (421.1)	13.28 (337.3)	2.25 (57.2)

#### Loadbreak Mounting



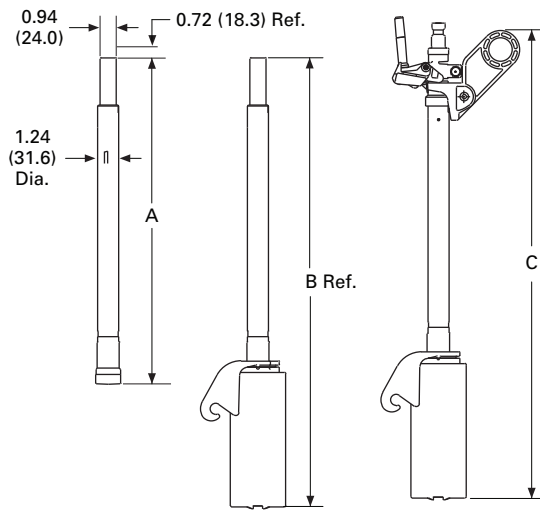
kV Max.	Catalog Number	kv BIL	Dimensions											
			A	B	C	D	E	F	G	H	J	K	L	M
17	DBU17-GDML ①	95	22.50 (571.5)	18.44 (468.4)	30.50 (774.7)	19.25 (489.0)	14.25 (362.0)	9.25 (235.0)	18.44 (468.4)	9.44 (240.0)	11.50 (292.1)	3.0 (76.2)	9.50 (241.3)	3.75 (95.3)
	DBU17-GDMR ②													
27	DBU27-GDML ①	125	26.75 (679.5)	22.69 (576.3)	34.63 (879.6)	21.38 (543.1)	16.75 (425.5)	11.56 (293.6)	22.69 (576.3)	11.75 (298.5)	13.50 (343.0)	3.0 (76.2)	9.50 (241.3)	3.75 (95.3)
	DBU27-GDMR ②													

#### Notes

- ① Bus for cable termination on right side of mounting.
- ② Bus for cable termination on left side of mounting.

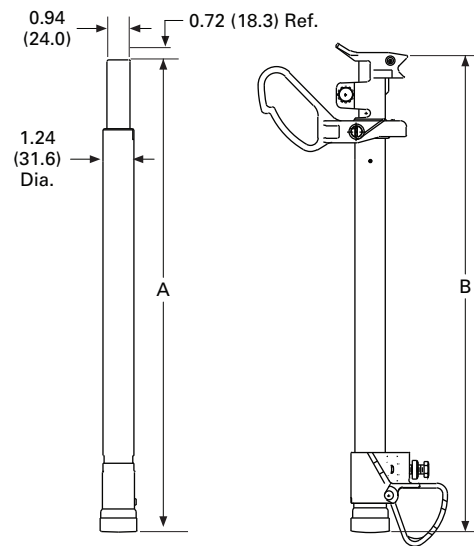
Dimensions are in Inches (mm)

### Indoor DBU Fuse Fittings



kV Max.	Fuse Unit Fittings		
	A	B	C
17	19.08 (484.6)	27.19 (538.2)	28.82 (732.0)
27	22.58 (573.5)	30.69 (779.5)	32.32 (821.0)
38	28.76 (730.5)	36.87 (936.5)	38.50 (978.0)

### Outdoor DBU Fuse Fittings



kV Max.	Fuse Unit Fittings	
	A	B
17	19.08 (484.6)	19.41 (493.0)
27	22.58 (573.5)	22.91 (581.9)
38	28.76 (730.5)	28.09 (713.5)

RBA Fuses

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## RBA/RDB Type Fuses (Including Superseded BA Fuses)

### Product Description

#### BA Fuses

Westinghouse Electric Company introduced the BA range of DE-ION boric acid refillable fuses in the 1930s, and BA refill units have been in continuous use and production since then. Eaton still manufactures BA refill units for use in existing fuse holders and installations. However, the manufacture of most BA fuse holders and all BA mountings has been discontinued.

#### RBA and RDB Fuses

In 1969, Westinghouse Electric Company introduced the redesigned and improved RBA (indoor with exhaust control device—filter or condenser) and RDB (vented outdoor dropout) ranges of boric acid DE-ION fuses to replace the BA range of fuses

Eaton’s RBA (Refillable Boric Acid) and RDB (Refillable Dropout Boric acid) power fuses are expulsion type power fuses designed for indoor or weatherproof enclosure (RBA) or outdoor vented (RDB) applications. RBA/RDB fuses are renewable (refillable) as the descriptions above state. The whole fuse unit is not discarded after a fault interruption. Usually, only one piece of the fuse, the refill unit, needs to be replaced after an interruption and for this reason, RBA/RDB fuses provide an economical approach to the protection of power circuits rated up to a maximum of 38 kV. They are especially well suited for large industrial load fusing needs.

An RBA/RDB fuse is basically a vented electromechanical device which is applicable to many different power applications. RBA/RDB power fuses are particularly effective for higher operational voltage and higher continuous current applications. RBA/RDB expulsion type fuses do not limit the magnitude of the fault current during operation. They limit the duration of the fault in the electrical system.

RBA/RDB expulsion fuses are available in a wide range of ratings to simplify the selection process. They offer continuous current ratings of 0.5 through 720 amperes, at maximum voltages of 8.3 through 38 kV and with symmetrical interrupting ratings up to 37,500 amperes. RBA and RDB fuses both use replaceable RBA refill units, which are available with both standard speed or time lag characteristics, that when combined with the wide range of ratings, allow maximization of both coordination and protection.

RBA power fuses can be used with either disconnect or non-disconnect mounting, so matching these fuses into the equipment type and layout is a simplified process. Thus RBA fuses are easy to install and maintain. RDB fuses are only available for use in outdoor dropout style mountings.

RBA power fuses have a long and enviable reputation for outstanding protection and reliability, broad selection possibilities, ease of installation and economy over time.

#### Installation

See Publication No. IL.36-65A-1C for installation instructions.

### Applications

In general, an electrical power system consists of three major parts: generation, transmission and distribution. The power distribution area offers an especially significant potential for RBA and RDB power fuse applications. This power distribution system potential could be with the utility, an industrial or commercial user, or the manufacturer of electrical equipment.

Since the RBA/RDB power fuse is refillable (renewable), it is economical for use in a variety of distribution system applications. Primarily, the RBA/RDB is designed for use on:

- Load interrupter switchgear;
- Power transformers;
- High voltage capacitors;
- Pad mounted transformers

RBA fuses can be installed in indoor metalclad or metal enclosed load interrupter switchgear, or fuse cabinets for both indoor and outdoor use. RDB fuses are intended for outdoor use, but protecting the same types of loads as RBA fuses.

A common application for RBA power fuses is in the primary circuit of a power transformer. In this application, fuses must isolate the transformer circuit from the upstream supply when a fault occurs in or beyond the transformer, but must not operate on transformer inrush.

RBA fuses can also be used to protect capacitor banks. Capacitors require protection from fault currents which could cause a capacitor to rupture.

Selection of the fuse type is dependent on many factors, including: user or supplier preference, cost and system coordination. If the required voltage and continuous current ratings are high and downstream coordination is critical, RBA power fuses can provide very effective protection. See **Page V14-T2-20** for more information on expulsion fuse application.

### Operation and Features

A renewable (refillable) boric acid expulsion type fuse comprises the following major components:

- A replaceable refill unit, comprising the current responsive element and the arc de-ionizing and extinguishing boric acid sold filler material, all contained within a high strength glass epoxy tube and with end connections for interfacing with the fuse holder. This is the part of the fuse which is discarded after a fuse interruption
- A reusable fuse holder. The fuse holder comprises a high strength glass epoxy tube and cast high conductivity end connections to interface the fuse holder with the internal refill unit and the external fuse mounting. The fuse holder assembly also includes the spring and shunt assembly which is pre-loaded when a fuse holder is charged with a refill unit
- For indoor applications only (RBA fuses only), a reusable exhaust control device, (condenser, discharge filter, or high capacity discharge filter) which de-ionizes and absorbs all or part of the "expulsion exhaust" from the fuse during operation
- A reusable mounting to interface the loaded fuse holder assembly into the protected circuit. The mounting comprises the live parts, a pair of assemblies that interface with and securely support the fuse holder, and provide suitable connection points for the external circuit. Below the live parts are insulators, appropriate for the system insulation rating, which are mounted on a rigid metal support to prevent flexing of the mounting during fuse or associated switch operation

Mountings are available in disconnect and non-disconnect configurations for RBA fuses and a dropout configuration for RDB fuses.

A non-disconnect mounting permanently mounts the fuse holder containing the refill with tension type fuse clips or bolted connections until it is completely removed.

The disconnect mounting permits a fuse to be opened, closed, or even lifted out of the mounting once it is opened. An insulated stick with a hook on the end of it is used to perform the opening and closing functions in a disconnect mounting. The insulated stick is referred to as a switch stick.

Depending on the point of application, it is often necessary to attach a discharge suppressor (filter, condenser or muffler) to the fuse unit. This metallic device acts to retard, to varying degrees, the gases and noise associated with an expulsion type fuse.

When the fuse element melts inside the refill, an arc is initiated and elongated. The heat of the arc decomposes the boric acid producing water vapor and boric anhydride. These two by-products extinguish the arc by blasting through it and exit from the bottom of the fuse. The gases are usually assisted with the interruption process by a spring loaded mechanical device located inside the fuse holder. In addition to the exhaust produced during interruption, a significant amount of noise also results. At this point, the previously mentioned suppressor is often used to limit this discharge and noise. The type of suppressor installed depends upon the requirements at the point of application.

**RBA and RDB Details**

Eaton's renewable RBA or RDB fuse unit is not totally discarded after it interrupts a fault. This makes the RBA quite economical to use over time. Normally, only the fuse refill is discarded with the RBA design.

The RBA power fuse provides performance characteristics especially intended for power system protection up to an operational voltage of 34.5 kV. Because RBA fuses are available in a wide range of continuous current ratings and time-current characteristics, close fusing can be achieved, maximizing the protection and overall coordination. The quality and accuracy of the RBA design and manufacturing process ensures accurate initial and ongoing melting time-current characteristics. Proven RBA power fuses perform as intended and operate exactly when and how they should, and do not operate when they should not operate. This is a subtle but important point.

Each individual RBA fuse component is discussed individually. Its makeup and unique role in the protection process are also discussed.

**RBA Refill Unit**

The internal parts of an RBA refill unit are a calibrated current responsive fuse element and a parallel high strength strain element, an arcing rod, an auxiliary arcing rod assembly, and a solid boric acid liner which assists with the interruption. The lower end of the fuse element is attached to an end cap which is securely crimped onto the lower end of a glass-epoxy refill tube and the upper end is brazed or securely crimped to the main arcing rod. The upper end of the tube permits the upper end of the arcing rod to exit the refill tube through a molded plug. At the upper end of the refill unit, the plug is sealed around the arcing rod where it exits from the refill tube. The lower end of the refill unit is sealed with a blowout disc to maintain the integrity of the seal in RDB outdoor applications. The seal must be removed before an exhaust control device is fitted to a fuse holder for indoor applications, to prevent clogging the exhaust control device.

The calibrated fuse element assembly determines the operational time-current characteristics of the RBA fuse. It is sensitive to the heat produced by the amount of current flowing. How, when or if it melts for different magnitudes of current and amounts of time, a particular current magnitude experienced by the fuse is indicated on the specific

time-current characteristic curve for a particular fuse. RBA fuse elements are available in standard and time-lag configurations. The standard element assemblies are made of pure silver with a parallel Nichrome strain wire, and the time-lag elements have a calibrated tin alloy joint. The Nichrome wire relieves the fuse element of any strain put on it by the spring loaded arcing rod. This parallel high resistance vaporizes immediately after the fuse element melts.

The heavy copper cylindrical arcing rod is contained within the main bore of the boric acid liner and performs two functions. Under normal operating conditions, it carries the continuous rated current of the fuse. When the fuse element melts during a fault interruption, the arcing rod lengthens the arc as it is pulled through the boric acid liner. This backward movement occurs because the arcing rod is under spring tension from the outside of the refill.

An auxiliary arcing rod is contained within the small bore of the boric acid liner. It plays a role in the proper operation of the fuse under low intensity fault conditions. No load current is carried by the auxiliary wire.

**RBA Refill Unit Operation**

Under fault conditions, the fuse and strain elements melt and the arcing rods pull the arc back through the boric acid liner. Intense heat from the arc separates the hydrated boric acid, producing water vapor and inert boric anhydride. This expanding mixture extinguishes the arc by blasting through and de-ionizing it. The exhaust caused by the interruption exits from the bottom of the fuse. The de-ionizing action prevents the arc from re-striking after a current zero.

RBA fuses are designed to interrupt short-circuit currents within 1/2 cycle at the next current zero. Two different chambers in parallel within the solid boric acid liner provide for selective operation and interruption for both low current and high current faults using the principles of de-ionization.

**Low Current Fault Interruption**

When a low current fault occurs, the main fuse and strain elements melt and the main and auxiliary arcing rods start to draw through the boric acid liner. At this stage, the main rod circuit is open, shorted out by the auxiliary rod. The fine auxiliary coil rapidly melts and the arc is extinguished in the small bore of the boric acid liner. The arcing rod drawing no arc, moves back to an open position because of the spring tension.

### High Current Fault Operation

A high fault current melts the main fuse and strain element and transfers to the auxiliary fuse wire. In the small bore, the high arc current creates a high voltage causing the arcing rod in the main bore to restrike. The arcing rod then draws the arc through the main bore where it is quickly extinguished.

### RBA Refill Unit Ratings

RBA fuse refills are ANSI/IEEE "E" rated. The "E" rating defines a current response that is intended to produce a degree of electrical interchangeability among fuse manufacturers. A 100E fuse carries 100 amperes or below continuously and will melt in a defined amount of time for a defined range of current above the fuse's continuous current magnitude. This performance will be the same for all fuses with an E designation.

### RBA Fuse Holder

An RBA fuse holder has a glass epoxy tube which encloses and supports the fuse refill unit. Also inside the tube is a spring and shunt assembly, which makes an electrical connection to the top end of the refill unit. At the ends, the fuse holder has high conductivity copper alloy ferrules, which include the required features to interface with a non-disconnect, or disconnect mounting. The holder delivers excellent dielectric strength as well as mechanical strength for support purposes. The RBA holder is not suitable for outdoor applications.

### RDB Fuse Holder

An RDB fuse holder has a glass epoxy tube which is coated with a protective gray colored UV resistant coating for outdoor application. This tube encloses and supports the fuse refill unit. Also inside the tube is a spring and shunt assembly which makes an electrical connection to the top end of the refill unit. The RDB spring and shunt assembly incorporates a ballistic trip pin to unlatch the fuse holder when the fuse operates, initiating the dropout action. At the ends, the fuse holder has high conductivity silver plated copper alloy ferrules, which include the required features to interface with a dropout mounting. The holder delivers excellent dielectric strength as well as mechanical strength for support purposes. The RDB holder is designed for outdoor applications with the UV protected tube and silver plated terminals.

After an RBA or RDB fuse unit performs its function by interrupting a fault, the fuse holder is removed from its mounting, opened and only the fuse refill unit is replaced. The fuse unit can then be once again put back into operation.

### Spring and Shunt Assembly

A spring and shunt assembly comprises a stainless steel helical spring that encloses a tangle free flexible braided high conductivity copper shunt, which prevents the spring from conducting load or fault current. This assembly attaches on the lower end to the threaded end of the refill unit, and at the top end to the top contact of the fuse holder. With the spring and shunt assembly properly attached to and enclosed in the holder, the refill arcing rod assembly is put under spring tension, ready to move the rod through the boric acid liner.

### Holder Contacts and Hardware

The high conductivity cast copper alloy upper and lower contacts of the fuse holder make low resistance electrical connections between the fuse refill and the mounting. These contacts also function to dissipate heat in normal service.

The difference between non-disconnect and disconnect or dropout type fuse holders is the design of the top and bottom contacts of the fuse holder. Disconnect or dropout electrical contacts permit the fuse to be switch stick operated in a compatible disconnect or dropout type mounting. A hookeye is provided at the lower contact of the fuse holder to allow the fuse holder to be lifted into the hinge end of the mounting, and at the upper contact to allow the fuse holder to be swung to open or close the fuse. A non-disconnect contact requires the fuse unit to be supported in a permanent position until completely assembled into or removed from a compatible mounting.

### RBA and RDB Mountings

Both non-disconnect and disconnect mountings are available for RBA power fuses. Dropout mountings are used with RDB fuse units. Mountings provide everything necessary to safely install a compatible RBA fuse unit into the protected circuit. The rigid mounting base is a metal support to which the porcelain or glass polyester insulators are attached. They insulate the live parts and the installed fuse unit from the mounting base and everything beyond the base.

Live parts are available without the insulators or mounting base because some applications have unique mounting situations or the customer may choose to add additional value by supplying the insulators and base. It is still necessary to mount the live parts and insulators to a rigid support structure to prevent the fuse from unlatching due to mechanical disturbances. It is the responsibility of the customer to make sure that all mounting requirements are met when using just the live parts.

RBA non-disconnect mountings can be supplied in one of two configurations. RBA-200 and RBA-400 mountings use upper and lower fuse clamps to hold the fuse unit in position. The clamps securely locate each end of the fuse holder into the mounting. RBA-800 mountings hold the fuse unit in place by solidly bolting it into position. The type of non-disconnect mounting to be used depends on the size and configuration of the fuse unit.

RBA disconnect and RDB dropout mountings are switch stick-operable, facilitating opening, closing, and fuse replacement. The switch stick can be used to open and close the fuse, and also to lift the fuse into and out of the mounting. This keeps the operator well clear of any live parts during fuse removal. The lower end of the mounting is the hinged end and the upper end is the latched end and they work in conjunction with the compatible contacts of the fuse holder. Positive electrical connections are maintained at both ends of the mounting through the spring fingers at the lower end and clip type contacts on the upper end. The spring fingers are compressed on closing in of the fuse holder.

#### **RBA Exhaust Control Devices**

For indoor applications, phase-to-phase clearances and clearances to ground are generally restricted, and exhaust control devices must be used with RBA indoor expulsion fuses to retard the gases and reduce the noise associated with this type of fuse operation. Eaton offers three devices called the condenser, the discharge filter and the high capacity discharge filter—the high capacity discharge filter has limited application at a specific voltage level. Other manufacturers refer to such devices as suppressors or silencers.

The exhaust control device is threaded onto the bottom of an RBA fuse holder to minimize the noise and exhaust while containing the arc within the fuse during interruption, and also to clamp the lower end of the fuse refill unit into the fuse holder to ensure an adequately tight electrical and mechanical connection to minimize contact resistance and enable thermal conduction out of the refill unit. Exhaust control devices are metallic containers with copper screen inside to absorb and dissipate arc heat and condense steam to water. Although the inner and outer metals of the condenser and discharge filter are similar, the internal designs and venting methods are different. A condenser can be identified by the very restrictive bottom plate with only one small hole to allow the slow release, after interruption, of water absorbed by the condenser during a fuse interruption. A discharge filter is very less restrictive, and acts only to de-ionize the exhaust gases and reduce the flow rate of the discharge. The flow restriction in a condenser causes a back-pressure in the fuse which reduces the ability of the fuse to interrupt higher current faults.

#### **RBA/RDB Interruption and Protection**

The operation of RBA and RDB fuses must be considered for three sets of conditions:

- **Normal loading**—This is when the circuit current is below the allowable continuous current or within the limits of the allowable short-time overload current shown on **Page V14-T2-8** of the Expulsion Fuse Introduction, for the particular set of application conditions. Under such normal loading, the fuse is not subject to any conditions that would degrade its long term integrity, or affect its ability to correctly interrupt fault conditions.

**Note:** If the current is at or below the allowable continuous current for the particular set of conditions, that is, allowing for an elevated ambient temperature, high altitude, or an enclosure that restricts natural cooling, the temperature rise and maximum temperature of the fuse will be below the allowable limits stated in IEEE Std. C37.40™-2003.

**Note:** If temporary overloads are below the temporary overload curve, with values based on the allowable continuous current, not on the rated continuous current, the fuse unit or refill unit, although it may be subject to temporarily slightly elevated temperatures, will not be subject to conditions that could affect its long term integrity or degrade its ability to correctly interrupt fault conditions.

**Note:** After the fuse has been subjected to a temporary overload as indicated on **Page V14-T2-8**, the current should be reduced to no more than the normal circuit full load condition—typically (fuse rated continuous current) /1.4 for a period long enough for any temporary excess heat to be dissipated—typically 2 hours minimum.

- **Overloading**—This occurs if the circuit current exceeds the allowable short-time overload conditions shown on **Page V14-T2-8** of the Expulsion Fuse Introduction, but is below 240% (for fuses rated 100E or below) or 264% (for fuses rated above 100E).



If the fuse is exposed to these overload conditions, the long term integrity of the fuse refill unit can be degraded and its ability to correctly interrupt fault conditions may be seriously compromised.

**Note:** With a fuse unit or fuse refill unit rated 100E or less, the element may melt at any current between 200% and 240% of the E rating, and with a fuse unit or refill unit rated more than 100E, the element may melt at any current between 220% and 264% of the E rating. These 10% ranges allow for variations between fuses because of manufacturing tolerances, and so on, on the fuse assembly. The minimum melting current of the fuse could be anywhere in the range between the value on the minimum-melting time-current characteristic and the value on the total-clearing time-current characteristic. At this end of the curve, the total-clearing and maximum-melting characteristics are effectively the same. The maximum values of the range are quoted here because this is the lower limit of the current at which it is known that the fuse element will melt.

- **Faults**—This covers all conditions from about 240% for a fuse rating of 100E or less, or 264% for a fuse rating greater than 100E up to the interrupting rating of the fuse. The fuse will interrupt the fault current in a time indicated by the published fuse time-current characteristic curves. Interruption occurs at a natural current zero of the fault current, when the dielectric strength of the fuse withstands the combination of power frequency recovery voltage and transient recovery voltage.

The noise of the operation and the quantity of exhaust products is reduced in indoor RBA applications by the use of an exhaust control device which partially absorbs and de-ionizes the exhaust gases. In outdoor applications, RDB fuses are exhausted to atmosphere.

The **rated maximum voltage** of RBA or RDB power fuse is the highest power frequency system voltage at which the fuse is designed to operate. The dielectric withstand level corresponds to insulation levels of power class equipment. Rated maximum voltage levels for RBA power fuses are: 8.3, 15.5, 25.5 and 38.0 kV.

Fuses, including RBA/RDB power fuses, should never be applied where the available fault current at the fuse location exceeds the rated maximum interrupting current of the fuse. The rated maximum interrupting current of an RBA fuse is the rms value of the symmetrical component (AC component) of the highest current which the RBA is has been demonstrated to be able to successfully interrupt under any condition of asymmetry. RBA interrupting ratings are shown in the table on **Page V14-T2-59**. The rated continuous current of an RBA or RDB power fuse should at least equal or preferably exceed the maximum load current where the fuse is applied. Fuses are designed to carry their rated continuous current without exceeding the temperature rise outlined in IEEE standards. RBA and RDB fuses are available with continuous current ratings up to 720 amperes current ratings and carry an "E" designation.

# 2.7

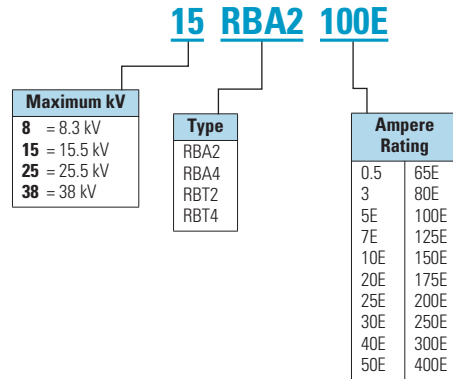
## Expulsion Fuses

RBA/RDB Type Fuses (Including Superseded BA Fuses)

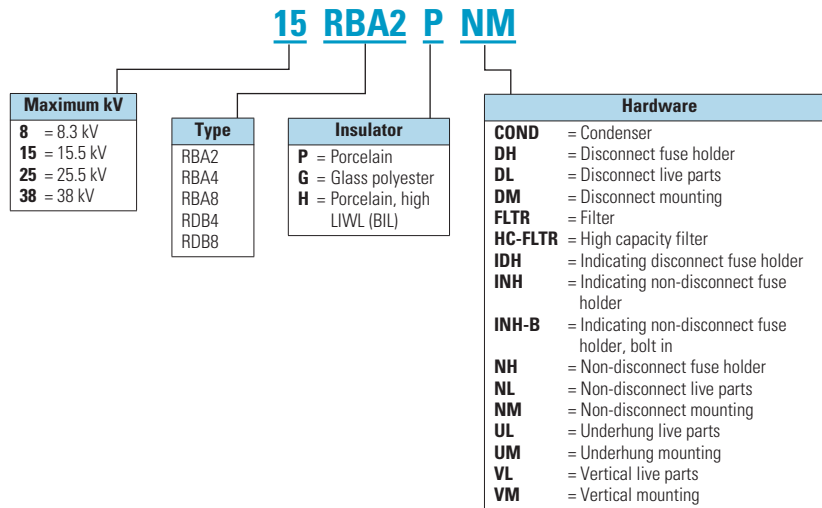
### Catalog Number Selection

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#### RBA and RBT Fuse Units



#### RBA and RBT Fuse Holders, Mounting and Accessories



## Interrupting Ratings

### RBA and RBT Fuse Interrupting Ratings

Fuse Nominal Rated Voltage Rating kV	Maximum System Voltage kV	RDB2 Outdoor Vented rms Symmetrical kA	RBA2 Indoor with Filter rms Symmetrical kA	RDB2 Indoor with Condenser rms Symmetrical kA
2.4	2.75	19.0	19.0	10.0
4.16	4.8	19.0	19.0	10.0
4.8	5.5	19.0	19.0	10.0
7.2	8.3	16.6	16.6	10.0
13.8	14.4	14.4	14.4	8.0
14.4	15.5	14.4	14.4	8.0
23	25.5	10.5	10.5	6.3
34.5	38	6.9	6.9	5.0

### RBA and RBT Fuse Interrupting Ratings, continued

Fuse Nominal Rated Voltage Rating kV	Maximum System Voltage kV	RDB4/8 Outdoor Vented rms Symmetrical kA	RBA4/8 Indoor with Filter rms Symmetrical kA	RDA4/4 Indoor with Condenser rms Symmetrical kA	RBA4/8 Indoor with High Capacity Filter rms Symmetrical kA
2.4	2.75	37.7	37.7	20.0	—
4.16	4.8	37.5	37.5	20.0	—
4.8	5.5	37.5	37.5	20.0	—
7.2	8.3	29.4	29.4	16.0	—
13.8	14.4	29.4	29.4	12.5	36.0
14.4	15.5	29.4	29.4	12.5	—
23	25.5	21.0	21.0	10.0	—
34.5	38	16.8	16.8	10.0	—

### Product Selection

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#### 8RBA2 and 8RBA4 Type Standard Speed and 8RBT2 and 8RBT4 Time Lag Fuse Refill Units

Voltage (kV)			Standard Speed			Time Lag			Performance Curves	
Nominal	Maximum	Ampere Rating	Catalog Number	Catalog Number	Approximate Shipping Weight Lbs (kg)	Minimum Melting	Total Clearing	Minimum Melting	Total Clearing	
7.2	8.3	10E	8RBA2-10E	—	1.0 (0.5)	TC62882301	TC66701401	—	—	
7.2	8.3	15E	8RBA2-15E	—	1.0 (0.5)	TC62882301	TC66701401	—	—	
7.2	8.3	20E	8RBA2-20E	8RBT2-20E	1.0 (0.5)	TC62882301	TC66701401	TC62886301	TC66701301	
7.2	8.3	25E	8RBA2-25E	8RBT2-25E	1.0 (0.5)	TC62882301	TC66701401	TC62886301	TC66701301	
7.2	8.3	30E	8RBA2-30E	8RBT2-30E	1.0 (0.5)	TC62882301	TC66701401	TC62886301	TC66701301	
7.2	8.3	40E	8RBA2-40E	8RBT2-40E	1.0 (0.5)	TC62882301	TC66701401	TC62886301	TC66701301	
7.2	8.3	50E	8RBA2-50E	8RBT2-50E	1.0 (0.5)	TC62882301	TC66701401	TC62886301	TC66701301	
7.2	8.3	65E	8RBA2-65E	8RBT2-65E	1.0 (0.5)	TC62882301	TC66701401	TC62886301	TC66701301	
7.2	8.3	80E	8RBA2-80E	8RBT2-80E	1.0 (0.5)	TC62882301	TC66701401	TC62886301	TC66701301	
7.2	8.3	100E	8RBA2-100E	8RBT2-100E	1.0 (0.5)	TC62882301	TC66701401	TC62886301	TC66701301	
7.2	8.3	125E	8RBA2-125E	8RBT2-125E	1.0 (0.5)	TC62882301	TC66701401	TC62886301	TC66701301	
7.2	8.3	150E	8RBA2-150E	8RBT2-150E	1.0 (0.5)	TC62882301	TC66701401	TC62886301	TC66701301	
7.2	8.3	175E	8RBA2-175E	—	1.0 (0.5)	TC62882301	TC66701401	—	—	
7.2	8.3	200E	8RBA2-200E	8RBT2-200E	1.0 (0.5)	TC62882301	TC66701401	TC62886301	TC66701301	
7.2	8.3	0.5	8RBA4-.5	—	2.1 (1.0)	TC62886101	TC66701501	—	—	
7.2	8.3	3	8RBA4-3	—	2.1 (1.0)	TC62886101	TC66701501	—	—	
7.2	8.3	5E	8RBA4-5E	—	2.1 (1.0)	TC62886101	TC66701501	—	—	
7.2	8.3	7E	8RBA4-7E	—	2.1 (1.0)	TC62886101	TC66701501	—	—	
7.2	8.3	10E	8RBA4-10E	—	2.1 (1.0)	TC62886101	TC66701501	—	—	
7.2	8.3	15E	8RBA4-15E	—	2.1 (1.0)	TC62886101	TC66701501	—	—	
7.2	8.3	20E	8RBA4-20E	8RBT4-20E	2.1 (1.0)	TC62886101	TC66701501	TC62886501	TC66701201	
7.2	8.3	25E	8RBA4-25E	8RBT4-25E	2.1 (1.0)	TC62886101	TC66701501	TC62886501	TC66701201	
7.2	8.3	30E	8RBA4-30E	8RBT4-30E	2.1 (1.0)	TC62886101	TC66701501	TC62886501	TC66701201	
7.2	8.3	40E	8RBA4-40E	8RBT4-40E	2.1 (1.0)	TC62886101	TC66701501	TC62886501	TC66701201	
7.2	8.3	50E	8RBA4-50E	8RBT4-50E	2.1 (1.0)	TC62886101	TC66701501	TC62886501	TC66701201	
7.2	8.3	65E	8RBA4-65E	8RBT4-65E	2.1 (1.0)	TC62886101	TC66701501	TC62886501	TC66701201	
7.2	8.3	70E	8RBA4-80E	8RBT4-80E	2.1 (1.0)	TC62886101	TC66701501	TC62886501	TC66701201	
7.2	8.3	100E	8RBA4-100E	8RBT4-100E	2.1 (1.0)	TC62886101	TC66701501	TC62886501	TC66701201	
7.2	8.3	125E	8RBA4-125E	8RBT4-125E	2.1 (1.0)	TC62886101	TC66701501	TC62886501	TC66701201	
7.2	8.3	150E	8RBA4-150E	8RBT4-150E	2.1 (1.0)	TC62886101	TC66701501	TC62886501	TC66701201	
7.2	8.3	175E	8RBA4-175E	—	2.1 (1.0)	TC62886101	TC66701501	—	—	
7.2	8.3	200E	8RBA4-200E	8RBT4-200E	2.1 (1.0)	TC62886101	TC66701501	TC62886501	TC66701201	
7.2	8.3	250E	8RBA4-250E	8RBT4-250E	2.1 (1.0)	TC62886101	TC66701501	TC63943501	TC66701101	
7.2	8.3	300E	8RBA4-300E	8RBT4-300E	2.1 (1.0)	TC62886101	TC66701501	TC63943501	TC66701101	
7.2	8.3	400E	8RBA4-400E	8RBT4-400E	2.1 (1.0)	TC62886101	TC66701501	TC63943501	TC66701101	
7.2	8.3	450E	(2) 8RBA4-250E	(2) 8RBT2-250E	—	TC62886102	TC66701001	TC63943502	TC66700901	
7.2	8.3	540E	(2) 8RBA4-300E	(2) 8RBT2-300E	—	TC62886102	TC66701001	TC63943502	TC66700901	
7.2	8.3	720E	(2) 8RBA4-400E	(2) 8RBT2-400E	—	TC62886102	TC66701001	TC63943502	TC66700901	

## 15RBA2 and 15RBA4 Type Standard Speed and 15RBT2 and 15RBT4 Time Lag Fuse Refill Units

Voltage (kV)		Ampere Rating	Standard Speed		Approximate Shipping Weight Lbs (kg)	Performance Curves			
Nominal	Maximum		Catalog Number	Time Lag Catalog Number		Standard Speed Minimum Melting	Total Clearing	Time Lag Minimum Melting	Total Clearing
14	16	10E	15RBA2-10E	—	1.1 (0.5)	TC62882301	TC66701401	—	—
14	16	15E	15RBA2-15E	—	1.1 (0.5)	TC62882301	TC66701401	—	—
14	16	20E	15RBA2-20E	15RBT2-20E	1.1 (0.5)	TC62882301	TC66701401	TC62886301	TC66701301
14	16	25E	15RBA2-25E	15RBT2-25E	1.1 (0.5)	TC62882301	TC66701401	TC62886301	TC66701301
14	16	30E	15RBA2-30E	15RBT2-30E	1.1 (0.5)	TC62882301	TC66701401	TC62886301	TC66701301
14	16	40E	15RBA2-40E	15RBT2-40E	1.1 (0.5)	TC62882301	TC66701401	TC62886301	TC66701301
14	16	50E	15RBA2-50E	15RBT2-50E	1.1 (0.5)	TC62882301	TC66701401	TC62886301	TC66701301
14	16	65E	15RBA2-65E	15RBT2-65E	1.1 (0.5)	TC62882301	TC66701401	TC62886301	TC66701301
14	16	80E	15RBA2-80E	15RBT2-80E	1.1 (0.5)	TC62882301	TC66701401	TC62886301	TC66701301
14	16	100E	15RBA2-100E	15RBT2-100E	1.1 (0.5)	TC62882301	TC66701401	TC62886301	TC66701301
14	16	125E	15RBA2-125E	15RBT2-125E	1.1 (0.5)	TC62882301	TC66701401	TC62886301	TC66701301
14	16	150E	15RBA2-150E	15RBT2-150E	1.1 (0.5)	TC62882301	TC66701401	TC62886301	TC66701301
14	16	175E	15RBA2-175E	—	1.1 (0.5)	TC62882301	TC66701401	—	—
14	16	200E	15RBA2-200E	15RBT2-200E	1.1 (0.5)	TC62882301	TC66701401	TC62886301	TC66701301
14	16	0.5	15RBA4-.5	—	2.3 (1.05)	TC62886101	TC66701501	—	—
14	16	3	15RBA4-3	—	2.3 (1.05)	TC62886101	TC66701501	—	—
14	16	5E	15RBA4-5E	—	2.3 (1.05)	TC62886101	TC66701501	—	—
14	16	7E	15RBA4-7E	—	2.3 (1.05)	TC62886101	TC66701501	—	—
14	16	10E	15RBA4-10E	—	2.3 (1.05)	TC62886101	TC66701501	—	—
14	16	15E	15RBA4-15E	—	2.3 (1.05)	TC62886101	TC66701501	—	—
14	16	20E	15RBA4-20E	15RBT4-20E	2.3 (1.05)	TC62886101	TC66701501	TC62886501	TC66701201
14	16	25E	15RBA4-25E	15RBT4-25E	2.3 (1.05)	TC62886101	TC66701501	TC62886501	TC66701201
14	16	30E	15RBA4-30E	15RBT4-30E	2.3 (1.05)	TC62886101	TC66701501	TC62886501	TC66701201
14	16	40E	15RBA4-40E	15RBT4-40E	2.3 (1.05)	TC62886101	TC66701501	TC62886501	TC66701201
14	16	50E	15RBA4-50E	15RBT4-50E	2.3 (1.05)	TC62886101	TC66701501	TC62886501	TC66701201
14	16	65E	15RBA4-65E	15RBT4-65E	2.3 (1.05)	TC62886101	TC66701501	TC62886501	TC66701201
14	16	70E	15RBA4-80E	15RBT4-80E	2.3 (1.05)	TC62886101	TC66701501	TC62886501	TC66701201
14	16	100E	15RBA4-100E	15RBT4-100E	2.3 (1.05)	TC62886101	TC66701501	TC62886501	TC66701201
14	16	125E	15RBA4-125E	15RBT4-125E	2.3 (1.05)	TC62886101	TC66701501	TC62886501	TC66701201
14	16	150E	15RBA4-150E	15RBT4-150E	2.3 (1.05)	TC62886101	TC66701501	TC62886501	TC66701201
14	16	175E	15RBA4-175E	—	2.3 (1.05)	TC62886101	TC66701501	—	—
14	16	200E	15RBA4-200E	15RBT4-200E	2.3 (1.05)	TC62886101	TC66701501	TC62886501	TC66701201
14	16	250E	15RBA4-250E	15RBT4-250E	2.3 (1.05)	TC62886101	TC66701501	TC63943501	TC66701101
14	16	300E	15RBA4-300E	15RBT4-300E	2.3 (1.05)	TC62886101	TC66701501	TC63943501	TC66701101
14	16	400E	15RBA4-400E	15RBT4-400E	2.3 (1.05)	TC62886101	TC66701501	TC63943501	TC66701101
14	16	450E	(2) 15RBA4-250E	(2) 15RBT2-250E	—	TC62886102	TC66701001	TC63943502	TC66700901
14	16	540E	(2) 15RBA4-300E	(2) 15RBT2-300E	—	TC62886102	TC66701001	TC63943502	TC66700901
14	16	720E	(2) 15RBA4-400E	(2) 15RBT2-400E	—	TC62886102	TC66701001	TC63943502	TC66700901

### 25RBA2 and 25RBA4 Type Standard Speed and 25RBT2 and 25RBT4 Time Lag Fuse Refill Units

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Voltage (kV)		Ampere Rating	Standard Speed		Approximate Shipping Weight Lbs (kg)	Performance Curves			
Nominal	Maximum		Catalog Number	Time Lag Catalog Number		Standard Speed Minimum Melting	Total Clearing	Time Lag Minimum Melting	Total Clearing
23	26	10E	25RBA2-10E	—	1.3 (0.6)	TC62882301	TC66701401	—	—
23	26	15E	25RBA2-15E	—	1.3 (0.6)	TC62882301	TC66701401	—	—
23	26	20E	25RBA2-20E	25RBT2-20E	1.3 (0.6)	TC62882301	TC66701401	TC62886301	TC66701301
23	26	25E	25RBA2-25E	25RBT2-25E	1.3 (0.6)	TC62882301	TC66701401	TC62886301	TC66701301
23	26	30E	25RBA2-30E	25RBT2-30E	1.3 (0.6)	TC62882301	TC66701401	TC62886301	TC66701301
23	26	40E	25RBA2-40E	25RBT2-40E	1.3 (0.6)	TC62882301	TC66701401	TC62886301	TC66701301
23	26	50E	25RBA2-50E	25RBT2-50E	1.3 (0.6)	TC62882301	TC66701401	TC62886301	TC66701301
23	26	65E	25RBA2-65E	25RBT2-65E	1.3 (0.6)	TC62882301	TC66701401	TC62886301	TC66701301
23	26	80E	25RBA2-80E	25RBT2-80E	1.3 (0.6)	TC62882301	TC66701401	TC62886301	TC66701301
23	26	100E	25RBA2-100E	25RBT2-100E	1.3 (0.6)	TC62882301	TC66701401	TC62886301	TC66701301
23	26	125E	25RBA2-125E	25RBT2-125E	1.3 (0.6)	TC62882301	TC66701401	TC62886301	TC66701301
23	26	150E	25RBA2-150E	25RBT2-150E	1.3 (0.6)	TC62882301	TC66701401	TC62886301	TC66701301
23	26	175E	25RBA2-175E	—	1.3 (0.6)	TC62882301	TC66701401	—	—
23	26	200E	25RBA2-200E	25RBT2-200E	1.3 (0.6)	TC62882301	TC66701401	TC62886301	TC66701301
23	26	0.5	25RBA4-5	—	2.7 (1.25)	TC62886101	TC66701501	—	—
23	26	3	25RBA4-3	—	2.7 (1.25)	TC62886101	TC66701501	—	—
23	26	5E	25RBA4-5E	—	2.7 (1.25)	TC62886101	TC66701501	—	—
23	26	7E	25RBA4-7E	—	2.7 (1.25)	TC62886101	TC66701501	—	—
23	26	10E	25RBA4-10E	—	2.7 (1.25)	TC62886101	TC66701501	—	—
23	26	15E	25RBA4-15E	—	2.7 (1.25)	TC62886101	TC66701501	—	—
23	26	20E	25RBA4-20E	25RBT4-20E	2.7 (1.25)	TC62886101	TC66701501	TC62886501	TC66701201
23	26	25E	25RBA4-25E	25RBT4-25E	2.7 (1.25)	TC62886101	TC66701501	TC62886501	TC66701201
23	26	30E	25RBA4-30E	25RBT4-30E	2.7 (1.25)	TC62886101	TC66701501	TC62886501	TC66701201
23	26	40E	25RBA4-40E	25RBT4-40E	2.7 (1.25)	TC62886101	TC66701501	TC62886501	TC66701201
23	26	50E	25RBA4-50E	25RBT4-50E	2.7 (1.25)	TC62886101	TC66701501	TC62886501	TC66701201
23	26	65E	25RBA4-65E	25RBT4-65E	2.7 (1.25)	TC62886101	TC66701501	TC62886501	TC66701201
23	26	70E	25RBA4-80E	25RBT4-80E	2.7 (1.25)	TC62886101	TC66701501	TC62886501	TC66701201
23	26	100E	25RBA4-100E	25RBT4-100E	2.7 (1.25)	TC62886101	TC66701501	TC62886501	TC66701201
23	26	125E	25RBA4-125E	25RBT4-125E	2.7 (1.25)	TC62886101	TC66701501	TC62886501	TC66701201
23	26	150E	25RBA4-150E	25RBT4-150E	2.7 (1.25)	TC62886101	TC66701501	TC62886501	TC66701201
23	26	175E	25RBA4-175E	—	2.7 (1.25)	TC62886101	TC66701501	—	—
23	26	200E	25RBA4-200E	25RBT4-200E	2.7 (1.25)	TC62886101	TC66701501	TC62886501	TC66701201
23	26	250E	25RBA4-250E	25RBT4-250E	2.7 (1.25)	TC62886101	TC66701501	TC63943501	TC66701101
23	26	300E	25RBA4-300E	25RBT4-300E	2.7 (1.25)	TC62886101	TC66701501	TC63943501	TC66701101
23	26	450E	(2) 25RBA4-250E	(2) 25RBT2-250E	2.7 (1.25)	TC62886102	TC66701001	TC63943502	TC66700901
23	26	540E	(2) 25RBA4-300E	(2) 25RBT2-300E	—	TC62886102	TC66701001	TC63943502	TC66700901

## 38RBA4 and 38RBA4 Type Standard Speed and 38RBT2 and 238RBT4 Time Lag Fuse Refill Units

Voltage (kV)		Ampere Rating	Standard Speed		Approximate Shipping Weight Lbs (kg)	Performance Curves			
Nominal	Maximum		Catalog Number	Time Lag Catalog Number		Standard Speed Minimum Melting	Total Clearing	Time Lag Minimum Melting	Total Clearing
35	38	10E	38RBA2-10E	—	1.4 (0.65)	TC62882301	TC66701401	—	—
35	38	15E	38RBA2-15E	—	1.4 (0.65)	TC62882301	TC66701401	—	—
35	38	20E	38RBA2-20E	38RBT2-20E	1.4 (0.65)	TC62882301	TC66701401	TC62886301	TC66701301
35	38	25E	38RBA2-25E	38RBT2-25E	1.4 (0.65)	TC62882301	TC66701401	TC62886301	TC66701301
35	38	30E	38RBA2-30E	38RBT2-30E	1.4 (0.65)	TC62882301	TC66701401	TC62886301	TC66701301
35	38	40E	38RBA2-40E	38RBT2-40E	1.4 (0.65)	TC62882301	TC66701401	TC62886301	TC66701301
35	38	50E	38RBA2-50E	38RBT2-50E	1.4 (0.65)	TC62882301	TC66701401	TC62886301	TC66701301
35	38	65E	38RBA2-65E	38RBT2-65E	1.4 (0.65)	TC62882301	TC66701401	TC62886301	TC66701301
35	38	80E	38RBA2-80E	38RBT2-80E	1.4 (0.65)	TC62882301	TC66701401	TC62886301	TC66701301
35	38	100E	38RBA2-100E	38RBT2-100E	1.4 (0.65)	TC62882301	TC66701401	TC62886301	TC66701301
35	38	125E	38RBA2-125E	38RBT2-125E	1.4 (0.65)	TC62882301	TC66701401	TC62886301	TC66701301
35	38	150E	38RBA2-150E	38RBT2-150E	1.4 (0.65)	TC62882301	TC66701401	TC62886301	TC66701301
35	38	175E	38RBA2-175E	—	1.4 (0.65)	TC62882301	TC66701401	—	—
35	38	200E	38RBA2-200E	38RBT2-200E	1.4 (0.65)	TC62882301	TC66701401	TC62886301	TC66701301
35	38	0.5	38RBA4-.5	—	3.1 (1.4)	TC62886101	TC66701501	—	—
35	38	3	38RBA4-3	—	3.1 (1.4)	TC62886101	TC66701501	—	—
35	38	5E	38RBA4-5E	—	3.1 (1.4)	TC62886101	TC66701501	—	—
35	38	7E	38RBA4-7E	—	3.1 (1.4)	TC62886101	TC66701501	—	—
35	38	10E	38RBA4-10E	—	3.1 (1.4)	TC62886101	TC66701501	—	—
35	38	15E	38RBA4-15E	—	3.1 (1.4)	TC62886101	TC66701501	—	—
35	38	20E	38RBA4-20E	38RBT4-20E	3.1 (1.4)	TC62886101	TC66701501	TC62886501	TC66701201
35	38	25E	38RBA4-25E	38RBT4-25E	3.1 (1.4)	TC62886101	TC66701501	TC62886501	TC66701201
35	38	30E	38RBA4-30E	38RBT4-30E	3.1 (1.4)	TC62886101	TC66701501	TC62886501	TC66701201
35	38	40E	38RBA4-40E	38RBT4-40E	3.1 (1.4)	TC62886101	TC66701501	TC62886501	TC66701201
35	38	50E	38RBA4-50E	38RBT4-50E	3.1 (1.4)	TC62886101	TC66701501	TC62886501	TC66701201
35	38	65E	38RBA4-65E	38RBT4-65E	3.1 (1.4)	TC62886101	TC66701501	TC62886501	TC66701201
35	38	70E	38RBA4-80E	38RBT4-80E	3.1 (1.4)	TC62886101	TC66701501	TC62886501	TC66701201
35	38	100E	38RBA4-100E	38RBT4-100E	3.1 (1.4)	TC62886101	TC66701501	TC62886501	TC66701201
35	38	125E	38RBA4-125E	38RBT4-125E	3.1 (1.4)	TC62886101	TC66701501	TC62886501	TC66701201
35	38	150E	38RBA4-150E	38RBT4-150E	3.1 (1.4)	TC62886101	TC66701501	TC62886501	TC66701201
35	38	175E	38RBA4-175E	—	3.1 (1.4)	TC62886101	TC66701501	—	—
35	38	200E	38RBA4-200E	38RBT4-200E	3.1 (1.4)	TC62886101	TC66701501	TC62886501	TC66701201
35	38	250E	38RBA4-250E	38RBT4-250E	3.1 (1.4)	TC62886101	TC66701501	TC63943501	TC66701101
35	38	300E	38RBA4-300E	38RBT4-300E	3.1 (1.4)	TC62886101	TC66701501	TC63943501	TC66701101
35	38	450E	(2) 38RBA4-250E	(2) 38RBT2-250E	—	TC62886102	TC66701001	TC63943502	TC66700901
35	38	540E	(2) 38RBA4-300E	(2) 38RBT2-300E	—	TC62886102	TC66701001	TC63943502	TC66700901

#### RBA2 Fuse Holders, Mountings and Live Parts

Voltage (kV)				Style	Fuse Holder Catalog Number	Mounting Porcelain Catalog Number	Glass Polyester Catalog Number	Live Parts Catalog Number	Spring and Shunt Assembly Catalog Number
Nominal	Maximum	Ampere Rating	LIWL (BIL)						
4.8	5.5	10E–200E	60	Disconnect non-indicating	8RBA2-DH	5RBA2-PDM	5RBA2-GDM	15RBA2-DL	8RBA2-ISHNT
				Non-disconnect non-indicating	8RBA2-NH	5RBA2-PNM	5RBA2-GNM	15RBA2-NL	8RBA2-ISHNT
				Disconnect indicating	8RBA2-IDH	5RBA2-PDM	5RBA2-GDM	15RBA2-DL	8RBA2-ISHNT
				Non-disconnect indicating	8RBA2-INH	5RBA2-PNM	5RBA2-GNM	15RBA2-NL	8RBA2-ISHNT
				Non-disconnect indicating bolt in	8RBA2-INH-B	5RBA8-PNM	5RBA8-GNM	15RBA8-NL	8RBA2-ISHNT
7.2	8.3	10E–200E	75	Disconnect non-indicating	8RBA2-DH	8RBA2-PDM	8RBA2-GDM	15RBA2-DL	8RBA2-ISHNT
				Non-disconnect non-indicating	8RBA2-NH	8RBA2-PNM	8RBA2-GNM	15RBA2-NL	8RBA2-ISHNT
				Disconnect indicating	8RBA2-IDH	8RBA2-PDM	8RBA2-GDM	15RBA2-DL	8RBA2-ISHNT
				Non-disconnect indicating	8RBA2-INH	8RBA2-PNM	8RBA2-GNM	15RBA2-NL	8RBA2-ISHNT
				Non-disconnect indicating bolt in	8RBA2-INH-B	8RBA8-PNM	8RBA8-GNM	15RBA8-NL	8RBA2-ISHNT
13.8	15.5	10E–200E	95	Disconnect non-indicating	15RBA2-DH	14RBA2-PDM	14RBA2-GDM	15RBA2-DL	15RBA2-ISHNT
				Non-disconnect non-indicating	15RBA2-NH	14RBA2-PNM	14RBA2-GNM	15RBA2-NL	15RBA2-ISHNT
				Disconnect indicating	15RBA2-IDH	14RBA2-PDM	14RBA2-GDM	15RBA2-DL	15RBA2-ISHNT
				Non-disconnect indicating	15RBA2-INH	14RBA2-PNM	14RBA2-GNM	15RBA2-NL	15RBA2-ISHNT
				Non-disconnect indicating bolt in	15RBA2-INH-B	14RBA8-PNM	14RBA8-GNM	15RBA8-NL	15RBA2-ISHNT
13.8	15.5	10E–200E	110	Disconnect non-indicating	15RBA2-DH	15RBA2-PDM	—	15RBA2-DL	15RBA2-ISHNT
				Non-disconnect non-indicating	15RBA2-NH	15RBA2-PNM	—	15RBA2-NL	15RBA2-ISHNT
				Disconnect indicating	15RBA2-IDH	15RBA2-PDM	—	15RBA2-DL	15RBA2-ISHNT
				Non-disconnect indicating	15RBA2-INH	15RBA2-PNM	—	15RBA2-NL	15RBA2-ISHNT
				Non-disconnect indicating bolt in	15RBA2-INH-B	15RBA8-PNM	—	15RBA8-NL	15RBA2-ISHNT
23	25.5	10E–200E	150	Disconnect non-indicating	25RBA2-DH	25RBA2-PDM	—	38RBA2-DL	25RBA2-ISHNT
				Non-disconnect non-indicating	25RBA2-NH	25RBA2-PNM	—	38RBA2-NL	25RBA2-ISHNT
				Disconnect indicating	25RBA2-IDH	25RBA2-PDM	—	38RBA2-DL	25RBA2-ISHNT
				Non-disconnect indicating	25RBA2-INH	25RBA2-PNM	—	38RBA2-NL	25RBA2-ISHNT
				Non-disconnect indicating bolt in	25RBA2-INH-B	25RBA8-PNM	—	38RBA8-NL	25RBA2-ISHNT
34.5	38	10E–200E	150	Disconnect non-indicating	38RBA2-DH	38RBA2-PDM	—	38RBA2-DL	38RBA2-ISHNT
				Non-disconnect non-indicating	38RBA2-NH	38RBA2-PNM	—	38RBA2-NL	38RBA2-ISHNT
				Disconnect indicating	38RBA2-IDH	38RBA2-PDM	—	38RBA2-DL	38RBA2-ISHNT
				Non-disconnect indicating	38RBA2-INH	38RBA2-PNM	—	38RBA2-NL	38RBA2-ISHNT
				Non-disconnect indicating bolt in	38RBA2-INH-B	38RBA8-PNM	—	38RBA8-NL	38RBA2-ISHNT

#### RBA2 Exhaust Control Devices

Voltage (kV)					Exhaust Control Devices Catalog Number
Nominal	Maximum	Ampere Rating	LIWL (BIL)	Style	
4.8–13.8	5.5–15.5	10E–200E	—	Condenser (1 pack)	RBA2-COND-1
				Condenser (3 pack)	RBA2-COND
				Filter (1 pack)	RBA2-FLTR-1
				Filter (3 pack)	RBA2-FLTR
23–34.5	25.5–38	10E–200E	—	Condenser (1 pack)	RBA2-COND-1
				Condenser (3 pack)	RBA2-COND
				Filter (1 pack)	RBA2-FLTR-1
				Filter (3 pack)	RBA2-FLTR



## RBA4 Fuse Holders, Mountings and Live Parts

Voltage (kV)		Ampere Rating	LIWL (BIL)	Style	Fuse Holder	Mounting	Glass Polyester	Live Parts	Spring and Shunt Assembly
Nominal	Maximum				Catalog Number	Porcelain			
4.8	5.5	0.5–400E	60	Disconnect non-indicating	8RBA4-DH	5RBA4-PDM	5RBA4-GDM	15RBA4-DL	8RBA4-ISHNT
				Non-disconnect non-indicating	8RBA4-NH	5RBA4-PNM	5RBA4-GNM	15RBA4-NL	8RBA4-ISHNT
				Disconnect indicating	8RBA4-IDH	5RBA4-PDM	5RBA4-GDM	15RBA4-DL	8RBA4-ISHNT
				Non-disconnect indicating	8RBA4-INH	5RBA4-PNM	5RBA4-GNM	15RBA4-NL	8RBA4-ISHNT
				Non-disconnect indicating bolt in	8RBA4-INH-B	5RBA8-PNM	5RBA8-GNM	15RBA8-NL	8RBA4-ISHNT
7.2	8.3	0.5–400E	75	Disconnect non-indicating	8RBA4-DH	8RBA4-PDM	8RBA4-GDM	15RBA4-DL	8RBA4-ISHNT
				Non-disconnect non-indicating	8RBA4-NH	8RBA4-PNM	8RBA4-GNM	15RBA4-NL	8RBA4-ISHNT
				Disconnect indicating	8RBA4-IDH	8RBA4-PDM	8RBA4-GDM	15RBA4-DL	8RBA4-ISHNT
				Non-disconnect indicating	8RBA4-INH	8RBA4-PNM	8RBA4-GNM	15RBA4-NL	8RBA4-ISHNT
				Non-disconnect indicating bolt in	8RBA4-INH-B	8RBA8-PNM	8RBA8-GNM	15RBA8-NL	8RBA4-ISHNT
13.8	15.5	0.5–400E	95	Disconnect non-indicating	15RBA4-DH	14RBA4-PDM	14RBA4-GDM	15RBA4-DL	15RBA4-ISHNT
				Non-disconnect non-indicating	15RBA4-NH	14RBA4-PNM	14RBA4-GNM	15RBA4-NL	15RBA4-ISHNT
				Disconnect indicating	15RBA4-IDH	14RBA4-PDM	14RBA4-GDM	15RBA4-DL	15RBA4-ISHNT
				Non-disconnect indicating	15RBA4-INH	14RBA4-PNM	14RBA4-GNM	15RBA4-NL	15RBA4-ISHNT
				Non-disconnect indicating bolt in	15RBA4-INH-B	14RBA8-PNM	14RBA8-GNM	15RBA8-NL	15RBA4-ISHNT
13.8	15.5	0.5–400E	110	Disconnect non-indicating	15RBA4-DH	15RBA4-PDM	—	15RBA4-DL	15RBA4-ISHNT
				Non-disconnect non-indicating	15RBA4-NH	15RBA4-PNM	—	15RBA4-NL	15RBA4-ISHNT
				Disconnect indicating	15RBA4-IDH	15RBA4-PDM	—	15RBA4-DL	15RBA4-ISHNT
				Non-disconnect indicating	15RBA4-INH	15RBA4-PNM	—	15RBA4-NL	15RBA4-ISHNT
				Non-disconnect indicating bolt in	15RBA4-INH-B	15RBA8-PNM	—	15RBA8-NL	15RBA4-ISHNT
23	25.5	0.5–300E	150	Disconnect non-indicating	25RBA4-DH	25RBA4-PDM	—	38RBA4-DL	25RBA4-ISHNT
				Non-disconnect non-indicating	25RBA4-NH	25RBA4-PNM	—	38RBA4-NL	25RBA4-ISHNT
				Disconnect indicating	25RBA4-IDH	25RBA4-PDM	—	38RBA4-DL	25RBA4-ISHNT
				Non-disconnect indicating	25RBA4-INH	25RBA4-PNM	—	38RBA4-NL	25RBA4-ISHNT
				Non-disconnect indicating bolt in	25RBA4-INH-B	25RBA8-PNM	—	38RBA8-NL	25RBA4-ISHNT
34.5	38	0.5–300E	150	Disconnect non-indicating	38RBA4-DH	38RBA4-PDM	—	38RBA4-DL	38RBA4-ISHNT
				Non-disconnect non-indicating	38RBA4-NH	38RBA4-PNM	—	38RBA4-NL	38RBA4-ISHNT
				Disconnect indicating	38RBA4-IDH	38RBA4-PDM	—	38RBA4-DL	38RBA4-ISHNT
				Non-disconnect indicating	38RBA4-INH	38RBA4-PNM	—	38RBA4-NL	38RBA4-ISHNT
				Non-disconnect indicating bolt in	38RBA4-INH-B	38RBA8-PNM	—	38RBA8-NL	38RBA4-ISHNT

## RBA8 Fuse Holders, Mountings and Live Parts

Voltage (kV)					Fuse Holder	Mounting	Glass Polyester	Live Parts	Spring and Shunt Assembly
Nominal	Maximum	Ampere Rating	LIWL (BIL)	Style	Catalog Number	Porcelain Catalog Number	Catalog Number	Catalog Number	Catalog Number
4.8	5.5	450E-720E	60	Non-disconnect indicating bolt in	8RBA8-INH	5RBA8-PNM	5RBA8-GNM	15RBA8-NL	8RBA4-ISHNT
7.2	8.3	450E-720E	75	Non-disconnect indicating bolt in	8RBA8-INH	8RBA8-PNM	8RBA8-GNM	15RBA8-NL	8RBA4-ISHNT
13.8	15.5	450E-720E	95	Non-disconnect indicating bolt in	15RBA8-INH	14RBA8-PNM	14RBA8-GNM	15RBA8-NL	15RBA4-ISHNT
13.8	15.5	450E-720E	110	Non-disconnect indicating bolt in	15RBA8-INH	15RBA8-PNM	—	15RBA8-NL	15RBA4-ISHNT
23	25.5	450E-754E	150	Non-disconnect indicating bolt in	25RBA8-INH	25RBA8-PNM	—	38RBA8-NL	15RBA4-ISHNT
34.5	38	450E-754E	150	Non-disconnect indicating bolt in	38RBA8-INH	38RBA8-PNM	—	38RBA8-NL	38RBA4-ISHNT

## RBA4 and RBA8 Exhaust Control Devices

Voltage (kV)					Exhaust Control Devices
Nominal	Maximum	Ampere Rating	LIWL (BIL)	Style	Catalog Number
4.8-13.8	5.5-15.5	0.5-720E	—	Condenser (1 pack)	RBA4-COND-1
				Condenser (3 pack)	RBA4-COND
				Filter (1 pack)	RBA4-FLTR-1
				Filter (3 pack)	RBA4-FLTR
23-34.5	25.5-38	0.5-540E	—	Condenser (1 pack)	RBA4-COND-1
				Condenser (3 pack)	RBA4-COND
				Filter (1 pack)	RBA4-FLTR-1
				Filter (3 pack)	RBA4-FLTR
13.2	14.4	0.5-720E	—	High capacity filter (3 pack)	RBA4-FLTR-HC-1
				High capacity filter (1 pack)	RBA4-FLTR-HC

**RDB2 Outdoor Dropout Fuse Holders, Mounting and Live Parts**

Ampere Rating	LIWL (BIL)	Style	Fuse Holder Catalog Number	Mounting			Live Parts		Spring and Shunt Assy Catalog Number
				Vertical Catalog Number	Underhung Catalog Number	Underhung Catalog Number	Vertical Catalog Number	Underhung Catalog Number	
10E–200E	95	Dropout	8RDB2-DH	8RDB2-VM	8RDB2-UM	8RDB2-UM	RDB2-VL	RDB2-UL	8RDB2-SHNT
	110	Dropout	8RDB2-DH	8RDB2-HVM	8RDB2-HUM	8RDB2-HUM	RDB2-VL	RDB2-UL	8RDB2-SHNT
10E–200E	110	Dropout	15RDB2-DH	15RDB2-VM	15RDB2-UM	15RDB2-UM	RDB2-VL	RDB2-UL	15RDB2-SHNT
	150	Dropout	15RDB2-DH	15RDB2-HVM	15RDB2-HUM	15RDB2-HUM	RDB2-VL	RDB2-UL	15RDB2-SHNT
10E–200E	150	Dropout	25RDB2-DH	25RDB2-VM	25RDB2-UM	25RDB2-UM	RDB2-VL	RDB2-UL	25RDB2-SHNT
	200	Dropout	25RDB2-DH	25RDB2-HVM	25RDB2-HUM	25RDB2-HUM	RDB2-VL	RDB2-UL	25RDB2-SHNT
10E–200E	200	Dropout	38RDB2-DH	38RDB2-VM	38RDB2-UM	38RDB2-UM	RDB2-VL	RDB2-UL	38RDB2-SHNT
	250	Dropout	38RDB2-DH	38RDB2-HVM	38RDB2-HUM	38RDB2-HUM	RDB2-VL	RDB2-UL	38RDB2-SHNT

**RDB4 Outdoor Dropout Fuse Holders, Mounting and Live Parts**

Ampere Rating	LIWL (BIL)	Style	Fuse Holder Catalog Number	Mounting			Live Parts		Spring and Shunt Assy Catalog Number
				Vertical Catalog Number	Underhung Catalog Number	Underhung Catalog Number	Vertical Catalog Number	Underhung Catalog Number	
0.5–400E	95	Dropout	8RDB4-DH	8RDB4-VM	8RDB4-UM	8RDB4-UM	RDB4-VL	RDB4-UL	8RDB4-SHNT
	110	Dropout	8RDB4-DH	8RDB4-HVM	8RDB4-HUM	8RDB4-HUM	RDB4-VL	RDB4-UL	8RDB4-SHNT
0.5–400E	110	Dropout	15RDB4-DH	15RDB4-VM	15RDB4-UM	15RDB4-UM	RDB4-VL	RDB4-UL	15RDB4-SHNT
	150	Dropout	15RDB4-DH	15RDB4-HVM	15RDB4-HUM	15RDB4-HUM	RDB4-VL	RDB4-UL	15RDB4-SHNT
0.5–300E	150	Dropout	25RDB4-DH	25RDB4-VM	25RDB4-UM	25RDB4-UM	RDB4-VL	RDB4-UL	25RDB4-SHNT
	200	Dropout	25RDB4-DH	25RDB4-HVM	25RDB4-HUM	25RDB4-HUM	RDB4-VL	RDB4-UL	25RDB4-SHNT
0.5–300E	200	Dropout	38RDB4-DH	38RDB4-VM	38RDB4-UM	38RDB4-UM	RDB4-VL	RDB4-UL	38RDB4-SHNT
	250	Dropout	38RDB4-DH	38RDB4-HVM	38RDB4-HUM	38RDB4-HUM	RDB4-VL	RDB4-UL	38RDB4-SHNT

**RDB8 Outdoor Dropout Fuse Holders, Mounting and Live Parts**

Ampere Rating	LIWL (BIL)	Style	Fuse Holder Catalog Number	Mounting			Live Parts		Spring and Shunt Assy Catalog Number
				Vertical Catalog Number	Underhung Catalog Number	Underhung Catalog Number	Vertical Catalog Number	Underhung Catalog Number	
450E–720E	95	Dropout	8RDB4-DH	8RDB8-VM	8RDB8-UM	8RDB8-UM	RDB8-VL	RDB8-UL	8RDB4-SHNT
	110	Dropout	8RDB4-DH	8RDB8-HVM	8RDB8-HUM	8RDB8-HUM	RDB8-VL	RDB8-UL	8RDB4-SHNT
450E–720E	110	Dropout	15RDB4-DH	15RDB8-VM	15RDB8-UM	15RDB8-UM	RDB8-VL	RDB8-UL	15RDB4-SHNT
	150	Dropout	15RDB4-DH	15RDB8-HVM	15RDB8-HUM	15RDB8-HUM	RDB8-VL	RDB8-UL	15RDB4-SHNT
450E–540E	150	Dropout	25RDB4-DH	25RDB8-VM	25RDB8-UM	25RDB8-UM	RDB8-VL	RDB8-UL	25RDB4-SHNT
	200	Dropout	25RDB4-DH	25RDB8-HVM	25RDB8-HUM	25RDB8-HUM	RDB8-VL	RDB8-UL	25RDB4-SHNT
450E–540E	200	Dropout	38RDB4-DH	38RDB8-VM	38RDB8-UM	38RDB8-UM	RDB8-VL	RDB8-UL	38RDB4-SHNT
	250	Dropout	38RDB4-DH	38RDB8-HVM	38RDB8-HUM	38RDB8-HUM	RDB8-VL	RDB8-UL	38RDB4-SHNT

# 2.7

## Expulsion Fuses

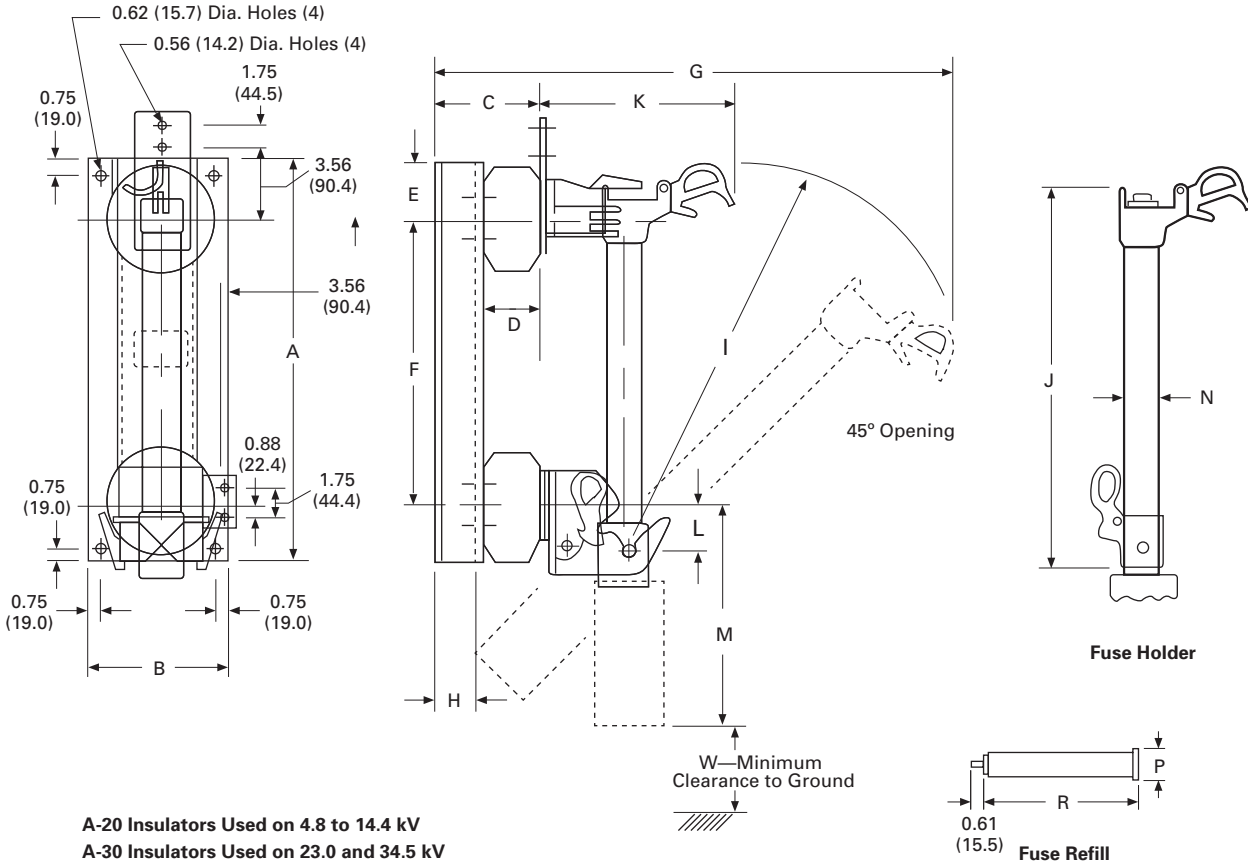
RBA/RDB Type Fuses (Including Superseded BA Fuses)

### Dimensions

Approximate Dimensions in Inches (mm)

2

#### RBA Fuse Mountings—RBA200, RBA400 Disconnect Mounting—4.8 to 34.5 kV



## RBA/RDB Type Fuses (Including Superseded BA Fuses)

Approximate Dimensions in Inches (mm)

## RBA200, RBA400

Catalog Number	kV	BIL	A	B	C	D	E	F	G	H	I	J	K	L	M	N	P	R	W With Condenser	With Discharge	Recommended Phase Spacing <sup>①</sup>
<b>5RBA2</b>	60		22.62 (574.5)	7.00 (177.8)	7.50 (190.5)	3.50 (89.9)	5.87 (149.1)	14.25 (362.0)	27.19 (690.6)	3.34 (84.8)	18.69 (474.7)	18.81 (477.7)	9.25 (234.9)	1.56 (39.6)	10.12 (257.0)	1.64 (41.7)	1.50 (38.1)	7.50 (190.5)	3.00 (76.2)	7.50 (190.5)	11.50 (292.1)
<b>8RBA2</b>	75		22.62 (574.5)	7.00 (177.8)	10.00 (254.0)	6.00 (152.4)	5.87 (149.1)	14.25 (362.0)	29.69 (754.1)	6.34 (161.0)	18.69 (474.7)	18.81 (477.7)	9.25 (234.9)	1.56 (39.6)	10.12 (257.0)	1.64 (41.7)	1.50 (38.1)	7.50 (190.5)	4.00 (101.6)	8.50 (215.9)	13.00 (330.2)
<b>14RBA2</b>	95		22.62 (574.5)	7.00 (177.8)	10.00 (254.0)	6.00 (152.4)	2.62 (66.5)	17.62 (447.5)	32.12 (815.8)	6.34 (161.0)	22.06 (560.3)	22.19 (563.6)	9.25 (234.9)	1.56 (39.6)	10.12 (257.0)	1.64 (41.7)	1.50 (38.1)	8.75 (222.2)	6.00 (152.4)	11.50 (292.1)	14.50 (368.3)
<b>15RBA2</b>	110		22.62 (574.5)	7.00 (177.8)	11.50 (292.1)	7.50 (190.5)	2.62 (66.5)	17.62 (447.5)	33.62 (853.9)	7.84 (199.1)	22.06 (560.3)	22.19 (563.6)	9.25 (234.9)	1.56 (39.6)	10.12 (257.0)	1.64 (41.7)	1.50 (38.1)	8.75 (222.2)	6.00 (152.4)	11.50 (292.1)	16.00 (406.4)
<b>25RBA2</b>	150		33.88 (860.6)	7.00 (177.8)	12.00 (304.8)	10.50 (254.0)	2.50 (63.5)	22.25 (565.1)	37.69 (957.3)	11.71 (297.4)	26.69 (677.9)	26.81 (681.0)	9.25 (234.9)	1.56 (39.6)	10.12 (257.0)	1.64 (41.7)	1.50 (38.1)	10.50 (266.7)	8.50 (215.9)	15.00 (381.0)	20.00 (508.0)
<b>38RBA2</b>	150		33.88 (860.6)	7.00 (177.8)	12.00 (304.8)	10.50 (254.0)	2.50 (63.5)	29.25 (742.9)	42.62 (1082.5)	11.71 (297.4)	33.69 (855.7)	33.81 (858.7)	9.25 (234.9)	1.56 (39.6)	10.12 (257.0)	1.64 (41.7)	1.50 (38.1)	13.12 (333.2)	12.00 (304.8)	19.50 (495.3)	25.00 (635.0)
<b>5RBA4</b>	60		22.25 (565.1)	7.00 (177.8)	7.50 (190.5)	3.50 (89.9)	5.94 (150.9)	13.81 (350.7)	27.40 (696.0)	3.03 (77.0)	19.69 (500.1)	20.00 (508.0)	9.25 (234.9)	2.63 (39.6)	11.75 (298.4)	2.17 (55.1)	2.20 (55.9)	7.62 (193.5)	3.00 (76.2)	7.50 (190.5)	11.75 (292.1)
<b>8RBA4</b>	75		22.25 (565.1)	7.00 (177.8)	10.00 (254.0)	6.00 (152.4)	5.94 (150.9)	13.81 (350.7)	29.90 (759.5)	5.53 (140.5)	19.69 (500.1)	20.00 (508.0)	9.25 (234.9)	2.63 (39.6)	11.75 (298.4)	2.17 (55.1)	2.20 (55.9)	7.62 (193.5)	4.00 (101.6)	8.50 (215.9)	13.25 (336.5)
<b>14RBA4</b>	95		22.25 (565.1)	7.00 (177.8)	10.00 (254.0)	6.00 (152.4)	2.56 (65.0)	17.19 (436.6)	32.81 (833.4)	5.53 (140.5)	23.69 (601.7)	23.38 (593.9)	9.25 (234.9)	2.63 (39.6)	11.75 (298.4)	2.17 (55.1)	2.20 (55.9)	8.88 (225.6)	6.00 (152.4)	11.50 (292.1)	14.75 (374.6)
<b>15RBA4</b>	110		22.25 (565.1)	7.00 (177.8)	11.50 (292.1)	7.50 (190.5)	2.56 (65.0)	17.19 (436.6)	34.31 (871.5)	7.03 (178.6)	23.69 (601.7)	23.38 (593.9)	9.25 (234.9)	2.63 (39.6)	11.75 (298.4)	2.17 (55.1)	2.20 (55.9)	8.88 (225.6)	6.00 (152.4)	11.50 (292.1)	16.25 (412.7)
<b>25RBA4</b>	150		33.81 (858.8)	8.00 (203.2)	13.50 (342.9)	10.50 (254.0)	2.50 (63.5)	21.81 (554.0)	39.56 (1004.8)	9.03 (229.4)	27.69 (703.3)	28.00 (711.2)	9.25 (234.9)	2.63 (39.6)	11.75 (298.4)	2.17 (55.1)	2.20 (55.9)	11.38 (289.1)	8.50 (215.9)	15.00 (381.0)	20.25 (514.4)
<b>38RBA4</b>	150		33.81 (858.8)	8.00 (203.2)	13.50 (342.9)	10.50 (254.0)	2.50 (63.5)	28.81 (731.8)	44.50 (1130.3)	9.03 (229.4)	27.69 (703.3)	35.00 (889.0)	9.25 (234.9)	2.63 (39.6)	11.75 (298.4)	2.17 (55.1)	2.20 (55.9)	13.62 (356.0)	12.00 (304.8)	19.50 (495.3)	25.25 (641.4)

**Note**

① Phase-to-phase center spacing, without barriers.

# 2.7

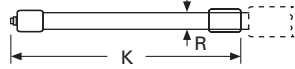
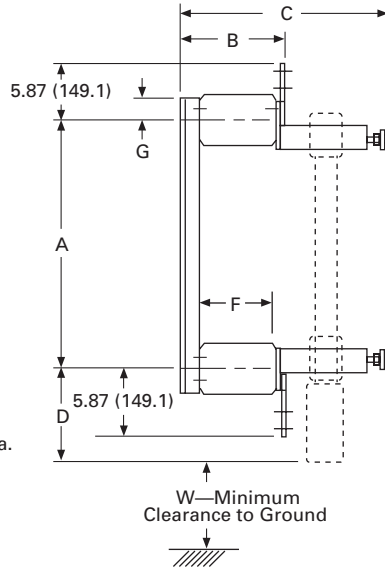
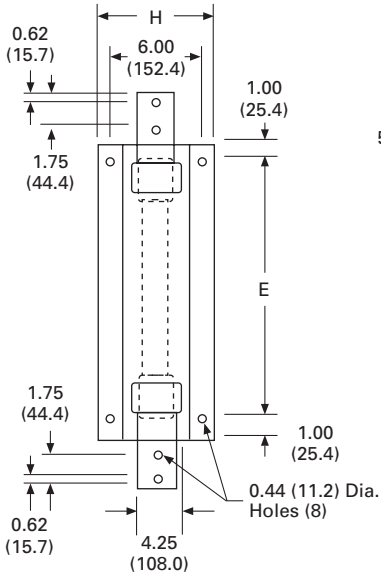
## Expulsion Fuses

RBA/RDB Type Fuses (Including Superseded BA Fuses)

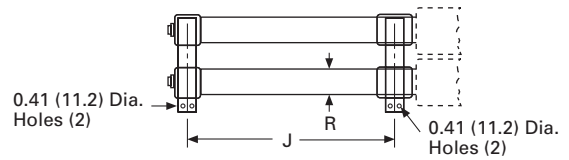
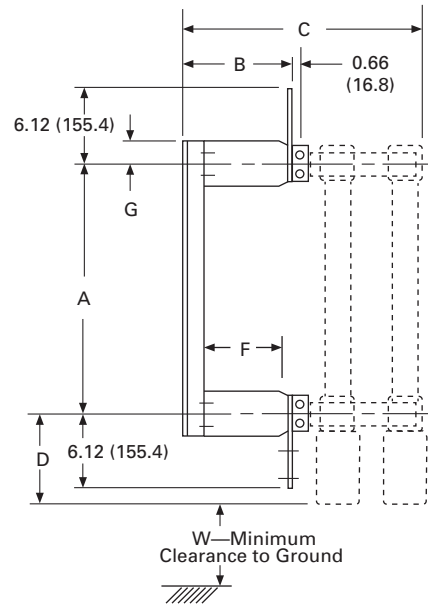
Approximate Dimensions in Inches (mm)

2

### RBA200, RBA400 and RBA800 (Piggyback Type)—Non-Disconnect Mounting 4.8 to 34.5 kV



Fuse Holder RBA200, RBA400



Fuse Holder RBA800

## RBA/RDB Type Fuses (Including Superseded BA Fuses)

Approximate Dimensions in Inches (mm)

## RBA200, RBA400 and RBA800 (Piggyback Type)

Catalog Number	kV BIL	A	B	C	D	E	F	G	H	J	K	R	W With Condenser	With Discharge	Recommended Phase Spacing <sup>①</sup>
5RBA2	60	15.62 (396.7)	4.62 (117.3)	11.43 (290.3)	8.62 (218.9)	15.62 (396.7)	7.50 (190.5)	1.32 (33.5)	7.50 (190.5)	—	18.25 (463.5)	1.64 (41.7)	3.00 (76.2)	7.50 (190.5)	11.16 (283.5)
8RBA2	75	15.62 (396.7)	7.12 (180.8)	13.93 (353.8)	8.62 (218.9)	15.62 (396.7)	7.50 (190.5)	1.32 (33.5)	7.50 (190.5)	—	18.25 (463.5)	1.64 (41.7)	4.00 (101.6)	8.50 (215.9)	12.56 (319.0)
14RBA2	95	19.00 (482.6)	7.12 (180.8)	13.93 (353.8)	8.62 (218.9)	19.00 (482.6)	7.50 (190.5)	1.32 (33.5)	7.50 (190.5)	—	21.63 (549.4)	1.64 (41.7)	6.00 (152.4)	11.50 (292.1)	13.06 (331.7)
15RBA2	110	19.00 (482.6)	8.62 (218.9)	15.43 (391.9)	8.62 (218.9)	19.00 (482.6)	7.50 (190.5)	1.32 (33.5)	7.50 (190.5)	—	21.63 (549.4)	1.64 (41.7)	6.00 (152.4)	11.50 (292.1)	15.56 (395.2)
25RBA2	150	26.43 (671.3)	12.12 (307.8)	18.93 (480.8)	7.25 (184.1)	29.43 (747.5)	8.50 (215.9)	2.50 (63.5)	8.50 (215.9)	—	26.25 (666.7)	1.64 (41.7)	8.50 (215.9)	15.00 (381.0)	19.56 (496.8)
38RBA2	150	33.43 (849.1)	12.12 (307.8)	18.93 (480.8)	7.25 (184.1)	36.43 (925.3)	8.50 (215.9)	2.50 (63.5)	8.50 (215.9)	—	33.25 (844.5)	1.64 (41.7)	12.00 (304.8)	19.50 (495.3)	24.56 (623.8)
5RBA4	60	16.56 (420.6)	4.62 (117.3)	12.31 (312.7)	8.75 (222.2)	16.56 (420.6)	7.50 (190.5)	1.32 (33.5)	7.50 (190.5)	—	19.52 (495.8)	2.17 (55.1)	3.00 (76.2)	7.50 (190.5)	11.16 (283.5)
8RBA4	75	16.56 (420.6)	7.12 (180.8)	14.81 (376.2)	8.75 (222.2)	16.56 (420.6)	7.50 (190.5)	1.32 (33.5)	7.50 (190.5)	—	19.52 (495.8)	2.17 (55.1)	4.00 (101.6)	8.50 (215.9)	12.56 (319.0)
14RBA4	95	19.94 (506.5)	7.12 (180.8)	14.81 (376.2)	8.75 (222.2)	19.94 (506.5)	7.50 (190.5)	1.32 (33.5)	7.50 (190.5)	—	22.90 (581.7)	2.17 (55.1)	6.00 (152.4)	11.50 (292.1)	13.06 (331.7)
15RBA4	110	19.94 (506.5)	8.62 (218.9)	16.31 (414.3)	8.75 (222.2)	19.94 (506.5)	7.50 (190.5)	2.50 (63.5)	7.50 (190.5)	—	22.90 (581.7)	2.17 (55.1)	6.00 (152.4)	11.50 (292.1)	15.56 (395.2)
25RBA4	150	27.37 (695.2)	12.12 (307.8)	19.81 (503.2)	7.37 (187.2)	30.37 (771.4)	8.50 (215.9)	1.32 (33.5)	8.50 (215.9)	—	22.90 (581.7)	2.17 (55.1)	8.50 (215.9)	15.00 (381.0)	19.56 (496.8)
38RBA4	150	34.37 (873.0)	12.12 (307.8)	19.81 (503.2)	7.37 (187.2)	37.37 (949.2)	8.50 (215.9)	2.50 (63.5)	8.50 (215.9)	—	34.52 (876.8)	2.17 (55.1)	12.00 (304.8)	19.50 (495.3)	24.56 (623.8)
5RBA8	60	16.31 (414.3)	4.50 (114.3)	12.85 (326.4)	9.31 (236.5)	17.56 (446.0)	3.50 (88.9)	1.62 (41.1)	3.50 (88.9)	16.31 (414.3)	—	2.17 (55.1)	3.00 (76.2)	7.50 (190.5)	11.00 (279.4)
8RBA8	75	16.31 (414.3)	7.00 (177.8)	15.35 (389.9)	9.31 (236.5)	17.56 (446.0)	6.00 (152.4)	1.62 (41.1)	6.00 (152.4)	16.31 (414.3)	—	2.17 (55.1)	4.00 (101.6)	8.50 (215.9)	12.50 (317.5)
14RBA8	95	19.81 (503.2)	7.00 (177.8)	15.35 (389.9)	9.31 (236.5)	21.06 (534.9)	6.00 (152.4)	1.62 (41.1)	6.00 (152.4)	19.81 (503.2)	—	2.17 (55.1)	6.00 (152.4)	11.50 (292.1)	14.00 (355.6)
15RBA8	110	19.81 (503.2)	8.50 (215.9)	16.85 (428.0)	9.31 (236.5)	21.06 (534.9)	7.50 (190.5)	1.62 (41.1)	7.50 (190.5)	19.81 (503.2)	—	2.17 (55.1)	6.00 (152.4)	11.50 (292.1)	15.50 (393.1)
25RBA8	150	24.50 (622.3)	11.50 (292.1)	19.85 (504.2)	9.31 (236.5)	27.50 (698.5)	10.50 (266.7)	2.50 (63.5)	10.50 (266.7)	24.50 (622.3)	—	2.17 (55.1)	6.00 (152.4)	15.00 (381.0)	19.50 (495.3)
38RBA8	150	31.50 (800.1)	11.50 (292.1)	19.85 (504.2)	9.31 (236.5)	34.50 (876.3)	10.50 (266.7)	2.50 (63.5)	10.50 (266.7)	31.50 (800.0)	—	2.17 (55.1)	12.00 (304.8)	19.50 (495.3)	24.50 (622.3)

**Note**

① Phase-to-phase center spacing, without barriers.

# 2.7

## Expulsion Fuses

RBA/RDB Type Fuses (Including Superseded BA Fuses)

