### Type RBA Expulsion Fuses for Use Indoors or in an Enclosure

<table>
<thead>
<tr>
<th>Ampere Rating</th>
<th>Catalog Number</th>
<th>Time-Lag (Fuse Refills)</th>
<th>Voltage (kV)</th>
<th>Mounting (including Live Parts less Holder)</th>
<th>Live Parts</th>
<th>Fuse Filters and Condensers</th>
<th>Spring and Shunt Assembly</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Porcelain Insulator</td>
<td>Glass Polyester</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Catalog Number</td>
<td>Catalog Number</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50E</td>
<td>(1) RBA4-50E</td>
<td>Non</td>
<td>13.8</td>
<td>15.5</td>
<td>95</td>
<td>15RBA4-PNM</td>
<td>15RBA4-GNM</td>
</tr>
<tr>
<td>300E</td>
<td>(1) RBA4-300E</td>
<td>Non</td>
<td>13.8</td>
<td>15.5</td>
<td>95</td>
<td>15RBA4-PNM</td>
<td>15RBA4-GNM</td>
</tr>
<tr>
<td>450E</td>
<td>(2) RBA4-450E</td>
<td>Non</td>
<td>13.8</td>
<td>15.5</td>
<td>95</td>
<td>15RBA4-PNM</td>
<td>15RBA4-GNM</td>
</tr>
<tr>
<td>720E</td>
<td>(2) RBA4-720E</td>
<td>Non</td>
<td>13.8</td>
<td>15.5</td>
<td>95</td>
<td>15RBA4-PNM</td>
<td>15RBA4-GMN</td>
</tr>
</tbody>
</table>

**For new installation**: Order one refill (Standard Speed or Time Lag), one fuseholder, one mounting, and one filter or condenser per phase. Live parts can be substituted for the mounting if user is supplying base support and insulators.

© Requires two fuse refills as shown. Price each refill individually. Example: To order refill units for a 720E, 15 kV fuse, order 2 pieces of an 15RBA4-400E.

© Two filters or condensers required.
RBA Fuses
Introduction

The Cutler-Hammer RBA (Refillable Boric Acid) Power Fuse is a vented, expulsion type power fuse designed for indoor or weatherproof enclosure applications. The RBA is a renewable (refillable) design. As the word renewable implies, the entire fuse unit is not discarded after it interrupts a fault. Usually, only one portion of the fuse, the refill, is replaced after an interruption. For this reason, RBA fuses provide an economical approach to the protection of distribution system equipment rated up to a maximum of 38 kV. They are especially well suited for large industrial load fusing needs.

An RBA is basically a vented electromechanical device designed for many different power applications. The RBA Power Fuse is most effective for higher operational voltage and higher continuous current requirements. The RBA expulsion type fuse, not unlike other similar devices, does not limit the magnitude of fault current during operation. It limits the duration of the fault on the electrical system.

RBA expulsion fuses are available in a wide range of ratings to simplify the selection process. They offer continuous current ratings of 1/2 through 720 amperes, maximum voltages of 8.3 through 38 kV, and symmetrical interrupting capabilities of 19,000 through 37,500 amperes. In addition, the RBA offers two operating time configurations, standard speed and time lag (delay). This feature, when combined with the wide range of ratings, permits customers to maximize both coordination and protection.

Since RBA Power Fuses can be used with either disconnect or non-disconnect mountings, fitting the fuse to the equipment type and layout restrictions is a simplified process. The RBA is an easy to install design and even easier to maintain.

Applications

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

Since the RBA Power Fuse is refillable (renewable), it is economical for use in a variety of indoor distribution system applications. Primarily, the RBA is designed for use on:

- Load Interrupter Switchgear
- Power Transformers
- High Voltage Capacitors
- Pad Mounted Transformers

The RBA can also be installed in fuse cabinets for both indoor and outdoor use.

RBA Power Fuses applied in a series combination with load break interrupter switches provide for reliable switching and fault protection. This type of equipment, commonly referred to as load interrupter switchgear, is an integrated assembly of switches, bus and fuses that are coordinated electrically and mechanically for effective circuit protection.

Another common application for RBA Power fuses is power transformer protection. Depending upon the transformer size and/or location, the RBA could be used to provide protection for the transformer’s primary. Fuses applied here must be selected so as not to blow on such things as transformer inrush current while still providing protection against short circuits.

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

Protective equipment is also applied to the primary of pad mounted transformers to protect the upstream system from faults which occur in or beyond the transformer. Selection of the fuse type is dependent on many factors including: user or supplier preference, cost, and system coordination to mention a few. If the required voltage and continuous current ratings are high and downstream coordination is critical, RBA Power Fuses can provide very effective protection.
Operation and Features

In general, a complete renewable (refillable) indoor boric acid expulsion type fuse unit consists of the following major components:

- Boric Acid Refill
- Fuse Holder
- Mounting
- Optional Discharge Suppressor

The boric acid refill is a part of the fuse unit which is discarded after an interruption. It contains the fusible element which melts and a boric acid liner which assists with the interruption.

A boric acid refill is contained inside a tube called the fuse holder. The fuse holder holds the refill and provides electrical contact between the refill on the inside and the line/load connections on the outside.

Everything required to safely mount a fuse at its point of application is provided by the mounting. A fuse mounting consists of a metal base to which a number of other items are attached, such as insulators and current carrying parts. Mountings are usually available in non-disconnect and disconnect configurations. 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. This insulated stick is referred to as a hookstick. Thus the frequently heard phrase - hookstick operated.

Depending upon 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. What type of suppressor is installed depends upon the requirements at the point of application.
RBA Details

The Cutler-Hammer renewable RBA 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 distribution system protection up to an operational voltage of 34.5 kV. Because the RBA is 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. The proven RBA Power fuse performs as intended. It operates exactly when and how it should, and does not operate when it should not operate. This is a subtle but important point.

Each individual RBA fuse component, which is part of the total fuse package, is discussed individually. Its makeup and unique role in the protection process are also discussed.

RBA Refill

It is difficult to call one fuse component more important than another component, since all components must be combined in a coordinated package to function properly. If such a designation had to made, however, the refill would have to be called the most important component. The term renewable is attributed to the refill, since it is the part of the fuse package that is replaced after an interruption. This replacement renews the fuse to its original state of protective readiness.

An RBA refill is comprised primarily of a conducting fuse element, an arcing rod, an auxiliary arcing wire, 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 is made of silver and the time-lag of tin.

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 condition, the arcing rod draws and lengthens the arc as it moves back into the boric acid liner. This backward movement is made possible because the arcing rod is under spring tension from the outside of the refill. The device causing the spring tension will be covered next in the RBA holder discussion.

A nichrome wire, called the strain element, parallels the fuse element and relieves the fuse element of any strain put on it by the spring loaded arcing rod. This high resistance wire shunts the fuse element and vaporizes immediately after the fuse element melts.

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

RBA Refill Operation

Under fault conditions, the fuse element melts, the strain element melts, the arcing rod and arc are pulled back through the boric acid cylinder. Intense heat from the arc decomposes the dry boric acid. On decomposition, the boric acid forms water vapor and inert boric anhydride which extinguishes the arc by blasting through it and de-ionizing the arc. The exhaust caused by the interruption exits from the bottom of the fuse.
through the blow-out disk. This prevents the arc from re-striking after a current zero.

RBA refills are designed to interrupt short circuit currents within 1/2 cycle at 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 utilizing the principles of De-Ionization.

**Low Current Fault Operation**

When a low current fault occurs, the main fuse and strain elements blow. The auxiliary wire shorts out the main fuse 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 blows the main fuse and strain element and transfers to the auxiliary fuse wire. In the small bore, the arc creates a high voltage so it restrikes in the main bore. The arcing rod then draws the arc through the main bore where it is quickly extinguished.

**RBA Refill Ratings**

RBA fuse refills are ANSI/IEEE “E” rated. The “E” rating is a current response definition that was intended to produce a degree of electrical interchangeability among fuse manufacturers. Rather than having just a pure current rating for a fuse, the refill has its ampere rating stated in terms of a number followed by the capital letter E, 100E for example. 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 would be the same for all manufacturers with the “E” designation.
RBA Features

RBA Holder
An RBA fuse holder is a glass epoxy tube which encloses and supports the fuse refill. It also includes a spring and shunt assembly, provides for electrical connections, and includes the required hardware for use with a non-disconnect or a disconnect mounting. The holder delivers excellent dielectric strength as well as mechanical strength for support purposes. The RBA holder is not suitable for use in outdoor applications.

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

Spring and Shunt Assembly
A spring and shunt assembly is comprised of a helical spring which encloses a flexible, braided copper wire called the shunt. This assembly attaches on one end to the threaded end of the refill just discussed, and on the other end to the top contact of the holder. Once the spring and shunt assembly are properly attached and enclosed in the holder, the refill’s arcing rod is put under spring tension and ready to operate by providing the required force to move the rod inside the refill up into the boric acid liner.

The flexible wire shunt inside the spring is an excellent conductor that completes the current path between the arcing rod and the top contact of the holder. Shunting or bypassing the helical shaped spring so the spring does not have to carry current requires the wire shunt to be very flexible. This flexibility is required to avoid any entanglement between the wire shunt and the spring which could impede movement of the arcing rod being pulled by the spring during operation.

Holder Contacts and Hardware
The upper and lower contacts of the fuse holder provide the means for making electrical connections between the fuse refill and the mounting. They are often referred to as end fittings, since they attach to each end of the fuse holder. The hardware is made of silver plated cast bronze ensuring good electrical contact between the mounting and fuse itself. In addition, the electrical contacts also function to dissipate heat while the fuse is conducting electricity.

The only difference between non-disconnect and disconnect type fuse holders is the type of electrical contacts attached to the fuse holder. Disconnect electrical hardware permits the fuse to be hookstick-operated in a compatible disconnect type mounting. A hookeye is provided at each end of the fuse holder’s disconnect hardware to accommodate the hook end of a hookstick opening and removal device. Non-disconnect electrical hardware requires the fuse unit to be held in a permanent position until completely removed from a compatible mounting.

RBA Mountings
Non-disconnect and disconnect mountings are both available for an RBA Power Fuse. A mounting provides everything necessary to safely mount a compatible RBA fuse unit to or in the applicable equipment. The mounting base is the metal support to which all the mounting parts attach. Porcelain or glass polyester insulators are attached to the base and insulate the live fuse unit and any other live part from the mounting base and everything beyond the base. Live parts, which are attached to the insulators, hold the fuse unit in place in the mounting, provide a place to make line and load connections, and are hot once electricity is flowing.

Live parts are available without the insulators or mounting base. Some applications have unique mounting situations or the customer may just choose to add additional value by supplying the insulators and base. It is still necessary to mount the live parts in a manner similar to that used with complete mountings. It is the customer’s responsibility 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 clips to hold the fuse unit in position under tension. The clips securely attach to both ends of the fuse holder. 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 upon the size and configuration of the fuse unit.

The RBA disconnect mounting is hookstick-operable which simplifies opening, closing, and fuse replacement. Not only is the hookstick used to open the fuse, it is used to lift the fuse from its mounting. This keeps the operator well clear of any live parts during fuse removal. One end of the mounting is the hinged end and one is the latched end. They work in conjunction with compatible disconnect parts attached to the fuse holder. Positive electrical connections are maintained at both ends of the mounting through the use of cadmium chromium copper spring fingers at the hinge end and clip type contacts on the break (latch) end. The spring fingers are compressed on closing in of the fuse holder. The current path is then made directly from the terminal pad to the fingers and the fuse holder. This upper end of the fuse holder is locked into position in the fuse holder by a stainless steel latch.

**RBA Accessories**

Optional accessory devices are often used with indoor expulsion fuses, like the RBA, to retard the gases and noise associated with this type of fuse during operation. Cutler-Hammer offers two devices called the condenser and the discharge filter. Other manufacturers might refer to such devices as suppressors or silencers. All of these devices act to retard, in varying degrees, the by-products of an interruption, much the same as an automobile muffler restricts the by-products of internal combustion.

In cases where installation clearances are small, a condenser or a discharge filter can be threaded to the bottom of an RBA fuse holder to minimize the noise and exhaust while containing the arc within the fuse during interruption. Both devices are metallic containers with copper screen inside to absorb and dissipate arc heat and to 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.

The **condenser's design** fully restricts the expulsion process, which requires the interrupting rating (kA) of the fuse to be reduced when it is used with the RBA. Use of the discharge filter does not restrict the expulsion process enough to affect the interrupting rating of the fuse. A view of the bottom of both devices would easily identify which was the condenser and which was the discharge filter. The bottom end of the condenser is almost totally closed with one small weep hole for the release of water. On the other hand, the **discharge filter** has a number of larger holes. The application and installation location usually determines which device is selected.