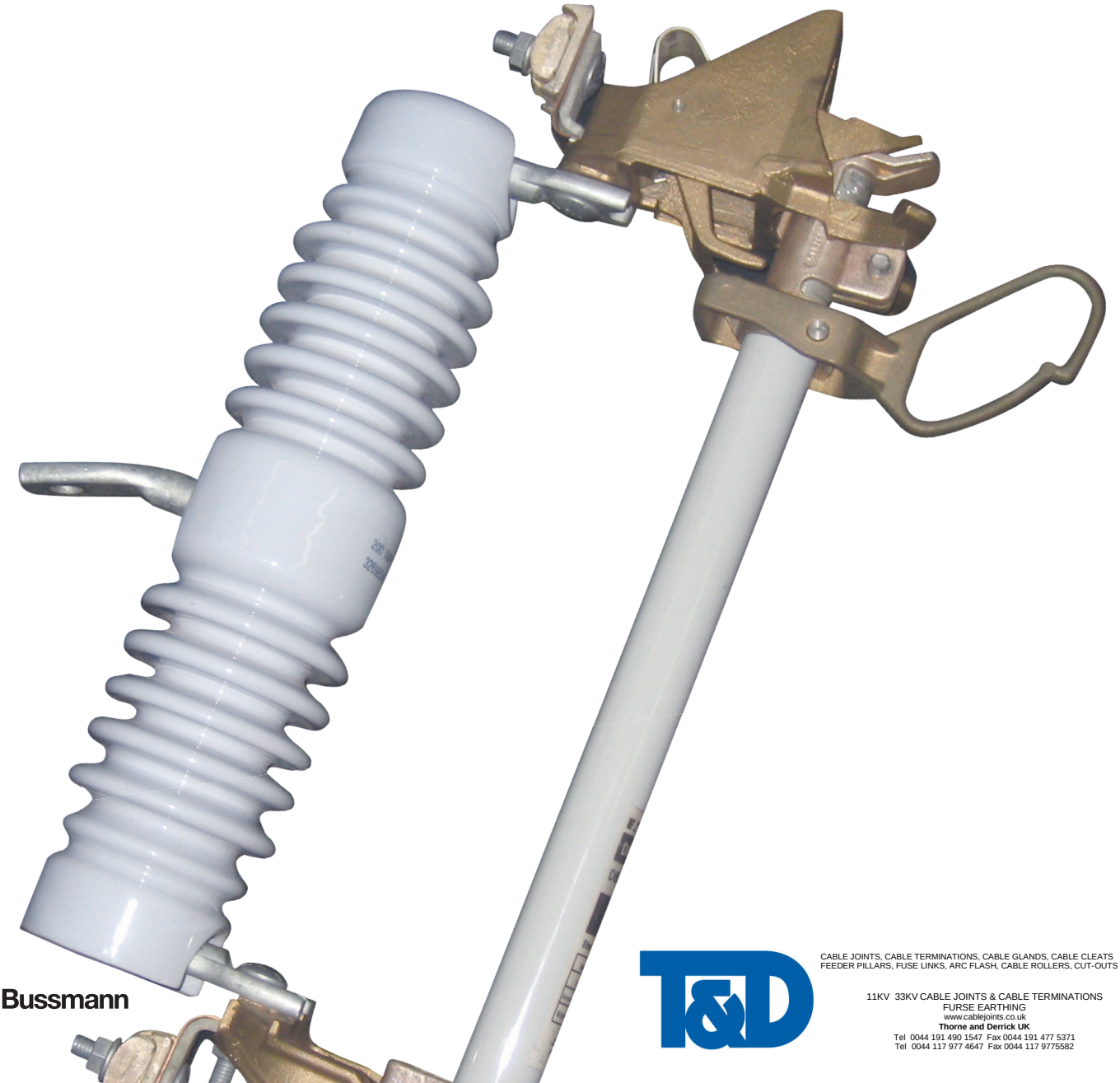
COOPER

# Bussmann®

Productivity Through Protection™

# Circuit Protection Solutions

## Medium Voltage Boric Acid Fuses



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## WORLD-WIDE CIRCUIT PROTECTION SOLUTIONS

Cooper Bussmann are one of the world's leading suppliers of fuses and fusible protection systems. Provider of the world's first truly global product line, each product is backed by an efficient worldwide distribution network service and unrivalled technical support. Cooper Bussmann circuit protection solutions comply with major international standards: BS, IEC, DIN and UL.

Cooper Bussmann Medium Voltage fuses have absorbed and embodied the expertise and experience of thirteen of the most prestigious manufacturers and are able to offer an unbeatable range of products in terms of technical excellence, performance and quality.

Cooper Bussmann offer a wider range of Medium Voltage fuses than any other manufacturer and types are available to meet most service applications. With over 50 years' experience in design and manufacture, Cooper Bussmann have supplied fuse-links to more than 90 countries world-wide.

Cooper Bussmann Medium Voltage fuse-links are extremely effective in preventing damage to a system in the event of a fault, due to considerable limitation of let-through current in DIN and British Standard designs to the latest IEC requirements.

Cooper Bussmann are pioneers in the development of Full Range Medium Voltage fuse-links and is consequently the market leader in this field offering genuine full range characteristics.

Cooper Bussmann team of specialist engineers play a leading role in international standardisation of Medium Voltage fuses, offering a comprehensive service of advice on selection and applications.

With a continual commitment to meet customers' needs, with innovative, high quality products with ISO9002 'approved systems', Cooper Bussmann are the suppliers choice for Medium Voltage Circuit Protection Solutions.

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# Boric Acid Fuses

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# Medium Voltage Boric Acid Fuses

## Introduction

The Cooper Bussmann® BBU medium voltage Boric Acid fuse-link and complementary fuse mount or cut-out package is an expulsion fuse-link style fuse, complete with a single pole porcelain fuse-mount offering medium voltage protection for indoor and outdoor applications.

The fuse mount is available at either 17 or 27 kV and is designed to withstand the most hazardous environmental conditions. The contact system is made from a copper alloy ensuring a long service life in the field.

The fuse mount already has the outdoor fittings, so simply adding a Cooper Bussmann® BBU fuse-link will deliver a complete outdoor transformer protection solution.

The Cooper Bussmann® range of BBU fuse-links can be used **indoors** as well as **outdoors**. A muffler attachment can be ordered to limit noise and contamination to **indoor** equipment during operation.

BBUs fuse-links are designed to be interchangeable with other leading manufacturers and are available from 17 kV through to 38 kV, from 3 to 200 amps, with K, E and SE time-current characteristics.

The Boric Acid fuse-link employs calibrated silver elements combined with boric acid crystals for its interruption media. The mechanical utilization of the spring and road mechanism creates an interruption technique that offers mild exhaustion during fault interruption.

Boric Acid fuse-links are ideally suited to provide distribution transformer protection within electrical distribution networks.

## Features of BBU Fuse-Links

**A complete distribution transformer package from a single source** – Cooper Bussmann® offers a single source for all of your protection needs; both fuse-link and fuse mount are **fully interchangeable** with other manufacturers product lines. Additionally, customers can benefit from access to Cooper Bussmann® other protection products in medium and low voltage delivering effective vendor based reduction, lowering procurement costs.

**Sealed fuse-links** – All BBU fuse-links are sealed from moisture ingress, preventing deterioration of performance in the field and **improving overall network reliability** while reducing costs.

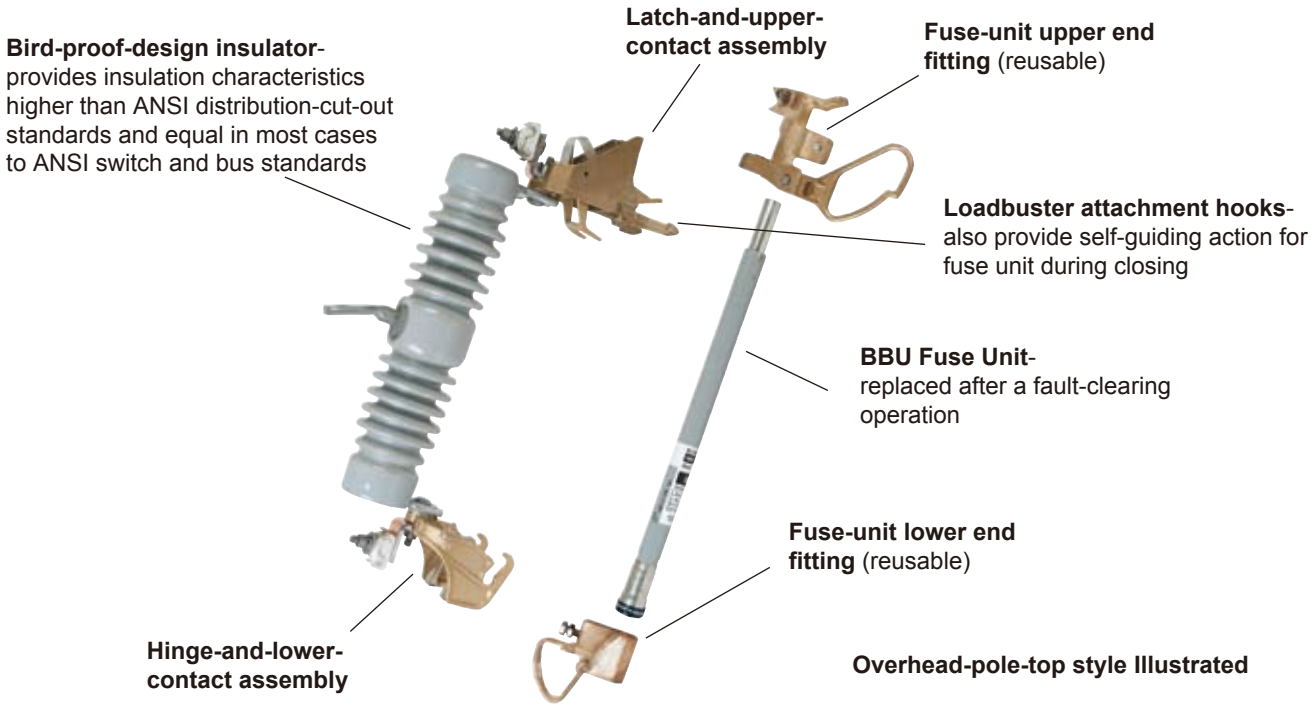
**Fully tested** – Cooper Bussmann® BBU fuse-links are tested to both ANSI C.37 and the Australian standard AS1033.1, which due to Australia's unique landscape and harsh climate, is widely regarded as the most onerous type test of expulsion fuse-link style protection in the world today.

**Single piece end fittings** – The Cooper Bussmann® fuse-link package comes with single piece end fittings, **reducing set-up time** in the field and lowering inventory, thereby **improving network productivity**.

**Single wrench installation** – the fuse-links are designed to be installed with a single type of tool, again **reducing maintenance**, replacement and installation costs

Other features to improve safety and overall reliability include the use of a **Nichrome strain element**, to reduce susceptibility to spurious operation in the field caused by vibration and corona, a glass epoxy tube, preventing warping during long time exposure and permanent date marking facilitating a more robust Operation & Maintenance regime.

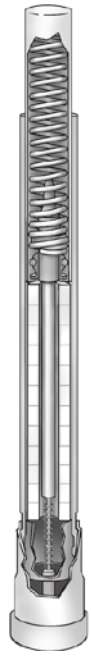
## BBU Fuse Mount




**Overhead-pole-top style Illustrated**

Principle parts of the replaceable BBU fuse unit are shown in the cross section view. Main operating parts are the silver element, arcing rod, boric acid cylinder and spring. A glass epoxy tube encloses the assembly.

The use of a pure silver element and Nichrome wire strain element makes the BBU less susceptible to outages caused by vibration, corona corrosion, and aging of the fuse elements. It is not damaged by transient faults or overloads which approach the minimum melt point.



## BBU Fuse Construction

The components are housed in a fiberglass reinforced resin tube with plated copper contacts. Positive connection is maintained between the arcing rod and contact with a sliding tulip contact.

## Operation

BBU expulsion fuse-links utilize the proven performance of boric acid to create the de-ionizing action needed to interrupt the current. Fault interruption is achieved by the action of an arcing rod and a charged spring, elongating the arc through a boric acid chamber upon release by the fuse element.

At high temperatures, boric acid decomposes producing a blast of water vapor and inert boric anhydride. Electrical interruption is caused by the steam extinguishing the arc, as the arc is being elongated through the cylinder.

Higher particle turbulence of the boric acid causes the rate of de-ionization in the cylinder to exceed the ionization of the electrical arc. Both high and low current faults are interrupted in the same manner with no foreign material other than the boric acid required. This enables the fuse to interrupt short circuits within one-half cycle and prevents the arc from restriking after a current zero.

After interruption, the gases are expelled from the bottom of the fuse.

The arching rod is prevented from falling back into its original position by a friction stop at the top of the fuse unit.

When the fuse operates, the upward motion of the spring forces the top ofthe arcing rod to penetrate the upperseal, striking the latch mechanism.

On indoor applications, this action caused the blown fuse indicator to actuate.

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

Element Melts

Rod withdraws, elongating arc and vaporizing Boric Acid

Vapor quenches arc at first current zero

## Application

The BBU Boric acid Fuse provides effective protection for circuits and equipment which operate on voltage systems up to 34,500V. They can be used on industrial distribution systems and all fuses are designed for use on the following:

- Power Transformers
- Feeder Circuits
- Distribution Transformers
- Metal-enclosed Switchgear
- Pad Mount Switches

**BBU Fuse units can be used in indoor applications, and can be used to directly replace competitive equivalent units.**

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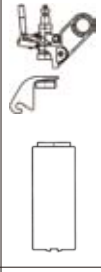
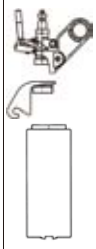
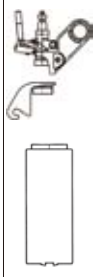
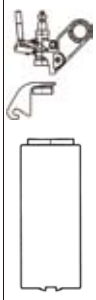
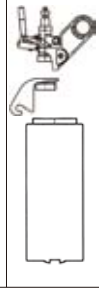
## Catalogue Numbers

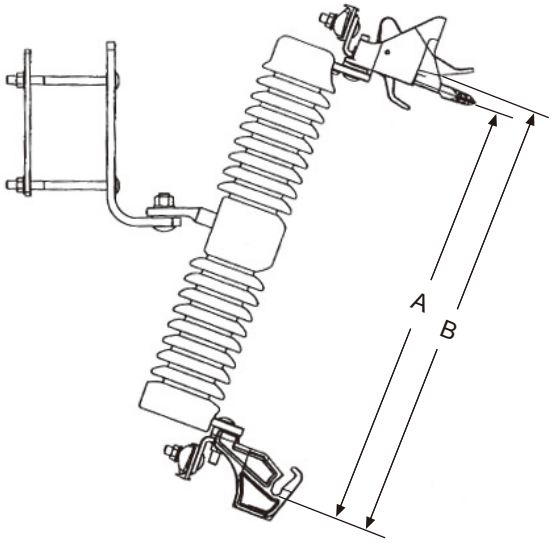
| Amps | Fuse Type | Voltage (kV) | Catalog Number | Max. Int. kA Sym | Indoor | | |
|---|---|---|---|---|---|---|---|
| | | | | | End Fittings | Catalog Number | Ampere Rating |
| 3 | K | 17 | BBU17-3K | 14 |  | BBU-EFID | 3K to 200K |
| 6 | K | 17 | BBU17-6K | | | | |
| 8 | K | 17 | BBU17-8K | | | | |
| 10 | K | 17 | BBU17-10K | | | | |
| 12 | K | 17 | BBU17-12K | | | | |
| 15 | K | 17 | BBU17-15K | | | | |
| 20 | K | 17 | BBU17-20K | | | | |
| 25 | K | 17 | BBU17-25K | | | | |
| 30 | K | 17 | BBU17-30K | | | | |
| 40 | K | 17 | BBU17-40K | | | | |
| 50 | K | 17 | BBU17-50K | | | | |
| 65 | K | 17 | BBU17-65K | | | | |
| 80 | K | 17 | BBU17-80K | | | | |
| 100 | K | 17 | BBU17-100K | | | | |
| 140 | K | 17 | BBU17-140K | | | | |
| 200 | K | 17 | BBU17-200K | | | | |
| 5 | E | 17 | BBU17-5E | 4 |  | BBU-EFID | 5E to 200E |
| 7 | E | 17 | BBU17-7E | | | | |
| 10 | E | 17 | BBU17-10E | | | | |
| 13 | E | 17 | BBU17-13E | | | | |
| 15 | E | 17 | BBU17-15E | | | | |
| 20 | E | 17 | BBU17-20E | | | | |
| 25 | E | 17 | BBU17-25E | | | | |
| 30 | E | 17 | BBU17-30E | | | | |
| 40 | E | 17 | BBU17-40E | | | | |
| 50 | E | 17 | BBU17-50E | | | | |
| 65 | E | 17 | BBU17-65E | | | | |
| 80 | E | 17 | BBU17-80E | | | | |
| 100 | E | 17 | BBU17-100E | | | | |
| 125 | E | 17 | BBU17-125E | | | | |
| 150 | E | 17 | BBU17-150E | | | | |
| 175 | E | 17 | BBU17-175E | | | | |
| 200 | E | 17 | BBU17-200E | | | | |
| 15 | SE | 17 | BBU17-15SE | 14 |  | BBU-EFID | 15SE to 200SE |
| 20 | SE | 17 | BBU17-20SE | | | | |
| 25 | SE | 17 | BBU17-25SE | | | | |
| 30 | SE | 17 | BBU17-30SE | | | | |
| 40 | SE | 17 | BBU17-40SE | | | | |
| 50 | SE | 17 | BBU17-50SE | | | | |
| 65 | SE | 17 | BBU17-65SE | | | | |
| 80 | SE | 17 | BBU17-80SE | | | | |
| 100 | SE | 17 | BBU17-100SE | | | | |
| 125 | SE | 17 | BBU17-125SE | | | | |
| 150 | SE | 17 | BBU17-150SE | | | | |
| 175 | SE | 17 | BBU17-175SE | | | | |
| 200 | SE | 17 | BBU17-200SE | | | | |
| 3 | K | 27 | BBU27-3K | 12.5 |  | BBU-EFID | 3K to 200K |
| 6 | K | 27 | BBU27-6K | | | | |
| 8 | K | 27 | BBU27-8K | | | | |
| 10 | K | 27 | BBU27-10K | | | | |
| 12 | K | 27 | BBU27-12K | | | | |
| 15 | K | 27 | BBU27-15K | | | | |
| 20 | K | 27 | BBU27-20K | | | | |
| 25 | K | 27 | BBU27-25K | | | | |
| 30 | K | 27 | BBU27-30K | | | | |
| 40 | K | 27 | BBU27-40K | | | | |
| 50 | K | 27 | BBU27-50K | | | | |
| 65 | K | 27 | BBU27-65K | | | | |
| 80 | K | 27 | BBU27-80K | | | | |
| 100 | K | 27 | BBU27-100K | | | | |
| 140 | K | 27 | BBU27-140K | | | | |
| 200 | K | 27 | BBU27-200K | | | | |
| 5 | E | 27 | BBU27-5E | 12.5 |  | BBU-EFID | 5E to 200E |
| 7 | E | 27 | BBU27-7E | | | | |
| 10 | E | 27 | BBU27-10E | | | | |
| 13 | E | 27 | BBU27-13E | | | | |
| 15 | E | 27 | BBU27-15E | | | | |
| 20 | E | 27 | BBU27-20E | | | | |
| 25 | E | 27 | BBU27-25E | | | | |
| 30 | E | 27 | BBU27-30E | | | | |
| 40 | E | 27 | BBU27-40E | | | | |

| Amps | Fuse Type | Voltage (kV) | Catalog Number | Max. Int. kA Sym | Indoor | | |
|---|---|---|---|---|---|---|---|
| | | | | | End Fittings | Catalog Number | Ampere Rating |
| 50 | E | 27 | BBU27-50E | 12.5 |  | BBU-EFID | 5E to 200E |
| 65 | E | 27 | BBU27-65E | | | | |
| 80 | E | 27 | BBU27-80E | | | | |
| 100 | E | 27 | BBU27-100E | | | | |
| 125 | E | 27 | BBU27-125E | | | | |
| 150 | E | 27 | BBU27-150E | | | | |
| 175 | E | 27 | BBU27-175E | | | | |
| 200 | E | 27 | BBU27-200E | | | | |
| 15 | SE | 27 | BBU27-15SE | 12.5 |  | BBU-EFID | 15SE to 200SE |
| 20 | SE | 27 | BBU27-20SE | | | | |
| 25 | SE | 27 | BBU27-25SE | | | | |
| 30 | SE | 27 | BBU27-30SE | | | | |
| 40 | SE | 27 | BBU27-40SE | | | | |
| 50 | SE | 27 | BBU27-50SE | | | | |
| 65 | SE | 27 | BBU27-65SE | | | | |
| 80 | SE | 27 | BBU27-80SE | | | | |
| 100 | SE | 27 | BBU27-100SE | | | | |
| 125 | SE | 27 | BBU27-125SE | | | | |
| 150 | SE | 27 | BBU27-150SE | | | | |
| 175 | SE | 27 | BBU27-175SE | | | | |
| 200 | SE | 27 | BBU27-200SE | | | | |
| 3 | K | 38 | BBU38-3K | 10 |  | BBU-EFID | 3K to 200K |
| 6 | K | 38 | BBU38-6K | | | | |
| 8 | K | 38 | BBU38-8K | | | | |
| 10 | K | 38 | BBU38-10K | | | | |
| 12 | K | 38 | BBU38-12K | | | | |
| 15 | K | 38 | BBU38-15K | | | | |
| 20 | K | 38 | BBU38-20K | | | | |
| 30 | K | 38 | BBU38-30K | | | | |
| 40 | K | 38 | BBU38-40K | | | | |
| 50 | K | 38 | BBU38-50K | | | | |
| 65 | K | 38 | BBU38-65K | | | | |
| 80 | K | 38 | BBU38-80K | | | | |
| 100 | K | 38 | BBU38-100K | | | | |
| 140 | K | 38 | BBU38-140K | | | | |
| 200 | K | 38 | BBU38-200K | | | | |
| 5 | E | 38 | BBU38-5E | 10 |  | BBU-EFID | 5E to 200E |
| 7 | E | 38 | BBU38-7E | | | | |
| 10 | E | 38 | BBU38-10E | | | | |
| 13 | E | 38 | BBU38-13E | | | | |
| 15 | E | 38 | BBU38-15E | | | | |
| 20 | E | 38 | BBU38-20E | | | | |
| 25 | E | 38 | BBU38-25E | | | | |
| 30 | E | 38 | BBU38-30E | | | | |
| 40 | E | 38 | BBU38-40E | | | | |
| 50 | E | 38 | BBU38-50E | | | | |
| 65 | E | 38 | BBU38-65E | | | | |
| 80 | E | 38 | BBU38-80E | | | | |
| 100 | E | 38 | BBU38-100E | | | | |
| 125 | E | 38 | BBU38-125E | | | | |
| 150 | E | 38 | BBU38-150E | | | | |
| 175 | E | 38 | BBU38-175E | | | | |
| 200 | E | 38 | BBU38-200E | | | | |
| 15 | SE | 38 | BBU38-15SE | 10 |  | BBU-EFID | 15SE to 200SE |
| 20 | SE | 38 | BBU38-20SE | | | | |
| 25 | SE | 38 | BBU38-25SE | | | | |
| 30 | SE | 38 | BBU38-30SE | | | | |
| 40 | SE | 38 | BBU38-40SE | | | | |
| 50 | SE | 38 | BBU38-50SE | | | | |
| 65 | SE | 38 | BBU38-65SE | | | | |
| 80 | SE | 38 | BBU38-80SE | | | | |
| 100 | SE | 38 | BBU38-100SE | | | | |
| 125 | SE | 38 | BBU38-125SE | | | | |
| 150 | SE | 38 | BBU38-150SE | | | | |
| 175 | SE | 38 | BBU38-175SE | | | | |
| 200 | SE | 38 | BBU38-200SE | | | | |

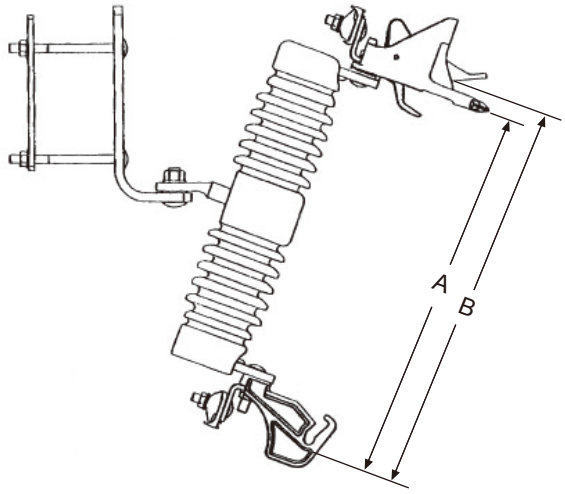
*Note: Muffler can be ordered separately for indoor use. Order Catalogue Number BBU-MFLR

## Outdoor BBU Mount

**BBU27-PDM**



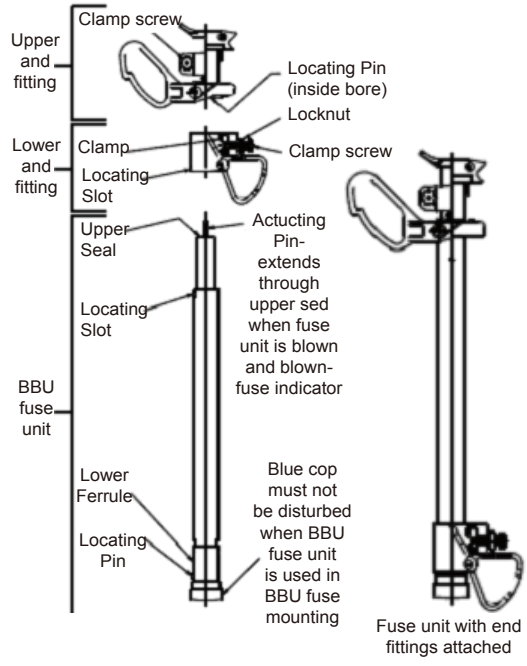

**BBU17-PDM**




| Outdoor mount catalogue number | 1Min high voltage withstand test KV | Total insulator length inches(mm) | A inches (mm) | B inches (mm) | Approximate weight(kg) |
|---|---|---|---|---|---|
| BBU27-PDM | 42 | 18.3(465) | 20.4 (516.9) | 21.0 (534) | 20 |
| BBU17-PDM | 35 | 14.8(375) | 16.8 (426.9) | 17.5 (444) | 17.5 |

## Outdoor BBU Fuse Fitting

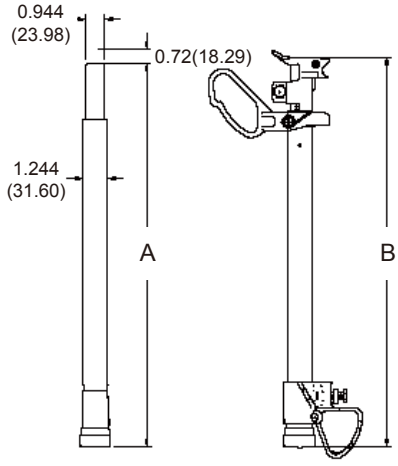
Outdoor end fittings are made of a cast-copper plated alloy. A large hook eye on the upper fitting allows for easy installation into pole-top mountings with a hook stick. The pivotal design of this hook eye provides for proper engagement of the upper live part. The positive locking action of the latch mechanism prevents detachment from the mounting due to shock or vibration. In the event of a fault, the arcing rod will penetrate through 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 a blown-fuse condition. The lower end fitting has two cylindrical posts that insert into the lower live part of the mounting. These posts allow the fuse to rotate into the proper engaged position, and suspend the fuse during a blown, drop-out condition.






For product data sheets, visit www.cooperbussmann.com/2/DataSheets.html

## Fuse Dimensions




| Fuse Unit Fittings Inches(mm) | |
|---|---|
| A | B |
| 19.08(484.63) | 19.41(493.01) |
| 22.58(573.53) | 22.91(581.91) |
| 28.76(730.50) | 29.29(743.97) |

## Installation

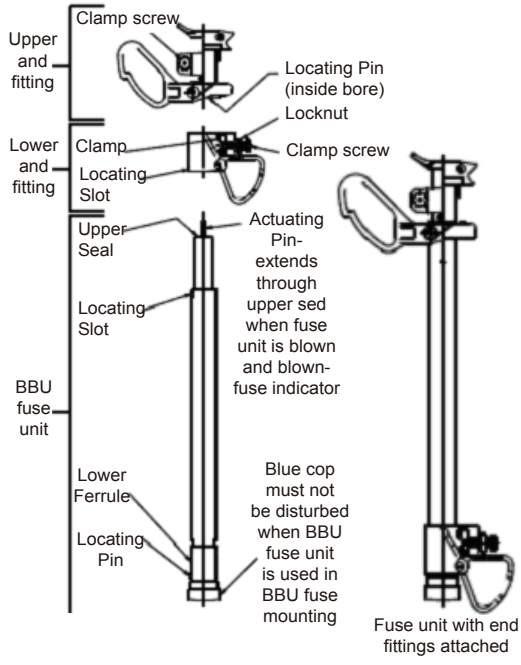
### Replacement (Refusing) in Outdoor Mountings

A. When the fuse operates, the fuse unit swings to the open position. Remove it from the mounting, using a universal pole equipped with a suitable fuse handling attachment. Examine the end of the fuse unit to determine that the actuating pin extends through the upper seal, indicating that the fuse unit has operated.

B. Loosen the upper and lower end fitting clamp screws (pry the upper end fitting clamp apart slightly with a screw driver), and slide both end fittings off the upper end of the fuse unit.

C. Next, attach the end fittings to a new fuse unit, following the instructions given above. A fuse unit that has operated cannot be salvaged. Discard it.

D. To avoid delay due to transferring of end fittings, spare sets of end fittings may be kept on hand for attachment to new fuse units immediately before refusing is to be performed.




### Unused Fuse-Unit End Fittings

A coating of oxidation-inhibiting grease was applied to the contact rod at the factory. Verify the presence of this oxidation inhibiting grease, and that it is still free of (from) contaminants. If necessary, clean the contact rod with a nontoxic, nonflammable solvent and apply a coating of oxidation-inhibiting grease. End Fittings should be stored in the original shipping package (if possible) in an area free from excessive moisture. End Fitting should only be attached immediately prior to installation.

### Re-used Fuse-Unit End Fittings

Remove the existing coating of oxidation-inhibiting grease, and any dirt from the contact rod using a nontoxic, nonflammable solvent. Inspect the contact rod for evidence of pitting. If pitting has occurred, file down any projections, abrade the surface, until smooth with an abrasive cloth or scratch brush, and wipe clean. Apply a new coating of oxidation-inhibiting grease, to the contact rod. If the contact has been burned, the contact and its mating part should be replaced.

## BBU Boric Acid Fuse-Application Notes

The BBU Fuse will provide effective protection for circuits and equipment which operates on voltages from 2,400 Volts through 34,500 Volts.

A spring-loaded arcing rod carries the normal continuous current through the unit when the circuit is operational. Under normal conditions, the fusible element's temperature is below its melting temperature and does not melt. When a fault occurs that is large enough to melt the fuse element, an arc is initiated and elongated by the units spring, pulling the arcing rod up into the boric acid interrupting media. The heat produced decomposes the boric acid liner inside producing water vapor and boric anhydride which helps to de-ionize the arc. The by-products extinguish the arc at a natural current zero by blasting through it and exiting out of the bottom of the fuse. When installed indoors, the exhaust and noise produced during the interruption process are limited by the muffler attached to the lower end fitting. The BBU fuse unit is then discarded, and replaced with a new unit, re-using the end fittings if undamaged.

This assembly is then re-engaged into the live parts and mounting. Although the process is more involved than just described, this should provide a general understanding of how the BBU Power Fuse works to provide outstanding and economical protection with limited down time.

During the interrupting process, current continues to flow in the circuit and in the fuse until a current zero is reached. When the arc is stopped at current zero, the voltage will attempt to re-ignite the arc. The voltage across the fuse terminals builds dramatically and is referred to as the Transient Recovery Voltage (TRV). The TRV is the most severe waveform the fuse will have to withstand. This voltage build-up puts a great deal of potentially destructive force on the fuse units and the system in total. Whether or not extinguishing of the arc is successful depends, in general, on the dielectric strength between the fuse terminals. In short, the dielectric strength between the fuse terminals must be greater than the voltage trying to re-ignite the arc for a successful interruption to occur. When properly applied, the BBU Power Fuse has a dielectric recovery that is greater than the TRV, regardless of the fault current. (Refer to Table 1)

The maximum voltage rating of the BBU fuse is the highest rms voltage at which the fuse is designed to operate. Its dielectric withstand level corresponds to insulation levels of power class equipment, thus the name "power fuse". Maximum voltage ratings for BBU Power Fuses are: 17KV, 27KV, and 38KV. The BBU has interrupting capabilities from 10,000 to 14,000 amperes symmetrical.

The continuous current rating of a BBU Power Fuse should equal or exceed the maximum load current where the fuse is applied. They are designed to carry their rated continuous current without exceeding the temperature rise outlined in NEMA and ANSI standards.

The BBU is available with continuous current ratings up to 200 amperes. The current ratings carry an "E" designation as defined by ANSI and NEMA. For example, the current responsive element rated 100E amperes or below shall melt in 300 seconds at an rms current within the range of 200 to 240 percent of the continuous current ratings. Above 100E amperes, melting takes place in 600 seconds at an rms current within the range of 220 to 264 percent of the continuous current rating. Slow "E" and "K" speeds are also available

Table 1: TRV Characteristics

| | Primary Faults | | | Secondary Faults | | |
|---|---|---|---|---|---|---|
| Fuse Rating kV Normal | Test Circuit Normal Frequency Recovery Voltage kV rms | TRV Natural Frequency Kc | TRV Amplitude Factor | Test Circuit Normal Frequency Recovery Voltage kV rms38 | TRV Natural Frequency Kc | TRV Amplitude Factor |
| 14.4<br>25<br>34.5 | 17.1<br>27<br>38 | 5.5<br>5.5<br>3.9 | 1.6<br>1.6<br>1.6 | 14.4<br>27<br>38 | 17<br>13<br>6.5 | 1.7<br>1.7<br>1.7 |

Table 2: BBU Power Fuse Short-Circuit Interrupting Ratings

| kV,Nominal | | Amperes,Interrupting (RMS) | | MVA,Interrupting (Three-phase symmetrical) |
|---|---|---|---|---|
| BBU | System | Symmetrical based on X/R = 15 | Asymmetrical | Where X/R= 15 |
| 17 | 7.2<br>4.8/ 8.32Y<br>7.2/ 12.47Y<br>7.62/ 13.2Y<br>13.8<br>14.4<br>16.5 | 14000 | 22400 | 175<br>200<br>300<br>320<br>335<br>350<br>400 |
| 27 | 7.2/ 12.47Y<br>7.62/ 13.2Y<br>13.8<br>14.4<br>16.5<br>23.0<br>14.4/ 24.9Y<br>20/ 34.5Y1 | 12500 | 20000 | 270<br>285<br>300<br>310<br>365<br>500<br>540<br>... |
| 38 | 23.0<br>14.4/ 24.9Y<br>27.6<br>20/ 34.5Y<br>34.5 | 10000 | 16000 | ...<br>...<br>475<br>600<br>600 |

1 Applies to 23kV Single-Insulator Style only,for Protection of single-phase-to-neutral circuits (line or transformers) and three phase transformers or banks with solidly grounded neutral connections.

## Coordination Consideration

Coordination considerations must be made to help determine what type of fuse is applied. The BBU Power Fuse interrupts at a natural current zero in the current wave and allows a minimum of a half cycle of fault current to flow before the fault is cleared. The time-current characteristics associated with a BBU has a rather gradual slope making it easier to coordinate with downstream equipment. In addition, the BBU is ideal for higher voltage (up to 38 kV) and high current applications (thru 200 Amps). 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 BBU Power Fuse is offered in 3 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 BBU 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.

## Cross-reference Charts

| Cooper Bussmann® BBU 17kV-38kV Comparison to S & C SM-20 & SMD-20 | | | | | | |
|---|---|---|---|---|---|---|
| New “BBU” End Fittings | Description | Style | kV Maximum | kV Nominal | S & C Catalogue | Cooper Bussmann® Catalogue |
|  | End Fitting with Muffler | Indoor | 17kV-38kV | 14.4kV-34.5kv | 3097 | BBU-EFID |
|   | Muffler Only | Indoor Only | 17kV-38kV | 14.4kV-34.5kV | FA-104675 | BBU-MFLR |

| Cooper Bussmann® BBU 17kV Comparison to S & C SMU | | | | | |
|---|---|---|---|---|---|
| Ampere Rating | kV Maximum | kV Nominal | Fuse Speed | S & C Catalogue | Cooper Bussmann® |
| 3K | 17kV | 14.4kV | Standard | 702003 | BBU17-3K |
| 6K | 17kV | 14.4kV | Standard | 702006 | BBU17-6K |
| 8K | 17kV | 14.4kV | Standard | 702008 | BBU17-8K |
| 10K | 17kV | 14.4kV | Standard | 702010 | BBU17-10K |
| 12K | 17kV | 14.4kV | Standard | 702012 | BBU17-12K |
| 15K | 17kV | 14.4kV | Standard | 702015 | BBU17-15K |
| 20K | 17kV | 14.4kV | Standard | 702020 | BBU17-20K |
| 25K | 17kV | 14.4kV | Standard | 702025 | BBU17-25K |
| 30K | 17kV | 14.4kV | Standard | 702030 | BBU17-30K |
| 40K | 17kV | 14.4kV | Standard | 702040 | BBU17-40K |
| 50K | 17kV | 14.4kV | Standard | 702050 | BBU17-50K |
| 65K | 17kV | 14.4kV | Standard | 702065 | BBU17-65K |
| 80K | 17kV | 14.4kV | Standard | 702080 | BBU17-80K |
| 100K | 17kV | 14.4kV | Standard | 702100 | BBU17-100K |
| 140K | 17kV | 14.4kV | Standard | 702140 | BBU17-140K |
| 200K | 17kV | 14.4kV | Standard | 702200 | BBU17-200K |
| 5E | 17kV | 14.4kV | Standard | 612005 | BBU17-5E |
| 7E | 17kV | 14.4kV | Standard | 612007 | BBU17-7E |
| 10E | 17kV | 14.4kV | Standard | 612010 | BBU17-10E |
| 13E | 17kV | 14.4kV | Standard | 612013 | BBU17-13E |
| 15E | 17kV | 14.4kV | Standard | 612015 | BBU17-15E |
| 20E | 17kV | 14.4kV | Standard | 612020 | BBU17-20E |
| 25E | 17kV | 14.4kV | Standard | 612025 | BBU17-25E |
| 30E | 17kV | 14.4kV | Standard | 612030 | BBU17-30E |
| 40E | 17kV | 14.4kV | Standard | 612040 | BBU17-40E |
| 50E | 17kV | 14.4kV | Standard | 612050 | BBU17-50E |
| 65E | 17kV | 14.4kV | Standard | 612065 | BBU17-65E |
| 80E | 17kV | 14.4kV | Standard | 612080 | BBU17-80E |
| 100E | 17kV | 14.4kV | Standard | 612100 | BBU17-100E |
| 125E | 17kV | 14.4kV | Standard | 612101 | BBU17-125E |
| 150E | 17kV | 14.4kV | Standard | 612150 | BBU17-150E |
| 175E | 17kV | 14.4kV | Standard | 612175 | BBU17-175E |
| 200E | 17kV | 14.4kV | Standard | 612200 | BBU17-200E |
| 15E | 17kV | 14.4kV | Slow | 712015 | BBU17-15SE |
| 20E | 17kV | 14.4kV | Slow | 712020 | BBU17-20SE |
| 25E | 17kV | 14.4kV | Slow | 712025 | BBU17-25SE |
| 30E | 17kV | 14.4kV | Slow | 712030 | BBU17-30SE |
| 40E | 17kV | 14.4kV | Slow | 712040 | BBU17-40SE |
| 50E | 17kV | 14.4kV | Slow | 712050 | BBU17-50SE |
| 65E | 17kV | 14.4kV | Slow | 712065 | BBU17-65SE |
| 80E | 17kV | 14.4kV | Slow | 712080 | BBU17-80SE |
| 100E | 17kV | 14.4kV | Slow | 712100 | BBU17-100SE |
| 125E | 17kV | 14.4kV | Slow | 712125 | BBU17-125SE |
| 150E | 17kV | 14.4kV | Slow | 712150 | BBU17-150SE |
| 175E | 17kV | 14.4kV | Slow | 712175 | BBU17-175SE |
| 200E | 17kV | 14.4kV | Slow | 712200 | BBU17-200SE |

| Cooper Bussmann® BBU 27kV Comparison to S & C SMU | | | | | |
|---|---|---|---|---|---|
| Ampere Rating | kV Maximum | kV Nominal | Fuse Speed | S & C Catalogue | Cooper Bussmann® Catalogue |
| 3K | 27kV | 24.5kV | Standard | 703003 | BBU27-3K |
| 6K | 27kV | 24.5kV | Standard | 703006 | BBU27-6K |
| 8K | 27kV | 24.5kV | Standard | 703008 | BBU27-8K |
| 10K | 27kV | 24.5kV | Standard | 703010 | BBU27-10K |
| 12K | 27kV | 24.5kV | Standard | 703012 | BBU27-12K |
| 15K | 27kV | 24.5kV | Standard | 703015 | BBU27-15K |
| 20K | 27kV | 24.5kV | Standard | 703020 | BBU27-20K |
| 25K | 27kV | 24.5kV | Standard | 703025 | BBU27-25K |
| 30K | 27kV | 24.5kV | Standard | 703030 | BBU27-30K |
| 40K | 27kV | 24.5kV | Standard | 703040 | BBU27-40K |
| 50K | 27kV | 24.5kV | Standard | 703050 | BBU27-50K |
| 65K | 27kV | 24.5kV | Standard | 703065 | BBU27-65K |
| 80K | 27kV | 24.5kV | Standard | 703080 | BBU27-80K |
| 100K | 27kV | 24.5kV | Standard | 703100 | BBU27-100K |
| 140K | 27kV | 24.5kV | Standard | 703140 | BBU27-140K |
| 200K | 27kV | 24.5kV | Standard | 703200 | BBU27-200K |
| 5E | 27kV | 24.5kV | Standard | 613005 | BBU27-5E |
| 7E | 27kV | 24.5kV | Standard | 613007 | BBU27-7E |
| 10E | 27kV | 24.5kV | Standard | 613010 | BBU27-10E |
| 13E | 27kV | 24.5kV | Standard | 613013 | BBU27-13E |
| 15E | 27kV | 24.5kV | Standard | 613015 | BBU27-15E |
| 20E | 27kV | 24.5kV | Standard | 613020 | BBU27-20E |
| 25E | 27kV | 24.5kV | Standard | 613025 | BBU27-25E |
| 30E | 27kV | 24.5kV | Standard | 613030 | BBU27-30E |
| 40E | 27kV | 24.5kV | Standard | 613040 | BBU27-40E |
| 50E | 27kV | 24.5kV | Standard | 613050 | BBU27-50E |
| 65E | 27kV | 24.5kV | Standard | 613065 | BBU27-65E |
| 80E | 27kV | 24.5kV | Standard | 613080 | BBU27-80E |
| 100E | 27kV | 24.5kV | Standard | 613100 | BBU27-100E |
| 125E | 27kV | 24.5kV | Standard | 613101 | BBU27-125E |
| 150E | 27kV | 24.5kV | Standard | 613150 | BBU27-150E |
| 175E | 27kV | 24.5kV | Standard | 613175 | BBU27-175E |
| 200E | 27kV | 24.5kV | Standard | 613200 | BBU27-200E |
| 15E | 27kV | 24.5kV | Slow | 713015 | BBU27-15SE |
| 20E | 27kV | 24.5kV | Slow | 713020 | BBU27-20SE |
| 25E | 27kV | 24.5kV | Slow | 713025 | BBU27-25SE |
| 30E | 27kV | 24.5kV | Slow | 713030 | BBU27-30SE |
| 40E | 27kV | 24.5kV | Slow | 713040 | BBU27-40SE |
| 50E | 27kV | 24.5kV | Slow | 713050 | BBU27-50SE |
| 65E | 27kV | 24.5kV | Slow | 713065 | BBU27-65SE |
| 80E | 27kV | 24.5kV | Slow | 713080 | BBU27-80SE |
| 100E | 27kV | 24.5kV | Slow | 713100 | BBU27-100SE |
| 125E | 27kV | 24.5kV | Slow | 713125 | BBU27-125SE |
| 150E | 27kV | 24.5kV | Slow | 713150 | BBU27-150SE |
| 175E | 27kV | 24.5kV | Slow | 713175 | BBU27-175SE |
| 200E | 27kV | 24.5kV | Slow | 713200 | BBU27-200SE |

| Cooper Bussmann® BBU 38kV Comparison to S & C SMU | | | | | |
|---|---|---|---|---|---|
| Ampere Rating | kV Maximum | kV Nominal | Fuse Speed | S & C Catalogue | Cooper Bussmann® Catalogue |
| 3K | 38kV | 34.5kV | Standard | 704003 | BBU38-3K |
| 6K | 38kV | 34.5kV | Standard | 704006 | BBU38-6K |
| 8K | 38kV | 34.5kV | Standard | 704008 | BBU38-8K |
| 10K | 38kV | 34.5kV | Standard | 704010 | BBU38-10K |
| 12K | 38kV | 34.5kV | Standard | 704012 | BBU38-12K |
| 15K | 38kV | 34.5kV | Standard | 704015 | BBU38-15K |
| 20K | 38kV | 34.5kV | Standard | 704020 | BBU38-20K |
| 25K | 38kV | 34.5kV | Standard | 704025 | BBU38-25K |
| 30K | 38kV | 34.5kV | Standard | 704030 | BBU38-30K |
| 40K | 38kV | 34.5kV | Standard | 704040 | BBU38-40K |
| 50K | 38kV | 34.5kV | Standard | 704050 | BBU38-50K |
| 65K | 38kV | 34.5kV | Standard | 704065 | BBU38-65K |
| 80K | 38kV | 34.5kV | Standard | 704080 | BBU38-80K |
| 100K | 38kV | 34.5kV | Standard | 704100 | BBU38-100K |
| 140K | 38kV | 34.5kV | Standard | 704140 | BBU38-140K |
| 200K | 38kV | 34.5kV | Standard | 704200 | BBU38-200K |
| 5E | 38kV | 34.5kV | Standard | 614005 | BBU38-5E |
| 7E | 38kV | 34.5kV | Standard | 614007 | BBU38-7E |
| 10E | 38kV | 34.5kV | Standard | 614010 | BBU38-10E |
| 13E | 38kV | 34.5kV | Standard | 614013 | BBU38-13E |
| 15E | 38kV | 34.5kV | Standard | 614015 | BBU38-15E |
| 20E | 38kV | 34.5kV | Standard | 614020 | BBU38-20E |
| 25E | 38kV | 34.5kV | Standard | 614025 | BBU38-25E |
| 30E | 38kV | 34.5kV | Standard | 614030 | BBU38-30E |
| 40E | 38kV | 34.5kV | Standard | 614040 | BBU38-40E |
| 50E | 38kV | 34.5kV | Standard | 614050 | BBU38-50E |
| 65E | 38kV | 34.5kV | Standard | 614065 | BBU38-65E |
| 80E | 38kV | 34.5kV | Standard | 614080 | BBU38-80E |
| 100E | 38kV | 34.5kV | Standard | 614100 | BBU38-100E |
| 125E | 38kV | 34.5kV | Standard | 614101 | BBU38-125E |
| 150E | 38kV | 34.5kV | Standard | 614150 | BBU38-150E |
| 175E | 38kV | 34.5kV | Standard | 614175 | BBU38-175E |
| 200E | 38kV | 34.5kV | Standard | 614200 | BBU38-200E |
| 15E | 38kV | 34.5kV | Slow | 714015 | BBU38-15SE |
| 20E | 38kV | 34.5kV | Slow | 714020 | BBU38-20SE |
| 25E | 38kV | 34.5kV | Slow | 714025 | BBU38-25SE |
| 30E | 38kV | 34.5kV | Slow | 714030 | BBU38-30SE |
| 40E | 38kV | 34.5kV | Slow | 714040 | BBU38-40SE |
| 50E | 38kV | 34.5kV | Slow | 714050 | BBU38-50SE |
| 65E | 38kV | 34.5kV | Slow | 714065 | BBU38-65SE |
| 80E | 38kV | 34.5kV | Slow | 714080 | BBU38-80SE |
| 100E | 38kV | 34.5kV | Slow | 714100 | BBU38-100SE |
| 125E | 38kV | 34.5kV | Slow | 714125 | BBU38-125SE |
| 150E | 38kV | 34.5kV | Slow | 714150 | BBU38-150SE |
| 175E | 38kV | 34.5kV | Slow | 714175 | BBU38-175SE |
| 200E | 38kV | 34.5kV | Slow | 714200 | BBU38-200SE |

# Testing and Performance

## Standards

Cooper Bussmann 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. Type BBU Power Fuses are designed and tested for compliance to global standards such as ANSI and Australian Standard AS1033.1 1990. ANSI (American National Standards Institute) is a nonprofit, privately funded membership organization that coordinates the development of U.S. voluntary national standards.

These standards are designed to test the performance of the equipment under a variety of performance criteria as outlined in the relevant publication. These tests verify the fuse-link performance under high short circuit currents.

A problem of major significance for countries with a hot dry climate, such as Australia, is the ignition of ground fires as a result of the emission of incandescent particles from expulsion fuse-links. Tests have shown it is possible for a grass fire to be initiated resulting in the loss of property and in extreme conditions loss of life. As a result the Australian Standard has included a “Fire Spark Test” capable of recording the existence of hot emissions and qualifying them according to their potential for fire ignition. In addition this Fire Spark Test is included for all of the 5 Duty test programs including test Duty 4 where all fuse-links are tested not just highest and lowest current ratings in a homogenous series. AS 1033.1 1990 is the most arduous testing standards for expulsion fuse-links in the world.

## Testing

Cooper Bussmann BBU Power Fuse-links and Fuse Mounts were tested for compliance to the standards listed below on production fuse-links, mounts and fitting accessories. This testing was carried out in independent test laboratories in Canada and in Australia by recognized independent power testing laboratories. Thermal and interrupting testing was conducted at 17, 27kV. 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.

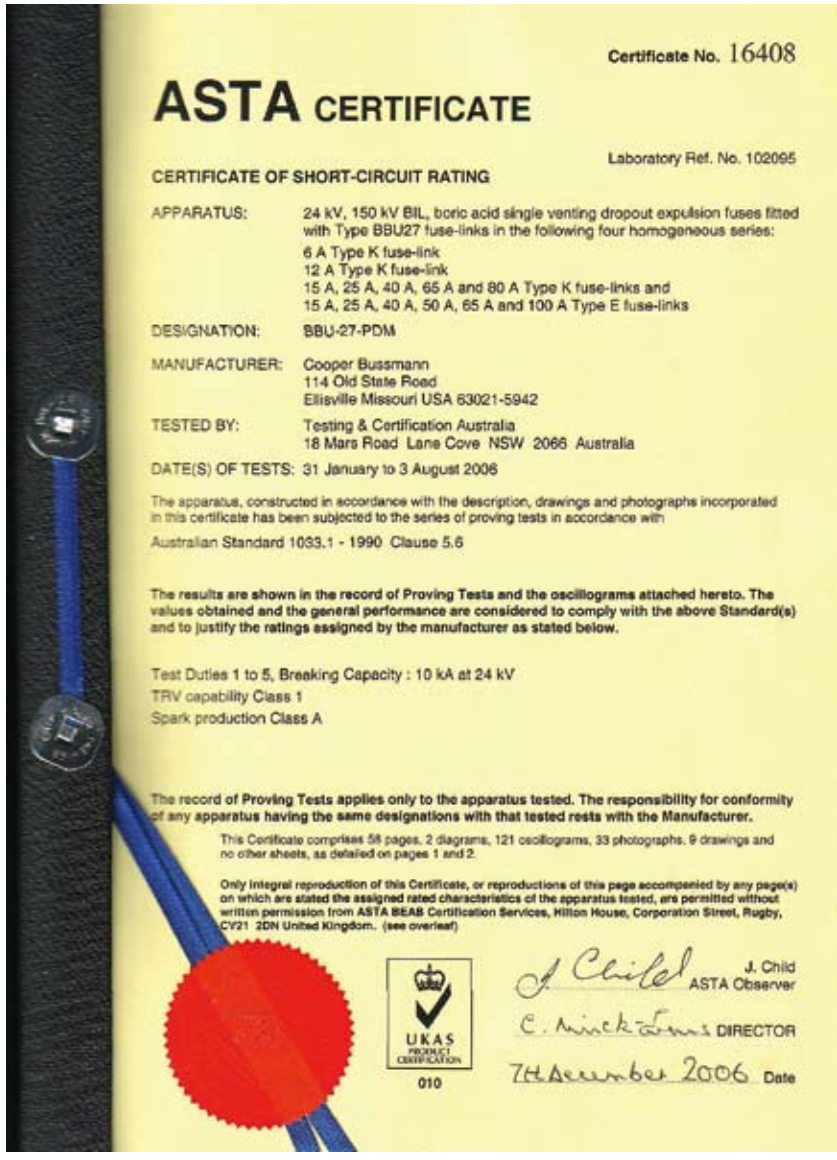
- ANSI C37.40 - Service Conditions and Definitions
- ANSI C37.41 - Power Fuse Design and Testing
- ANSI C37.42 - Distribution Fuse Ratings and Specification
- ANSI C37.46 - Power Fuse Ratings and Specifications
- ANSI C37.48 - Power Fuse Application, Operation and Maintenance
- AS1033.1 1990 – Australian Standard High Voltage Fuses Expulsion type

# Quality

Every effort is made to ensure the delivery of quality fuse units and customer satisfaction. All Cooper Bussmann 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 BBU 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 over packed in a shipping carton to prevent shipping damage.

## Certification

AUSTRALIAN STANDARD AS1033-1 1990



Certificate No. 16408

# ASTA CERTIFICATE

Laboratory Ref. No. 102095

**CERTIFICATE OF SHORT-CIRCUIT RATING**

APPARATUS: 24 kV, 150 kV BIL, boric acid single venting dropout expulsion fuses fitted with Type BBU27 fuse-links in the following four homogeneous series:
6 A Type K fuse-link
12 A Type K fuse-link
15 A, 25 A, 40 A, 65 A and 80 A Type K fuse-links and
15 A, 25 A, 40 A, 50 A, 65 A and 100 A Type E fuse-links

DESIGNATION: BBU-27-PDM

MANUFACTURER: Cooper Bussmann
114 Old State Road
Ellisville Missouri USA 63021-5942

TESTED BY: Testing & Certification Australia
18 Mars Road Lane Cove NSW 2066 Australia

DATE(S) OF TESTS: 31 January to 3 August 2006

The apparatus, constructed in accordance with the description, drawings and photographs incorporated in this certificate has been subjected to the series of proving tests in accordance with

Australian Standard 1033.1 - 1990 Clause 5.6

**The results are shown in the record of Proving Tests and the oscillograms attached hereto. The values obtained and the general performance are considered to comply with the above Standard(s) and to justify the ratings assigned by the manufacturer as stated below.**

Test Duties 1 to 5, Breaking Capacity : 10 kA at 24 kV
TRV capability Class 1
Spark production Class A

**The record of Proving Tests applies only to the apparatus tested. The responsibility for conformity of any apparatus having the same designations with that tested rests with the Manufacturer.**

This Certificate comprises 58 pages, 2 diagrams, 121 oscillograms, 33 photographs, 9 drawings and no other sheets, as detailed on pages 1 and 2.

**Only integral reproduction of this Certificate, or reproductions of this page accompanied by any page(s) on which are stated the assigned rated characteristics of the apparatus tested, are permitted without written permission from ASTA BEAB Certification Services, Hilton House, Corporation Street, Rugby, CV21 2DN United Kingdom. (see overleaf)**

UKAS PRODUCT CERTIFICATION
010

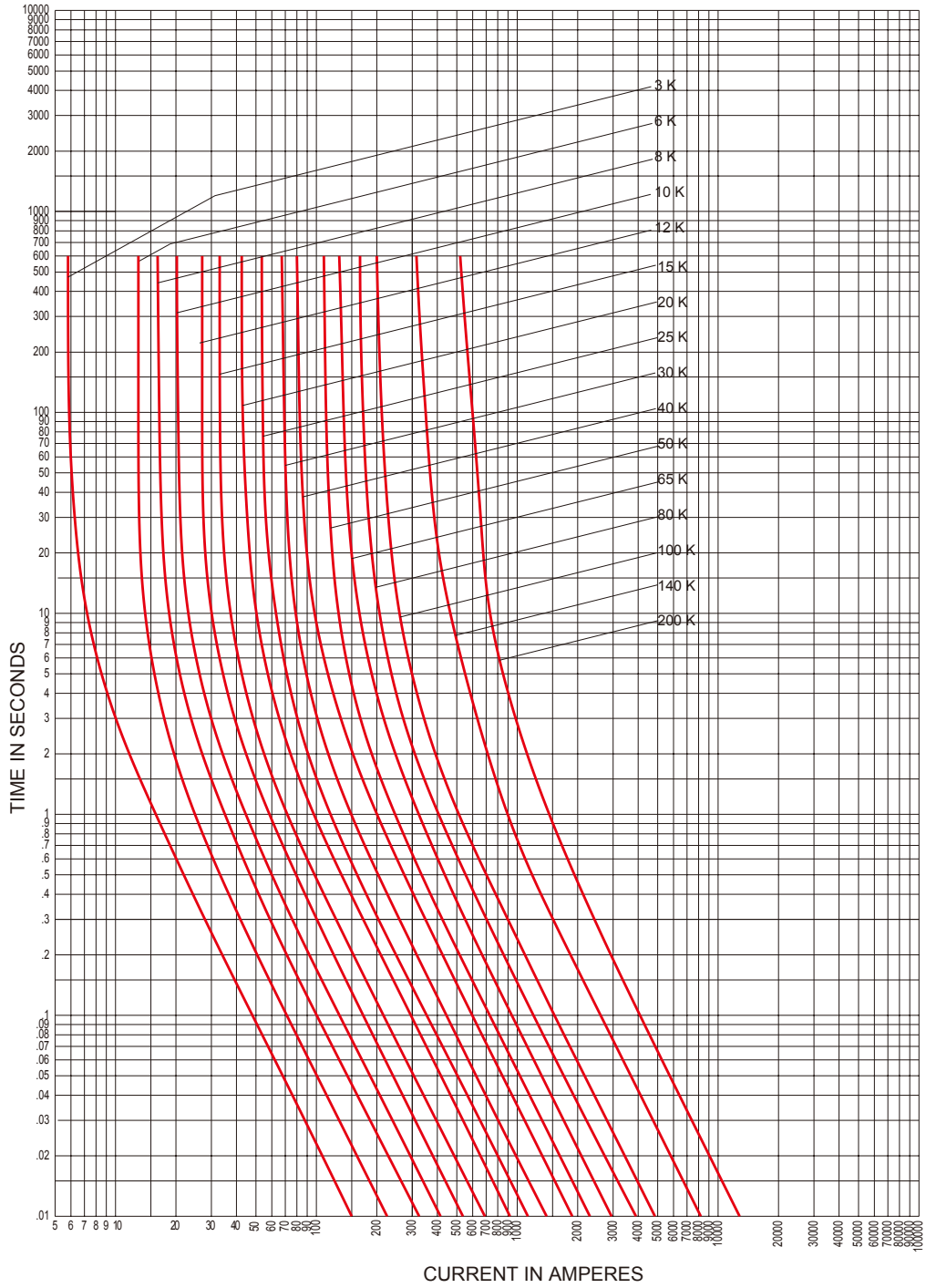
J. Child ASTA Observer

C. Minck-Lewis DIRECTOR

7th December 2006 Date

# Time Current Characteristics

## Standard K Speed Fuses - 17.1 to 38 kV

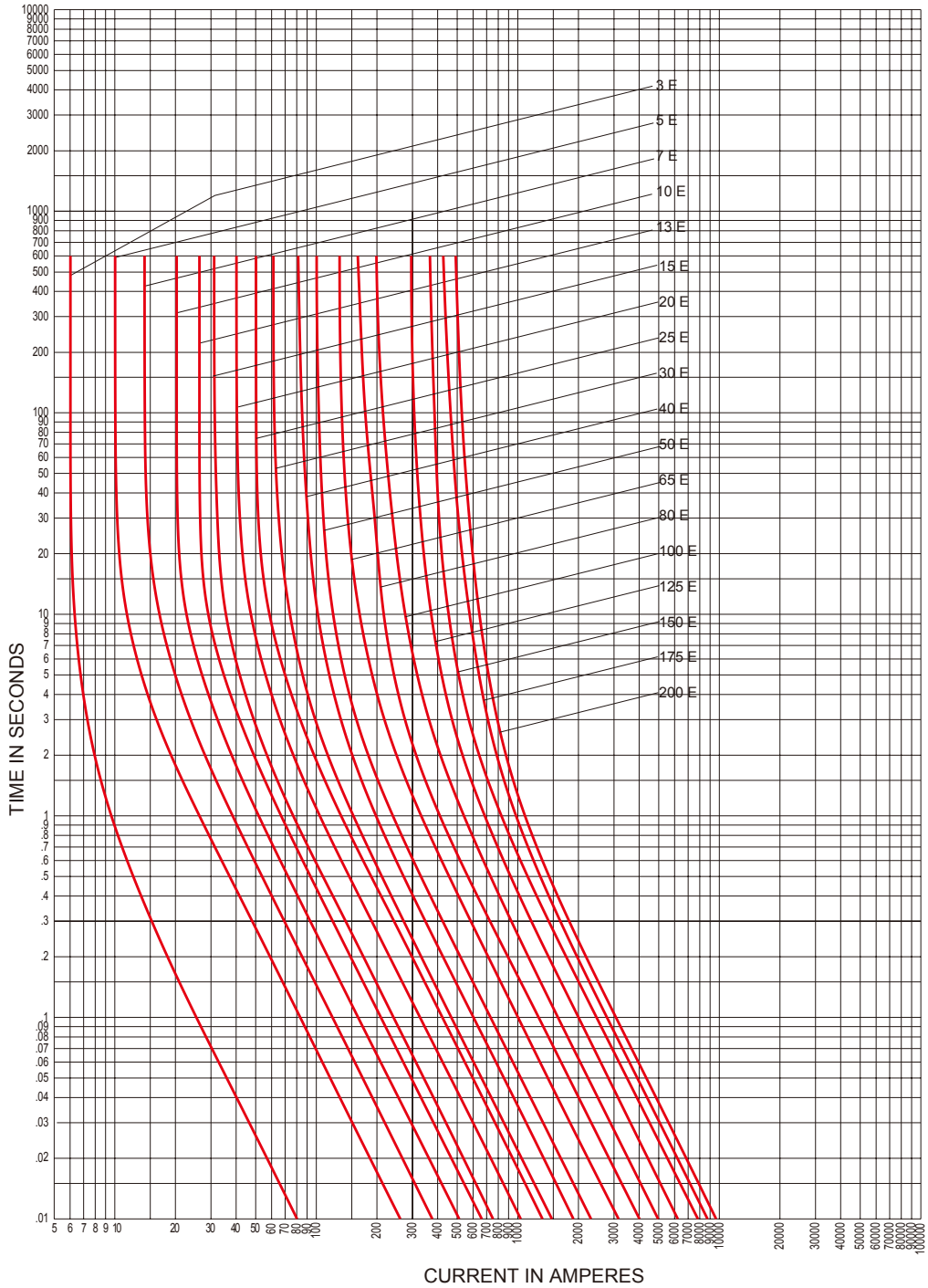



Type BBU Standard K Speed Fuses
Minimum Melting Time-Current Characteristics - 17.1 - 38 kV

Curves are based on tests starting with fuse unit at ambient temperature of 25°C and without initial load. Curves are plotted to minimum test points so all variations should be positive.

# Time Current Characteristics

## Standard E Speed Fuses - 17.1 kV to 38 kV

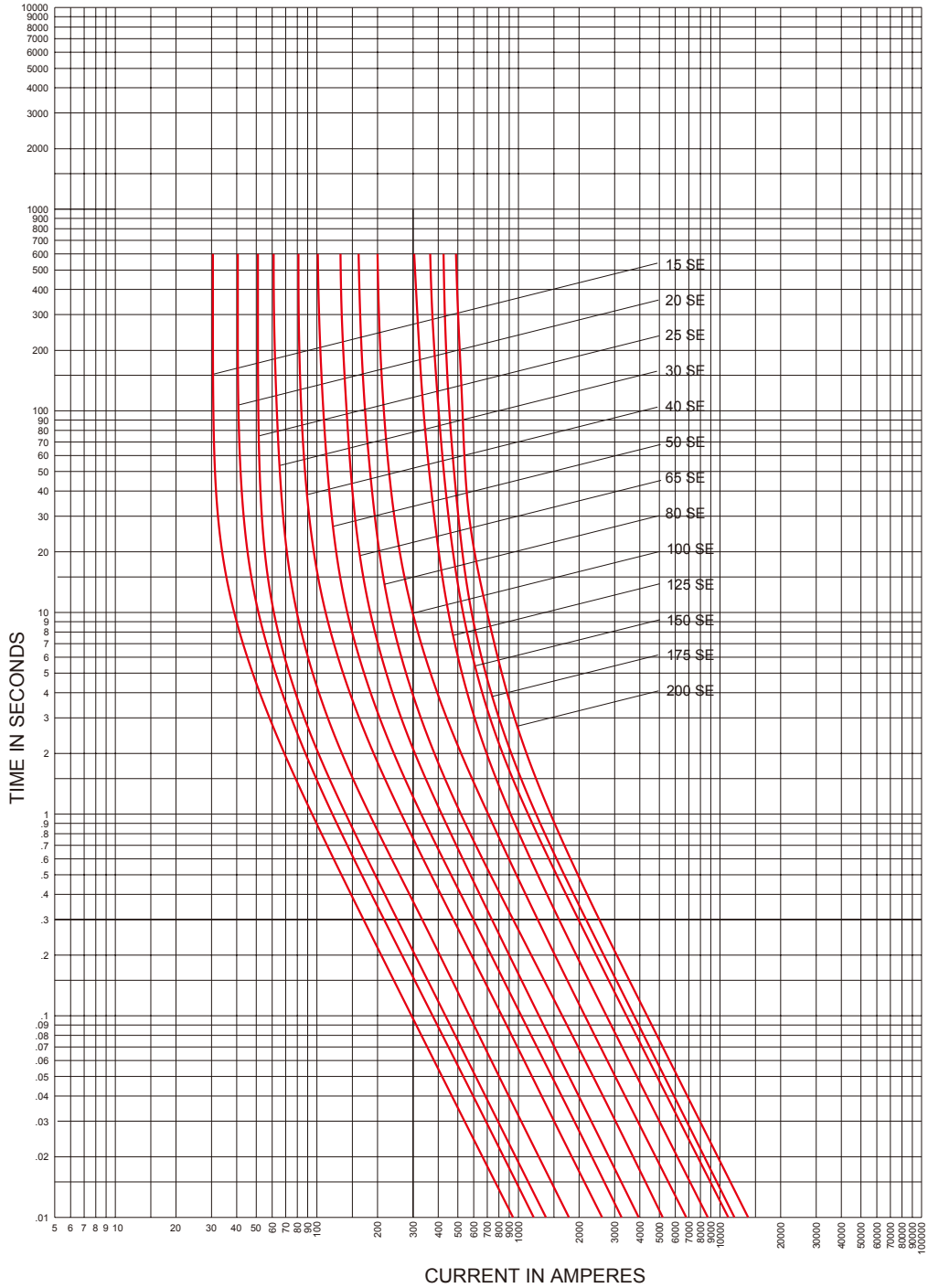



Type BBU Standard E Speed Fuses
Minimum Melting Time-Current Characteristics - 17.1 - 38 kV

Curves are based on tests starting with fuse unit at ambient temperature of 25°C and without initial load. Curves are plotted to minimum test points so all variations should be positive.

# Time Current Characteristics

## Slow E Speed Fuses - 17.1 kV to 38 kV

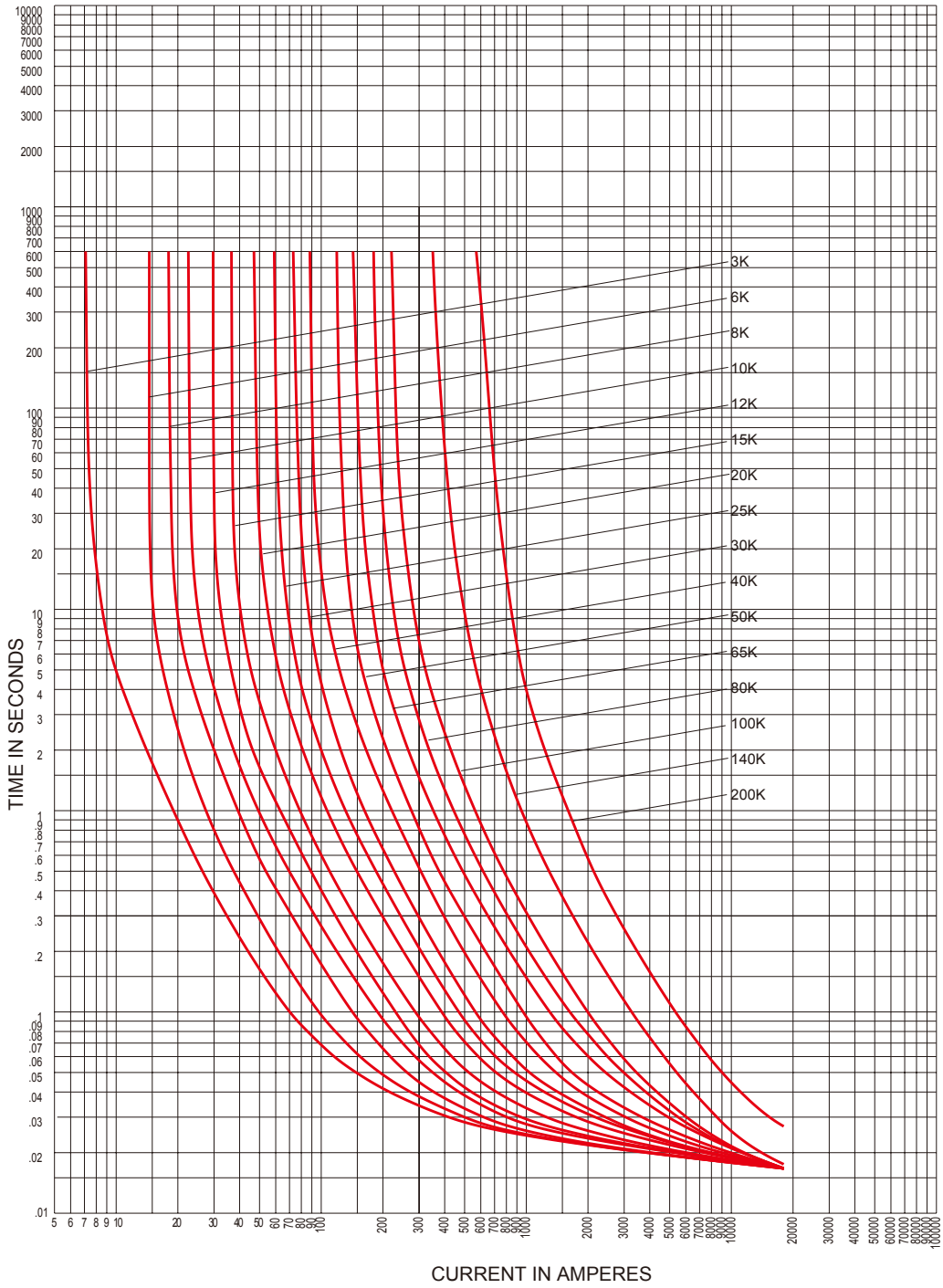



Type BBU Slow E Speed Fuses
Minimum Melting Time-Current Characteristics - 17.1 - 38 kV

Curves are based on tests starting with fuse unit at ambient temperature of 25°C and without initial load.Curves are plotted to minimum test points so all variations should be positive.

# Time Current Characteristics

## Standard K Speed Fuses - 17.1 kV

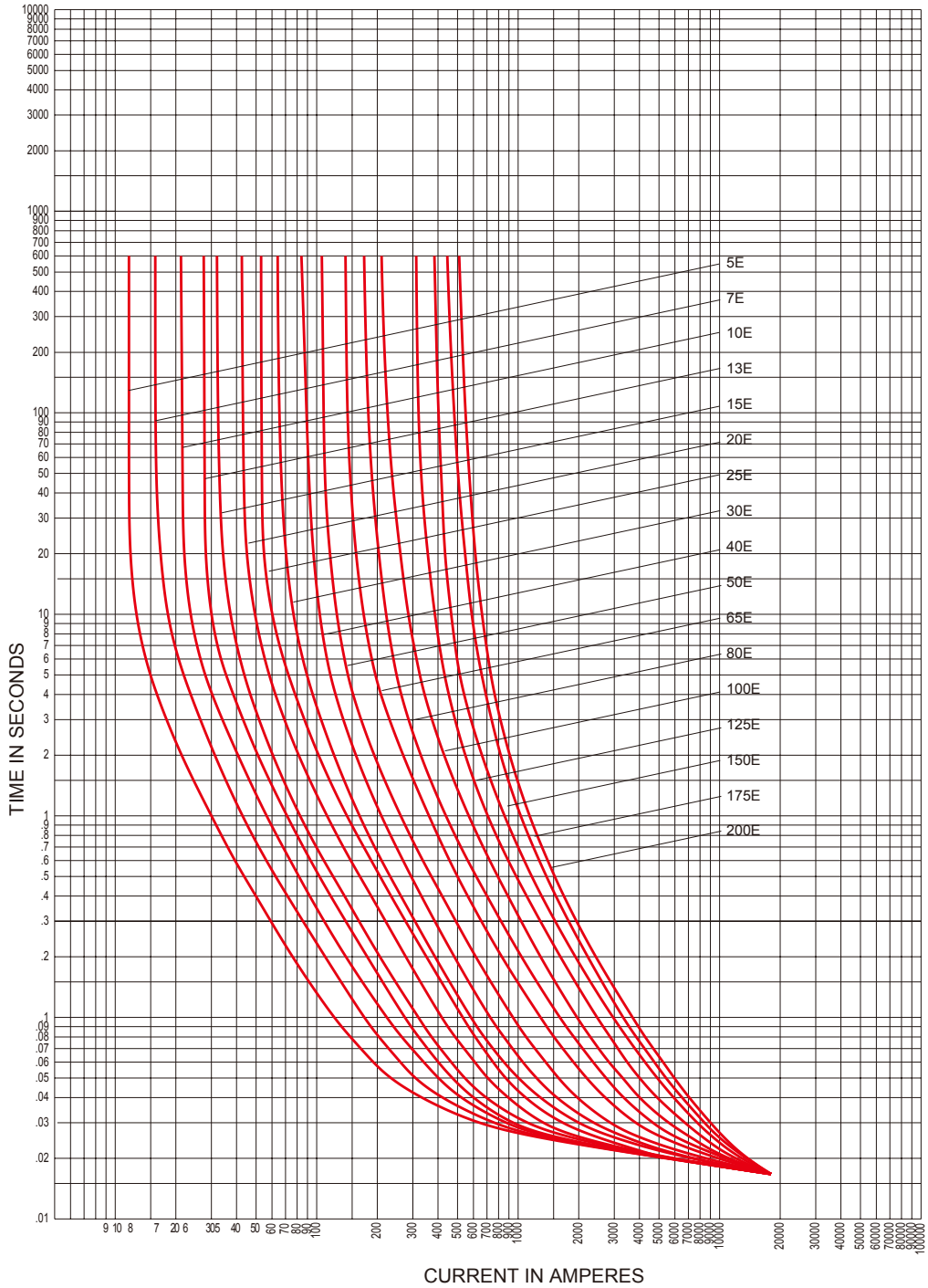



Type BBU Standard K Speed Fuses
Total Clearing Time-Current Characteristics - 17.1 kV

Curves are based on tests starting with fuse unit at ambient temperature of 25°C and without initial load. Curves are plotted to maximum test points so all variations should be negative.

# Time Current Characteristics

## Standard E Speed Fuses - 17.1 kV

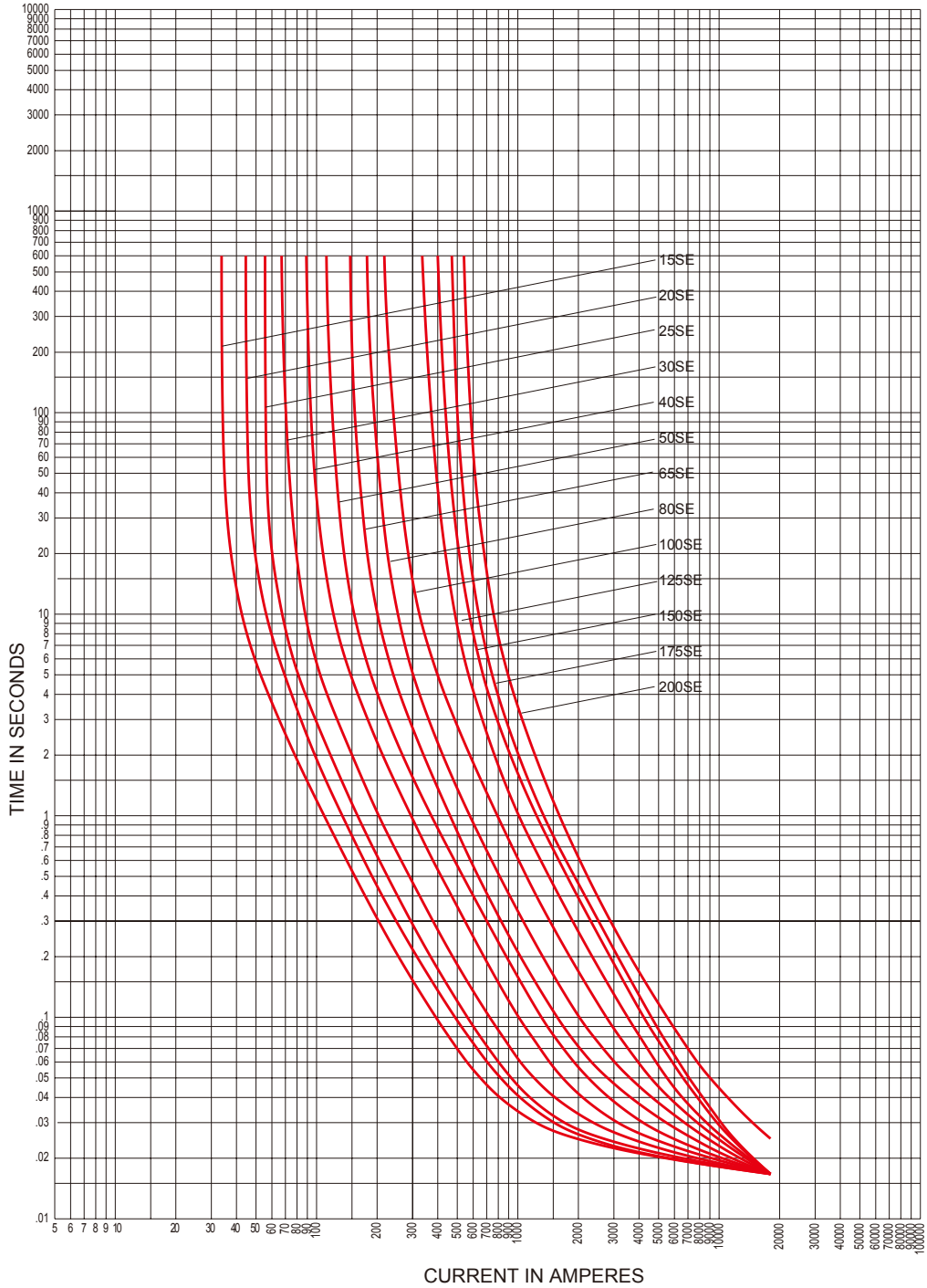



Type BBU Standard E Speed Fuses
Total Clearing Time-Current Characteristics - 17.1 kV

Curves are based on tests starting with fuse unit at ambient temperature of 25°C and without initial load. Curves are plotted to maximum test points so all variations should be negative.

# Time Current Characteristics

## Slow E Speed Fuses - 17.1 kV

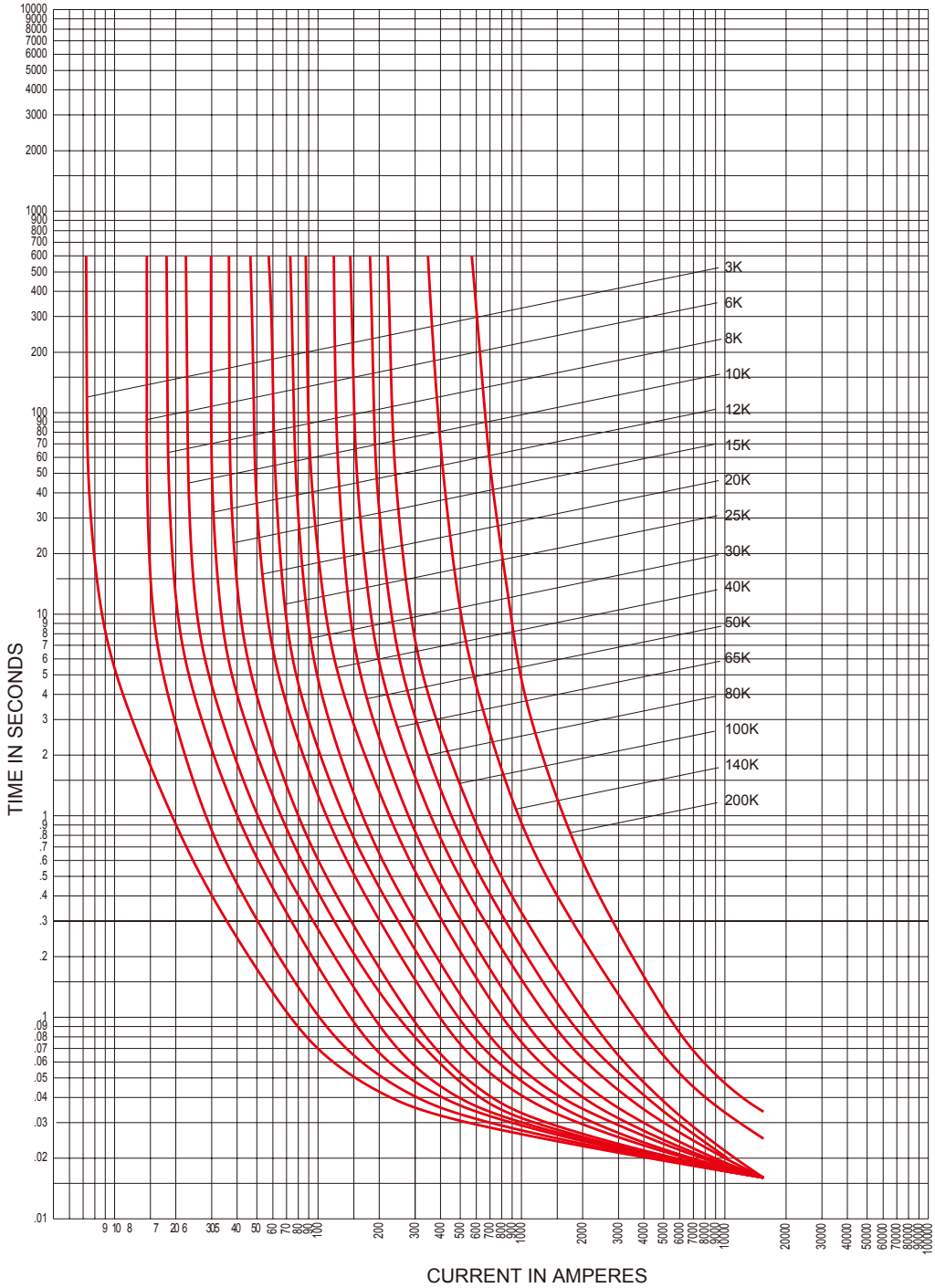



Type BBU Slow E Speed Fuses
Total Clearing Time-Current Characteristics - 17.1 kV

Curves are based on tests starting with fuse unit at ambient temperature of 25°C and without initial load. Curves are plotted to maximum test points so all variations should be negative.

# Time Current Characteristics

## Standard K Speed Fuses - 27 and 38 kV

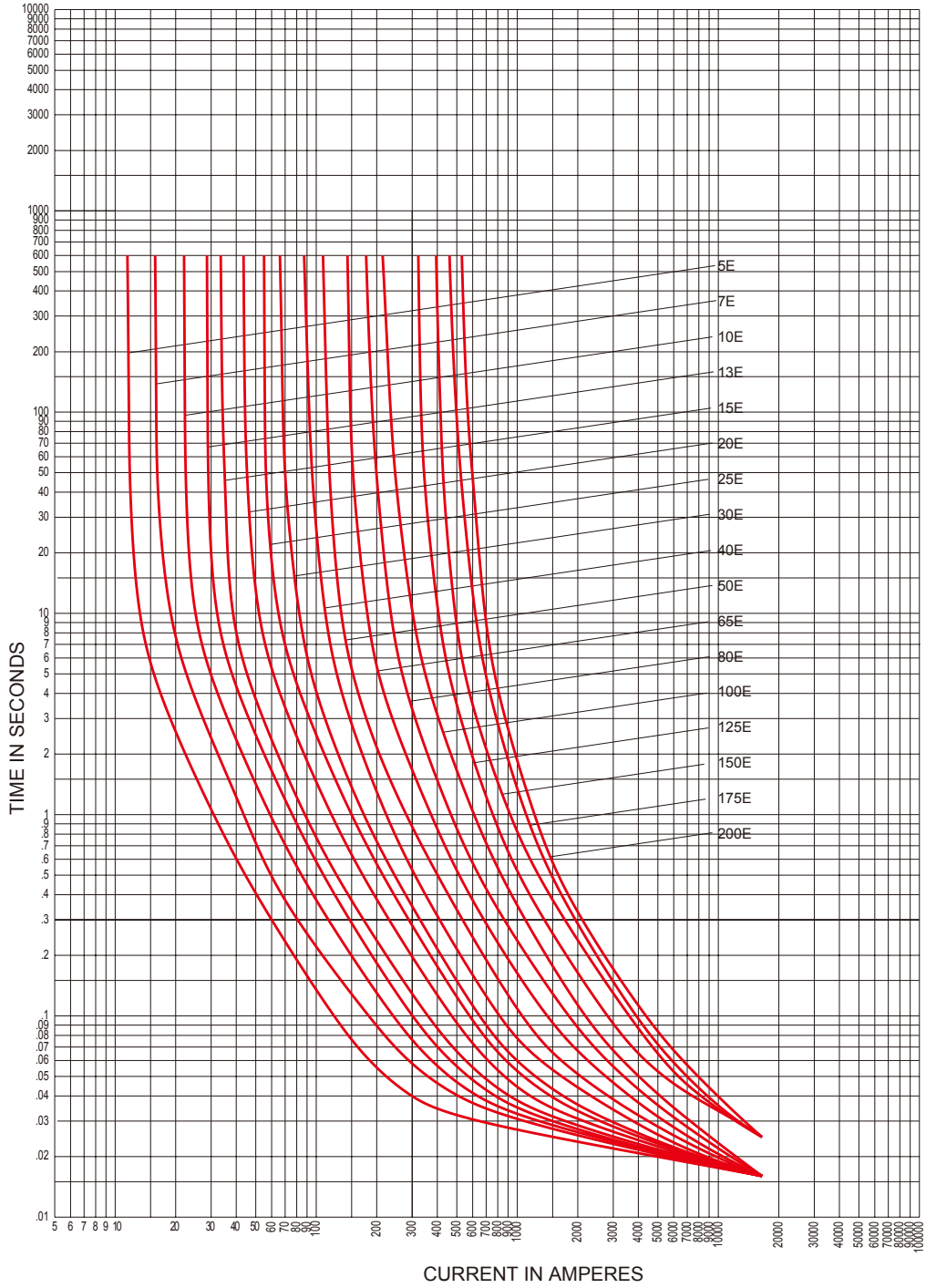



Type BBU Standard K Speed Fuses
Total Clearing Time-Current Characteristics - 27 and 38 kV

Curves are based on tests starting with fuse unit at ambient temperature of 25°C and without initial load. Curves are plotted to maximum test points so all variations should be negative.

# Time Current Characteristics

## Standard E Speed Fuses - 27 and 38 kV

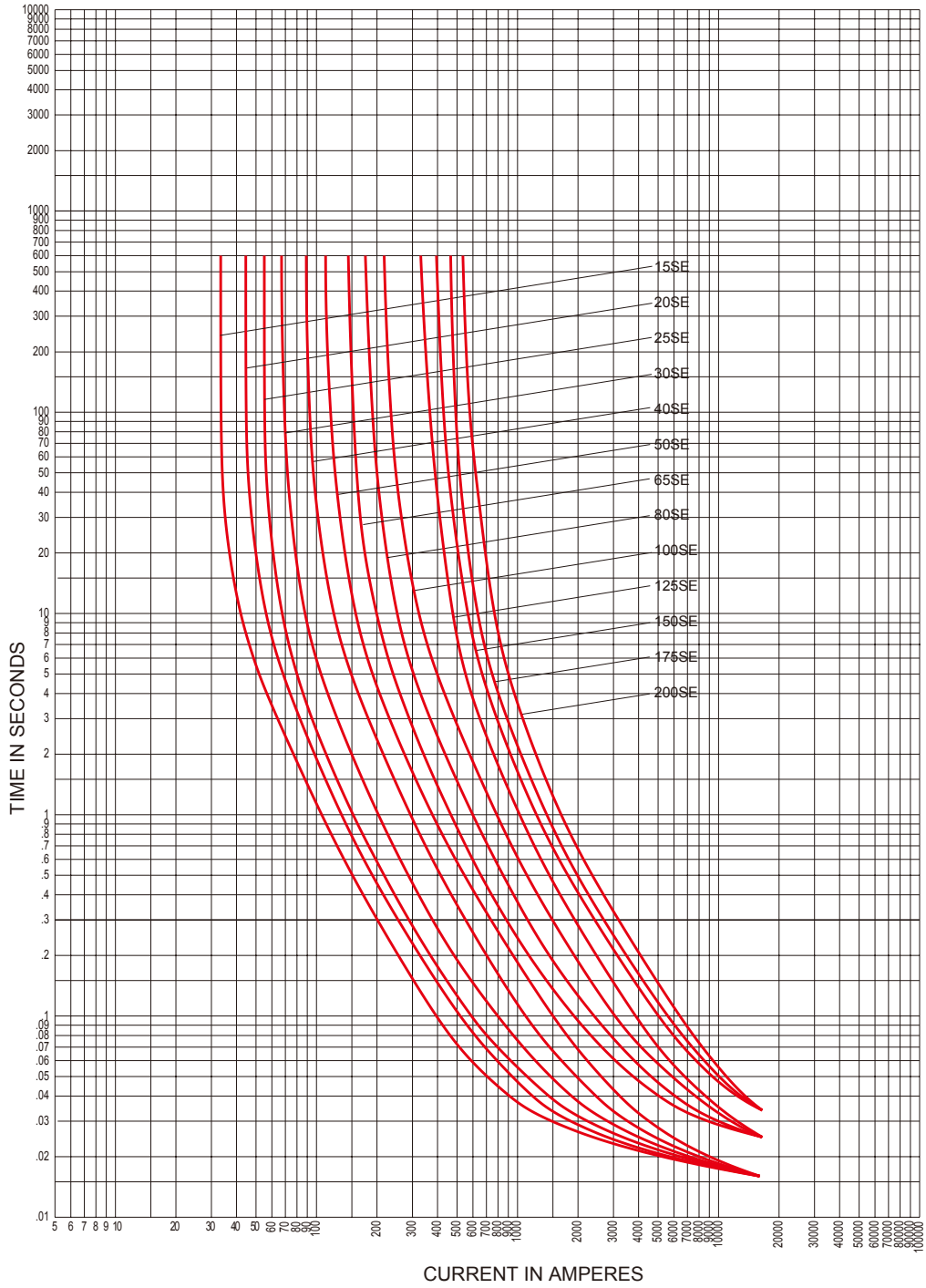



Type BBU Standard E Speed Fuses
Total Clearing Time-Current Characteristics - 27 and 38 kV

Curves are based on tests starting with fuse unit at ambient temperature of 25°C and without initial load. Curves are plotted to maximum test points so all variations should be negative.

# Time Current Characteristics

## Slow E Speed Fuses - 27 and 38 kV




Type BBU Slow E Speed Fuses
Total Clearing Time-Current Characteristics - 27 and 38 kV

Curves are based on tests starting with fuse unit at ambient temperature of 25°C and without initial load. Curves are plotted to maximum test points so all variations should be negative.

## NOTES

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# Cooper Bussmann Products And Technical Support Delivered Worldwide

## Customer Assistance

## Web Services

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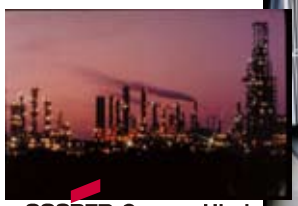

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