DBU Fuses

Introduction

The Cutler-Hammer DBU Power Fuse is a Boric Acid, expulsion-style fuse unit. Suitable for both indoor and outdoor applications, the DBU provides a low initial cost alternative to refillable fuses.

New DBU with End Fittings

In comparison to the conventional distribution cutout that utilizes the fiber tube and fuse link design for fault interruption, the DBU far exceeds the cutout in interrupting rating, and considerably reduces the hazards and noise of the violent exhaust common to cutouts under fault interrupting conditions. The DBU fuse employing the use of calibrated silver elements, boric acid for its interrupting media, and the mechanical utilization of the spring and rod mechanism, creates a technique which gives a low arc and mild exhaust fault interruption.

DBU Expulsion Fuses are available in 3 maximum voltage classes: 17kV, 27kV, and 38kV. The replaceable fuse unit comes in 3 speed variations: Standard "E", Slow "E", and "K". Amperage sizes range from 3 Amps through 200 Amps.

Construction

In terms of application, the complete fuse consists of the fuse unit, end fittings, and a mounting.

Principle parts of the replaceable DBU fuse unit are shown in the cross section view of Fig. 9. Main operating parts are the silver element, arcing rod, boric acid cylinder, and spring. To prevent warping under outdoor conditions and assure adequate strength to contain the force of the arc interruption, a glass epoxy tube encloses the assembly.

The use of a pure silver element and Nichrome wire strain element makes the DBU 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.

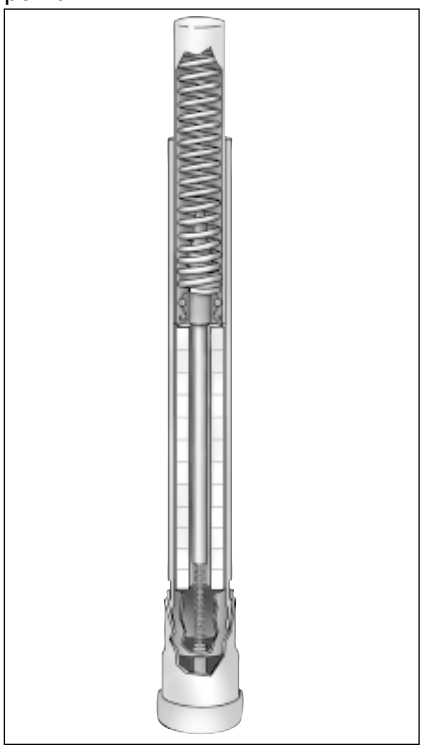


Figure 9: DBU Fuse Construction

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. A durable weatherproof label is located on each fuse which provides ratings and manufacturer information.

Operation

DBU Expulsion Fuses 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.

Element Melts | **Rod withdraws, elongating arc and vaporizing Boric Acid** | **Vapor quenches arc at first current zero**

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.

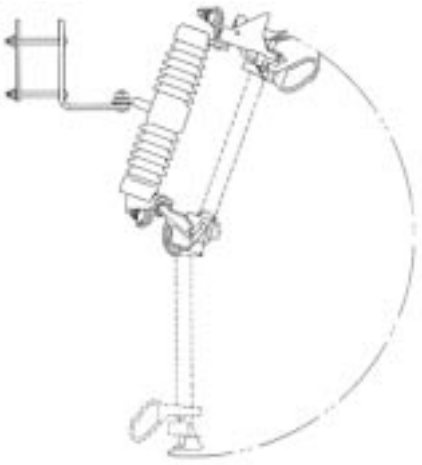
Higher particle turbulence of the boric acid causes the rate of de-ionization in the cylinder to exceed the ionization of the electrical arc. Both high and low current faults are interrupted in the same manner with no foreign material other than the boric acid required. This enables the fuse to interrupt 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 arcing 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 of the arcing rod to penetrate the upper seal, striking the latch mechanism. On indoor applications, this action caused the blown fuse indicator to actuate.

On outdoor installations, the latch releases the fuse unit allowing the ejector spring to move the assembly outward and swing through a 180 degree arc into a dropout position. This dropout action provides immediate visual indication that the fuse has operated. When the fuse is blown and the dropout action completed, the entire unit is removed with a hookstick.



Outdoor dropout action.

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

Application

The DBU Power Fuse provides effective protection for circuits and equipment which operate on voltage systems up to 34,500V. They can be used on both electric utility and industrial distribution systems and all fuses are designed 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 can be used in outdoor or indoor applications, and can be used to directly replace competitive equivalent units.

WLI gear w/ Fuses

Since the DBU Fuse Unit has superb, reliable performance characteristics, it can be used on upstream as well as downstream applications.

Regarding upstream system protection, the DBU operates promptly to limit the stress on electrical systems due to short circuits. It provides isolation for the faulted circuit, limiting the amount of interruption to the service. Downstream equipment is equally protected. The DBU acts rapidly to take transformer and feeder circuits off-line before damage can become widespread. It provides excellent isolation for capacitors as well in the event of a fault condition.

When installed on the primary side of substation power transformers, 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

The Cutler-Hammer DBU pro vides superior performance especially intended for distribution system protection up to an operational voltage of 34.5KV. Because the DBU is available in various current ratings and time-current characteristics, 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.

DBU Fuse Unit

A DBU fuse unit is comprised of an arcing rod, an auxiliary arcing wire, a strain element, and a solid boric acid liner which assists with the interruption. All of these components are contained within a separate fiberglass tube. The fiberglass tube has an end cap on one end with a blowout disk which permits exhaust to exit during interruption. The fuse element determines the operational time-current characteristics of the DBU fuse unit. How the fuse reacts for different magnitudes of current and amounts of time is indicated on the specific time-current characteristic curve. The DBU is available in

Standard "E", "K", and Slow "E" configurations.

The heavy copper cylindrical arcing rod is contained within the main bore of the boric acid liner and performs two functions. Under normal conditions, it conducts the continuous rated current of the fuse.

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. The high resistance wire shunts the fuse element and vaporizes immediately after the fuse element melts.

When the fuse element melts 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 placed on the arcing rod by the attached charged spring.

Intense heat from the arc decomposes the dry boric acid. On decomposition, the boric acid forms water vapor and inert boric anhydride which by blasting through it, extinguishes and de-ionizes the arc.

The exhaust caused by the interruption exits from the bottom of the fuse through the blowout disk. This prevents the arc from restriking after a current zero.

The replaceable DBU fuse unit is discarded after it interrupts a fault.

DBU End Fittings

End Fittings are required to complete the electrical connection between the fuse unit and the live parts and mounting.

End fittings are positioned on the top and bottom of the fuse unit. They can be used over again if they remain undamaged.

End Fittings are available in 2 versions: indoor and outdoor.

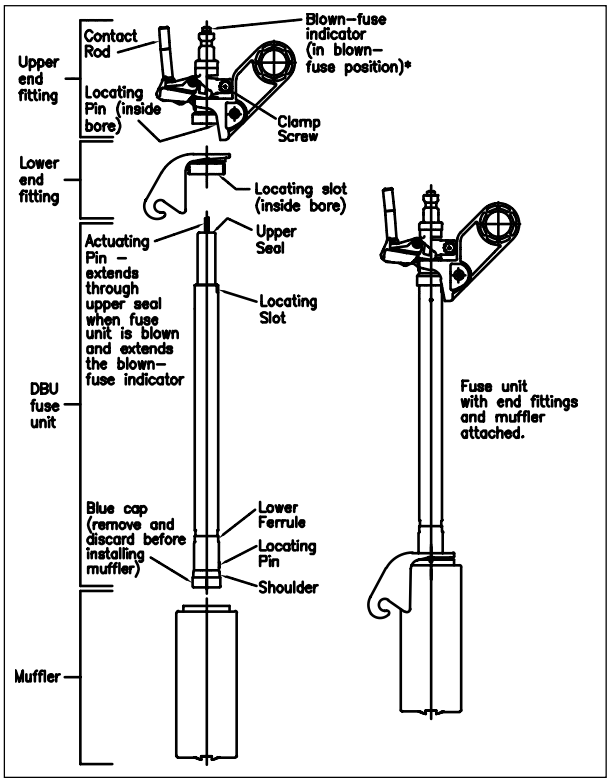
The indoor fittings accept a Muffler attachment to limit noise and contamination to indoor equipment. The blown fuse indicator located on the top end fitting, provides visual indication of a faulted fuse unit.

Outdoor Fittings

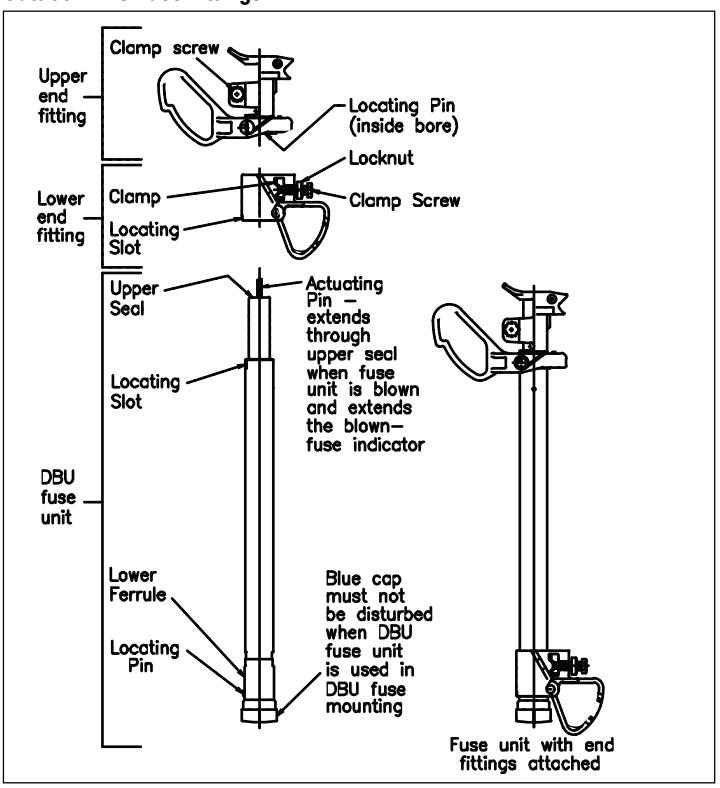
Outdoor end fittings are made of a cast-copper plated alloy. A large hookeye on the upper fitting allows for easy installation into pole-top mountings with a hookstick. The pivotal design of this hookeye provides for proper engagement of the upper live part. The positive locking action of the latch mechanism 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.

Indoor DBU Fuse Fittings



Outdoor DBU Fuse Fittings



Indoor Fittings

The indoor end fittings are composed of high-impact plastic and high-conducting copper alloy. The blown fuse indicator located on the top end fitting, provides visual indication of a faulted fuse unit. The silver-plated contact rod insures positive conductivity between the fuse unit and the live parts of the mounting.

The spring-loaded plastic mounting handle actuates the latch mechanism when engaged into the mounting. It readily accepts a hookstick to install or remove the assembled fuse unit.

A locating pin in the upper fitting assures proper alignment and engagement with the fuse unit.

The cast bottom indoor fitting has a locating slot on the inside bore. This slot aligns with a locating pin on the lower section of the fuse unit to provide proper alignment with the fuse unit and the mounting. Two pivotal slots are formed into the fitting for mechanical insertion into the mounting.

The bottom indoor fitting is threaded to accept a Muffler attachment for limiting noise and contamination to indoor equipment. The Muffler is constructed of a plated steel housing, containing copper mesh screening. This copper mesh acts to absorb and contain the noise and exhaust materials of the fuse during a fault condition. The Muffler prevents contamination of indoor components and mechanisms located within the switchgear. This containment action also prevents accidental flash-over from phase-to-phase or phase-to-ground by limiting foreign airborne particles and gases.

All end fittings are re-usable if undamaged. They are completely interchangeable with other manufacturers' equivalent fuse units and mountings.

Mountings & Live Parts

Cutler-Hammer offers a full line of loadbreak and non-loadbreak mountings and live parts for the DBU fuse family. Mountings are available in 17KV, 27KV, and 38KV class designs.

These mountings will readily accommodate all DBU class fuses as well as other equivalent manufacturers.

All mountings are applicable for indoor applications of pad-mount and switchgear designs.

Units have a maximum current rating up to 200A, with a maximum interrupt rating of 14kA. The following lists the BIL rating of each voltage class:

- 17KV - 95 BIL
- 27KV - 125 BIL
- 38KV - 150 BIL

Loadbreak units have a maximum 3-time fault close ASYM of 22,400A RMS. Refer to the catalog number section for exact ratings per unit.

Non-Loadbreak Mounting

Loadbreak Mounting

Mountings are constructed of rigid steel bases. Non-load break units are galvanized while loadbreak styles are epoxy coated. Bases are supplied with preformed mounting holes for easy installation.

Isolators are molded of cycloaliphatic material for superior insulating characteristics. Live parts are rigidly secured to the isolators with standard mounting hardware.

Bus for cable terminations for non-loadbreak units are located on the right side of the mountings. Loadbreak units have both left and right side mountings available for proper installation spacing. All bus connections are plated copper for improved conductivity and endurance.

All loadbreak units have a 3 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.

DBU Interruption and Protection

Discussions have concentrated on the individual components that make up a DBU Power Fuse. This section will center around the operation of the complete fuse assembly.

When completely assembled, the DBU Power Fuse will provide effective protection for circuits and equipment which operates on voltages from 2400 Volts through 34,500 Volts. At this point, it would be beneficial to briefly review the overall operation of the entire DBU Power Fuse.

The DBU assembly, whether disconnect or non-disconnect, is positioned to perform its protective function as current flows through the mounting's line and load connectors. The DBU fuse unit makes the electrical connection with the mounting through its end fittings when properly engaged. 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 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 DBU 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 DBU 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 DBU 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 DBU 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 DBU Power Fuses are: 17KV, 27KV, and 38KV.

No fuse should ever be applied where the available fault current exceeds the interrupting rating of the fuse. The rated interrupting capacity of the DBU is the rms value of the symmetrical component (AC component) of the highest current which the DBU is able to successfully interrupt under any conditions of asymmetry. In short, the interrupting rating must be equal to or greater than the maximum symmetrical fault current at the point where the fuse is applied. The DBU has interrupting capabilities from 10,000 to 14,000 amperes symmetrical.

The continuous current rating of a DBU Power Fuse should equal or

Table 1: TRV Characteristics

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

Table 2: DBU Power Fuse Short-Circuit Interrupting Ratings

kV, Nominal		Amperes, Interrupting		MVA, Interrupting (Three-Phase Symmetrical)
DBU	System	Symmetrical based on X/R = 15	Asymmetrical	Where X/R = 15
17	7.2 4.8 / 8.32Y 7.2 / 12.47Y 7.62 / 13.2Y 13.8 14.4 16.5	14000	22400	175 200 300 320 335 350 400
27	7.2 / 12.47Y 7.62 / 13.2Y 13.8 14.4 16.5 23.0 14.4 / 24.9Y 20 / 34.5Y ①	12500	20000	270 285 300 310 365 500 540 ...
38	23.0 14.4 / 24.9Y 27.6 20 / 34.5Y 34.5	10000	16000	... ... 475 600 600

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.

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 DBU 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.

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 of a half cycle of fault current 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 (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.

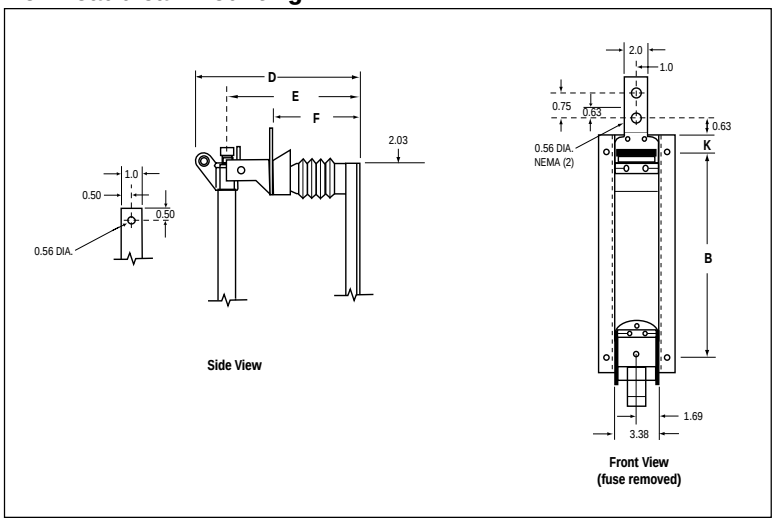
The total clearing time is the total amount of time it takes to clear a fault once the element has melted. The total clearing time is really the sum of the melting time and the time the fuse arcs during the clearing process.

The DBU 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 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 Cutler-Hammer DBU family of power fuses is broad and comprehensive. Refer to the DBU Ratings Table 2 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.

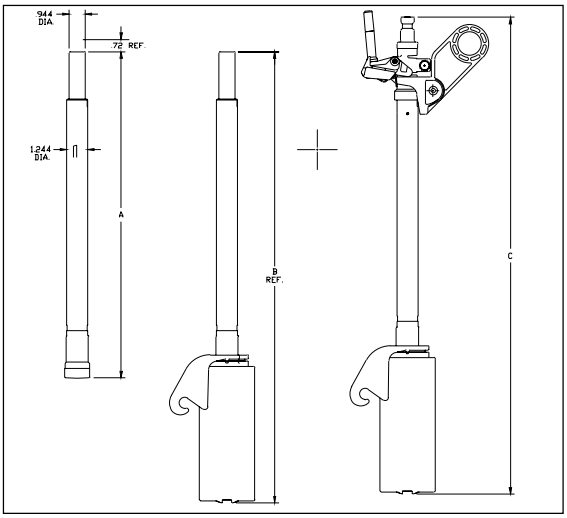
Non-Loadbreak Mounting



kV Max.	Catalog Number*	kV BIL	Fuse Mounting (Dimensions in Inches)				
			B	D	E	F	K
17	DBU17-GNM	95	17.75	17.63	12.63	9.50	3.0
27	DBU27-GNM	95	22.25	19.19	14.44	11.06	3.0
38	DBU38-GNM	150	28.25	22.0	17.25	13.63	3.0

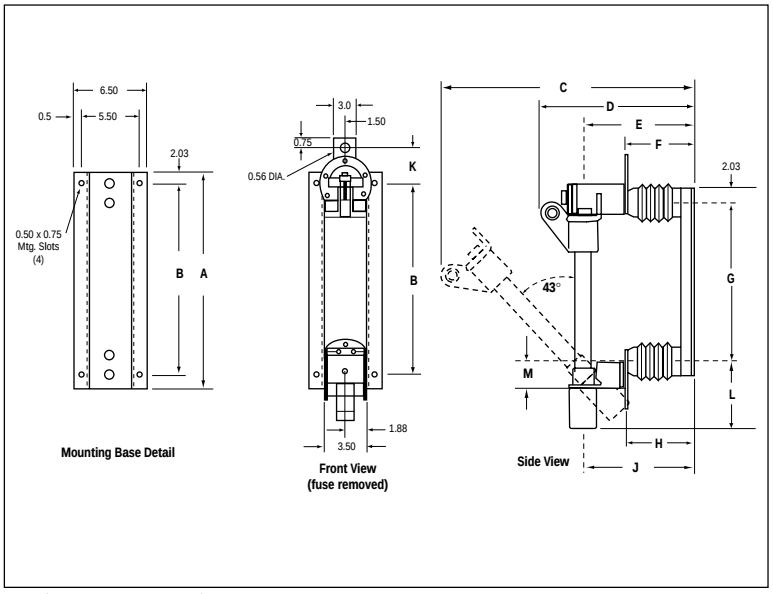
* Bus for cable termination on right side of mounting.

Indoor DBU Fuse Fittings



kV Max.	Fuse Unit Fittings		
	A	B	C
17	19.08	27.19	28.82
27	22.58	30.69	32.32
38	28.76	36.87	38.50

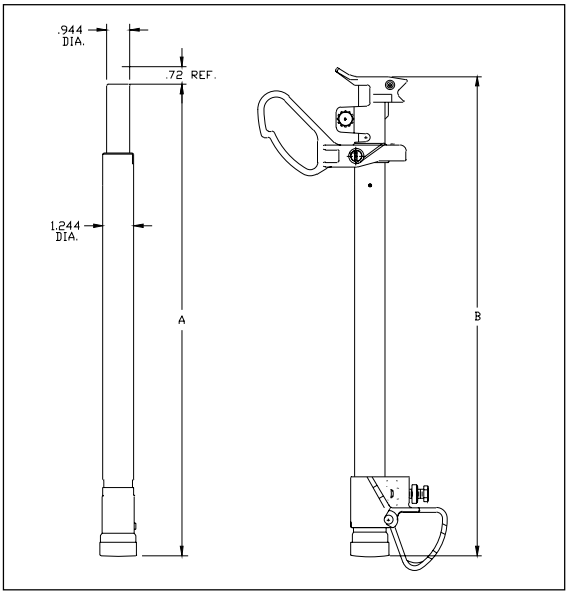
Loadbreak Mounting



kV Max.	Catalog Number	kV BIL	Fuse Mounting (Dimensions in Inches)											
			A	B	C	D	E	F	G	H	J	K	L	M
17	DBU17-GDML**	95	22.50	18.44	30.50	19.25	14.25	9.25	18.44	9.44	11.50	3.0	9.50	3.75
17	DBU17-GDMR*	95	22.50	18.44	30.50	19.25	14.25	9.25	18.44	9.44	11.50	3.0	9.50	3.75
27	DBU17-GDML**	125	26.75	22.69	34.63	21.38	16.75	11.56	22.69	11.75	13.50	3.0	9.50	3.75
27	DBU17-GDMR*	125	26.75	22.69	34.63	21.38	16.75	11.56	22.69	11.75	13.50	3.0	9.50	3.75
38	…	…	…	…	…	…	…	…	…	…	…	…	…	…

* Bus for cable termination on right side of mounting.
* Bus for cable termination on left side of mounting.

Outdoor DBU Fuse Fittings



kV Max.	Fuse Unit Fittings	
	A	B
17	19.08	19.41
27	22.58	22.91
38	28.76	29.09

Testing and Performance

- Standards
- Testing
- Quality Standards

Cutler-Hammer 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 DBU P ower 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 Cutler-Hammer. 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 C37.48 - 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 at the Cutler-Hammer Technical Center and also at recognized independent power testing laboratories. Thermal and interrupting testing was conducted at 17, 27, and 38kV 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 Cutler-Hammer fuses are completely inspected at each manufacturing stage.

In addition to ongoing quality control inspections, testing is performed prior to shipment. A Micro-Ohm R esistance 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.

1. Installation for New DBU Applications

1.1 Installation (Fusing) in Pad-Mount/Indoor Applications with Exhaust Control Device

Attach fuse-unit end fittings (Fig. 10) as follows:

A. The lower end fitting must be attached first. Remove and discard the blue cap located on the lower end of the fuse unit. Next, slip the lower end fitting over the upper end of the fuse unit and slide it down until the locating slot is seated on the locating pin of the lower ferrule. Then thread the Exhaust Control Device onto the lower end fitting and screw it on firmly. The final fractional turn should be made with a bar or wrench handle.

B. Slip the upper end fitting over the fuse unit. Align the locating pin (inside the upper end fitting) with the locating slot in the Fuse Unit and seat the upper end firmly against the upper end of the Fuse Unit. Tighten the clamp screw firmly.

CAUTION

ANY AND ALL APPLICABLE SAFETY REGULATIONS MUST BE STRICTLY ADHERED TO CONCERNING THE CLOSURE OR POSSIBLE CLOSURE OF DBU FUSE UNITS ONTO "LIVE" CIRCUITS.

1.1.1 Unused Fuse-Unit End Fittings

A coating of oxidation-inhibiting grease was applied to the contact rod at the factory. Verify the presence of the 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 Fittings should only be attached immediately prior to installation.

1.1.2 Re-used Fuse-Unit End Fittings

Remove the existing coating of oxidation-inhibiting grease, and 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.

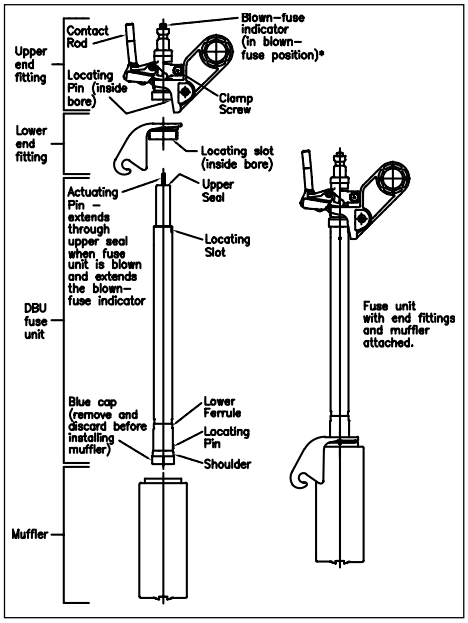


Figure 10: Indoor DBU Fuse Fittings

1.2 Installation (Fusing) in Outdoor Mountings

Attach the fuse-unit end fittings (Fig. 11) as follows:

A. The lower end fitting must be attached first. Slip the lower end fitting over the upper end of the fuse unit and slide it down until the locating slot seats on the locating pin of the lower Fuse Unit ferrule. Next, back off the locknut on the clamp screw and tighten the clamp screw firmly; secure it with the locknut.

B. Slip the upper end fitting over the fuse unit. Align the locating pin (inside the upper end fitting) with the locating slot in the Fuse Unit and seat the upper end fitting firmly against the upper end of the Fuse Unit. Tighten the clamp screw firmly. Do not remove the blue outer cap from the bottom of the Fuse Unit.

1.2.1 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 Fittings should only be attached immediately prior to installation.

1.2.2 Re-used Fuse-Unit End Fittings

Remove the existing coating of oxidation-inhibiting grease, and 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.

2. Replacement of existing Applications

2.1 Replacement (Refusing) in Pad-Mount/Indoor Applications with Exhaust Control Device

A. When the fuse operates, the fuse unit does not swing open but the blown-fuse indicator moves to the extended position, providing visual evidence that the Fuse Unit has operated. Move the Fuse Unit to the open position and then remove it from the

mounting. Note: Non-loadbreak mountings do not incorporate a live switching device. Hence, an unblown DBU Fuse Unit in such mountings must not be moved to the open position without first opening an upstream series interrupting and isolating switch or loadbreak elbow.

B. Loosen the upper end fitting clamp screw, and pry the clamp apart slightly using a screwdriver. Slide the upper end fitting off the upper end of the Fuse Unit. Then unscrew and remove the Exhaust Control Device. Slide the lower end fitting off the upper end of the Fuse Unit. (Refer to Figure 10.)

C. Attach the end fittings and muffler 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 and exhaust control devices may be kept on hand for attachment to new Fuse Units immediately before re-fusing is to be performed.

The use of a pure silver element and Nichrome strain element makes the DBU less susceptible to outages caused by vibration, corona corrosion, and aging of the fuse elements, nor is it damaged by transient faults or overloads which approach the minimum melting point.

2.2 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 (see Figure 11) 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 screwdriver), 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 re-fusing is to be performed.

2.2.1 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.

2.2.2 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.

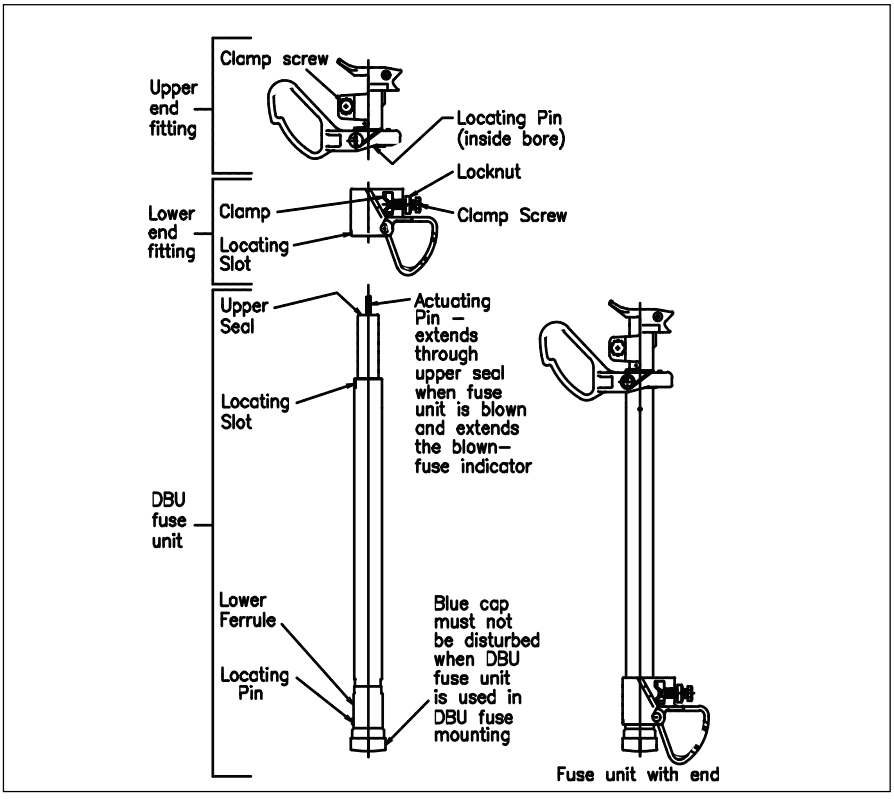
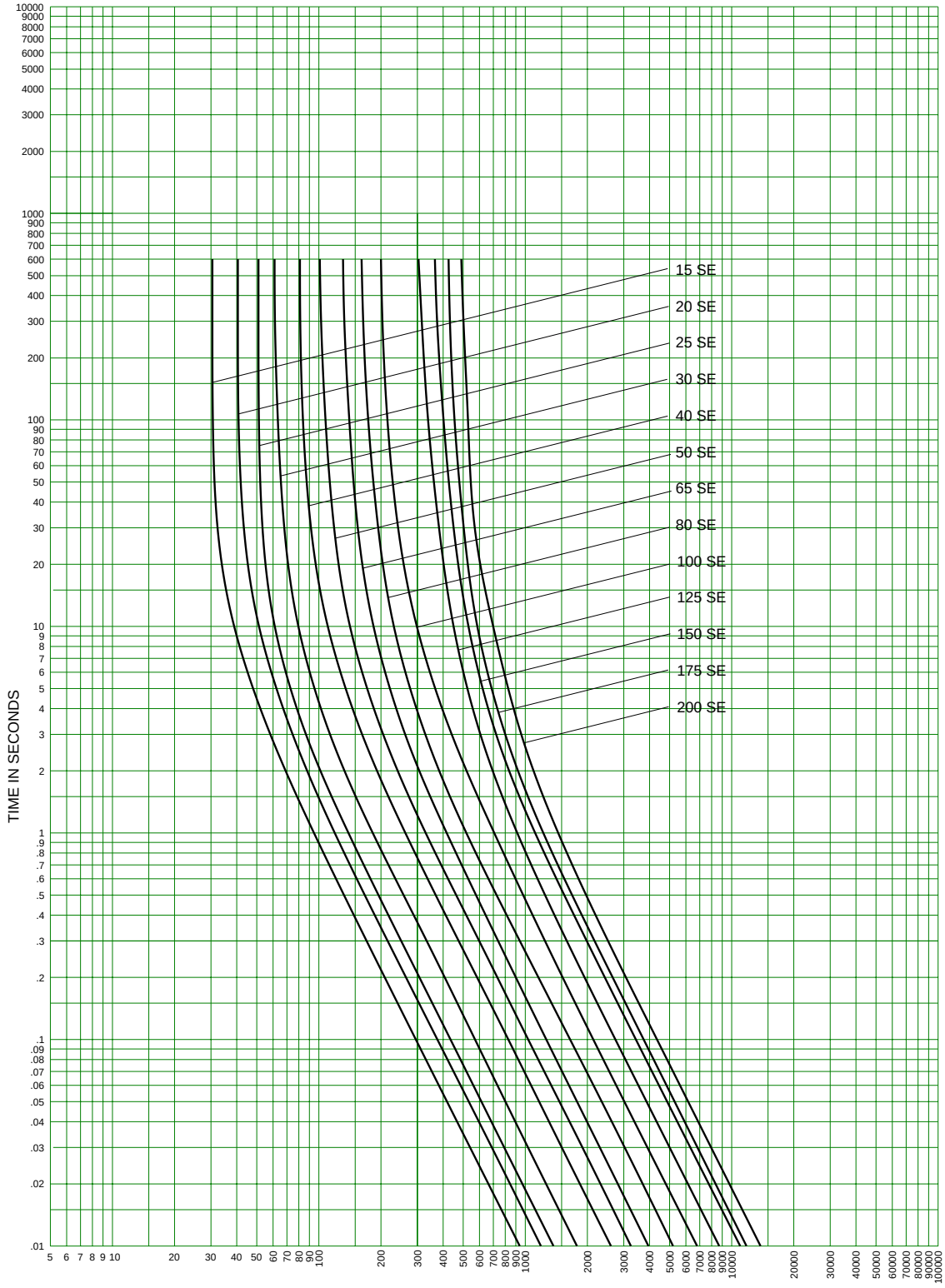


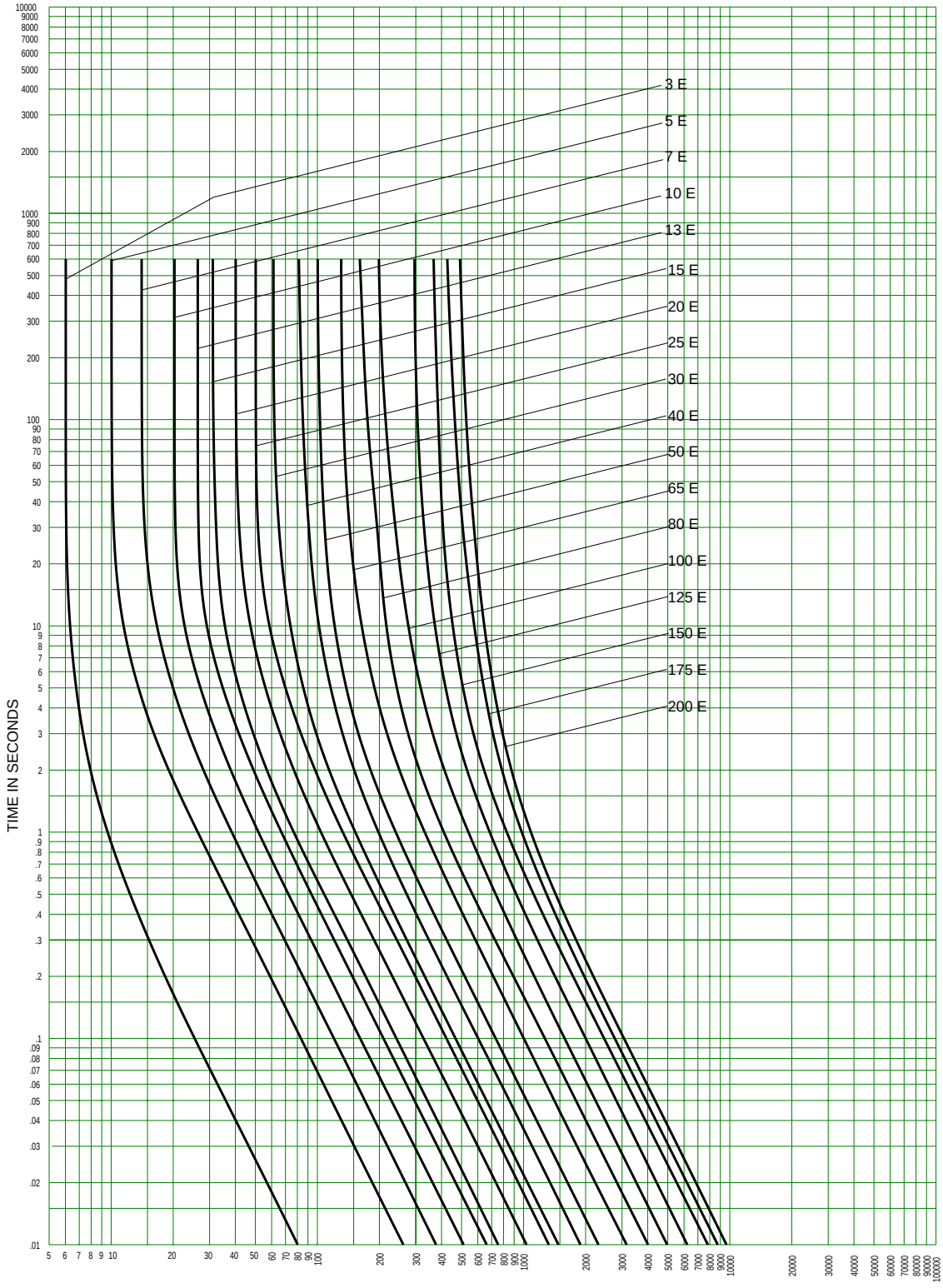
Figure 11: Outdoor DBU Fuse Fittings



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

CURVE 36-643 # 10
July 21, 1999
Reference # 667026

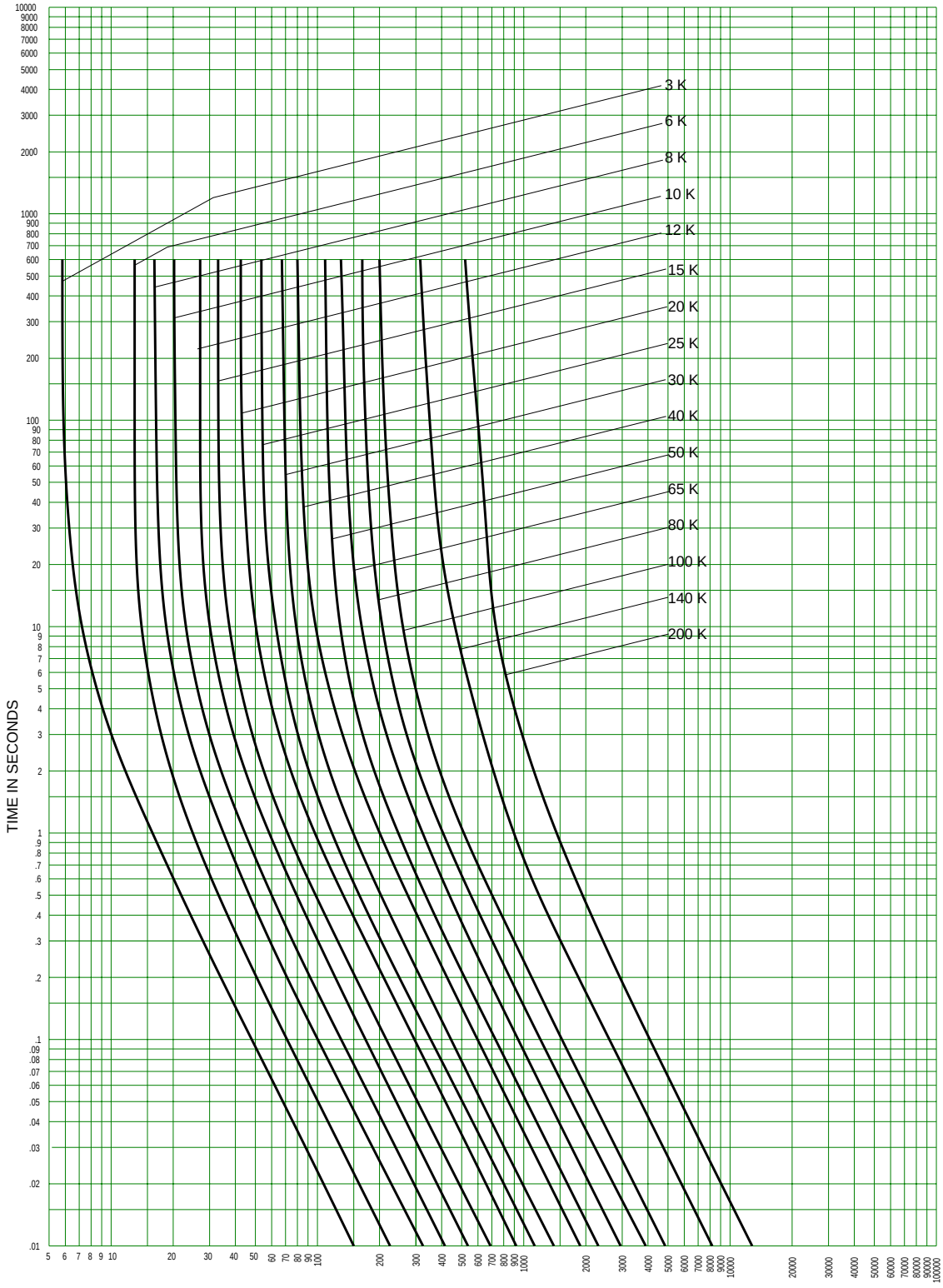
Curves are based on tests starting with fuse unit at ambient temperature of 25°C and without initial load.
Curves are plotted to minimum test points so all variations should be positive.



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

CURVE 36-643 # 11
July 21, 1999
Reference # 667027

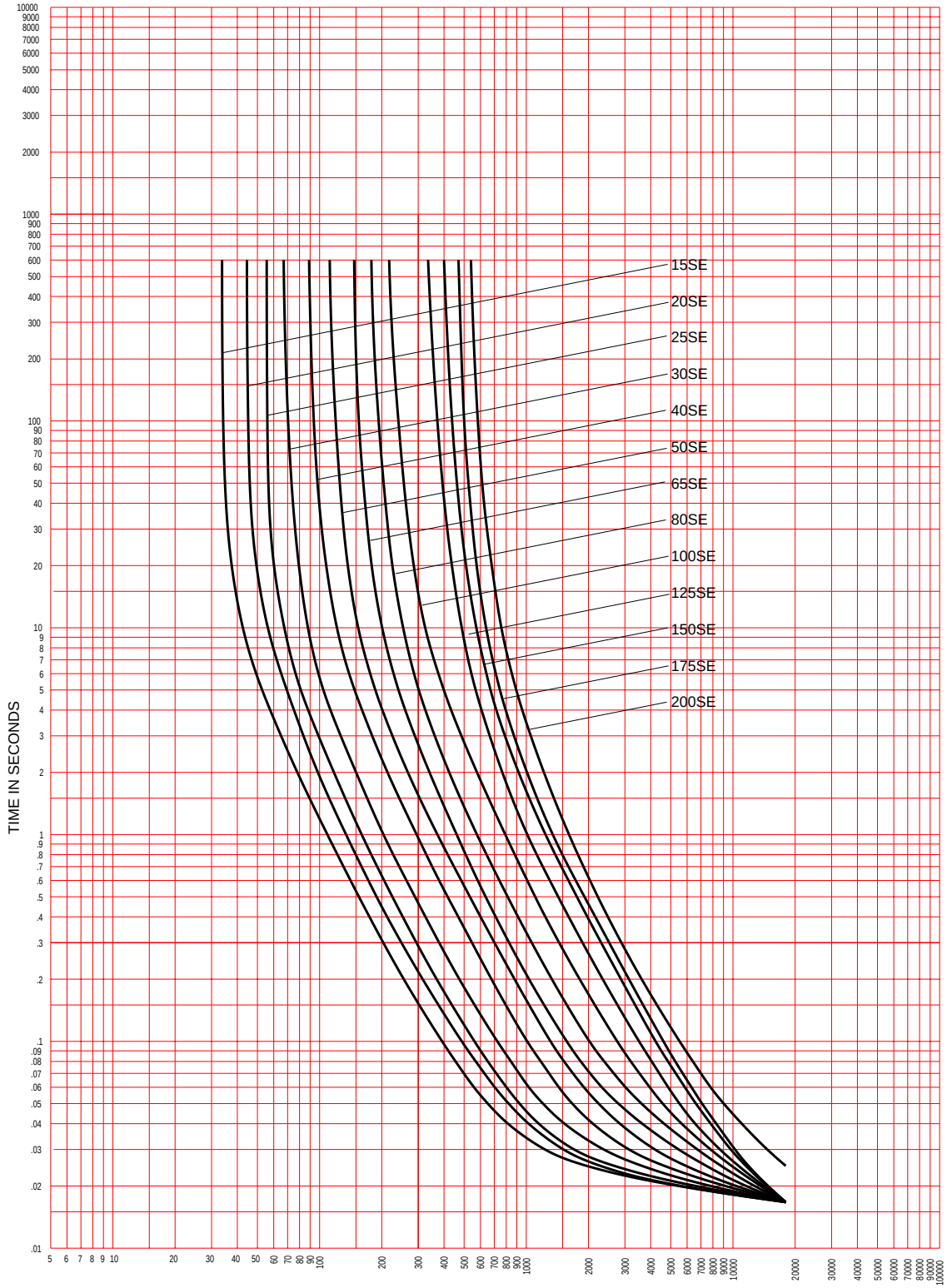
Curves are based on tests starting with fuse unit at ambient temperature of 25°C and without initial load.
Curves are plotted to minimum test points so all variations should be positive.



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

CURVE 36-643 # 12
July 21, 1999
Reference # 667028

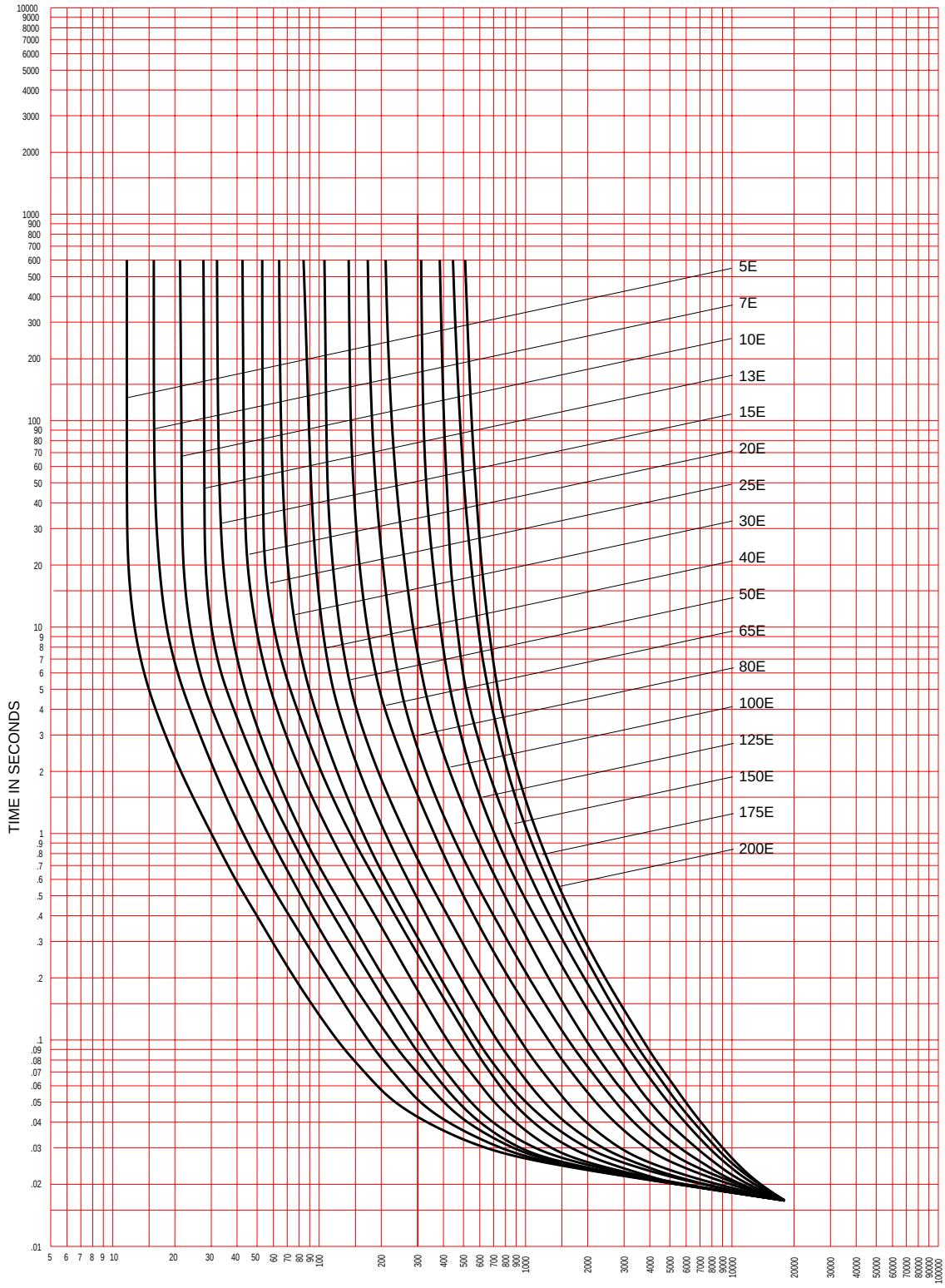
Curves are based on tests starting with fuse unit at ambient temperature of 25°C and without initial load.
Curves are plotted to minimum test points so all variations should be positive.



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

CURVE 36-643 # 13
July 21, 1999
Reference # 667029

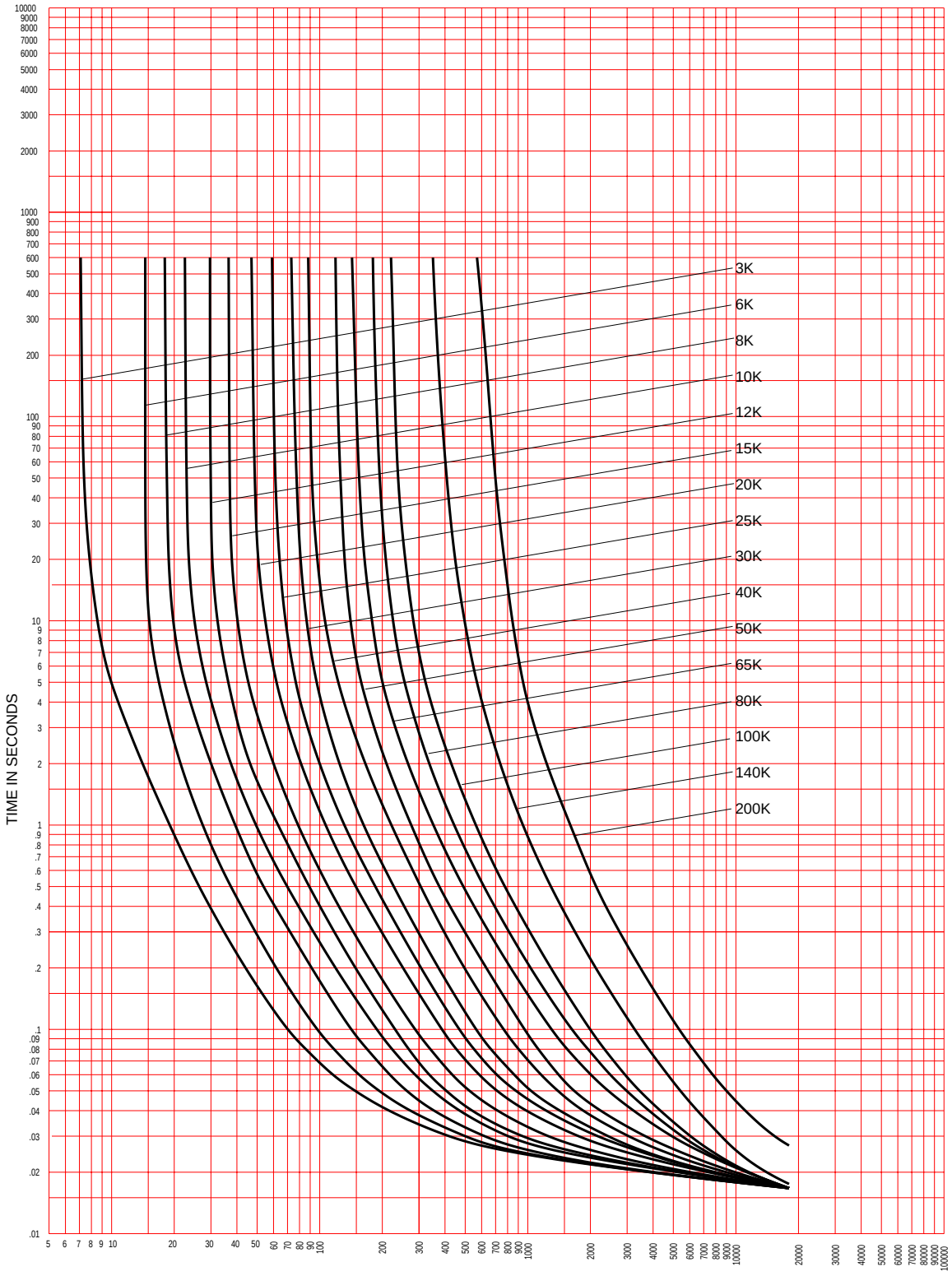
Curves are based on tests starting with fuse unit at ambient temperature of 25°C and without initial load.
Curves are plotted to maximum test points so all variations should be negative.



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

CURVE 36-643 # 14
July 21, 1999
Reference # 667030

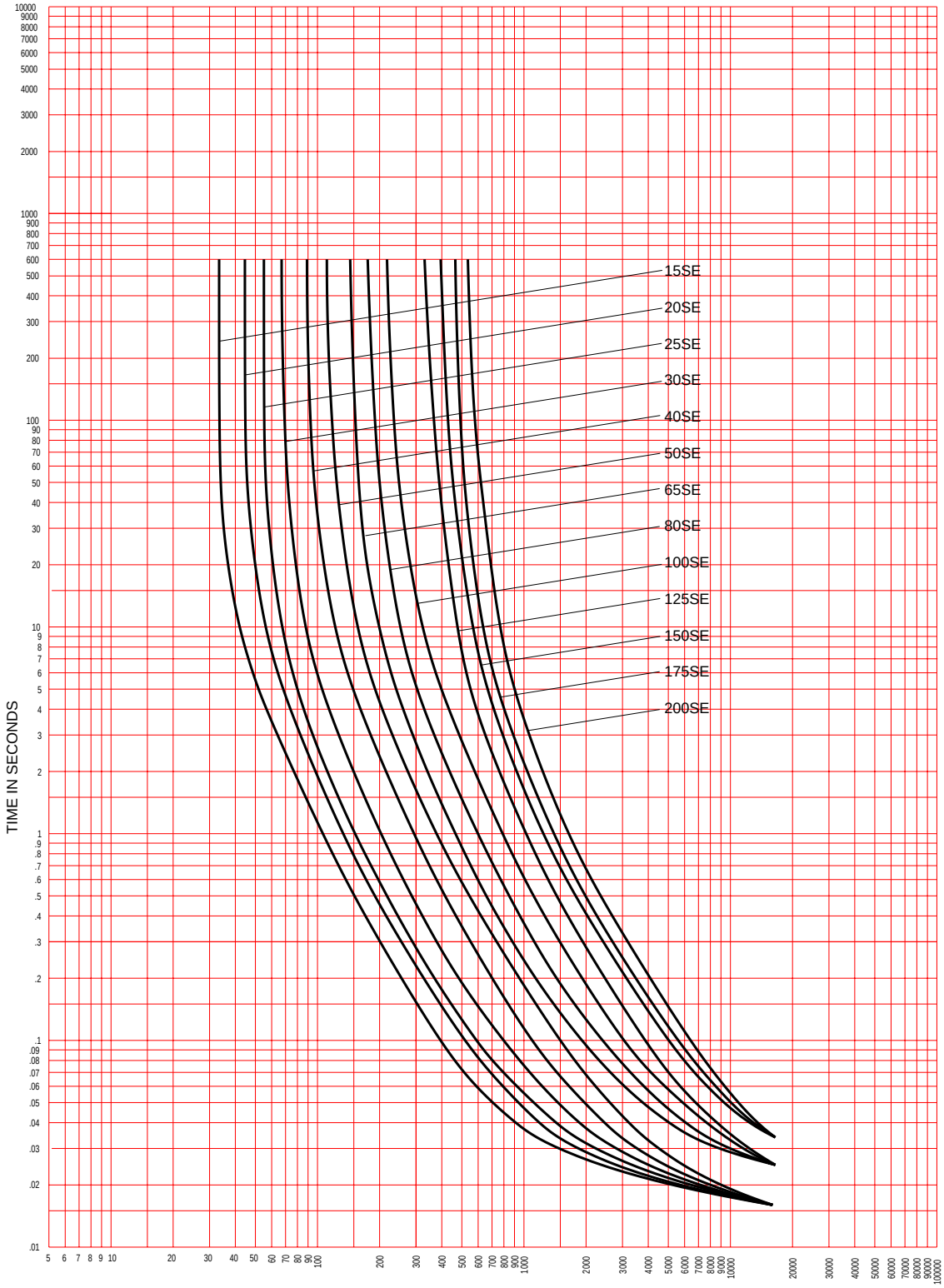
Curves are based on tests starting with fuse unit at ambient temperature of 25°C and without initial load.
Curves are plotted to maximum test points so all variations should be negative.



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

CURVE 36-643 # 15
July 21,
Reference # 667031

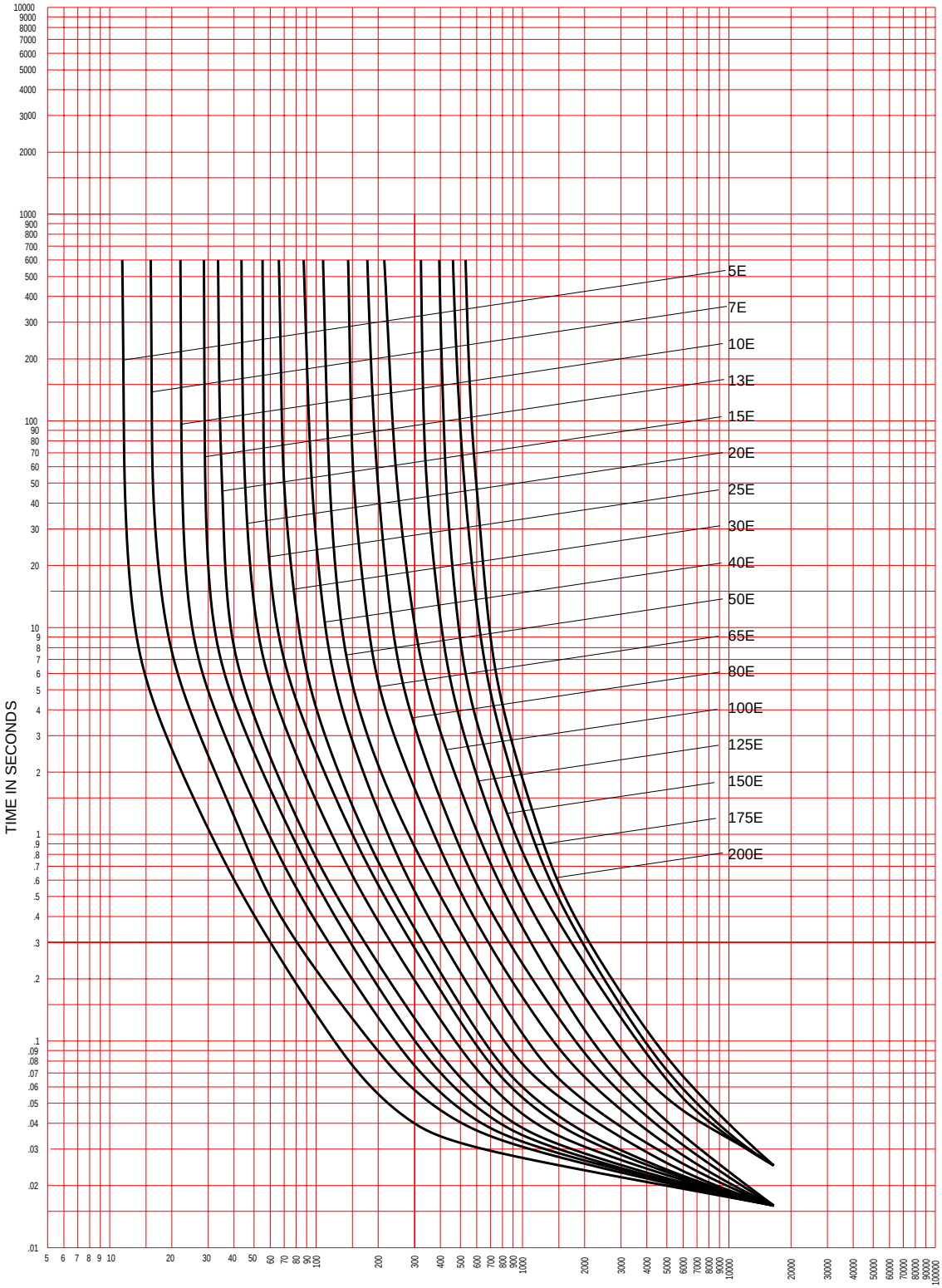
Curves are based on tests starting with fuse unit at ambient temperature of 25°C and without initial load.
Curves are plotted to maximum test points so all variations should be negative.



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

CURVE 36-643 # 16
January 5, 2000
Reference # 667038

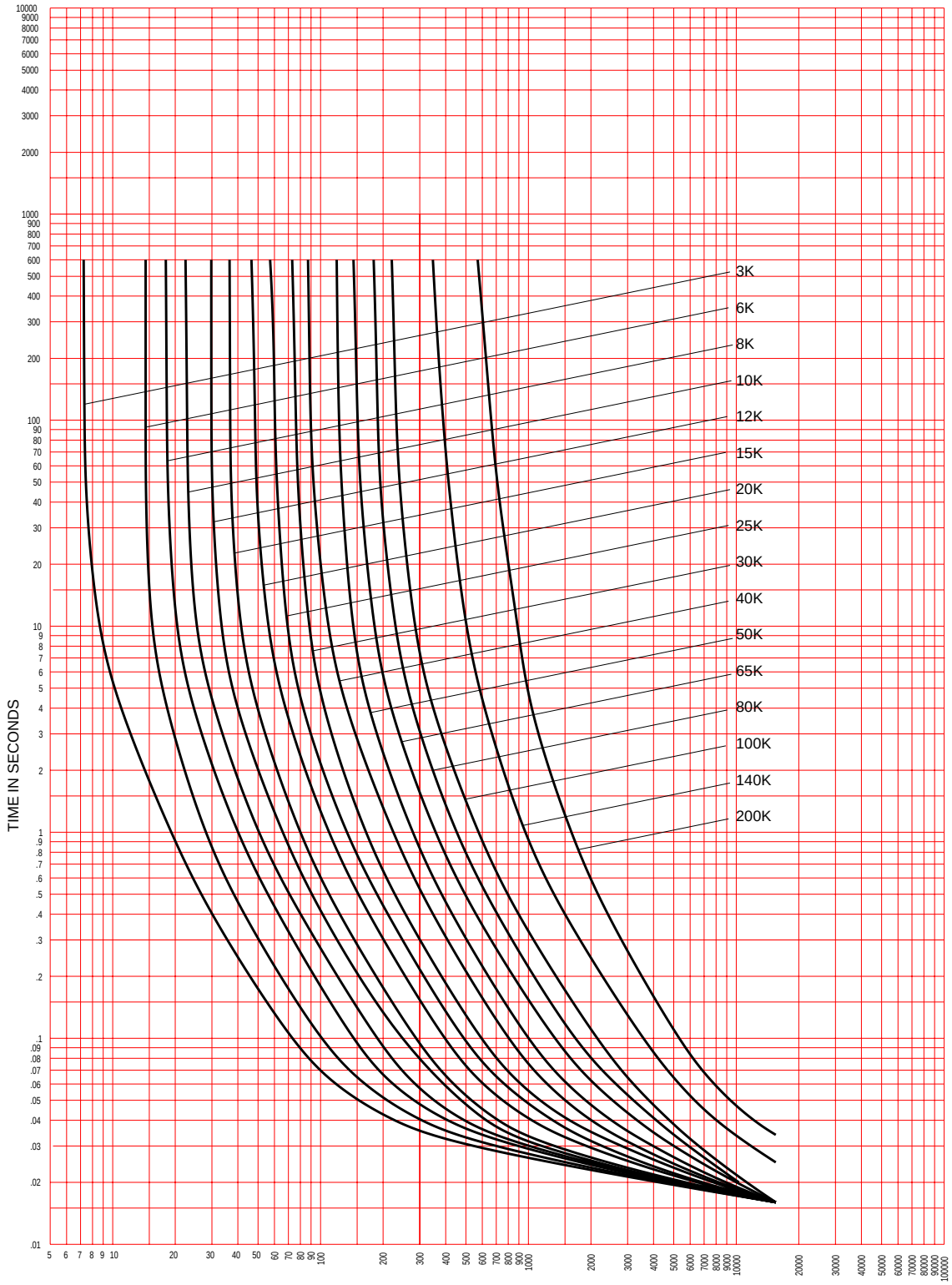
Curves are based on tests starting with fuse unit at ambient temperature of 25°C and without initial load.
Curves are plotted to maximum test points so all variations should be negative.



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

CURVE 36-643 # 17
January 6, 2000
Reference # 667039

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.

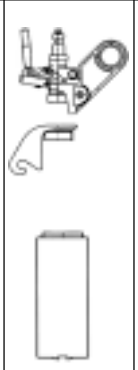
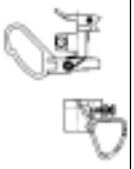
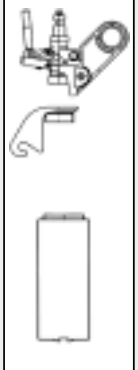
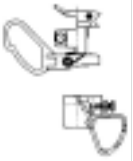
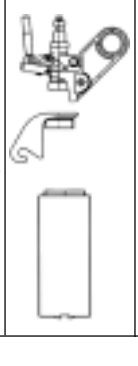
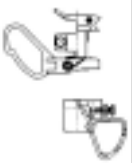


Type DBU Standard K Speed Fuses
Total Clearing Time-Current Characteristics - 27 and 38 kV

CURVE 36-643 # 18
January 6, 2000
Reference # 667040

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.

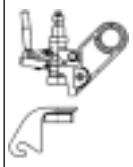
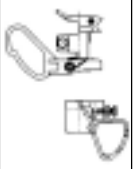
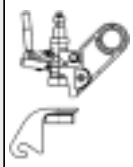
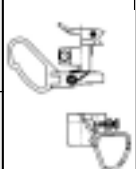
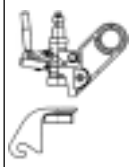
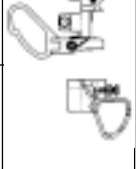
Type DBU Expulsion Fuses for Use Indoors or Outdoors

Rating Amperes	Catalog Number	Curve Reference 36-643	Max. Int. kA Sym	Approx. Shipping Wt.	Indoor									Outdoor								
					End Fittings	Catalog Number	Ampere Rating	Disconnect Fuse Mounting	Style	Voltage (kV)			Catalog Number		End Fittings	Catalog Number	Ampere Rating	Fuse Mounting	Style	Voltage (kV)			
										Nominal	Max	BIL	Mountings (Includes Live Parts)	Live Parts only						Nominal	Max	BIL	Catalog Number
3K	DBU17-3K	12, 15	14	2.1		DBU-EFID	3K to 200K		Non-Loadbreak	14.4	17.0	95	DBU17-GNM	DBU17-NL		DBU-EFOD	3K to 200K						
6K	DBU17-6K																					
8K	DBU17-8K																					
10K	DBU17-10K																					
12K	DBU17-12K																					
15K	DBU17-15K																					
20K	DBU17-20K																					
25K	DBU17-25K								Loadbreak	14.4	17.0	95	DBU17-GDM*	DBU17-DL*								
30K	DBU17-30K																					
40K	DBU17-40K																					
50K	DBU17-50K																					
65K	DBU17-65K																					
80K	DBU17-80K																					
100K	DBU17-100K																					
140K	DBU17-140K																					
200K	DBU17-200K																					
5E	DBU17-5E	11, 14	14	2.1		DBU-EFID	5E to 200E		Non-Loadbreak	14.4	17.0	95	DBU17-GNM	DBU17-NL		DBU-EFOD	5E to 200E						
7E	DBU17-7E																					
10E	DBU17-10E																					
13E	DBU17-13E																					
15E	DBU17-15E																					
20E	DBU17-20E																					
25E	DBU17-25E																					
30E	DBU17-30E																					
40E	DBU17-40E																					
50E	DBU17-50E								Loadbreak	14.4	17.0	95	DBU17-GDM*	DBU17-DL*								
65E	DBU17-65E																					
80E	DBU17-80E																					
100E	DBU17-100E																					
125E	DBU17-125E																					
150E	DBU17-150E																					
175E	DBU17-175E																					
200E	DBU17-200E																					
15E	DBU17-15SE	10,13	14	2.1		DBU-EFID	15SE to 200SE		Non-Loadbreak	14.4	17	95	DBU17-GNM	DBU17-NL		DBU-EFOD	15SE to 200SE						
20E	DBU17-20SE																					
25E	DBU17-25SE																					
30E	DBU17-30SE																					
40E	DBU17-40SE																					
50E	DBU17-50SE																					
65E	DBU17-65SE																					
80E	DBU17-80SE								Loadbreak	14.4	17	95	DBU17-GDM*	DBU17-DL*								
100E	DBU17-100SE																					
125E	DBU17-125SE																					
150E	DBU17-150SE																					
175E	DBU17-175SE																					
200E	DBU17-200SE																					

Note: Muffler can be ordered separately. Order Catalog number DBU-MFLR.

* To complete the Catalog Number, specify "R" for right side cable termination or "L" for left side cable termination.

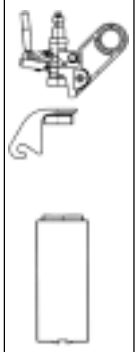
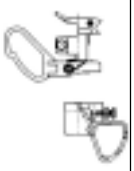
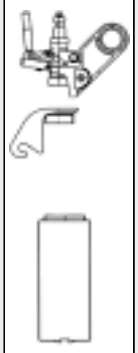
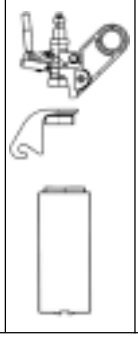
Type DBU Expulsion Fuses for Use Indoors or Outdoors

Rating Amperes	Catalog Number	Curve Reference 36-643	Max. Int. kA Sym	Approx. Shipping Wt.	Indoor									Outdoor								
					End Fittings	Catalog Number	Ampere Rating	Disconnect Fuse Mounting	Style	Voltage (kV)			Catalog Number		End Fittings	Catalog Number	Ampere Rating	Fuse Mounting	Style	Voltage (kV)			
										Nominal	Max	BIL	Mountings (Includes Live Parts)	Live Parts only						Nominal	Max	BIL	Catalog Number
3K	DBU27-3K					DBU-EFID	3K to 200K		Non-Loadbreak	25	27.0	125	DBU27-GNM	DBU27-NL		DBU-EFOD	3K to 200K							
6K	DBU27-6K																					
8K	DBU27-8K																					
10K	DBU27-10K																					
12K	DBU27-12K																					
15K	DBU27-15K																					
20K	DBU27-20K																					
25K	DBU27-25K																					
30K	DBU27-30K	12, 18	12.5	2.1					Loadbreak	25	27.0	125	DBU27-GDM*	DBU27-DL*								
40K	DBU27-40K																					
50K	DBU27-50K																					
65K	DBU27-65K																					
80K	DBU27-80K																					
100K	DBU27-100K																					
140K	DBU27-140K																					
200K	DBU27-200K																					
5E	DBU27-5E					DBU-EFID	5E to 200E		Non-Loadbreak	25	27.0	125	DBU27-GNM	DBU27-NL		DBU-EFOD	5E to 200E							
7E	DBU27-7E																					
10E	DBU27-10E																					
13E	DBU27-13E																					
15E	DBU27-15E																					
20E	DBU27-20E																					
25E	DBU27-25E																					
30E	DBU27-30E																					
40E	DBU27-40E																					
50E	DBU27-50E	11, 17	12.5	2.1					Loadbreak	25	27.0	125	DBU27-GDM*	DBU27-DL*								
65E	DBU27-65E																					
80E	DBU27-80E																					
100E	DBU27-100E																					
125E	DBU27-125E																					
150E	DBU27-150E																					
175E	DBU27-175E																					
200E	DBU27-200E																					
15E	DBU27-15SE					DBU-EFID	15SE to 200SE		Non-Loadbreak	25	27.0	125	DBU27-GNM	DBU27-NL		DBU-EFOD	15SE to 200SE							
20E	DBU27-20SE																					
25E	DBU27-25SE																					
30E	DBU27-30SE																					
40E	DBU27-40SE																					
50E	DBU27-50SE																					
65E	DBU27-65SE																					
80E	DBU27-80SE	10, 16	12.5	2.1					Loadbreak	25	27.0	125	DBU27-GDM*	DBU27-DL*								
100E	DBU27-100SE																					
125E	DBU27-125SE																					
150E	DBU27-150SE																					
175E	DBU27-175SE																					
200E	DBU27-200SE																					

Note: Muffler can be ordered separately. Order Catalog number DBU-MFLR.

* To complete the Catalog Number, specify "R" for right side cable termination or "L" for left side cable termination.

Type DBU Expulsion Fuses for Use Indoors or Outdoors

Rating Amperes	Catalog Number	Curve Reference 36-643	Max. Int. kA Sym	Approx. Shipping Wt.	Indoor									Outdoor							
					End Fittings	Catalog Number	Ampere Rating	Disconnect Fuse Mounting	Style	Voltage (kV)			Catalog Number		End Fittings	Catalog Number	Ampere Rating	Fuse Mounting	Style	Voltage (kV)			
										Nominal	Max	BIL	Mountings (Includes Live Parts)	Live Parts only						Nominal	Max	BIL	Catalog Number
3K	DBU38-3K	12, 18	10	2.8		DBU-EFID	3K to 200K		Non-Loadbreak	34.5	38.0	150	DBU38-GNM	DBU38-NL		DBU-EFOD	3K to 200K						
6K	DBU38-6K																						
8K	DBU38-8K																						
10K	DBU38-10K																						
12K	DBU38-12K																						
15K	DBU38-15K																						
20K	DBU38-20K							NA	Loadbreak														
30K	DBU38-30K																						
40K	DBU38-40K																						
50K	DBU38-50K																						
65K	DBU38-65K																						
80K	DBU38-80K																						
100K	DBU38-100K																						
140K	DBU38-140K																						
200K	DBU38-200K																						
5E	DBU38-5E	11, 17	10	2.8		DBU-EFID	5E to 200E		Non-Loadbreak	34.5	38.0	150	DBU38-GNM	DBU38-NL		DBU-EFOD	5E to 200E						
7E	DBU38-7E																						
10E	DBU38-10E																						
13E	DBU38-13E																						
15E	DBU38-15E																						
20E	DBU38-20E																						
25E	DBU38-25E																						
30E	DBU38-30E																						
40E	DBU38-40E																						
50E	DBU38-50E							NA	Loadbreak														
65E	DBU38-65E																						
80E	DBU38-80E																						
100E	DBU38-100E																						
125E	DBU38-125E																						
150E	DBU38-150E																						
175E	DBU38-175E																						
200E	DBU38-200E																						
15E	DBU38-15SE	10, 16	10	2.8		DBU-EFID	15SE to 200SE		Non-Loadbreak	34.5	38.0	150	DBU38-GNM	DBU38-NL		DBU-EFOD	15SE to 200SE						
20E	DBU38-20SE																						
25E	DBU38-25SE																						
30E	DBU38-30SE																						
40E	DBU38-40SE																						
50E	DBU38-50SE																						
65E	DBU38-65SE																						
80E	DBU38-80SE							NA	Loadbreak														
100E	DBU38-100SE																						
125E	DBU38-125SE																						
150E	DBU38-150SE																						
175E	DBU38-175SE																						
200E	DBU38-200SE																						

*Note: Muffler can be ordered separately. Order Catalog number DBU-MFLR.