

IEEE Std C37.40™-2003

(Revision of
IEEE Std C37.40-1993)

IEEE Standards

C37.40™

IEEE Standard Service Conditions and Definitions for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories

IEEE Power Engineering Society

Sponsored by the
Switchgear Committee



Published by
The Institute of Electrical and Electronics Engineers, Inc.
3 Park Avenue, New York, NY 10016-5997, USA

25 February 2004

Print: SH95182
PDF: SS95182

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Approved 11 September 2003

Reaffirmed 19 March 2009

IEEE-SA Standards Board

Approved 15 January 2004

American National Standards Institute

Abstract: Service conditions and definitions for high-voltage fuses (above 1000 V), distribution enclosed single-pole air switches, fuse disconnecting switches, and accessories for ac distribution systems are covered. These include enclosed, open, and open-link types of distribution cutouts and fuses; distribution current-limiting fuses; distribution enclosed single-pole air switches; power fuses, including current-limiting types; outdoor and indoor fuse disconnecting switches; fuse supports, mountings, switch sticks, and links, all of the type used exclusively with the above; and removable switch blades for certain products among the above.

Keywords: distribution enclosed single-pole air switch, fuse accessories, fuse disconnecting switch, high-voltage fuse

The Institute of Electrical and Electronics Engineers, Inc.
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Print: ISBN 0-7381-3838-X SH95182
PDF: ISBN 0-7381-3839-8 SS95182

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Introduction

(This introduction is not part of IEEE Std C37.40-2003, IEEE Standard Service Conditions and Definitions for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories.)

This standard is a revision of IEEE Std C37.40-1993, to bring it up-to-date and in-line with present day requirements for high-voltage fuses and switches. Supplement IEEE Std C37.40B™-1996 has been incorporated. Temperature rise requirements presently used in IEC fuse standards have been adopted, while altitude correction factors have been removed from the standard, due to the current controversy surrounding their use. Historically used altitude correction factors, together with proposals from the IEEE Switchgear Committee Common Clauses Working Group, have been put in informative Annex A and informative Annex B.

This standard was prepared by the Revision of Fuse Standards Working Group of the IEEE Subcommittee on High-Voltage Fuses. Liaison was maintained with the National Electrical Manufacturers Association (NEMA) and the International Electrotechnical Commission (IEC) during the development of the revisions in order to incorporate the latest activities at the time of publication. It is one of a series of complementary standards covering various types of high-voltage fuses and switches, arranged so that certain standards apply to all devices while other standards provide additional specifications for a particular device. For any device, IEEE Std C37.40-2003, IEEE Std C37.41™-2000, plus the additional standard covering that device, constitute a complete standard for the device. In addition, IEEE Std C37.48™-1997 is an application, operation, and maintenance guide for all the devices, and IEEE Std. C37.48.1™-2002 is an operation, classification, application, and coordination guide for current-limiting fuses.

The following standards make up this series:

ANSI C37.42-1996, American National Standard Specification for High Voltage Expulsion Type Distribution Class Fuses, Cutouts, Fuse Disconnecting Switches, and Fuse Links.

ANSI C37.45-1981 (Reaff 1992), American National Standard Specifications for Distribution Enclosed Single-Pole Air Switches.

ANSI C37.46-2000, American National Standard for High Voltage Expulsion and Current-Limiting Type Power Class Fuses and Fuse Disconnecting Switches.

ANSI C37.47-2000, American National Standard for High-Voltage Current-Limiting Type Distribution Class Fuses and Fuse Disconnecting Switches.

IEEE Std C37.40-2003, IEEE Standard Service Conditions and Definitions for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories.

IEEE Std C37.41-2000, IEEE Standard Design Tests for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories.

IEEE Std C37.48-1997, IEEE Guide for Application, Operation, and Maintenance of High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories.

IEEE Std C37.48.1-2002, IEEE Guide for the Operation, Classification, Application, and Coordination of Current-Limiting Fuses with Rated Voltages 1–38 kV.

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IEEE Standard Service Conditions and Definitions for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories

1. Overview

1.1 Scope

This standard applies to high-voltage (above 1000 V) fuses and equipment. This includes distribution class and power class fuses, distribution class enclosed single-pole air switches, distribution class and power class fuse disconnecting switches, and associated accessories that are intended for use on ac distribution systems. This standard applies to the following specific types of equipment:

- a) Distribution class and power class expulsion type fuses
- b) Distribution class and power class current-limiting fuses
- c) Distribution class and power class fuse disconnecting switches
- d) Items a) through c) used in fuse enclosure packages
- e) Fuse supports, fuseholders, fuse units, switch sticks and other parts and devices intended for use with distribution class and power class fuse disconnecting switches
- f) Switch blades of the type used exclusively with distribution class and power class fuses and distribution class and power class fuse disconnecting switches
- g) Fuse links when used exclusively with distribution class and power class fuses and distribution class and power class fuse disconnecting switches
- h) Distribution class enclosed single-pole air switches
- i) Distribution class and power class expulsion, current-limiting, and combination types of external capacitor fuses used with a capacitor unit, groups of units, or capacitor banks

1.2 Background

The distribution class and power class expulsion type fuses listed in 1.1 are similar to those now covered in IEC 60282-2: 1997.¹ The distribution class expulsion type fuses are similar to the class “A” fuse covered in the IEC standard and the power class fuses are similar to their class “B” fuses. At present, IEEE/ANSI standards do not cover the class “C” fuses listed in the IEC standard. Some of the current-limiting type fuses listed in 1.1 are similar to those now covered in IEC 60282-1: 2002. Use caution if devices specified and tested per IEC standards are compared to those specified and tested per IEEE/ANSI standards. Differences in test requirements between the two groups of standards may result in devices tested to IEC not being suitable for applications where devices tested to IEEE/ANSI standards are required, or vice versa.

Following certain definitions in Clause 4, there will be terms in brackets []. The information in the brackets is a term used in IEC standards that may be similar to the term used in this standard, a term that is common in some parts of the world, or a term that has been used previously in IEEE or ANSI standards. Caution is again advised when making comparisons.

2. References and related standards

This standard is intended to be used in conjunction with the following referenced standards. When the standard referenced below is superseded by an approved revision, the revised standard may or may not apply. At the time of publication of this standard, the editions listed below were valid. Since all standards are subject to revision at varying times, a revised standard may or may not apply. In the interim period prior to revision of this standard, all parties making agreements based on these standards are encouraged to investigate the possibility of using the most recent editions of the relevant standards.

ANSI C37.42-1996, American National Standard Specifications for High Voltage Expulsion Type Distribution Class Fuses, Cutouts, Fuse Disconnecting Switches and Fuse Links.²

ANSI C37.45-1981, American National Standard Specifications for High Voltage Distribution Class Enclosed Single-Pole Air Switches.

ANSI C37.46-2000, American National Standard for High Voltage Expulsion and Current-Limiting Type Distribution Class Fuses and Fuse Disconnecting Switches.

ANSI C37.47-2000, American National Standard for High Voltage Current-Limiting Type Distribution Class Fuses and Fuse Disconnecting Switches.

ANSI C37.53.1-1989 (Reaff 1996), American National Standard for High-Voltage Current-Limiting Motor-Starter Fuses—Conformance Test Procedures.

ANSI C84.1-1995 (Reaff 2001), American National Standard for Electric Power Systems and Equipment—Voltage Ratings (60 Hz).

IEC 60282-1: 2002, High Voltage Fuses—Part 1, Current-Limiting Fuses.³

IEC 60282-2: 1997, High Voltage Fuses—Part 2, Expulsion Fuses.

¹Information on references can be found in Clause 2.

²ANSI publications are available from the Sales Department, American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY 10036, USA (<http://www.ansi.org/>).

³IEC publications are available from the Sales Department of the International Electrotechnical Commission, Case Postale 131, 3, rue de Varembe, CH-1211, Genève 20, Switzerland/Suisse (<http://www.iec.ch/>). IEC publications are also available in the United States from the Sales Department, American National Standards Institute, 25 West 43rd Street, 6th Floor, New York, NY 10036, USA.

IEEE Std C37.41TM-2000, IEEE Standard Design Tests for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories.^{4,5}

IEEE Std C37.48TM-1997, IEEE Guide for Application, Operation, and Maintenance of High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories.

IEEE Std C37.48.1TM-2002, IEEE Guide for the Operation, Classification, Application, and Coordination of Current-Limiting Fuses with Rated Voltages 1–38kV.

IEEE Std C37.100TM-1992, IEEE Standard Definitions for Power Switchgear.

3. Service conditions

The capabilities, as defined in this standard, for fuses and other devices is predicated on the device being used and applied in accordance with the manufacturer's recommendations and under circuit conditions that are equal to or less severe than the conditions required by the specifications and testing standards for the device. The environment where the fuse is used may affect its performance and shall be carefully considered for all applications. Devices covered by this standard should not be closed into an energized circuit since they do not have making-current ability, and devices that do not have load-breaking means should not be opened with the circuit energized.

3.1 Usual service conditions

3.1.1 For fuses and switches rated for use at a maximum application temperature of 40 °C

Equipment conforming to this standard that is rated for use in a maximum application temperature of 40 °C or less shall be suitable for operation at its assigned ratings, provided the ambient temperature of the surrounding medium is not above 40 °C or below –30 °C, the altitude does not exceed 1000 m, and the frequency of the power system is 60 Hz.

3.1.2 For fuses and switches rated for use at a maximum application temperature above 40 °C

Equipment conforming to this standard that is rated for use in a maximum application temperature of greater than 40 °C shall be suitable for operation at its assigned ratings, provided the ambient temperature of the surrounding medium is not above its assigned maximum application temperature and it is not below –30 °C, the altitude does not exceed 1000 m, and the frequency of the power system is 60 Hz.

3.2 Other service conditions

The majority of fuses presently manufactured conform to the service conditions listed in 3.1. Fuses can be designed for other service conditions and still conform to this standard and the specification standards and applications guidelines listed in Clause 2, providing they are designed and tested with those other conditions considered in the design and testing process. Fuses are routinely designed for higher altitudes and power frequencies that are different from 60 Hz. Applications with conditions other than those listed in 3.1 should be brought to the attention of those responsible for the design and application. The following is a listing of some of the conditions that fuses have in the past been designed to accommodate:

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- a) Altitudes in excess of 1000 m (see 3.3)
- b) Power system frequencies other than 60 Hz
- c) Ambient temperatures less than -30°C
- d) Exposure to damaging fumes or vapors, excessive or abrasive dust, explosive mixtures of dust or gases, steam, salt spray, excessive moisture, or dripping water
- e) Exposure to abnormal vibration, shocks, or tilting
- f) Exposure to abnormal transportation or storage conditions
- g) Abnormal space limitations
- h) Abnormal operating duty, frequency of operation, difficulty of maintenance, etc.

3.3 Correction of altitudes in excess of 1000 m

Equipment covered by this standard that depends on air at atmospheric pressure for its insulating and cooling medium will have a higher temperature rise and a lower dielectric withstand when operated at altitudes higher than 1000 m. Historically, equipment covered by this standard has used correction factors for dielectric strength and rated continuous current when applied at altitudes above 1000 m. In addition, equipment designed for standard temperature use could be used at its normal rated continuous current without exceeding ultimate standard temperature limits, provided that the ambient temperature did not exceed the maximum ambient temperature assigned to the device in accordance with 3.1, multiplied by an appropriate factor. Altitude correction factors are being studied by the Switchgear Committee and will be added to this standard directly or by reference when they are approved. In the meantime, users should consult the manufacturer for appropriate derating when the equipment is applied above 1000 m. The historically used factors (from IEEE Std C37.40-1993 [B3])⁶ are listed in Annex A, and the factors proposed in the initial draft of IEEE PC37.100.1 [B1] are contained in Annex B.

4. Definitions

These definitions are recognized as standard only for the purposes of this particular standard and the fuse and switch standards listed in Clause 2.

4.1 General definitions

4.1.1 air switch: A switching device designed to close and open one or more electric circuits by means of guided separable contacts that separate in air. These devices have no load-break ability if they are not equipped with a load-breaking means.

NOTE—While this term is defined in IEEE Std C37.100-1992, the two definitions are not identical.

4.1.2 allowable continuous current (of replaceable fuse links, fuses that include the fusible element, fuse units, refill units, and other assemblies that include a fusible element): The allowable continuous current is the designated value of rms current, in amperes, at rated frequency, assigned by the manufacturer to these devices for a specific ambient temperature. The device shall be capable of carrying this allowable continuous current without exceeding the allowable total temperature specified in Table 1 when it is in the normal service position. *See also: rated continuous current.*

⁶The numbers in brackets correspond to those of the bibliography in Annex C.

Table 1—Limits of temperature and temperature rise for components and materials where the rated maximum application temperature for the device is 40 °C or less

Component or material ^{a,b}	Maximum value of	
	Temperature °C	Temperature rise °C
a) Contacts in air or other insulating gasses		
1) Spring-loaded contacts (copper or copper alloy)		
– Bare	75	35
– Tin coated	95	55
– Silver or nickel coated	105	65
– Other coatings ^a		
2) Bolted contacts or equivalent (copper, copper alloy and aluminum alloy)		
– Bare	90	50
– Tin coated	105	65
– Silver or nickel coated	115	75
– Other coatings ^a		
b) Contacts in liquid insulating material (copper or copper alloy)		
1) Spring-loaded contacts		
– Bare	80	40
– Silver, tin, or nickel coated	90	50
– Other coatings ^a		
2) Bolted contacts		
– Bare	80	60
– Silver, tin, or nickel coated	100	40
– Other coatings ^a		
c) Bolted terminals in air ^c		
– Bare	90	50
– Silver, tin, or nickel coated	105	65
– Other coatings ^a		
d) Metal parts acting as springs ^d		
e) Materials used as insulation and metal parts in contact with insulation of following classes:		
Bone fiber	70	30
90	90	50
105	105	65
130	130	90
155	155	115
180	180	140
220	220	180
Over 220 ^e		

^aIf the manufacturer uses coatings other than those indicated in this table, the properties of these materials should be taken into consideration.

^bWhere engaging contact surfaces have different coatings, the permissible temperatures and temperature rises shall be those of the component having the lowest values permitted.

^cThe temperature of a terminal should be no higher than that of the nearest device contact also subject to temperature limits covered by this table.

^dThe temperature or the temperature rise should not reach such a value that the elasticity of the metal is impaired.

^eLimited only by the requirement not to cause any damage to surrounding parts.

2—The maximum value of current that the device will carry without the device exceeding the total temperature may be higher, or it may be lower, than the assigned rated continuous current. The allowable continuous current is associated with a specific ambient temperature. The value of allowable continuous current varies with ambient temperature, and therefore, the device may have many allowable continuous currents. Higher values of allowable continuous current are normally associated with certain types of distribution fuse links and are allowed for specific application conditions. Lower values of allowable continuous current are normally associated with elevated ambient temperatures and specific application conditions.

3—Depending on the design of the device, the allowable continuous current and the rated continuous current may be the same at the rated maximum application temperature of the device.

3—For current-limiting fuses immersed in the top liquid of a liquid filled transformer, when the fuse is carrying the allowable continuous current assigned by the manufacturer, the temperatures specified in Table 1 may or may not be exceeded. This deviation from usual application procedures is allowable because of the fuse's particular design features and the use of solidly bolted current connection techniques.

4—At the time this standard, IEEE Std C37.40-2003, was approved, there was no corresponding definition in IEEE Std C37.100-1992.

4.1.3 ambient temperature: The temperature of the surrounding medium that comes in contact with the device or equipment.

4.1.4 arcing time (of a fuse): The time that elapses from the initiation of arcing in the current-responsive element(s) to the final interruption of the circuit, i.e., the length of the time that the fuse arcs.

NOTE—While this term is defined in IEEE Std C37.100-1992, the two definitions are not identical.

4.1.5 available short-circuit current (at a given point in a circuit): See: **prospective short-circuit current (at the point of test).**

NOTE—While this term is defined in IEEE Std C37.100-1992, the two definitions are not identical.

4.1.6 backup current-limiting fuse: A current-limiting fuse capable of interrupting all currents from its rated maximum interrupting current down to its rated minimum interrupting current. See also: **current-limiting fuse.**

NOTE—While this term is defined in IEEE Std C37.100-1992, the two definitions are not identical.

4.1.7 barrier: A partition for the insulation or isolation of electric circuits or electric arcs.

4.1.8 base: The supporting member of the equipment to which the insulator unit or units are attached. A base also normally has a means for attaching the equipment to the crossarm(s) or other mounting structure(s).

NOTE—While this term is defined in IEEE Std C37.100-1992, the two definitions are not identical.

4.1.9 basic impulse insulation level (BIL): See: **impulse withstand voltage; rated lightning impulse withstand voltage.**

NOTES

1—While this term is defined in IEEE Std C37.100-1992, the two definitions are not identical.

2—[rated impulse withstand voltage] See 1.2.

4.1.10 blade; disconnecting blade (of a switch or disconnecting cutout): A nonfusible electrically conducting part that, when in the closed position, bridges the fixed or stationary contacts or contact clips of the switch, allowing current to be conducted through the switch and the blade. Removing or repositioning this conducting part opens the connection between the contacts or contact clips of the switch. This isolates the fixed or stationary contacts, and thus prevents current from flowing through the switch.

NOTE—While this term is defined in IEEE Std C37.100-1992, the two definitions are not identical.