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(Revision of IEEE Std C37.40-1981)

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

Sponsor
Switchgear Committee
of the
IEEE Power Engineering Society

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Abstract: Service conditions and definitions for high-voltage fuses (above 1,000 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 oil cutouts; distribution enclosed single-pole air switches; power fuses, including current-limiting types; outdoor and indoor fuse disconnecting switches; fuse supports, mountings, hooks, 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

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Introduction

(This introduction is not a part of IEEE Std C37.40-1993, 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 C37.40-1981 (Reaff 1987) to bring it up-to-date and in line with present day requirements for high-voltage fuses and switches.

This standard was prepared by the IEEE Subcommittee on High-Voltage Fuses with cooperation from the C37 Subcommittee on High-Voltage Fuses and the National Electrical Manufacturers Association (NEMA). Liaison was maintained with Edison Electric Institute (EEI) and International Electrotechnical Commission (IEC) during the development of the revisions in order to incorporate the latest activities at the time of publication.

This standard 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 C37.40-1993, IEEE Std C37.41-1988, plus the additional standard covering that device, constitute a complete standard for the device. In addition, IEEE Std C37.48-1987 is an application, operation, and maintenance guide for all the devices.

The following standards make up this series:

ANSI C37.42-1989, Specifications for Distribution Cutouts and Fuse Links

ANSI C37.44-1981 (R1987), Specifications for Distribution Oil Cutouts and Fuse Links

ANSI C37.45-1981 (R1987), Specifications for Distribution Enclosed Single-Pole Air Switches

ANSI C37.46-1981 (R1987), Specifications for Power Fuses and Fuse Disconnecting Switches

ANSI C37.47-1981 (R1987), Specifications for Distribution Fuse Disconnecting Switches, Fuse Supports, and Current Limiting Fuses

IEEE Std C37.40-1993, IEEE Standard Service Conditions and Definitions for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories (ANSI)

IEEE Std C37.41-1988, IEEE Standard Design Tests for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories (ANSI)

IEEE Std C37.48-1987 (Reaff 1992), IEEE Guide for Application, Operation, and Maintenance of High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories (ANSI)

Suggestions for improvement gained in the use of this standard will be welcome.

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CLAUSE PAGE

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

1. Scope and references

1.1 Scope

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

a) Enclosed, open, and open-link types of distribution cutouts and fuses
b) Distribution current-limiting fuses
c) Distribution oil cutouts
d) Distribution enclosed single-pole air switches
e) Power fuses, including current-limiting types
f) Outdoor and indoor fuse disconnecting switches
g) Fuse supports, fuse mountings, fuse hooks, and fuse links, all of the type used exclusively with products listed in items a through f above
h) Removable switch blades for products listed in items a through c above

1.2 References

This standard shall be used in conjunction with the following publications:

ANSI C84.1-1989, Voltage Ratings for Electric Power Systems and Equipment (60 Hz).[1]

[1]ANSI publications are available from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036-8002, USA.

IEEE Std C37.41-1988, IEEE Standard Design Tests for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories (ANSI).[2]

IEEE Std C37.48-1987 (Reaff 1992), IEEE Guide for Application, Operation, and Maintenance of High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories (ANSI).

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

2. Service conditions

2.1 Usual service conditions

Equipment conforming to this standard shall be suitable for operation at its standard rating, provided that the ambient temperature of the surrounding medium is not above 40 °C or below −30 °C, the altitude does not exceed 1000 m (3300 ft), and the frequency of the system is 60 Hz.

2.2 Unusual service conditions

Where equipment is to be used under conditions other than those listed in 2.1 as usual conditions, the unusual conditions should be brought to the attention of those responsible for the design and application. Examples of such conditions follow:

a) Ambient temperature greater than 40 °C or less than −30 °C
b) Altitudes in excess of 1000 m (3300 ft); use corrections in 2.3
c) Exposure to damaging fumes or vapors, excessive or abrasive dust, explosive mixtures of dust or gases, steam, salt spray, excessive moisture, or dripping water
d) Exposure to abnormal vibration, shocks, or tilting
e) Exposure to unusual transportation or storage conditions
f) Unusual space limitations
g) Unusual operating duty, frequency of operation, difficulty of maintenance, etc.
h) System frequency other than 60 Hz

2.3 Correction of altitudes in excess of 1000 m (3300 ft)

Equipment that depends on air 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 (3300 ft).

Correction factors for dielectric strength and rated continuous current are given in columns 1 and 2 of table 1.

Equipment designed for standard temperature use may be used at its normal rated continuous current without exceeding ultimate standard temperature limits provided that the ambient temperature does not exceed the ambient allowed in 2.1, multiplied by the appropriate factor shown in column 3 of table 1.

[2]IEEE publications are available from the Institute of Electrical and Electronics Engineers, Service Center, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA.

Table 1— Altitude correction

Altitude above sea level		Altitude correction factor to be applied to		
		Dielectric strength	Rated continuous current	Ambient temperature
Meters	Feet	1	2	3
1000	3300	1.00	1.00	1.00
1200	4000	0.98	0.99	0.992
1500	5000	0.95	0.99	0.980
1800	6000	0.92	0.98	0.968
2100	7000	0.89	0.98	0.956
2400	8000	0.86	0.97	0.944
2700	9000	0.83	0.96	0.932
3000	10 000	0.80	0.96	0.920
3600	12 000	0.75	0.95	0.896
4300	14 000	0.70	0.93	0.872
4900	16 000	0.65	0.92	0.848
5500	18 000	0.61	0.91	0.824
6100	20 000	0.56	0.90	0.800

NOTE — Use one correction factor from columns 2 or 3, but not both, for any one application. If the derating, as determined from the table, is significant, equipment of suitable higher rating should be chosen to meet requirements after the correction factor has been applied.

3. Definitions

Most of the following definitions are taken from those given in IEEE Std C37.100-1992. [3]

A dagger (†) following a definition indicates that while the term is defined in IEEE Std C37.100-1992, the two definitions are not identical.

An asterisk (*) indicates that at the time this standard was approved, there were no corresponding definitions in IEEE Std C37.100-1992.

These definitions are recognized as standard only for the purposes of this particular standard.

3.1 General

3.1.1 air switch: A switch with contacts that separate in air.†

[3]Information on references can be found in 1.2.

3.1.2 allowable continuous current (of a fuse link, fuse unit or refill unit): The maximum rms current in amperes at rated frequency and at a specific ambient temperature, which a device will carry continuously without exceeding the allowable total temperature as listed in table 2.*

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

3.1.4 arc-extinguishing medium (fuse filler): Material included in the fuse to facilitate current interruption.

3.1.5 arcing time (of a fuse): The time elapsing from the severance of the current-responsive element to the final interruption of the circuit.

3.1.6 available (prospective) short-circuit current (at a given point in a circuit): See 3.1.107, prospective (available) short-circuit current.†

3.1.7 back-connected fuse: A fuse in which the current-carrying conductors are fastened to the studs in the rear of the mounting base.*

3.1.8 backup current-limiting fuse: A fuse capable of interrupting all currents from the maximum rated interrupting current down to the rated minimum interrupting current.†

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

3.1.10 base: The supporting member to which the insulator unit or units are attached.

3.1.11 basic impulse insulation level (BIL) (rated impulse withstand voltage): A reference impulse insulation strength expressed in terms of the crest value of the withstand voltage of a standard full impulse voltage wave.

3.1.12 blade (disconnecting blade of a switch or disconnecting cutout): The moving contact member that enters or embraces the contact clips.†

NOTE — In distribution cutouts, the blade may be a non-fusible member for mounting on a fuse carrier in place of a fuse link, or in a fuse support, in place of a fuseholder.

3.1.13 break distance (of a switching device): The minimum open-gap distance between the main-circuit contacts, or live parts connected thereto, when the contacts are in the open position.

NOTE — In a multiple-break device, it is the sum of the breaks in series.

3.1.14 clearing time (total clearing time) (of a fuse): The time elapsing from the beginning of a specified overcurrent to the final circuit interruption at rated maximum voltage.

NOTE — The clearing time is equal to the sum of melting time and the arcing time.

3.1.15 conducting element (fuse link) (of a fuse): The conducting means, including the current-responsive element, for completing the electric circuit between the terminals of a fuseholder or fuse unit.

3.1.16 current-carrying part: A conducting part intended to be connected in an electric circuit to a source of voltage.

NOTE — Non-current-carrying parts are those not intended to be so connected.

3.1.17 current-limiting (peak let-through or cut-off) characteristic curve (of a current-limiting fuse): A curve showing the relationship between the maximum peak current passed by a fuse and the correlated rms prospective current magnitude under specified voltage and circuit impedance conditions.†

NOTE — The rms prospective current may be symmetrical or asymmetrical.

3.1.18 current-limiting fuse unit: A fuse unit that, when its current-responsive element is melted by a current within the fuse's specified current-limiting range, abruptly introduces a high resistance to reduce current magnitude and duration, resulting in subsequent current interruptions.†

NOTES:

1 — The values specified in standards for the threshold ratio, peak let-through current, and I^2t characteristics are used as the measures of current-limiting ability.

2 — There are two classes of current-limiting fuse units—power and distribution. They are differentiated from one another by current ratings and minimum melting time-current characteristic.

3.1.19 current-responsive element (of a fuse): That part with predetermined characteristics, the melting and severance or severances of which initiate the interrupting function of the fuse.

NOTE — The current-responsive element may consist of one or more fusible elements combined with a strain element or other components, or both, which affect(s) the current-responsive characteristic.

3.1.20 cutout: See 3.1.24, distribution cutout.

3.1.21 disconnecting switch: A switch used for changing the connections in a circuit, or for isolating a circuit or equipment from the source of power.†

NOTE — The switch is required to carry normal load current continuously and also abnormal or short-circuit currents for short intervals as specified. It is also required to open or close circuits either when negligible current is broken or made, or when no significant change in the voltage across the terminals of each of the switch poles occurs. Some disconnecting switches have some inherent load-break ability which can best be evaluated by the user, based on experience under operating conditions.

3.1.22 distribution (used as an adjective): A general term used, by reason of specific physical or electrical characteristics, to denote application or restriction of the modified term, or both, to that part of an electrical system used for conveying energy to the point of utilization from a source or from one or more main receiving stations.

NOTES:

1 — From the standpoint of a utility system, the area described is between the generating source or intervening substations and the customer's entrance equipment.

2 — From the standpoint of a customer's internal system, the area described is between a source or receiving station within the customer's plant and the points of utilization.

3.1.23 distribution current-limiting fuse: A fuse consisting of a fuse support and a current-limiting fuse unit.

NOTE — In addition, the distribution current-limiting fuse is identified by the following characteristics:
a) Dielectric withstand basic impulse insulation level (BIL) strengths at distribution levels
b) Application primarily on distribution feeders and circuits
c) Operating voltage limits correspond to distribution system voltage

3.1.24 distribution cutout: A fuse or disconnecting device consisting of any one of the following assemblies:
a) A fuse support and fuseholder that may or may not include the conducting element (or fuse link)
b) A fuse support and disconnecting blade
c) A fuse support and fuse carrier that may or may not include the conducting element (fuse link) or disconnecting blade

NOTE — In addition, the distribution cutout is identified by the following characteristics:
a) Dielectric withstand (BIL) (basic impulse insulation level) strengths at distribution levels
b) Application primarily on distribution feeders and circuits
c) Mechanical construction basically adapted to pole or crossarm mounting except for the distribution oil cutout
d) Operating voltage limits correspond to distribution system voltage

3.1.25 distribution disconnecting cutout: A distribution cutout having a disconnecting blade that is used for closing, opening, or changing the connections in a circuit or system, or for isolating purposes.†

NOTE — Some load-break ability is inherent in the device but it has no load-break rating. This ability can best be evaluated by the user based on experience under operating conditions.

3.1.26 distribution enclosed single-pole air switch (distribution enclosed air switch): A single-pole disconnecting switch in which the contacts and blade are mounted completely within an insulated enclosure (cannot be converted into a distribution cutout or disconnecting fuse).

NOTES:

1 — The distribution enclosed air switch is identified by the following characteristics:
a)Dielectric withstand basic impulse insulation level (BIL) strengths at distribution level
b)Application primarily on distribution feeders and circuits
c)Mechanical construction basically adapted to crossarm mounting

d)Operating voltage limits correspond to distribution voltages
e)Unless incorporating load-break means, it has no interrupting load-break current rating

2 — Some load-break ability is inherent in the device. This ability can best be evaluated by the user based on experience under operating conditions.

3.1.27 distribution fuse cutout: A distribution cutout having a fuseholder or fuse carrier and fuse link or a fuse unit.†

NOTE — A fuse cutout is a fuse disconnecting switch. It has some inherent load-break ability but does not have a load-break rating. The load-break ability can best be evaluated by the user based on experience under operating conditions.

3.1.28 dropout fuse: A fuse in which the fuseholder or fuse unit automatically drops into an open position after the fuse has interrupted the circuit.

3.1.29 electrical interchangeability (of fuse links or fuse units): The characteristic that permits the designs of various manufacturers to be used interchangeably so as to provide a uniform degree of overcurrent protection and fuse coordination.

3.1.30 enclosed cutout: A cutout in which the fuse clips and fuseholder or disconnecting blade are mounted completely within an insulating enclosure.

3.1.31 entrance terminal (for distribution oil cutouts): A terminal with an electrical connection to the fuse contact and suitable insulation where the connection passes through the housing.

3.1.32 expansion chamber (for a distribution oil cutout): A sealed chamber separately attachable to the vent opening to provide additional air space into which the gases developed during circuit interruption can expand and cool.

3.1.33 expendable-cap cutout: An open cutout having a fuse support designed for, and equipped with, a fuse holder having an expendable cap.

3.1.34 expendable cap (of an expendable-cap cutout): A replacement part or assembly for clamping the button head of a fuse link and closing one end of the fuseholder. It includes a pressure-responsive section which opens to relieve the pressure within the fuseholder when a predetermined value is exceeded during circuit interruption.

3.1.35 explosionproof fuse: A fuse, so constructed or protected, that for all current interruptions within its rating shall not be damaged nor transmit flame to the outside of the fuse.

3.1.36 expulsion fuse (unit): A vented fuse (unit) in which the expulsion effect of the gases produced by internal arcing, either alone or aided by other mechanisms, results in current interruption.†

3.1.37 factory-renewable fuse unit: A fuse unit that, after circuit interruption, must be returned to the manufacturer to be restored for service.

3.1.38 field-renewable fuse unit: A fuse unit that, after circuit interruption, may be readily restored for service by the replacement of the fuse link or refill unit.†

3.1.39 front- and back-connected fuse: A fuse in which one or more current-carrying conductors are connected directly to the fixed terminals located at the front of the mounting base, with the remaining conductors connected to the studs on the back of the mounting base.†

3.1.40 front-connected fuse: A fuse in which the current-carrying conductors are fastened to the fixed terminals in front of the mounting base.†

3.1.41 full-range current-limiting fuse: A fuse capable of interrupting all currents from the rated interrupting current down to the minimum continuous current that causes melting of the fusible element(s), with the fuse applied at the maximum ambient temperature specified by the fuse manufacturer.*

3.1.42 fuse: A current-responsive protective device with a circuit-opening fusible part that is heated and severed by passage of current through it, creating an arc within the fuse. The interaction of the arc with certain other parts of the fuse results in current interruption.†

NOTE — A fuse comprises all the parts that form a unit capable of performing the prescribed functions. It may or may not be the complete device necessary to connect it into an electric circuit.

3.1.43 fuse carrier (for a distribution oil cutout): An assembly of a cap that closes the top opening of an oil-cutout housing, an insulating member, and fuse contacts with means for making contact with the conducting element and for insertion into the fuse contacts of the fuse support.

NOTE — The fuse carrier does not include the conducting element (fuse link).

3.1.44 fuse clips (contact clips or fuse contacts): The current-carrying parts of a fuse support that engage the fuse carrier, fuseholder, fuse unit, or blade.

3.1.45 fuse condenser: A device that, added to a vented fuse, converts it to a nonvented fuse by providing a sealed chamber for condensation of gases developed during circuit interruption.

3.1.46 fuse-disconnecting switch (disconnecting fuse): A disconnecting switch in which a fuse unit or fuseholder and fuse link form all or part of the blade.

3.1.47 fuse-enclosure package (FEP): An enclosure supplied with one or more fuses as a package for which application data covering the specific fuse(s) and enclosure are supplied.

3.1.48 fuseholder (of a high-voltage fuse): An assembly of a fuse tube or tubes together with parts necessary to enclose the conducting element and provide a means of making contact with the conducting element and the fuse clips. The fuseholder does not include the conducting element (fuse link or refill unit).

3.1.49 fuse hook (switch hook): A hook provided with an insulating handle for opening and closing fuses or switches and for inserting the fuseholder, fuse unit, or disconnecting blade into, and for removing it from, the fuse support.

3.1.50 fuse link: A replaceable part or assembly, made up entirely or principally of the conducting element required to be replaced after each circuit interruption to restore the fuse to operating condition.

3.1.51 fuse muffler: An attachment for the vent of a fuse, or a vented fuse, that confines the arc and substantially reduces the venting from the fuse.

3.1.52 fuse support (fuse mounting): An assembly of base or mounting support or oil cutout housing, insulator(s) or insulator unit(s), and fuse clips for mounting a fuse carrier, fuse holder, fuse unit, or blade and connecting it into the circuit.†

3.1.53 fuse time-current characteristic: The correlated values of time and current that designate the performance of all or a stated portion of the functions of the fuse.

NOTE — The time-current characteristics of a fuse are usually shown on a curve.

3.1.54 fuse tube: A tube of insulating material that encloses the conducting element.†

3.1.55 fuse unit: An assembly comprising a conducting element mounted in a fuseholder with parts and materials in the fuseholder essential to the operation of the fuse.

3.1.56 fusible element (of a fuse): That part, having predetermined current-responsive melting characteristics, which may be all or part of the current-responsive element.

3.1.57 general-purpose current-limiting fuse: A fuse capable of interrupting all currents from the rated interrupting current down to the current that causes melting of the fusible element in no less than 1 h.†

3.1.58 granular-filled fuse unit: A fuse unit in which the arc is drawn through powdered, granular, or fibrous material.

3.1.59 groundable parts: Those parts that may be connected to ground without affecting operation of the device.

3.1.60 grounded parts: Parts that are intentionally connected to ground.

3.1.61 guide: An attachment used to secure proper alignment when operating a fuse or switch.*

3.1.62 homogeneous series (of current-limiting fuse units): A series of fuse units deviating from each other only in such characteristics that, for a given test, the testing of one or a reduced number of particular fuse unit(s) of the series may be taken as representative of all the fuse units of the series.

3.1.63 housing (body) (of an oil cutout): A part of the fuse support that contains the oil and provides means for mounting the fuse carrier, entrance terminals, and fixed contacts. The housing includes the means for mounting the cutout on a supporting structure and openings for attaching accessories such as a vent or an expansion chamber.

3.1.64 impulse withstand voltage: The crest voltage of an impulse that, under specified conditions, can be applied without causing flashover or puncture.

3.1.65 indicating fuse: A fuse that automatically indicates that the fuse has interrupted the circuit.

3.1.66 indoor: Designed for use inside buildings or weatherproof (weather-resistant) enclosures.†

NOTE — Because of the wide variety of enclosures available, when a fuse that is designed for indoor application is installed inside an outdoor enclosure, such installations should be verified with the fuse manufacturer.

3.1.67 insulating-material classifications: For the purpose of establishing temperature limits, insulating materials shall be classified as follows:

Class 90. Materials or combinations of materials such as cotton, silk, and paper without impregnation. Other materials, or combinations of materials may be included in this class if, by experience or accepted tests, they can be shown to be capable of operation at 90 °C.

Class 105. Materials or combinations of materials such as cotton, silk and paper when suitably impregnated or coated or when immersed in a dielectric liquid such as oil. Other materials or combinations of materials may be included in this class if, by experience or accepted tests, they can be shown to be capable of operation at 105 °C.

Class 130. Materials or combinations of materials such as mica, glass fiber, asbestos, etc., with suitable bonding substances. Other materials or combinations of materials, not necessarily inorganic, may be included in this class if, by experience or accepted tests, they can be shown to be capable of operation at 130 °C.

Class 155. Materials or combinations of materials such as mica, glass fiber, asbestos, etc., with suitable bonding substances. Other materials or combinations of materials, not necessarily inorganic, may be included in this class if, by experience or accepted tests, they can be shown to be capable of operation at 155 °C.

Class 180. Materials or combinations of materials such as silicone elastomer, mica, glass fiber, asbestos, etc., with suitable bonding substances such as appropriate silicone resins. Other materials or combinations of materials may be included in this class if, by experience or accepted tests, they can be shown to be capable of operation at 180 °C.

Class 220. Materials or combinations of materials that by experience or accepted tests can be shown to be capable of operation at 220 °C.

Over Class 220. Insulation that consists entirely of mica, porcelain, glass, quartz, and similar inorganic materials. Other materials or combinations of materials may be included in this class if, by experience or accepted tests, they can be shown to be capable of operation at temperatures over 220 °C.*

NOTES:

1 — Insulation is considered to be *impregnated* when a suitable substance provides a bond between components of the structure and also a degree of filling and surface coverage sufficient to give adequate performance under the extremes of temperature, surface contamination (moisture, dirt, etc.), and mechanical stress expected in service. The impregnant shall not flow or deteriorate enough at operating temperature so as to seriously affect performance in service.

2 — The electrical and mechanical properties of the insulation shall not be *impaired* by the prolonged application of the limiting insulation temperature permitted for the specific insulation class. The word impaired is used here in the sense of causing any change that could disqualify the insulating material for continuously performing its intended function, whether it is creepage, spacing, mechanical support, or dielectric barrier action.

3 — In the above descriptions of insulating materials classifications, the words *accepted tests* refer to recognized test procedures established for the thermal evaluation of materials by themselves or in simple combinations. Experience or test data, used in classifying insulating materials, are distinct from the experience or test data derived for the use of materials in complete insulation systems. The thermal endurance of complete systems may be determined by test procedures specified by the responsible technical committees. A material that is classified as suitable for a given temperature in the above tabulation may be found suitable for a different temperature other than the given one, either higher or lower, by an insulation system test procedure. For example, it has been found that some materials suitable for operation at one temperature in air may be suitable for a higher temperature when used in a system operated in an inert gas atmosphere.

4 — It is important to recognize that other characteristics, in addition to thermal endurance, such as mechanical strength, moisture resistance, and corona endurance, are required in varying degrees in different applications for the successful use of insulating materials.

3.1.68 insulation: A material having the property of an insulator used to separate parts of the same or different potential.

3.1.69 insulator unit: An insulator assembled with such metal parts as may be necessary for attaching it to other insulating units or device parts.

3.1.70 latch: An attachment used to hold a fuse or switch in the closed position.

3.1.71 lifting eye (of a fuseholder, fuse unit, or disconnecting blade): An eye provided for receiving a fuse hook or switch hook for inserting the fuse or disconnecting blade into, and for removing it from, the fuse support.

3.1.72 link-break cutout: A load-break fuse cutout that is operated by breaking the fuse link to interrupt the load current.

3.1.73 liquid-filled fuse unit: A fuse unit in which the arc is drawn through a liquid.

3.1.74 live parts: Those parts that are designed to operate at a voltage different from that of the earth.

3.1.75 load-break cutout: A cutout with means for interrupting load currents.

3.1.76 mechanical interchangeability (of fuse links): The characteristic that permits the designs of various manufacturers to be interchanged physically so that they fit into and withstand the tensile stresses imposed by various types of prescribed cutouts made by different manufacturers.

3.1.77 melting speed ratio: The ratio between 0.1 s and 300 s or 600 s minimum melting currents, whichever is specified, which designates the relative speed of the fuse link.†

3.1.78 melting time (of a fuse): The time required for overcurrent to sever the current-responsive element.

3.1.79 minimum clearance between poles (phases): The shortest distance between any live parts of adjacent poles (phases).

NOTE — Cautionary differentiation should be made between clearance and spacing or center-to-center distance.

3.1.80 minimum clearance to ground: The shortest distance between any live part and adjacent grounded parts.

3.1.81 minimum melting current: The smallest current at which a current responsive fuse element will melt at any specified time.

3.1.82 mounting position (of a switch or fuse support): A position determined by, and corresponding to, the position of the base of the device.

NOTE — The usual positions are

a) Vertical
b) Horizontal upright (when the fuse holder or fuse unit is mounted above the supporting insulators)
c) Horizontal underhung (when the fuse holder or fuse unit is mounted below the supporting insulators)
d) Angle (from vertical)

3.1.83 multipole fuse: An assembly of two or more single-pole fuses.†

3.1.84 nondisconnecting fuse: An assembly consisting of a fuse unit or fuseholder and a fuse support having clips for directly receiving the associated fuse unit or fuseholder, which has no provision for guided operation as a disconnecting switch.

3.1.85 nonrenewable fuse unit: A fuse unit that, after circuit interruption, cannot readily be restored for service.†

3.1.86 nonvented fuse (or fuse unit): A fuse without intentional provision for the escape of arc gases, liquids, or solid particles to the atmosphere during circuit interruption.

3.1.87 oil cutout (oil-filled cutout): A cutout in which all or part of the fuse support and its fuse link or disconnecting blade are mounted in oil with complete immersion of the contacts and the fusible portion of the conducting element (fuse link), so that arc interruption by severing of the fuse link or by opening of contacts will occur under oil.

3.1.88 oil-immersible current-limiting fuse unit: A current-limiting fuse unit suitable for application requiring total or partial immersion directly in oil or other dielectric liquid of a transformer or switchgear.

3.1.89 oil switch: A switch with contacts that separate in oil.†

3.1.90 open cutout: A cutout in which the fuse clips and fuseholder, fuse unit, or disconnecting blade are exposed.

3.1.91 opening eye (of a fuseholder, fuse unit, or disconnecting blade): An eye provided for receiving a fuse hook or switch hook for opening and closing the fuse.

3.1.92 open-link cutout: A cutout that does not employ a fuseholder and in which the fuse support directly receives an open-link fuse link or a disconnecting blade.

3.1.93 open-link fuse link: A replaceable part or assembly comprised of the conducting element and fuse tube, together with the parts necessary to confine and aid in extinguishing the arc and to connect it directly into the fuse clips of the open-link fuse support.

3.1.94 open-link fuse support: An assembly of base or mounting support, insulators or insulator unit, and fuse clips for directly mounting an open-link fuse link and for connecting it into the circuit.

3.1.95 outdoor: Designed for use outside buildings or enclosures.†

3.1.96 peak let-through cutoff current (of a current-limiting fuse): The highest instantaneous current passed by the fuse during the interruption of the circuit.

3.1.97 peak overvoltages (for current-limiting fuses): The peak value of the voltage that can exist across a current-limiting fuse during its arcing interval.†

3.1.98 performance characteristic (of a device): An operating characteristic, the limit or limits of which are given in the design test specifications.

3.1.99 phase spacing: The distance between center-lines of adjacent devices of differing phases.†

3.1.100 power (used as an adjective): A general term used by reason of specific physical or electrical characteristics to denote application or restriction, or both, to generating stations, switching stations, or substations.†

3.1.101 power-frequency dew withstand voltage: The rms voltage that can be applied to an insulator or a device, completely covered with condensed moisture, under specified conditions for a specified time without causing flashover or puncture.*

3.1.102 power-frequency dry withstand voltage: The rms voltage that can be applied to a dry device under specified conditions for a specified time without causing flashover or puncture.*

3.1.103 power-frequency recovery voltage: The power-frequency rms voltage that occurs across the terminals of an ac circuit-interrupting device after the interruption of the current and after the high-frequency transients have subsided.*

3.1.104 power-frequency wet withstand voltage: The rms voltage that can be applied to a wetted device under specified conditions for a specified time without causing flashover or puncture.*

3.1.105 power fuse: A fuse consisting of an assembly of a fuse support and a fuse unit or fuseholder that may or may not include the refill unit or fuse link.

NOTE — The power fuse is identified by the following characteristics:

a) Dielectric withstand basic impulse insulation level (BIL) strengths at power levels
b) Application primarily in stations and substations
c) Mechanical construction basically adapted to station and substation mountings

3.1.106 proof (used as a suffix): So constructed, protected, or treated that successful operation is not interfered with when the device is subjected to the specified material or condition.

NOTE — Explosionproof requires that the fuse shall not be injured and flame shall not be transmitted to the outside of the fuse for all current interruptions within the rating of the fuse.

3.1.107 prospective (available) short-circuit current (at a given point in a circuit): The maximum current that the power system can deliver through a given circuit point to any negligible impedance short circuit applied at the given point, or at any other point that will cause the highest current to flow through the given point.†

NOTES:

1 — This value can be in terms of either symmetrical or asymmetrical, peak, or rms current, as specified.

2 — In some resonant circuits, the maximum available short-circuit current may occur when the short-circuit is placed at some other point than the given one where the available current is measured.

3.1.108 quick-break switch: A switch that has a high contact opening speed independent of the operators.†

3.1.109 reclosing fuse: A combination of two or more fuseholders, fuse units, or fuse links mounted on a fuse support or supports, mechanically or electrically interlocked, so that one fuse at a time can be connected into the circuit and the functioning of that fuse automatically connects the next fuse into the circuit, with or without intentionally added time delay, thereby permitting one or more service restorations without replacement of fuse links, refill units, or fuse units.

3.1.110 recovery voltage: The voltage that occurs across the terminals of a pole of a circuit-interrupting device upon an interruption of the current.

3.1.111 refill unit (of a fuse unit): An assembly comprised of a conducting element, the complete arc-extinguishing medium, and parts normally required to be replaced after each circuit interruption to restore the fuse unit to its original operating condition.

3.1.112 resistant (used as a suffix): So constructed, protected, or treated that damage will not occur readily when the device is subjected to the specified material or condition.

3.1.113 slant-voltage-rated (multiple voltage rated) distribution cutout: A distribution cutout intended primarily for application on three-phase solidly grounded neutral (multi-grounded) systems where prescribed conditions exist. See 3.2.15, slant-voltage (multiple voltage) ratings of a distribution cutout.

3.1.114 solid-material fuse unit: A fuse unit in which the arc is drawn through a hole in solid material.

3.1.115 strain element (strain wire) (of a fuse): That part of the current-responsive element that is connected in parallel with the fusible element in order to relieve it of tensile strain.

NOTE — The fusible element melts and severs first, and then the strain element melts during circuit interruption.

3.1.116 submersible entrance terminals (cableheads) (of distribution oil cutouts): A hermetically sealable entrance terminal for the connection of cable having a submersible sheathing or jacket.

3.1.117 submersible fuse (subway oil cutout): A fuse that is so constructed that it will operate successfully when submerged in water under specified conditions of pressure and time.†

3.1.118 switch: A device designed to close or open, or both, one or more electric circuits.

3.1.119 terminal (terminal connector): A connector for attaching a conductor to electrical apparatus.

3.1.120 terminal pad: A usually flat conducting part of a device to which a terminal connector is fastened.

3.1.121 tight (used as a suffix): So constructed that the specific material is excluded under specified conditions.

3.1.122 transient recovery voltage (TRV): The voltage transient that occurs across the terminals of a pole of a circuit switching device upon interruption of the current.†

NOTE — TRV is the difference between the transient voltages to ground occurring on the terminals. The term may refer to a circuit TRV, a modified circuit TRV, or an actual TRV.

3.1.123 universal fuse links: Fuse links that, for each rating, provide mechanical and electrical interchange-ability within prescribed limits over the specified time-current range.

3.1.124 vent (of a fuse): The means provided for the escape of the gases developed during circuit interruption.

NOTE — In distribution oil cutouts, the vent may be an opening in the housing, or an accessory attachable to a vent opening in the housing, with suitable means to prevent loss of oil.

3.1.125 vented fuse (or fuse unit): A fuse with provision for the escape of arc gases, liquids, or solid particles to the surrounding atmosphere during circuit interruption.

3.2 Ratings

3.2.1 intermediate current ratings (of distribution fuse links): A series of distribution fuse-link ratings chosen from a series of preferred numbers that are spaced between the preferred current ratings, but may not provide coordination therewith. Coordination between adjacent intermediate ratings may be secured to the same degree as between adjacent preferred current ratings.*

3.2.2 preferred current ratings (of distribution fuse links): A series of distribution fuse-link ratings so chosen from a series of preferred numbers that a specified degree of coordination may be obtained between adjacent sizes.*

3.2.3 rated continuous current: The maximum rms current in amperes, at rated frequency, which a device will carry continuously without exceeding the allowable temperature rise and total temperature as listed in table 2.*

3.2.4 rated 15-cycle current (15-cycle current rating) (of a disconnecting device or assembly): The rms symmetrical current of an asymmetrical wave produced by a circuit having a prescribed X/R ratio, which the device or assembly is required to carry for 15 cycles.*

NOTE — This rating is an index of the ability of the disconnecting device to withstand heat that may be generated under short-circuit conditions.

3.2.5 rated frequency (frequency rating) (of a fuse): The system frequency for which it is designed.†

3.2.6 rated interrupting current (rated interrupting capacity) (current interrupting rating) (of a fuse): The designated value of the highest available rms short-circuit current that the fuse is required to interrupt successfully under stated conditions.*

3.2.7 rated load-break current (load-break current rating): The designated value of the maximum rms current that a device having operable means for interrupting load currents is required to interrupt successfully under stated conditions when opened by manual or remote control means.*

3.2.8 rated making current: The maximum rms current against which the device is required to close successfully when switched from the open to the closed position.*

Table 2— Summary of temperature limitations

Allowable temperature-rise (and total temperature shown in parentheses) Temperature shown in °C							
Device		**All conducting parts except conducting element of fuse link**				**All parts made up of, or in contact with, insulating materials except fuse link**	
		Type of contact				**Class of insulation**	**Temperature limits**
		Ag-Ag	**Ag-Cu**	**Cu-Cu**	**Sn-Sn**		
Distribution cutouts (except oil cutouts and open link cutouts	With fuse link	40 (80)	—	30 (70)	—	Bone fiber 90 105 130	30 (70) 50 (90) 65 (105) 90 (130)
	With switch blade	40 (80)	35 (75)	35 (75)	—		
Distribution oil cutouts	With link or blade	45 (85)	30 (70)	30 (70)	—	90 105 130	50 (90) 65 (105) 90 (130)
Distribution air switches		40 (80)	35 (75)	35 (75)	40 (80)		
Distribution current-limiting fuses Power fuses		65 (105)	—	30 (70)	55 (95)	90 105 130 155 180 220	50 (90) 65 (105) 90 (130) 115 (155) 140 (180) 180 (220)

3.2.9 rated maximum voltage (maximum voltage rating): The highest rms voltage at which the device is designed to operate.*

NOTE — This voltage corresponds to the maximum tolerable zone primary voltage at distribution transformers for distribution cutouts and single-pole air switches, and at substations and on transmission systems for power fuses given in ANSI C84.1-1989.

3.2.10 rated minimum interrupting current: The designated value of the smallest current that a fuse is required to interrupt at a voltage under prescribed conditions.*

3.2.11 rated momentary current (momentary current rating): The maximum current measured at the major peak of the maximum cycle, which the device or assembly is required to carry.*

NOTES:

1 — The current is expressed as the rms value including the direct-current component, as determined from the envelope of the current wave by the method shown in Appendix A of IEEE Std C37.41-1988.

2 — This rating is an index of the ability of the disconnecting device to withstand electromagnetic forces under short-circuit conditions.

3.2.12 rated short-time current (short-time current rating) (of a disconnecting device): The maximum rms total current (including the direct-current component) that the device is required to carry successfully for a specified short-time interval.*

NOTE — The ratings recognize the limitations imposed by both thermal and electromagnetic effects.

3.2.13 rated three-second current (three-second current rating): The rms total current, including the direct-current component that the device, or assembly, is required to carry for 3 s.*

NOTE — For practical purposes, this current is measured at the end of the first second. This rating is an index of the ability of the disconnecting device to withstand the heat that may be generated under short-circuit conditions.

3.2.14 rating: The designated limit(s) of the rated operating characteristic(s) of a device.

NOTE — Such operating characteristics as current, voltage, frequency, etc., may be given in the rating.

3.2.15 slant-voltage (multiple-voltage) ratings of a distribution cutout: A pair of maximum voltage ratings assigned to a distribution cutout intended primarily for application on three-phase solidly grounded neutral (multigrounded) systems [see note] where construction conditions are such that two cutouts will normally operate in series to clear phase-to-phase faults. In applying these cutouts, the system line-to-line voltage must be equal to or less than the maximum voltage rating to the right of the slant (/), and the system line-to-ground voltage must be equal to or less than the maximum voltage rating to the left of the slant (/).

For application in other systems, and for more complete application guidance, refer to IEEE Std C37.48-1987.

NOTE — Slant voltage rated cutouts may be used in single-phase applications where the power-frequency recovery voltage across the cutout does not exceed the maximum voltage rating to the left of the slant (/).

3.3 Tests

3.3.1 conformance tests: Those tests that are specifically made to demonstrate the conformity of switchgear or its component parts with applicable standards.†

3.3.2 design tests: Those tests made to determine the adequacy of a particular type, style, or model of equipment with its component parts to meet its assigned ratings and to operate satisfactorily under normal service conditions or under special conditions if specified.

NOTE — Design tests are made only on representative apparatus to substantiate the ratings assigned to all other apparatus of basically the same design. These tests are not intended to be used as a part of normal production. The applicable portion (part) of these design tests may also be used to evaluate modifications of a previous design and to assure that performance has not been adversely affected. Test data from previous similar designs may be used for current designs, where appropriate.

3.3.3 dielectric withstand-voltage tests: Tests made to determine the ability of insulating materials and spacings to withstand specified overvoltages for a specified time without flashover or puncture.

3.3.4 interrupting tests: Tests that are made to determine or check the interrupting performance of a switching device.

3.3.5 load-break tests (load-interrupting tests): Tests that consist of manual or remote-control opening of a device, which is provided with a means for breaking load, while the device is carrying a prescribed current under specified conditions.*

3.3.6 making-current tests: Tests that consist of manual or remote-control closing of the device against a prescribed current.*

3.3.7 radio-influence tests: Tests that consist of the application of voltage and the measurement of the corresponding radio-influence voltage produced by the device being tested.

3.3.8 routine tests (production tests): Those tests made to check the quality and uniformity of the workmanship and materials used in the manufacture of switchgear or its components.

3.3.9 short-time current tests: Tests that consist of the application of a current higher than the rated continuous current for specified short periods to determine the adequacy of the device to withstand short-circuit currents for the specified short time.*

3.3.10 temperature-rise tests: Tests to determine the temperature rise, above ambient, of various parts of the tested device when subjected to specified test quantities.

NOTES:

1 — The test quantities may be current, load, etc.

2 — Values for various types of devices are shown in table 2.

3.3.11 time-current tests: Tests that consist of the application of current to determine the relation between the rms alternating current or direct current and the time for the fuse to perform the whole or some specified part of its interrupting function.