

American National Standard

guide for application, operation, and
maintenance of high-voltage fuses,
distribution enclosed single-pole air switches,
fuse disconnecting switches, and accessories

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

1. Scope and References

1.1 Scope. This guide applies to high-voltage fuses (above 600 V), distribution enclosed single-pole air switches, fuse disconnecting switches, and accessories for ac distribution systems as follows:

- (1) Enclosed, open, and open-link types of distribution cutouts and fuses
- (2) Distribution current-limiting fuses
- (3) Distribution oil cutouts
- (4) Distribution enclosed single-pole air switches
- (5) Power fuses including current-limiting types
- (6) Outdoor and indoor fuse disconnecting switches
- (7) Fuse supports, fuse mountings, fuse hooks, fuse tongs, and fuse links, all of the type used exclusively with products listed in (1) through (6)
- (8) Removable switch blades for products listed in (1) through (3).

1.2 References. This guide shall be used in conjunction with the following publications:

- [1] ANSI C37.42-1981, American National Standard Specifications for Distribution Cutouts and Fuse Links.
- [2] ANSI C37.44-1981, American National Standard Specifications for Distribution Oil Cutouts and Fuse Links.
- [3] ANSI C37.45-1981, American National Standard Specifications for Distribution Enclosed Single-Pole Air Switches.

[4] ANSI C37.46-1981, American National Standard Specifications for Power Fuses and Fuse Disconnecting Switches.²

[5] ANSI C37.47-1981, American National Standard Specifications for Distribution Fuse Disconnecting Switches, Fuse Supports, and Current-Limiting Fuses.

[6] ANSI/IEEE C37.40-1981, IEEE Standard Service Conditions and Definitions for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnection Switches, and Accessories.³

[7] ANSI/IEEE C37.41-1981, IEEE Standard Design Tests for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories.

[8] ANSI/IEEE Std 18-1980, IEEE Standard for Shunt Power Capacitors.

[9] ASTM E-498-73 (R 1980), Leaks Using the Mass Spectrometer Leak Detector or Residual Gas Analyzer in the Tracer Probe Mode.⁴

²ANSI publications are available from the American National Standards Institute, 1430 Broadway, New York, NY 10018.

³ANSI/IEEE publications are available from IEEE Service Center, 445 Hoes Lane, PO Box 1331, Piscataway, NJ 08855-1331, or from the Sales Department, American National Standards Institute, 1430 Broadway, New York, NY 10018.

⁴ASTM publications are available from the American Society for Testing and Materials, 1916 Race St, Philadelphia, PA 19103.

2. General

The application, operation, and maintenance of equipment covered by this guide is the responsibility of the user who is expected to take into account his/her own particular requirements. As an aid in obtaining satisfactory performance of equipment, this guide provides a general guide on some of the more important features of the above functions for normal conditions of service; unusual conditions may require special measures.

Although fuses are single-phase devices, they can be applied to single- or three-phase equipments or lines, or a combination of these. However, characteristics of the power system should be considered when selecting all fuses.

A fuse when applied in an electric circuit within the limits of its ratings protects the circuit. Its primary function is to isolate faulty equipment from the system. When applied with other equipment in a coordinated over-current protection scheme, it may also limit service interruptions to only a predetermined section of a power system. In many applications it is possible that the equipment connected to the system can be protected from excessive damage. In this latter application the primary function is to remove the faulted equipment from the system, and the secondary function is to minimize the damage to the connected equipment as much as possible, considering the varying fault or overload circumstances that can occur.

Fuse performance depends upon the integrity with which it was manufactured, the correctness of its application, and the attention it receives after it is installed. If not properly applied and maintained, it might fail to perform when required, which might result in considerable damage to costly equipment or extensive interruptions in service.

It cannot be stressed too strongly that prescribed safety rules and manufacturers' recommendations and instructions should be adhered to at all times when operating or maintaining these devices near energized equipment or conductors. This is especially true for devices where air insulated blades, insulating barriers or liners, or fuses are removed or replaced while mating contacts are energized.

3. Application

3.1 Usual Service Conditions. Usual service conditions conforming to this guide are defined in

ANSI/IEEE C37.40-1981 [6],⁵ 2.1. These conditions specify limits in altitude and ambient temperature.

3.2 Unusual Service Conditions. Unusual service conditions are defined in ANSI/IEEE C37.40-1981 [6], paragraph 2.2, which gives examples of such conditions. ANSI/IEEE C37.40-1981 [6], Table 1 lists altitude correction factors for rated voltage, rated continuous current, and ambient temperature for altitudes above 3300 ft (1000 m).

3.3 Clearances and Spacings. Minimum electrical spacings and clearances for power fuse and disconnecting switch installations shall be in accordance with ANSI C37.46-1981 [4], Tables 7, 8, and 9. The application should recognize the conditions prevalent during proof testing (per ANSI/IEEE C37.41-1981 [7]) and generally conform to the test clearances and conditions as a minimum, unless the manufacturer recommends the minimum clearances to be observed.

Vented fuses should be provided with adequate clearances in the direction or directions in which they are vented, and facilities should be provided to ensure that operators are not exposed to fuse discharges either during replacement or when working in the area. When this is not possible, the circuit should be de-energized.

Clearances for oil cutouts are generally dictated by type of cable connection and should be in accordance with the manufacturer's recommendations.

3.4 Position on Crossarm. The positioning of the fuses on a pole or crossarm should be such that their operation is facilitated. Fuses that are far out on a crossarm should open in a plane that is inclined toward the pole, rather than in a plane that is perpendicular to the crossarm.

3.5 Noise Level. Vented fuses may produce intense short time noise levels during fault interruption. The height, location, and exhaust control of vented fuses should be such as to minimize the noise level at any location normally occupied by personnel.

3.6 Factors in Selection of Fuse Voltage Rating. The selection of the proper voltage rating for power fuses, distribution cutouts, or distribution

⁵The numbers in brackets correspond to the references listed in 1.2 of this standard.

current-limiting fuses, is based on consideration of the following system parameters:

- (1) Maximum system line-to-line or line-to-ground normal frequency recovery voltage
- (2) System neutral grounding
- (3) Single- or three-phase circuits

3.7 Guide for Selection of Fuse Voltage Ratings

3.7.1 Power Fuses (including current-limiting types). The fuse should have a maximum voltage rating equal to or exceeding the maximum system line-to-line voltage.

NOTE: Most power fuses are used on three-phase applications. When used on single-phase line-to-ground circuits, the fuse should have a maximum voltage rating of at least 1.15 times maximum system line-to-ground voltage or be used so that fault currents do not exceed 0.87 times the fuse rated interrupting current.

3.7.2 Distribution Fuses (Cutouts and Distribution Current-Limiting Types)

3.7.2.1 Ungrounded-Neutral Systems or Systems Having Grounding Poorer Than Solidly Grounded Neutral (Multigrounded) Systems. A single-voltage-rated distribution fuse should have a maximum voltage rating equal to or exceeding the maximum system line-to-line voltage. A slant-voltage-rated (multiple-voltage-rated) cutout should have a maximum voltage rating to the left of the slant equal to or exceeding the maximum system line-to-line voltage.

3.7.2.2 Solidly Grounded-Neutral (Multigrounded) Systems

3.7.2.2.1 Single-Voltage-Rated Distribution Fuses.

(1) In single-phase, line-to-neutral circuits, the fuse should have a maximum voltage rating equal to or exceeding the maximum system line-to-ground voltage, and a basic insulation level (BIL) coordinated with the line-to-ground insulation of other connected apparatus.

(2) In three-phase circuits where multiphase faults not involving ground can occur, the fuse should have a maximum voltage rating equal to or exceeding the maximum system line-to-line voltage.

(3) In three-phase circuits where multiphase faults not involving ground cannot occur or are unlikely (for example, where phase isolation is employed as in underground or cubicle construction), and the fuse is not required to protect transformers against secondary faults of the types that would impose greater than line-to-ground recovery voltage, the fuse may have a maximum voltage rating equal to or exceeding the maximum system line-to-ground voltage, and should

have a basic insulation level (BIL) coordinated with the line-to-ground insulation of other connected apparatus. A backup device may be required to clear such faults, should they occur.

3.7.2.2.2 Slant-Voltage-Rated (Multiple-Voltage-Rated) Cutouts.⁶

(1) In single-phase, line-to-neutral circuits, the cutout should have a maximum voltage rating to the left of the slant equal to or exceeding the maximum system line-to-ground voltage.

(2) In three-phase circuits, the cutout should have a maximum voltage rating to the right of the slant equal to or exceeding the maximum system line-to-line voltage. Some of the criteria for using slant-voltage-rated cutouts in three-phase circuits as herein set forth are

(a) Three-phase faults not involving ground, which impose 87% of line-to-line voltage across the first cutout to clear, seldom occur. Operation of a backup device may be required to clear such faults, but experience indicates such cases are rare.

(b) Phase-to-phase faults not involving ground generally cause two cutouts to operate in series to clear the fault. Even with differences in fuse-link melting time, both cutouts work together to clear high-current faults. On medium-current faults, the possibility exists of load current continuing to flow through one of the cutouts, after fault clearing by series operation of the two cutouts. Operation of backup devices may be required if the cutout does not clear the continuing load current, but experience indicates that such cases are extremely rare.

(c) The maximum current to be cleared by one cutout operating alone at line-to-line voltage is limited to approximately the one-cycle melting current of the fuse link in the second cutout involved. Slant-voltage-rated cutouts will generally clear such relatively low currents at full line-to-line recovery voltage.

(d) The basic impulse insulation level (BIL) of a slant-voltage-rated cutout should be coordinated with the line-to-ground insulation of other connected apparatus.

Consideration should also be given to service conditions listed in ANSI/IEEE C37.40-1981 [6], Section 2, as they apply to dielectric strength.

(e) Manufacturer's recommendations should be followed on the suitability of particular slant-voltage-rated cutouts for three-phase application.

3.7.3 All Systems. Expulsion fuse voltage ratings may exceed the system voltage by any desired

⁶Definitions and test specifications under development.