IEC 60282-4

Edition 1.0 2020-04

INTERNATIONAL STANDARD

NORME INTERNATIONALE

High-voltage fuses –
Part 4: Additional testing requirements for high-voltage expulsion fuses utilizing polymeric insulators

Fusibles à haute tension –
Partie 4: Exigences d'essai supplémentaires pour les fusibles à expulsion à haute tension utilisant des isolateurs polymériques

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CONTENTS

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HIGH-VOLTAGE FUSES –

Part 4: Additional testing requirements for high-voltage expulsion fuses utilizing polymeric insulators

FOREWORD

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International Standard IEC 60282-4 has been prepared by subcommittee 32A: High-voltage fuses, of IEC technical committee 32: Fuses.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
32A/346/FDIS	32A/348/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 60282 series, published under the general title *High-voltage fuses*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

High-voltage expulsion fuses are tested according to IEC 60282-2 which recognizes that fuse-bases may use polymer (non-ceramic) insulators. However, very little additional testing is specified for fuses using such insulators. In the case of polymer post insulators and suspension insulators, only artificial pollution tests are required in accordance with IEC 61592 and IEC 61109, respectively. However, for fuses that use insulators not covered by these International Standards, such as certain fuse-cutouts, the additional testing required is by agreement between manufacturer and user. Fuses that need such "additional testing" are expulsion fuses that utilize polymer insulators in which a single mounting bracket is used, either at the centre of an insulator or connected to two insulators (a "cutout fuse-base"). As the market for expulsion fuses using polymer insulators has grown, manufacturers have introduced many tests in addition to artificial pollution tests, covering other aspects of a fuse's performance. This document formalises such testing and provides standardisation and consistency. It should be noted that the document focusses on product testing as opposed to material testing. In addition to drawing on test procedures covered by IEC 62217:2012, *Polymeric HV insulators for indoor and outdoor use – General definitions, test methods and acceptance criteria*, material from IEEE Std C37.41™:2016 (primarily 18.1.2 *Long-term deformation/creep testing*) is also used, with the permission of IEEE.

HIGH-VOLTAGE FUSES –

Part 4: Additional testing requirements for high-voltage expulsion fuses utilizing polymeric insulators

1 Scope

This part of IEC 60282 applies to expulsion fuses complying with IEC 60282-2 and specifies additional testing requirements for fuses employing a cutout fuse-base that utilizes polymeric insulators.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60060-1:2010, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60282-2:2008, *High-voltage fuses – Part 2: Expulsion fuses*

ISO 4287, *Geometrical Product Specifications (GPS) – Surface Texture: Profile method – Terms, definitions and surface texture parameters*

ISO 4892-2, *Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps*

ISO 868, *Plastics and ebonite – Determination of indentation hardness by means of a durometer (Shore hardness)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
polymeric insulator
insulator whose insulating body consists of at least one organic based material

Note 1 to entry: Polymeric insulators are also known as non-ceramic insulators.

Note 2 to entry: Coupling devices may be attached to the ends of the insulating body.

[SOURCE: IEC 60050-471:2007, 471-01-13]

3.2
composite polymeric insulator
polymeric insulator made of at least two polymeric insulating parts, namely a core and a housing equipped with end fittings

[SOURCE: IEC 60050-471:2007, 471-01-02, modified – the term "polymeric" added and the note to entry deleted.]

3.3
core (of a composite polymeric insulator)
central insulating part of a composite polymeric insulator which provides the primary mechanical characteristics of the insulator

[SOURCE: IEC 60050-471:2007, 471-01-03, modified – addition of "composite polymeric"; addition of "primary" and "of the insulator"; note to entry deleted.]

3.4
housing
external insulating part(s) of a composite polymeric insulator that provides the necessary creepage distance, other dielectric characteristics of the insulator, and protects the core from the environment

[SOURCE: IEC 60050-471:2007, 471-01-09, modified – "of a composite polymeric insulator" and "other dielectric characteristics of the insulator" added.]

3.5
insulating body
insulating assembly that contains the insulator and permanent fittings

3.6
insulator trunk
central insulating part of an insulator from which the sheds project

Note 1 to entry: Also known as shank on smaller insulators.

[SOURCE: IEC 60050-471:2007, 471-01-11]

3.7
shed (of an insulator)
insulating part, projecting from the insulator trunk, intended to increase the creepage distance

Note 1 to entry: The shed can be with or without ribs.

[SOURCE: IEC 60050-471:2007, 471-01-15]

3.8
cutout fuse-base
fuse-base that uses an insulator or insulators having a single point mounting bracket

Note 1 to entry: The mounting bracket is generally located centrally between the terminals that are mounted at the outer ends of the insulator(s).

3.9
resin insulator
polymeric insulator whose insulating body consists of a solid shank and sheds protruding from the shank made from only one organic based housing material (e.g. cycloaliphatic epoxy)

3.10
interface
surface between the different materials

Note 1 to entry: Various interfaces occur in most composite insulators, for example:

– between housing and fixing devices;
– between core and housing.

4 Type tests

4.1 General requirements

Fuses according to this document shall comply with the requirements of IEC 60282-2, except for those that are specifically replaced with requirements specified in this document for the following type tests.

4.2 Mechanical tests

4.2.1 Mechanical stressing at temperature extremes

4.2.1.1 General

When conducting this test with a fuse using a polymeric insulator(s), it is not necessary to perform the mechanical tests outlined in 8.8.1 of IEC 60282-2:2008. The testing covered in 4.2.1 only applies to devices that can be opened and closed manually.

4.2.1.2 Test procedure

Three new fuses shall be used for this test. The test samples shall consist of the fuse-base, fuse-carrier, and end fittings. The fuse carriers should contain fuse-links of sufficiently high current rating, or dummy links, so that the fuse-links are not subjected to the same endurance test as the fuse-bases and fuse-carriers.

All samples shall be cycled between −30 °C (+0 °C, −5 °C) and +40 °C (+5 °C, −0 °C). The samples shall remain at each temperature extreme for a minimum of 8 h per cycle. The cycle time from one temperature extreme to the other shall be any convenient value, however the sample rate of temperature change should be no more than 0,5 °C/min to avoid thermal shock. All samples shall complete 4 cycles (a cycle includes both temperature extremes) resulting in a minimum total test time of approximately 83 h. See Figure 1 for a representation of the preferred test sequence. If the specified minimum ambient air temperature for the fuse is other than −30 °C (see IEC 60282-2:2008, 4.1 a)) then this value (+0 °C, −5 °C) shall be used for the minimum temperature of the cycle.

Once per cycle, manual open/close operations shall be performed, using a device approved by the manufacturer. At the end of an eight-hour cold or hot period, each sample is subjected to 50 open/close operations. All operations shall be performed at a minimum 30° angle from centreline with 25 on the right and 25 on the left. The closing force should simulate typical service conditions as recommended by the manufacturer. Tests shall alternate with each cycle such that over the four cycles, a total of 100 open/close operations are performed hot and 100 open/close operations cold. The four-cycle sequence can start with a hot period or cold period, but a cold period is the preferred sequence.

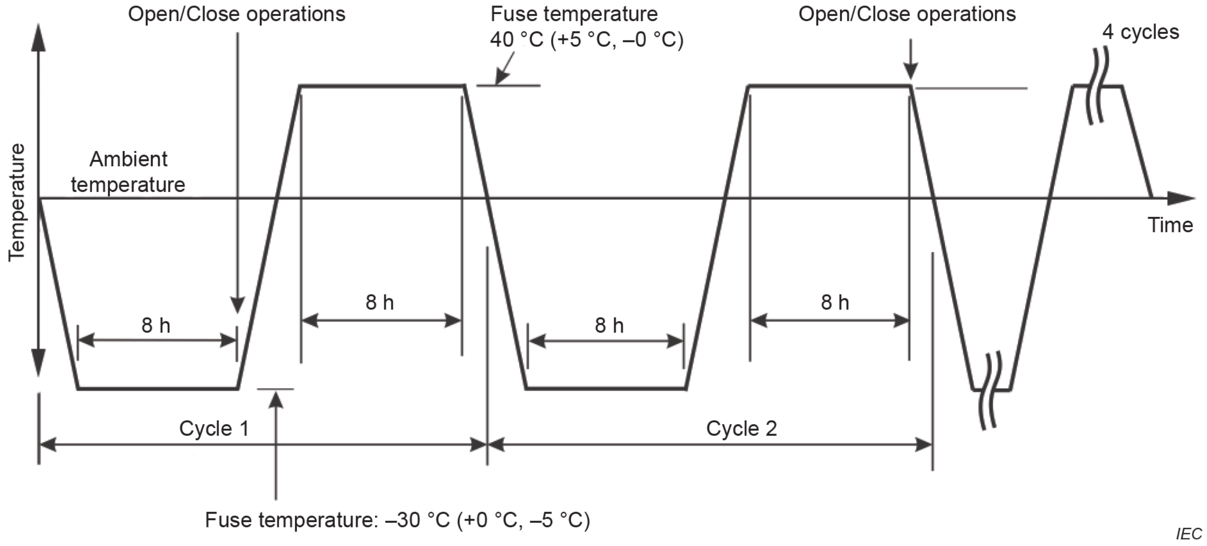

Figure 1 – Test sequence

4.2.1.3 Acceptance criteria

4.2.1.3.1 Initial acceptance criteria

The following are the initial criteria for successful completion of this test:

a) Overall length of fuse-base shall comply with manufacturer's specification.

b) No loose or deformed parts, cracks or other obvious visual deformation in any of the assemblies shall occur.

c) Each sample shall perform its intended function as demonstrated by 4.2.1.3.2.

4.2.1.3.2 Acceptance testing

After the samples have passed the initial acceptance criteria listed in 4.2.1.3.1, further tests are performed to determine that the fuse has not received damage to impair its current carrying capability and drop-out capability.

a) Each sample shall be subjected to a temperature rise test as specified in IEC 60282-2. The temperature rise of individual components may exceed the temperature rise limits specified in IEC 60282-2, provided that all temperature measurements demonstrate that the fuse has reached temperature stability, without thermal runaway occurring.

b) Each sample shall demonstrate it is capable of full mechanical performance when a fuse element melts. For drop-out devices, capability can be verified by the following process. Each sample shall have a fuse-carrier mounted in the fuse-support with an appropriately sized fuse-link. Sufficient current shall be passed through the fuse to cause the element to melt. The sample shall operate and move to the proper open condition.

4.2.1.4 Dye penetration test for composite polymeric insulators

After the testing detailed in 4.2.1.3.1 and 4.2.1.3.2 a dye penetration test is performed to verify that no damage to the core material occurred during the mechanical tests. Four samples shall be cut from each tested insulator making the cut approximately 90° to the long axis of the insulator. Using a diamond-coated circular saw blade under running cold water is the preferred method, however other cutting methods may be used with agreement from the manufacturer. The length of the samples shall be 10 mm ± 1,0 mm. The cut surfaces shall be smoothed by means of fine abrasive cloth (grain size 180). The cut ends shall be clean and parallel. The specimens shall be placed (long axis of the insulator vertical) on a layer of steel or glass balls of the same diameter (1 mm to 2 mm) in a vessel or tray. A solution of 1 % (by weight) of Astrazon BR 200[1] in methanol shall be poured into the vessel, its level being 2 mm to 3 mm higher than the level of the balls. See Figure 2 for a representation of this test arrangement. The specimens shall be observed for 15 min. Other, equivalent, products to Astrazon BR 200 may be used.

Dimensions in millimetres

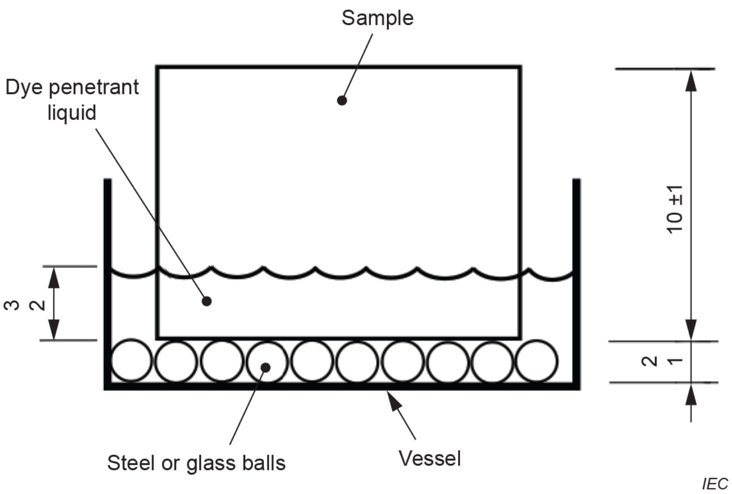

Figure 2 – Dye penetration test arrangement

4.2.1.5 Dye penetration test acceptance criteria

No dye shall rise through the specimens before the 15 min have elapsed. Steps may be taken to prevent dye wicking up the outside surface of the samples.

4.2.2 Long term deformation/creep testing

4.2.2.1 General

This test is for fuses that incorporate composite and/or resin type polymeric insulators.[2]

4.2.2.2 Number of devices to be tested

Three new test samples shall be used for this test, consisting of a fuse-base and a disconnecting blade, or a fuse-base, fuse-carrier and fuse-link. The test procedure is:

a) The distance between the upper contact and lower hinge on all three fuse-bases shall be measured.
b) The test samples shall be placed into an oven at 75 °C (+5 °C, −0 °C) until all components have reached thermal equilibrium.
c) Once all components have reached the proper temperature, the three disconnecting blades or fuse-carriers and fuse-links shall be installed into the three fuse-bases in the closed position.
d) After 8 h have passed, the first device is removed and placed in a water bath, at ambient temperature, for one minute. After one minute, the disconnecting blade or fuse-carrier and fuse-link is removed and the distance between the upper contact and lower hinge is measured.

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1 Astrazon BR 200 is an example of a suitable product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by the IEC of this product.

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