IEC 62217

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Polymeric HV insulators for indoor and outdoor use – General definitions, test methods and acceptance criteria

Isolateurs polymériques à haute tension pour utilisation à l'intérieur ou à l'extérieur – Définitions générales, méthodes d'essai et critères d'acceptation

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

POLYMERIC HV INSULATORS FOR INDOOR AND OUTDOOR USE – GENERAL DEFINITIONS, TEST METHODS AND ACCEPTANCE CRITERIA

FOREWORD

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International Standard IEC 62217 has been prepared by IEC technical committee 36: Insulators.

This second edition cancels and replaces the first edition published in 2005. This edition constitutes a technical revision.

This edition includes a significant technical change with respect to the previous edition.

The first edition of IEC 62217 (2005) included two other alternative tracking and erosion tests (a 5 000 hour multi-stress test and a tracking wheel test) which were based on tests developed by CIGRE and utilities. These tests are no longer given as normative alternatives following the results of a study/questionnaire by TC 36 on the relative merits of all three tracking and erosion tests. The 5 000 hour multi-stress test and a tracking wheel test are described in IEC/TR 62730 (2012).

The text of this standard is based on the following documents:

FDIS	Report on voting
36/321/FDIS	36/324/RVD

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

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

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

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- withdrawn,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

INTRODUCTION

Polymeric insulators consist either of one insulating material (resin insulators) or two or several insulating materials (composite insulators). The insulating materials are generally cross-linked organic materials synthesised from carbon or silicon chemistry and form the insulating body. Insulating materials can be composed from organic materials containing various inorganic and organic ingredients, such as fillers and extenders. End fittings are often used at the ends of the insulating body to transmit mechanical loads. Despite these common features, the materials used and the construction details employed by different manufacturers may be widely different.

The tests given in this standard are those which are, in general, common to a great majority of insulator designs and materials, whatever their final application. They have been regrouped in this standard to avoid repetition in the relevant product standards and drift between procedures as the various product standards are drafted or revised.

The majority of these tests have been grouped together as "Design tests", to be performed only once for insulators of the same design. The design tests are intended to eliminate insulator designs, materials or manufacturing technologies which are not suitable for high-voltage applications. The influence of time on the electrical properties of the complete polymeric insulator and its components (core material, housing, interfaces etc.) has been considered in specifying the design tests in order to ensure a satisfactory lifetime under normal operating and environmental conditions.

Pollution tests, according to IEC 60507 or IEC 61245, are not included in this document, the applicability of their methodology to composite insulators not having been proven and still requiring study by CIGRE. The results of such pollution tests performed on insulators made of polymeric materials do not correlate with experience obtained from service. Specific pollution tests for polymeric insulators are still under consideration.

The 1 000 hour salt-fog tracking and erosion test given in this second edition of IEC 62217 is considered as a screening test intended to reject materials or designs which are inadequate. This test is not intended to predict long term performance for insulator designs under cumulative service stresses. For more information, see Annex C. The first edition of IEC 62217 (2005) included two other alternative tracking and erosion tests (a 5 000 hour multi-stress test and a tracking wheel test) which were based on tests developed by CIGRE and utilities. These tests are no longer given as normative alternatives following the results of a study/questionnaire by TC 36 on the relative merits of all three tracking and erosion tests. The 5 000 hour multi-stress test and a tracking wheel test are described in IEC/TR 62730 (2012).

Composite insulators are used in both a.c. and d.c. applications. In spite of this fact a specific tracking and erosion test procedure for d.c. applications as a design test has not yet been defined and accepted. The 1 000 hour a.c. tracking and erosion test described in this standard is used to establish a minimum requirement for the tracking resistance of the housing material.

IEC Guide 111 has been followed wherever possible during the preparation of this standard.

POLYMERIC HV INSULATORS FOR INDOOR AND OUTDOOR USE – GENERAL DEFINITIONS, TEST METHODS AND ACCEPTANCE CRITERIA

1 Scope and object

This International Standard is applicable to polymeric insulators whose insulating body consists of one or various organic materials. Polymeric insulators covered by this standard include both solid core and hollow insulators. They are intended for use on HV overhead lines and in indoor and outdoor equipment.

The object of this standard is

– to define the common terms used for polymeric insulators;

– to prescribe common test methods for design tests on polymeric insulators;

– to prescribe acceptance or failure criteria, if applicable;

These tests, criteria and recommendations are intended to ensure a satisfactory life-time under normal operating and environmental conditions (see Clause 5). This standard shall only be applied in conjunction with the relevant product standard.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050-471:2007, *International Electrotechnical Vocabulary – Part 471: Insulators*

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

IEC 60068-2-11, *Environmental testing – Part 2: Tests. Test KA: Salt mist*

IEC 60507, *Artificial pollution tests on high-voltage insulators to be used on a.c. systems*

IEC 60695-11-10, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

IEC 60721-1, *Classification of environmental conditions – Part 1: Environmental parameters and their severities*

IEC 60815-1, *Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 1: Definitions, information and general principles*

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

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

ISO 4892-1, *Plastics – Methods of exposure to laboratory light sources – Part 1: General Guidance*

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

3 Terms and definitions

For the purposes of this document the terms and definitions given in IEC 60050-471:2007 and the following apply:

3.1
high voltage (HV)
voltage over 1 000 V a.c. or over 1 500 V d.c. or over 1 500 V peak value

3.2
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]

3.3
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)

3.4
composite insulator
insulator made of at least two insulating parts, namely a core and a housing equipped with metal fittings

Note 1 to entry: Composite insulators, for example, can consist either of individual sheds mounted on the core, with or without an intermediate sheath, or alternatively, of a housing directly moulded or cast in one or several pieces on to the core.

[SOURCE: IEC 60050-471:2007, 471-01-02]

3.5
core
central insulating part of an insulator which provides the mechanical characteristics

Note 1 to entry: The housing and sheds are not part of the core.

[SOURCE: IEC 60050-471:2007, 471-01-03]

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
housing
external insulating part of a composite insulator providing the necessary creepage distance and protecting core from environment

Note 1 to entry: An intermediate sheath made of insulating material may be part of the housing.

[SOURCE: IEC 60050-471:2007, 471-01-09]

3.8
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]

3.9
creepage distance
shortest distance or the sum of the shortest distances along the surface on an insulator between two conductive parts which normally have the operating voltage between them

Note 1 to entry: The surface of cement or of any other non-insulating jointing material is not considered as forming part of the creepage distance.

Note 2 to entry: If a high resistance coating is applied to parts of the insulating part of an insulator, such parts are considered to be effective insulating surfaces and the distance over them is included in the creepage distance.

[SOURCE: IEC 60050-471:2007, 471-01-04]

3.10
arcing distance
shortest distance in air external to the insulator between the metallic parts which normally have the operating voltage between them

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

3.11
interfaces
surface between the different materials

Note 1 to entry: Various interfaces occur in most composite insulators, e.g.:

– between housing and fixing devices;
– between various parts of the housing; e.g. between sheds, or between sheath and sheds;
– between core and housing.

3.12
end fitting
fixing device
integral component or formed part of an insulator, intended to connect it to a supporting structure, or to a conductor, or to an item of equipment, or to another insulator

Note 1 to entry: Where the end fitting is metallic, the term “metal fitting” is normally used.

[SOURCE: IEC 60050-471:2007, 471-01-06, modified by the addition of a synonym]

3.13
connection zone
zone where the mechanical load is transmitted between the insulating body and the fixing device

3.14
coupling
part of the fixing device which transmits load to the hardware external to the insulator

3.15
tracking
process which forms irreversible degradation by formation of conductive paths (tracks) starting and developing on the surface of an insulating material.

Note 1 to entry: Tracking paths are conductive even under dry conditions.

3.16
erosion
irreversible and non-conducting degradation of the surface of the insulator that occurs by loss of material. This can be uniform, localized or tree-shaped

Note 1 to entry: Light surface traces, commonly tree-shaped, can occur on composite insulators as on ceramic insulators, after partial flashover. These traces are not considered to be objectionable as long as they are non-conductive. When they are conductive they are classified as tracking.

3.17
crack
any internal fracture or surface fissure of depth greater than 0,1 mm

3.18
puncture
permanent loss of dielectric strength due to a disruptive discharge passing through the solid insulating material of an insulator

[SOURCE: IEC 60050-471:2007, 471-01-14, modified to define puncture as the result of a discharge, rather than the discharge itself]

4 Identification

The manufacturer's drawing shall show the relevant dimensions and information necessary for identifying and testing the insulator in accordance with this International Standard and the applicable IEC product standard(s). The drawing shall also show applicable manufacturing tolerances.

Each insulator shall be marked with the name or trademark of the manufacturer and the year of manufacture. In addition, each insulator shall be marked with the rated characteristics specified in the relevant IEC product standards. These markings shall be legible, indelible and their fixings (if any) weather- and corrosion-proof.

5 Environmental conditions

The normal environmental conditions to which insulators are submitted in service are defined according to Table 1.

When special environmental conditions prevail at the location where insulators are to be put in service, they shall be specified by the user by reference to IEC 60721-1.

Table 1 – Normal environmental conditions

	Indoor insulation	Outdoor insulation
Maximum ambient air temperature	does not exceed 40 °C and its average value measured over a period of 24 h does not exceed 35 °C	
Minimum ambient air temperature	–25 °C	–40 °C
Vibration	Negligible vibration due to causes external to the insulators or to earth tremors [a].	
Solar radiation [b]	To be neglected	Up to a level of 1 000 W/m^2
Pollution of the ambient air	No significant pollution by dust, smoke, corrosive and/or flammable gases, vapours, or salt.	Pollution by dust, smoke, corrosive gases, vapours or salt may occur. Pollution does not exceed “heavy” as defined in IEC 60815-1.
Humidity	The average value of the relative humidity, measured over a period of 24 h, does not exceed 95 % and measured over a period of one month, does not exceed 95 %. For these conditions, condensation may occasionally occur.	

[a] Vibration due to external causes can be dealt with in accordance to IEC 60721-1.

[b] Details of solar radiation are given in IEC 60721-1.

6 Information on transport, storage and installation

Manufacturers of insulators shall provide appropriate instructions and information covering general conditions during transport, storage and installation of the insulators. These instructions can include recommendations for cleaning or maintenance.

7 Classification of tests

The tests are divided into four groups as follows:

7.1 Design tests

The design tests are intended to verify the suitability of the design, materials and method of manufacture (technology).

A polymeric insulator design is generally defined by:

– materials of the core, housing and manufacturing method;

– material of the end fittings, their design, and method of attachment;

– layer thickness of the housing over the core (including a sheath where used).

Additional parameters defining design may be given in the relevant product standard.

When changes in the design of a polymeric insulator occur, re-qualification shall be carried out according to the prescriptions of the relevant product standard. Typically, only part of the tests is repeated. A survey of the tests is given in Annex C.

When a polymeric insulator is submitted to the design tests, it becomes a parent insulator for a design class and the results shall be considered valid for the whole class. This tested parent insulator defines a design class of insulators which have the following characteristics:

a) same materials for the core and housing and same manufacturing method;

b) same material of the end fittings, the same design and the same method of attachment;

c) same or greater minimum layer thickness of the housing over the core (including a sheath where used).

Additional parameters defining a class of design may be given in the relevant product standard.

7.2 Type tests

The type tests are intended to verify the main characteristics of a polymeric insulator, which depend mainly on its shape and size. Type tests shall be applied to polymeric insulators belonging to an already qualified design class. The type tests shall be repeated only when the type of the polymeric insulator is changed. The parameters defining a type of polymeric insulator are given in the relevant product standard.

The applicable type tests are given in the relevant product standard.

7.3 Sample tests

The sample tests are intended to verify the characteristics of polymeric insulators which depend on the quality of manufacture and on the materials used. They are made on insulators taken at random from lots offered for acceptance.

The applicable sample tests are given in the relevant product standard.

7.4 Routine tests

These tests are intended to eliminate polymeric insulators with manufacturing defects. They are carried out on every insulator to be supplied.

The applicable routine tests are given in the relevant product standard.

8 General requirements for insulator test specimens

Insulator test specimens for tests of polymeric insulators shall be checked prior to tests:

- for correct assembly, for example by applying the mechanical routine test specified in the relevant product standard,
- by visual examination according to the relevant product standard;
- for conformance of dimensions with the actual drawing.

For dimensions d without tolerances the following tolerances are acceptable:

- $\pm$ (0,04 $\times$ d + 1,5) mm when $d \leq$ 300 mm;
- $\pm$ (0,025 $\times$ d + 6) mm when $d >$ 300 mm with a maximum tolerance of $\pm$50 mm.

The measurement of creepage distances shall be related to the design dimensions and tolerances as determined from the insulator drawing, even if this dimension is greater than the value originally specified. When a minimum creepage is specified, the negative tolerance is also limited by this value.

In the case of insulators with creepage distance exceeding 3 m, it is allowed to measure a short section around 1 m long of the insulator and to extrapolate.

The housing colour of the test specimens shall be approximately as specified in the drawing.

The number of test specimens, their selection and dimensions are specified in the relevant clauses of this standard or in the relevant test standards.

9 Design tests

9.1 General

The following tests are normally classified as design tests, unless otherwise specified in the relevant product standard.

The design tests shall be performed only once according to the relevant product standard and the results shall be recorded in a test report.

Each test (9.2, 9.3and 9.4) can be performed independently on new test specimens where appropriate, according to the test sequence given in the relevant test standard. The polymeric insulator of a particular design shall be deemed qualified only when all insulators or test specimens pass all the design tests specified in the relevant product standard.

9.2 Tests on interfaces and connections of end fittings

9.2.1 General

The test sequence consists of:

- reference dry power frequency test
- pre-stressing
- verification test

9.2.2 Test specimens

For this series of tests insulators assembled on the production line shall be selected. The number of specimens and their dimensions shall be according to the relevant product standard. They shall be checked and tested as indicated in Clause 8.

If the manufacturer only has facilities to produce insulators with one or more dimensions smaller than indicated in the relevant product standard, the design tests may be performed on insulators of those dimensions available to him, however the results are only valid for other insulators of the same design class up to the dimensions tested.

9.2.3 Reference voltage and temperature for verification tests

For time or economic reasons the reference power frequency test in 9.2.4 at the beginning of the test sequence may be omitted if an additional reference test specimen conforming to 9.2.2 is used. The power frequency voltages after pre-stressing according to 9.2.7.4 and the shank temperature shall be compared either with the values of the reference test specimen or with the voltages determined prior to pre-stressing. It is clearly understood that the reference test specimen shall be not submitted to pre-stressing.

9.2.4 Reference dry power frequency test

The reference dry power frequency external flashover voltage shall be determined by averaging five flashover voltages determined according to IEC 60060-1 on the test specimens or on the reference test specimen. This average flashover voltage shall be corrected to standard conditions in accordance with IEC 60060-1. The flashover voltage shall be obtained by increasing the voltage linearly from zero to flashover within 1 min.

9.2.5 Product specific pre-stressing

The test specimens shall be subjected to pre-stressing (e.g. thermal-mechanical) according to the relevant product standard.