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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Composite hollow insulators – Pressurized and unpressurized insulators for use in electrical equipment with AC rated voltage greater than 1 000 V AC and D.C. voltage greater than 1500V – Definitions, test methods, acceptance criteria and design recommendations

Isolateurs composites creux – Isolateurs avec ou sans pression interne pour utilisation dans des appareillages électriques de tensions alternatives assignées supérieures à 1 000 V et de tensions continues supérieures à 1 500 V – Définitions, méthodes d'essai, critères d'acceptation et recommandations de conception



IEC 61462:2023-09(en-fr)



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COMPOSITE HOLLOW INSULATORS – PRESSURIZED AND UNPRESSURIZED INSULATORS FOR USE IN ELECTRICAL EQUIPMENT WITH AC RATED VOLTAGE GREATER THAN 1 000 V AND DC VOLTAGE GREATER THAN 1 500 V – DEFINITIONS, TEST METHODS, ACCEPTANCE CRITERIA AND DESIGN RECOMMENDATIONS

FOREWORD

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IEC 61462 has been prepared by IEC technical committee 36: Insulators. It is an International Standard.

This new edition cancels and replaces the previous edition published in 2007. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) modifications of terms and definitions;
b) modifications of tests procedures included in IEC TR 62039 and IEC 62217 (Hydrophobicity transfer test; Water diffusion test on the core with housing);
c) modification of Clause 8 (type tests) to reflect common practice and to also consider tapered (conical) insulators;

d) modification of order of the stages of mechanical sample test (9.4) by setting the tightness test as last stage;

e) harmonization of Table 3 (Tests to be carried out after design changes) with other product standards;

f) addition of a new informative Annex D: Principle sketch of hollow insulators design assembly;

g) addition of a new informative Annex E: Type tests on tapered (conical) insulators.

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

Draft	Report on voting
36/567/FDIS	36/586/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under 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

Composite hollow insulators consist of an insulating tube bearing the mechanical load protected by an elastomeric housing, the loads being transmitted to the tube by metal fittings. Despite these common features, the materials used and the construction details employed by different manufacturers may vary.

Some tests have been grouped together as "Design tests" to be performed only once for insulators of the same design and material. The design tests are performed in order to eliminate designs and materials not suitable for high-voltage applications.

The relevant design tests defined in IEC 62217 are applied for composite hollow insulators; additional specific mechanical tests are given in this document. The influence of time on the electrical and mechanical properties of the complete composite hollow insulator and its components (tube material, housing material, interfaces, etc.) has been considered in specifying the design tests in order to ensure a satisfactory lifetime under normal service conditions. These conditions may also depend on the equipment inside or outside the composite hollow insulators; however, this matter has not been covered in this document. It is possible for test methods not specified in this document to be considered for specific combinations of materials and specific applications, and are a matter of agreement between manufacturers and users. In this document, the term "user" in general means the equipment manufacturer using composite hollow insulators.

Composite hollow insulators are used in both AC and DC applications. Before the appropriate standard for DC applications will be issued, the majority of tests listed in this document can also be applied to DC insulators. In spite of this, a specific tracking and erosion test procedure for DC applications as a design test is still being considered to be developed. Some information about the difference of AC and DC material erosion test can be found in the CIGRE Technical Brochure 611. For the time being, the 1 000 h AC tracking and erosion test of IEC 62217 is used to establish a minimum requirement for the tracking and erosion resistance, for both AC and DC

This document distinguishes between design tests and type tests because several general characteristics of a specific design and specific combinations of materials do not vary for different insulator types. In these cases results from design tests can be adopted for different insulator types.

Pollution tests according to IEC 60507 or IEC 61245 are not included in this document since they are designed for non-polymeric items. Specific pollution tests for polymeric insulators are still under consideration.

The mechanical characteristics of composite hollow insulators are quite different compared to those of hollow insulators made of ceramics. In order to determine the onset of mechanical deterioration of composite hollow insulators under the influence of mechanical stress, strain gauge measurements are used.

This document refers to different characteristic pressures which are used for design and testing of composite hollow insulators. The term "maximum service pressure" (MSP) is equivalent to the term "design pressure" which is used in other standards for ceramic hollow insulators; however, this latter term is not used in this standard in order to avoid confusion with "design" as used in "design tests".

General recommendations for the design and construction of composite hollow insulators are presented in Annex B.

COMPOSITE HOLLOW INSULATORS – PRESSURIZED AND UNPRESSURIZED INSULATORS FOR USE IN ELECTRICAL EQUIPMENT WITH AC RATED VOLTAGE GREATER THAN 1 000 V AND DC VOLTAGE GREATER THAN 1 500 V – DEFINITIONS, TEST METHODS, ACCEPTANCE CRITERIA AND DESIGN RECOMMENDATIONS

1 Scope

This document, which is an International Standard, applies to composite hollow insulators consisting of a load-bearing insulating tube made of resin impregnated fibres, a housing (outside the insulating tube) made of elastomeric material (for example silicone or ethylene-propylene) and metal fixing devices at the ends of the insulating tube (see Figure D.1 and Figure D.2 for examples). Composite hollow insulators as defined in this document are intended for general use (unpressurized) or for use with a permanent gas pressure (pressurized). They are intended for use in both outdoor and indoor electrical equipment operating on alternating current with a rated voltage greater than 1 000 V AC and a frequency not greater than 100 Hz or for use in direct current equipment with a rated voltage greater than 1 500 V DC.

The object of this document is:

– to define the terms used;

– to specify test methods;

– to specify acceptance criteria.

Hollow insulators are integrated into electrical equipment which is electrically type tested as required by the applicable equipment standard. So, it is not the object of this document to specify dielectric type tests because the withstand voltages and flashover behaviour are not characteristics of the hollow insulator itself but of the apparatus of which it ultimately forms a part.

All the tests in this document, apart from the thermal-mechanical test, are performed at normal ambient temperature. This document does not specify tests that might be characteristic of the equipment of which the hollow insulator ultimately forms a part.

Composite hollow insulators are intended for use in electrical equipment, such as, but not limited to:

- HV circuit-breakers,
- switch-disconnectors,
- disconnectors,
- station posts,
- disconnecting circuit breakers,
- earthing switches,
- instrument- and power transformers,
- bushings,
- housing for surge arresters,
- cable terminations.

Additional testing defined by the relevant IEC equipment standard may be required.

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 62155, *Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1 000 V*

IEC 62217, *Polymeric HV insulators for indoor and outdoor use – General definitions, test methods and acceptance criteria*

IEC TR 62039, *Selection guidelines for polymeric materials for outdoor use under HV stress*

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
composite hollow insulator
insulator consisting of at least two insulating parts, namely a tube and a housing

Note 1 to entry: The housing may consist either of individual sheds mounted on the tube, with or without an intermediate sheath, or directly applied in one or several pieces onto the tube. A composite hollow insulator unit is permanently equipped with fixing devices or end fittings

3.2
tube (core)
central internal insulating part of a composite hollow insulator which provides the mechanical characteristics

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

Note 2 to entry: The tube is generally cylindrical or conical, but may have other shapes (for example barrel). The tube is made of resin impregnated fibres.

Note 3 to entry: Resin impregnated fibres are structured in such a manner as to achieve sufficient mechanical strength. Layers of different fibres may be used to fulfil special requirements.

[SOURCE: IEC 60050-471:2007, 471-01-03, modified – addition of "tube" in term, addition of "internal", addition of "composite hollow", addition of Notes 2 and 3 to entry]

3.3
fixing device
end fitting
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 – addition of "fixing device" in term]

3.4
coupling
part of the fixing device which transmits load to the hardware external to the insulator

[SOURCE: IEC 62217:2012, 3.14]

3.5
connection zone
zone where the mechanical load is transmitted between the insulating body and the end fitting

[SOURCE: IEC 62217:2012, 3.13]

3.6
housing
external insulating part of composite hollow insulator providing necessary creepage distance and protecting tube from environment

Note 1 to entry: If an intermediate sheath is used it forms a part of the housing.

[SOURCE: IEC 62217:2012, 3.7]

[SOURCE: IEC 60050-471:2007, 471-01-09, modified – addition of "hollow", replacement of "core" by "tube"]

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
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]

3.9
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 any non-insulating jointing material is not considered as forming part of the creepage distance.

[SOURCE: IEC 60050-471:2007, 471-01-04, modified – removal of Note 2 to entry]

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

Note 1 to entry: The term "dry arcing distance" is also used.

[SOURCE: IEC 60050-471:2007, 471-01-01, modified – addition of Note 1 to entry]

3.11
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: These paths are conductive even under dry conditions.

[SOURCE: IEC 62217:2012, 3.15]

3.12
erosion
irreversible and non-conducting degradation of the surface of the insulator that occurs by loss of material which can be uniform, localised 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.

[SOURCE: IEC 62217:2012, 3.16]

3.13
crack
any fracture or surface fissure of depth greater than 0,1 mm

[SOURCE: IEC 62217:2012, 3.17]

3.14
interface
contact surface between the different materials

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

– between housing and end fittings,

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

– between core and housing.

[SOURCE: IEC 62217:2012, 3.11, modified – addition of "contact"]

3.15
damage limit of the tube under mechanical stress
limit below which mechanical loads (pressure, bending load) can be applied, at normal ambient temperature, without micro damage to the composite tube

Note 1 to entry: Applying such loads means that the tube is in a reversible elastic phase. If the damage limit of the tube is exceeded, the tube is in an irreversible plastic phase, which means permanent damage to the tube which may not be visible at a macroscopic level (for a quantitative definition see Annex C).

3.16
maximum mechanical load (MML)
highest cantilever bending load which is expected to be applied to the hollow insulator in service and in the equipment in which it is used

Note 1 to entry: This load is specified by the equipment manufacturer.

3.17
specified mechanical load (SML)
cantilever bending load specified by the manufacturer that is used in the mechanical tests and which is verified during a type test at normal ambient temperature

Note 1 to entry: The SML forms the basis of the selection of composite hollow insulators with regard to external loads.

3.18
deflection under bending load
displacement of a point on an insulator, measured perpendicularly to its axis, under the effect of a load applied perpendicularly to this axis

Note 1 to entry: Deflection/load relationships are determined by the manufacturer.

[SOURCE: IEC 60050-471:2007, 471-01-05, modified – addition of Note 1 to entry]

3.19
failing load
load at ultimate failure of the insulator, maximum load that can be reached when the insulator is tested under the specified conditions (valid for bending or pressure tests)

Note 1 to entry: Damage of the tube may occur at loads lower than the insulator failing load.

3.20
residual deflection
difference between the initial deflection of a hollow insulator prior to bending load application, and the final deflection after release of the load

3.21
overpressure
pressure above ambient pressure within a pressurized enclosure

[SOURCE: IEC 60050-426:2020, 426-09-16]

3.22
maximum service pressure (MSP)
maximum internal overpressure in service which is specified by the equipment manufacturer

3.23
specified internal pressure (SIP)
internal overpressure specified by the equipment manufacturer which is verified during a type test at normal ambient temperature

Note 1 to entry: The SIP is specified as the short-time withstand design limit, under which the insulator structure stays intact, but damages may already occur. It can be higher than 4 × MSP.

3.24
pressurized insulator
insulator permanently filled with gas or liquid whose maximum service pressure is greater than 0,05 MPa overpressure

3.25
unpressurized insulator
insulator permanently filled with gas or liquid whose maximum service pressure is smaller than or equal to 0,05 MPa overpressure

3.26
specified temperature
highest and/or lowest temperature permissible for the composite hollow insulator

Note 1 to entry: The specified temperature is specified by the manufacturer.

3.27
manufacturer
individual or organization producing the composite hollow insulators

3.28
equipment manufacturer
individual or organization producing the electrical equipment utilizing the composite hollow insulators

3.29
lot
group of insulators offered for acceptance from the same manufacturer, of the same design and manufactured under similar conditions of production

Note 1 to entry: One or more lots may be offered together for acceptance: the lot(s) offered may consist of the whole, or part, of the quantity ordered.

[SOURCE: IEC 62155:2003, 3.22, modified – removal of "hollow", removal of "or hollow insulator bodies"]

4 Relationships of mechanical loads

4.1 Loads from outside the insulator

Table 1 lists mechanical loads applied to the insulator.

Table 1 – Mechanical loads applied to the insulator

Load	Relation	Tube is in:
Maximum mechanical load (MML) which is the load specified by the equipment manufacturer	= 1,0 × MML	reversible elastic phase
1,5 × Maximum mechanical load (MML) which is the load applied during sample and type test	= 1,5 × MML	reversible elastic phase
Damage limit	> 1,5 × MML	reversible elastic phase
Type test SML bending load	= 2,5 × MML	irreversible plastic phase
Failing bending load	> 2,5 × MML	irreversible plastic phase

An overview of loads is shown in Figure B.1.

4.2 Pressures

Table 2 lists pressures applied to the insulator.

Table 2 – Pressures applied to the insulator

Pressure	Relation	Tube is in:
Maximum service pressure (MSP) which is the pressure specified by the equipment manufacturer	= 1,0 x MSP	reversible elastic phase
Routine test pressure	= 2,0 × MSP	reversible elastic phase
Damage limit	> 2,0 × MSP	reversible elastic phase
Type test pressure	= 4,0 × MSP	irreversible plastic phase
Specified internal pressure (SIP) which is an additional / optional type test pressure specified by the equipment manufacturer	> 4,0 × MSP	irreversible plastic phase

An overview of pressures is shown in Figure B.2.