BS EN 62772:2016

BSI Standards Publication

Composite hollow core station post insulators for substations with a.c. voltage greater than 1 000 V and d.c. voltage greater than 1 500 V — Definitions, test methods and acceptance criteria

bsi.

National foreword

This British Standard is the UK implementation of EN 62772:2016. It is identical to IEC 62772:2016.

The UK participation in its preparation was entrusted to Technical Committee PEL/36, Insulators for power systems.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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EUROPEAN STANDARD
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EN 62772

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English Version

Composite Hollow Core Station Post Insulators for substations with a.c. voltage greater than 1000 V and d.c. voltage greater than 1500V- Definitions, test methods and acceptance criteria (IEC 62772:2016)

Isolateurs supports composites creux pour postes présentant une tension alternative supérieure à 1 000 V et une tension continue supérieure à 1 500 V - Définitions, méthodes d'essai et critères d'acceptation (IEC 62772:2016)

Hohlkern-Verbundstützinsolatoren für Schaltanlagen mit Wechsel - und Gleichspannung über 1 000 V - Begriffe, Prüfverfahren und Annahmekriterien (IEC 62772:2016)

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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European foreword

The text of document 36/386/FDIS, future edition 1 of IEC 62772, prepared by IEC/TC 36 "Insulators" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62772:2016.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2017-06-21
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2019-09-21

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The text of the International Standard IEC 62772:2016 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standard indicated :

IEC 60068-2-17	NOTE	Harmonized as EN 60068-2-17.
IEC 62155	NOTE	Harmonized as EN 62155.
ISO 1101	NOTE	Harmonized as EN ISO 1101.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

Publication	Year	Title	EN/HD	Year
IEC 60060-1	2010	High-voltage test techniques -- Part 1: General definitions and test requirements	EN 60060-1	2010
IEC 60168	2001	Tests on indoor and outdoor post-insulators of ceramic material or glass for systems with nominal voltages greater than 1000 V	-	-
IEC 61109	2008	Insulators for overhead lines - Composite suspension and tension insulators for a.c. systems with a nominal voltage greater than 1 000 V - Definitions, test methods and acceptance criteria	EN 61109	2008
IEC 61462	2007	Composite hollow insulators - Pressurized and unpressurized insulators for use in electrical equipment with rated voltage greater than 1 000 V - Definitions, test methods, acceptance criteria and design recommendations	EN 61462	2007
IEC 62217	2012	Polymeric HV insulators for indoor and outdoor use - General definitions, test methods and acceptance criteria	EN 62217	2013
IEC 62231	2006	Composite station post insulators for substations with a.c. voltages greater than 1 000 V up to 245 kV - Definitions, test methods and acceptance criteria	EN 62231	2006

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMPOSITE HOLLOW CORE STATION POST INSULATORS FOR SUBSTATIONS WITH A.C. VOLTAGE GREATER THAN 1 000 V AND D.C. VOLTAGE GREATER THAN 1 500 V – DEFINITIONS, TEST METHODS AND ACCEPTANCE CRITERIA

FOREWORD

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International Standard IEC 62772 has been prepared by IEC technical committee 36: Insulators.

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

FDIS	Report on voting
36/386/FDIS	36/389/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 website 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

Composite hollow core station post insulators consist of an insulating hollow core (tube), bearing the mechanical load protected by a polymeric housing, the load being transmitted to the core by end fittings. The hollow core is filled entirely with an insulating material. The core is made of resin impregnated fibres.

Composite hollow core station post insulators are typically applied as post insulators in substations. In order to perform the design tests, IEC 62217 is to be applied for materials and interfaces of the insulator. Some tests have been grouped together as "design tests", to be performed only once on insulators which satisfy the same design conditions. For all design tests on composite hollow core station post insulators, the common clauses defined in IEC 62217 are applied. As far as practical, the influence of time on the electrical and mechanical properties of the components (core material, housing, interfaces etc.) and of the complete composite hollow core station post insulator has been considered in specifying the design tests to ensure a satisfactory life-time under normally known stress conditions in service.

This standard relates to IEC 61462, *Composite hollow insulators – Pressurized and unpressurized insulators for use in electrical equipment with rated voltage greater than 1 000 V – Definitions, test methods, acceptance criteria and design recommendations*, as well as IEC 62231, *Composite station post insulators for substations with a.c. voltages greater than 1 000 V up to 245 kV – Definitions, test methods and acceptance criteria*. Tests and requirements described in IEC 62231 can be used although this standard has no voltage limit.

The use of polymeric housing materials that show hydrophobicity and hydrophobicity transfer mechanism (HTM) is preferred for composite hollow core station post insulators. This is due to the fact that the influence of diameter can be significant for hydrophilic surfaces (see also IEC 60815-3). For instance silicone rubber is recognized as successful countermeasure against severe polluted service conditions. The ageing performance of the polymeric housing can be evaluated by the salt fog test standardized in IEC 62217. For the time being, no test is defined to quantify the HTM, but CIGRE SC D.1 deals with this subject intensively and Technical Brochure No. 442 is available for the evaluation of the retention of the hydrophobicity.

COMPOSITE HOLLOW CORE STATION POST INSULATORS FOR SUBSTATIONS WITH A.C. VOLTAGE GREATER THAN 1 000 V AND D.C. VOLTAGE GREATER THAN 1 500 V – DEFINITIONS, TEST METHODS AND ACCEPTANCE CRITERIA

1 Scope

This International Standard applies to composite hollow core station post insulators consisting of a load-bearing insulating tube (core) made of resin impregnated fibres an insulating filler material (e.g. solid, liquid, foam, gaseous – pressurized or unpressurized), a housing (outside the insulating tube) made of polymeric material (for example silicone or ethylene-propylene) and metal fixing devices at the ends of the insulating tube. Composite hollow core station post insulators as defined in this standard are intended for general use in substations in both, outdoor and indoor environments, operating with a rated AC voltage greater than 1 000 V and a frequency not greater than 100 Hz or for use in direct current systems with a rated voltage greater than 1 500 V.

The object of this standard is:

– to define the terms used;
– to prescribe test methods;
– to prescribe acceptance criteria.

All the tests in this standard, apart from the thermal-mechanical test, are performed at normal ambient temperature. This standard does not prescribe tests that may be characteristic of the apparatus of which the composite hollow core station post insulator ultimately may form a part. Further technical input is required in this area.

NOTE 1 "Pressurized" means a permanent gas or liquid pressure greater than 0,05 MPa (0,5 bar) gauge. The gas can be dry air or inert gases, for example sulphur hexafluoride, nitrogen, or a mixture of such gases.

NOTE 2 "Unpressurized" means a gas or liquid pressure smaller than or equal to 0,05 MPa (0,5 bar) gauge.

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 60168:2001, *Tests on indoor and outdoor post insulators of ceramic material or glass for systems with nominal voltages greater than 1 000 V*

IEC 61109:2008, *Insulators for overhead lines – Composite suspension and tension insulators for a.c. systems with a nominal voltage greater than 1 000 V – Definitions, test methods and acceptance criteria*

IEC 61462:2007, *Composite hollow insulators – Pressurized and unpressurized insulators for use in electrical equipment with rated voltage greater than 1 000 V – Definitions, test methods, acceptance criteria and design recommendations*

IEC 62217:2012, *Polymeric HV insulators for indoor and outdoor use – General definitions, test methods and acceptance criteria*

IEC 62231:2006, *Composite station post insulators for substations with a.c. voltages greater than 1 000 V up to 245 kV – Definitions, test methods and acceptance criteria*

3 Terms and definitions

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

3.1
composite hollow core station post insulator
insulator consisting of at least three insulating parts, namely a tube, an internal filler 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 core station post insulator unit is permanently equipped with fixing devices.

3.2
tube (core)
insulating part of a composite hollow core station post insulator designed to ensure the mechanical characteristics

Note 1 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 2 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.

3.3
filler
insulating material filling the entire space (e.g. solid, liquid, foam, gaseous – pressurized or unpressurized) of the hollow core station post insulator which has no load bearing function

3.4
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]

3.5
coupling
part of the end fitting which transmits the load to the accessories external to the insulator

[SOURCE: IEC 62217:2012, definition 3.13]

3.6
connection zone
zone where the mechanical load is transmitted between the insulating body and the end fitting

[SOURCE: IEC 62217:2012, definition 3.12]

3.7
housing
external insulating part of composite hollow core station post insulator providing necessary creepage distance and protecting the tube from the environment

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

[SOURCE: IEC 62217:2012, definition 3.7, modified ("composite insulator" replaced by "composite hollow core station post insulator", "protecting core" replaced by "protecting the tube")]

3.8
shed
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
insulator trunk
central insulating part of an insulator from which the sheds protrude

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

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

3.10
creepage distance
shortest distance or the sum of the shortest distances along the surface of 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.

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]

3.11
arcing distance
shortest distance in the 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]

3.12
interface
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
– between core and filler.

[SOURCE: IEC 62217:2012, definition 3.11]

3.13
damage limit of the tube under mechanical stress
limit below which mechanical loads 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 of IEC 61462:1997).

3.14
specified mechanical load
SML
cantilever load specified by the manufacturer that is used in the mechanical tests in accordance with IEC 61462

Note 1 to entry The load is normally applied by bending at normal ambient temperature.

Note 2 to entry The SML forms the basis of the selection of composite hollow station post insulators with regard to external loads.

3.15
maximum mechanical load
MML
highest cantilever load which is expected to be applied to the composite hollow core station post insulators in accordance with IEC 61462

Note 1 to entry: The MML of the composite hollow core station post insulator is specified by the insulator manufacturer.

3.16
specified cantilever load
SCL
cantilever load which can be withstood by the insulator when tested under the prescribed conditions in accordance with IEC 62231

3.17
maximum design cantilever load
MDCL
load level above which damage to the insulator begins to occur and that should not be exceeded in service in accordance with IEC 62231

Note 1 to entry: In the context of this standard (IEC 62772) MDCL is considered to be equal to 1,25 times MML as determined in IEC 61462:1997, Clause 8 or 0,5 times of SML.

3.18
specified torsion load
SToL
torsion load level which can be withstood by the insulator when tested under the prescribed conditions in accordance with IEC 62231

3.19
maximum design torsion load
MDToL
load level above which damage to the insulator begins to occur and that should not be exceeded in service in accordance with IEC 62231

3.20
specified tension load
STL
tension load which can be withstood by the insulator when tested under the prescribed conditions in accordance with IEC 62231

3.21
maximum design tension load
MDTL
load level above which damage to the insulator begins to occur and that should not be exceeded in service in accordance with IEC 62231

3.22
specified compression load
SCoL
compression load which can be withstood by the insulator when tested under the prescribed conditions in accordance with IEC 62231

3.23
buckling load
compression load that induces buckling of the insulator core in accordance with IEC 62231

3.24
maximum design compression load
MDCoL
load level above which damage to the insulator begins to occur and that should not be exceeded in service in accordance with IEC 62231 and IEC 61462

3.25
failing load of a composite hollow core station post insulator
maximum load that can be reached when the insulator is tested under the prescribed conditions (valid for bending or pressure tests)

Note 1 to entry: Damage to the core and / or the connection zone is likely to occur at loads lower than the insulator failing load.

3.26
deflection under cantilever 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.

3.27
residual deflection
difference between the initial deflection of a composite hollow core station post insulator prior to bending load application, and the final deflection after release of the load

Note 1 to entry: The measurement of residual deflection serves for qualitative comparison with strain gauge measurements.

3.28
residual angular displacement
difference between the initial angular displacement, if any, of one of the insulator end fitting with respect to the other insulator end fitting measured prior to the application of the torsion load and the final angular displacement measured after torsion load release

Note 1 to entry: The residual angular displacement may depend on the duration of application of the torsion load and on the time duration between the torsion load release and the measurement of the displacement.

3.29
specified internal pressure
SIP
internal pressure specified by the manufacturer which is verified during a type test at normal ambient temperature

Note 1 to entry: The SIP forms the basis of the selection of composite hollow station post insulators with respect to internal pressure.

3.30
maximum service pressure
MSP
difference between the maximum absolute internal pressure at maximum operational temperature and the normal outside pressure

Note 1 to entry The MSP of the composite hollow core station post insulator is specified by the insulator manufacturer.

Note 2 to entry The MSP is equivalent to "design pressure" as used for ceramic hollow insulators (see IEC 62155).

3.31
specified temperatures
highest and lowest temperature permissible for the composite hollow core station post insulator

Note 1 to entry: The specified temperatures are specified by the manufacturer.

3.32
manufacturer
individual or organization producing the composite hollow core station post insulator

3.33
equipment manufacturer
individual or organization producing the electrical equipment utilizing the composite hollow core station post insulator

4 Identification and marking

The manufacturer's drawing shall show the relevant dimensions and values necessary for identifying and testing the insulator in accordance with this standard. The drawing shall also show applicable manufacturing tolerances. In addition, the relevant IEC designation, when available, shall be stated on the drawing.

Each composite hollow core station post insulator shall be marked with the name or trade mark of the manufacturer and the year of manufacture. In addition, each hollow core station post composite insulator shall be marked with the type reference and serial numbers in order to allow identification. In addition, each insulator shall be marked with at least the maximum design mechanical load, for example: MDCL: 4 kN. This marking shall be legible and indelible.

5 Environmental conditions

See description in IEC 62217.

6 Information on transport, storage and installation

See description in IEC 62217.

7 Classification of tests

7.1 General

The tests are divided into groups as follows:

7.2 Design tests

These tests are intended to verify the suitability of the design, materials and manufacturing technology.

A composite hollow core station post insulators design is defined by:

- materials and design of the tube, housing, filler and manufacturing method,
- material of the end fittings, their design and method of attachment,
- layer thickness of the housing over the tube (including a sheath where used).

For new designs and when changes in the design occur, re-qualification shall be done according to Table 1.

7.3 Type tests

Type tests are intended to verify the main characteristics of a composite hollow core station post insulator, which depend mainly on its shape and size. Type tests in accordance with Table 1 shall be applied to composite hollow core station post insulators, the class of which has passed the design tests. They shall be repeated only when the type or material of the composite hollow core station post insulator is changed (see Table 1). The type tests shall be performed, according to the type tests defined in IEC 62231.

Electrically, a composite hollow core station post insulator type is defined by the

- arcing distance,
- creepage distance,
- housing profile,
- internal filler.

Mechanically, a composite hollow core station post insulator type is defined by the

- length (only for the compression and buckling withstand load test),
- tube‘s diameter, wall thickness, design and material,
- design and method of attachment of the end fittings.

7.4 Sample tests

These tests are for the purpose of verifying the characteristics of composite hollow core station post insulators which depend on the manufacturing quality and the material used. They shall be made on insulators taken at random from batches offered for acceptance.

7.5 Routine tests

These tests are for the purpose of eliminating composite hollow core station post insulators with manufacturing defects. They shall be made on each composite hollow core station post insulator.

Table 1 – Required design and type tests

If a new design is made or if the change in insulator design concerns:		THEN the following tests shall be repeated:									
		Design Tests								Type Tests	
		Assembled core load test, only 8.3.1 [f]	Interfaces and connections of end fittings	Hardness test	Accelerated weathering test	Tracking and erosion test	Flammability test	Dye penetration test	Water diffusion test	Mechanical type tests	Electrical type tests
1	Housing materials		X	X	X	X	X				
2	Housing profile [a]					X					X
3	Tube material	X	X					X	X	X	
4	Tube design [b]	X						X	X	X	
5	Manufacturing process of housing [c]		X	X	X	X					
6	Manufacturing process of tube [d]	X	X					X	X	X	
7	End fitting material	X	X							X	
8	End fitting method of attachment to tube [e]	X	X							X	
9	Tube-housing-end fitting interface design	X	X			X					
10	Filling material and / or method		X					X	X		X

[a] The following variation of the housing profile within following tolerances do not constitute a change:

Overhang of sheds: ±10 %; Spacing: ±10 %; Mean inclination of sheds: ±3°; Thickness at root and tip of sheds: ±15 %; Shed repetition: identical.

[b] Liner, winding angle

[c] Curing and moulding method (e.g. extrusion, injection, single shed assembly…)

[d] Pultrusion, wet filament winding, vacuum impregnation, including surface preparation

[e] Applications: bending, pressure, combined pressure-bending

[f] one sample smallest OD and smallest wall thickness, and one sample largest OD and smallest wall thickness

8 Design tests

8.1 General

These tests are described in IEC 62217. The design tests shall be performed only once and the results are recorded in a test report. Each part can be performed independently on new test specimens where appropriate. A composite hollow core station post insulator of a particular design shall be deemed accepted only when all insulators or test specimens pass the design tests in the given sequence.

All the design tests, apart from the thermal-mechanical test, are performed at normal ambient temperature.

A summary of the tests is shown in Table 1.

Extreme service temperatures may affect the mechanical behaviour of composite insulators. A general rule to define “extreme high or low” insulator temperatures is not available at this time, for this reason the supplier should always specify service temperature limitations. Whenever the insulators are subjected to very high or low temperatures for long periods of time, it is advisable that both manufacturer and user agree on a mechanical test at higher or lower temperatures than mentioned in this standard.

8.2 Tests on interfaces and connections of end fittings

8.2.1 General

See IEC 62217.

These tests shall be performed in the given sequence on the same specimen.

8.2.2 Test specimens

One composite hollow core station post insulator assembled on the production line shall be tested. The tube's internal diameter shall be at least 100 mm and the wall thickness at least 3 mm. The insulation length (metal-to-metal spacing) shall be at least three times the tube's internal diameter but not less than 800 mm. Both end fittings shall have the same method of attachment and sealing as on standard production insulators. The composite hollow core station post insulator shall be submitted to the routine tests

Caution should be taken in case of pressurized designs which may have hazardous failure mode

The manufacturer shall define the SML value for the test specimen.

8.2.3 Reference dry power frequency test

See IEC 62217.

8.2.4 Thermal mechanical pre-stressing test

See IEC 61462.

8.2.5 Water immersion pre-stressing test

See IEC 62217.

8.2.6 Verification tests

8.2.6.1 General

See IEC 62217.

8.2.6.2 Visual examination

See IEC 62217.

8.2.6.3 Steep-front impulse high voltage test

See IEC 62217.

8.2.6.4 Dry power frequency voltage test

See IEC 62217.

8.2.6.5 Internal pressure test

See IEC 61462.

This test is not applicable for composite hollow core station post insulators with solid material fillers and foam. For unpressurized types with non-solid fillers only a gas leakage test must be performed in accordance with Subclause 11.2.

8.3 Assembled core load tests

8.3.1 Test for the verification of the maximum design cantilever load (MDCL)

NOTE MDCL is considered to be equal with 1,25 times MML as determined by the type test as determined in IEC 61462:2007, Clause 8.

8.3.1.1 Test procedure

The test can be performed without a filler or the filler may be removed after the test and before the dye penetration test.

One insulator with the smallest outer tube diameter and the smallest wall thickness and one insulator with the largest outer tube diameter and the smallest wall thickness made on the production line using the standard end fittings shall be selected. The overall length of the insulators shall be at least 8 times the outer diameter of the tube, unless the manufacturer does not have facilities to make such a length. In this case, the length of insulator shall be as near as possible to the prescribed length range. The base end-fitting has to be fixed rigidly. The insulators shall be gradually loaded to 1,1 times the MDCL rating at a temperature of 20 °C ± 10 K and held for 96 h. The load shall be applied to the insulators at the conductor position, perpendicular to the direction of the conductor, and perpendicular to the core of the insulators.

At 24 h, 48 h, 72 h and 96 h, the deflection of the insulators at the point of application of the load shall be recorded, as additional information. After removal of the load, the steps below shall be followed:

- visually inspect the base end fitting for cracks or permanent deformation,
- check that threads of the end fitting are re-usable,
- if required, measure the residual deflection.

Cut each insulator 90° to the axis of the core and about 50 mm from the junction of the tube to the end fitting, then cut the base end fitting part of the insulator longitudinally into two halves in the plane of the previously applied cantilever load. The cut surfaces shall be smoothed by means of fine abrasive cloth (grain size 180).

- Visually inspect the cut halves for cracks and delaminations,
- perform a dye penetration test to the cut surfaces to reveal cracks.

Some housing and filler materials may be penetrated by the penetrant. In such cases, evidence shall be provided to validate the interpretation of the results (see IEC 61109:2008, 11.2.2 and 11.2.3).

8.3.1.2 Acceptance criteria

Observation of any cracks, permanent deformation or delaminations shall constitute failure of the test.

8.3.2 Test for the verification of the maximum design torsion load (MDToL)

8.3.2.1 Test procedure

The test can be performed without a filler or the filler may be removed after the test and before the dye penetration test.

One insulator with the smallest outer tube diameter and the smallest wall thickness and one insulator with the largest outer tube diameter and the smallest wall thickness made on the production line using the standard end fittings shall be selected.

The overall length of the insulators shall be at least 8 times the diameter of the core, unless the manufacturer does not have facilities to make such a length. In this case, the length of insulators shall be as near as possible to the prescribed length range. The torsion load shall be applied to the insulators perpendicularly with the axis of the core of the insulator. No bending moment should be applied. The insulators shall be gradually loaded to 1,1 times the MDToL rating at a temperature of 20 °C ± 10 K and held for 30 min. The angular displacement shall be measured at 30 min as additional information. An acceptable value of the angular displacement shall be agreed between manufacturer and user.

NOTE In a torsion test, the angular displacement is proportional to the length of the core between the end fittings.

An example of a test arrangement can be found in Annex C of IEC 62231:2006. After removal of the load, the steps below shall be followed:

- if required, measure the residual angular displacement,
- visually inspect the end fittings for cracks or permanent deformation,
- check that threads of the end fitting are re-usable,
- cut each insulator 90° to the axis of the core at about 50 mm from the end fittings, and in the middle part of this cut section,
- polish the cut surfaces by means of fine abrasive cloth (grain size 180),
- visually inspect the cut surfaces for cracks and delaminations,
- perform a dye penetration test to the cut surfaces to reveal cracks or delaminations.

Some housing and filler materials may be penetrated by the penetrant. In such cases, evidence shall be provided to validate the interpretation of the results (see IEC 61109:2008, 11.2.2 and 11.2.3).

8.3.2.2 Acceptance criteria

The test shall be regarded as passed if there is no evidence of

- pullout or slip of the core from the end fitting, or
- breakage of the end fitting.

8.3.3 Verification of the specified tension load (STL)

8.3.3.1 Test procedure

The test can be performed without a filler.

One insulator with the smallest outer tube diameter and the smallest wall thickness and one insulator with the largest outer tube diameter and the smallest wall thickness made on the production line using the standard end fittings shall be selected.

The overall length of the insulators shall be at least 8 times the diameter of the core, unless the manufacturer does not have facilities to make such a length. In this case, the length of insulator shall be as near as possible to the prescribed length range.

The tensile load shall be applied to the insulators in line with the axis of the core of the insulator at a temperature of 20 °C ± 10 K. The load shall be increased rapidly but smoothly from zero to approximately 75 % of the specified tensile load and shall then be gradually increased in a time between 30 s and 90 s until the specified tensile load is reached. If 100 %

of the STL is reached in less than 90 s, the load (100 % of STL) shall be maintained for the remainder of the 90 s.

8.3.3.2 Acceptance criteria

The test shall be regarded as passed if there is no evidence of

- pullout or slip of the core from the end fitting, or
- breakage of the end fitting.

8.4 Tests on shed and housing material

8.4.1 General

See IEC 62217.

8.4.2 Tracking and erosion test

See IEC 62217.

8.4.3 Flammability test

See IEC 62217.

8.5 Tests on the tube material

8.5.1 General

See IEC 62217 (Tests on the core material).

The tests shall be carried out on specimens either with or without housing material.

8.5.2 Dye penetration test

See IEC 62217.

This test is carried out with solid filler material.

8.5.3 Water diffusion test

See IEC 62217. In case of solid filler material this test needs to be done with the filler.

If the test specimen are made of foam the samples sizes for the pre stressing can be extended by 10 mm in all directions. After boiling, the outer surfaces shall be cut to the specified size of the samples before the voltage test. See Annex A.

NOTE For other filling materials testing procedures need to be agreed between manufacturer and user.

9 Type tests

9.1 Internal pressure test

See IEC 61462.

9.2 Bending test

See IEC 61462.

9.3 Specified tension load test, compression and buckling withstand load test

These tests are to be performed for the major service conditions applicable.

See IEC 62231.

One sample from production line for each test.

If agreed between manufacturer and user these tests can be replaced by calculation.

9.4 Electrical tests

See IEC 62231.

In case of DC application the wet or dry power frequency withstand voltage test of the insulator shall be performed with DC voltage.

9.5 Wet switching impulse withstand voltage

See IEC 60060-1, IEC 60168.

Test values to be applied in accordance with IEC 60273.

10 Sample tests

See IEC 61462.

11 Routine tests

11.1 General

See IEC 61462.

11.2 Routine seal leak rate test

This test verifies the gas/watertightness of the tube sealing system and is only applicable for hollow core station post insulators with gas (unpressurized or pressurized service conditions) as internal insulation. The test shall verify the tightness of all possible leak paths in the sealing system, including the end fitting to tube interface, the end fitting, the sealing system of the end fitting, and the gas valve.

11.3 Test procedure

The manufacturer may use any sensitive method suitable for the measurement of the specified seal leak rate. For pressurized hollow core station post insulators the test shall be performed at MSP using gas (e.g. air, nitrogen or helium) pressure. The internal pressure shall be maintained for at least 5 min. For unpressurized hollow core station post insulators the test shall be performed under a differential pressure of at least 0,05 MPa with a test duration of at least 5 min

11.4 Acceptance criteria

Unpressurized and pressurized hollow core station post insulators without pressure monitoring: The total relative seal leak rate shall be lower than the volume fraction of 0,1 % per year.

Pressurized hollow core station post insulators with pressure monitoring: The total relative seal leak rate shall be lower than the volume fraction of 0,5 % per year

For hollow core station post insulators without pressure monitoring the tightness of the gas valve shall be verified after filling to service pressure and final closing of the valve.

The maximum leakage rate (Pa m^3/s) based on acceptance leakage rate limit of $F_{\text{rel,p}}$ per year is calculated as follows:

$$F = \frac{F_{\text{rel.p}} \times V_{\text{to}} \times P_{\text{to}} \left(\dfrac{273\ K + T_{\text{test}}}{273\ K + 20\ °\text{C}} \right) \times g}{365\ \text{days} \times 24\ \text{hours} \times 60\ \text{minutes} \times 60\ \text{seconds}}$$

where

F is the leakage rate, in Pa m^3/s;

V_{to} is the hollow core station post insulators gas volume, in m^3;

P_{to} is the rated filling pressure at T = 20 °C, in Pa absolute;

T_{test} is the ambient temperature during leakage measurement, in °C;

g is the percentage of tracer gas in the hollow core station post insulator gas volume.

12 Documentation

The manufacturer shall maintain records of all serially produced composite hollow insulators in accordance with this standard for a minimum of 10 years. These records shall contain the following information:

- type reference number;
- serial number;
- date of manufacture;
- routine and sample tests, date and results.

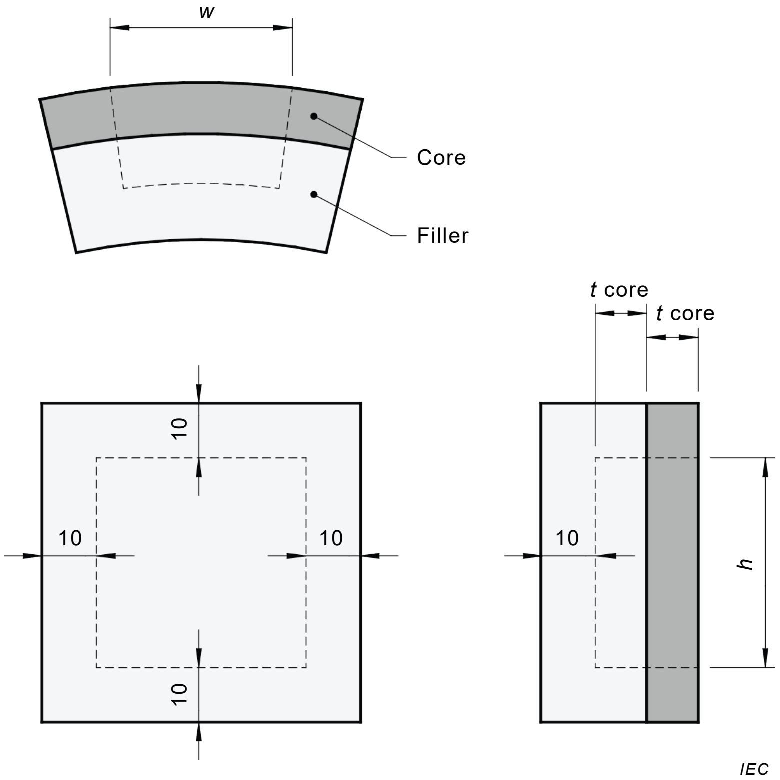
The manufacturer of equipment shall be provided with extracts of the records upon request.

Annex A
(informative)

Water diffusion test

Figure A.1 gives an example of sample preparation for the water diffusion test.

Dimensions in millimetres



Legend:

h = 30 mm ± 0,5 mm for samples for the water diffusion test

w = 15 mm ± 0,5 mm for samples for the water diffusion test

Figure A.1 – Example of sample preparation for water diffusion test

Bibliography

[1] IEC 60068-2-17, *Basic environmental testing procedures – Part 2-17: Tests – Test Q: Sealing*

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

[3] ISO 1101, *Geometrical Product Specifications (GPS) – Geometrical tolerancing – Tolerancing of form, orientation, location and run out*

[4] IEC 60050-471, *International Electrotechnical Vocabulary – Part 471: Insulators*

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