IEC 62772

Edition 2.0 2023-11
REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

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

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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COMPOSITE HOLLOW CORE STATION POST INSULATORS ~~FOR SUBSTATIONS~~ WITH AC VOLTAGE GREATER THAN 1 000 V AND DC VOLTAGE GREATER THAN 1 500 V – DEFINITIONS, TEST METHODS AND ACCEPTANCE CRITERIA

FOREWORD

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 62772:2016. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

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

This second edition cancels and replaces the first edition published in 2016. 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) harmonization of Table 1 (Required design and type tests) with other product standards;
d) update of Annex A (Qualification of fillers);
e) addition of a new informative Annex B (Load definitions, relationship of loads).

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

Draft	Report on voting
36/569/FDIS	36/587/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.

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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 document 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 AC 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~~ despite the intended operating voltage limit for substations.

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.~~ 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.

Composite hollow core station post 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 standard 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 [8][1]. 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.

[1] Numbers in square brackets refer to the Bibliography.

COMPOSITE HOLLOW CORE STATION POST INSULATORS ~~FOR SUBSTATIONS~~ WITH AC VOLTAGE GREATER THAN 1 000 V AND DC VOLTAGE GREATER THAN 1 500 V – DEFINITIONS, TEST METHODS AND ACCEPTANCE CRITERIA

1 Scope

This document, which is an International Standard, applies to composite hollow core station post insulators consisting of a load-bearing insulating tube (core) made of resin impregnated fibres, 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 DC.

The object of this document is:

- to define the terms used;
- to ~~prescribe~~ specify test methods;
- to ~~prescribe~~ specify acceptance criteria.

All the tests in this document, apart from the thermal-mechanical test, are performed at normal ambient temperature. This document does not ~~prescribe~~ specify tests that ~~may be~~ are characteristic of the apparatus of which the composite hollow core station post insulator ultimately may form a part (e.g. disconnector switch, reactor support, HVDC valves). ~~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 1000 V*

IEC 61109~~:2008~~, *Insulators for overhead lines – Composite suspension and tension insulators for AC 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 AC voltages greater than 1 000 V up to 245 kV – 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 core station post insulator
post insulator, consisting of at least three insulating parts, namely a tube, a housing with or without sheds, and 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.

Note 1 to entry: End fittings are attached to the insulating tube. The housing, with or without sheds, may be omitted in case of specific environmental conditions (e.g. indoor).

Note 2 to entry: A hollow insulator can be made from one or more permanently assembled insulating elements

3.2
post insulator
insulator intended to give rigid support to a live part which is to be insulated from earth or from another live part

Note 1 to entry: A post insulator may be an assembly of a number of post insulator units (stack).

Note 2 to entry: Post insulators for substations are also known as station post insulators.

[SOURCE: IEC 60050-471:2007, 471-04-01, modified – addition of "(stack)" in Note 1 to entry]

3.3
tube (core)
central internal insulating part of a composite hollow core station post insulator designed to ensure which provides 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. The housing, insulating filler material and sheds are not part of the core.

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.

3.4
filler
insulating material filling the entire internal space (~~e.g.~~ solid, liquid~~, foam~~, gaseous – pressurized or unpressurized) of the hollow core station post insulator~~ which has no load bearing function~~

3.5
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]

3.6
coupling
part of the end fitting which transmits the load to the accessories external to the insulator

[SOURCE: IEC 62217:2012, 3.~~13~~14]

3.7
connection zone
zone where the mechanical load is transmitted between the insulating body and the end fitting

[SOURCE: IEC 62217:2012, 3.~~12~~13]

3.8
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")~~]

3.9
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]

3.10
insulator trunk
central insulating part of an insulator from which the sheds ~~protrude~~ project

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

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

3.11
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, modified – removal of Note 2 to entry]

3.12
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]

3.13
interface
contact surface between the different materials

Note 1 to entry: Various interfaces occur in most composite insulators (cf. Annex C), e.g.

– between housing and end fittings,
– between various parts of the housing; e.g. between sheds, or between sheath and sheds,
– between ~~core~~ tube and housing
– between ~~core~~ tube and filler.

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

3.14
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~~).

3.15
maximum mechanical load
MML
highest cantilever bending 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 mechanical load
SML
cantilever bending load specified by the manufacturer that is used in the mechanical tests, ~~in accordance with IEC 61462~~ and which is verified during a type test at normal ambient temperature

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

Note ~~2~~ 1 to entry: The SML forms the basis of the selection of composite hollow station post insulators with regard to external loads.

3.17
specified cantilever load
SCL
cantilever load ~~which can~~ to be withstood by the insulator when tested under the ~~prescribed~~ specified conditions in accordance with IEC 62231

3.18
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.~~ For more information to load philosopies and relationships, see Annex B.

3.19
specified torsion load
SToL
torsion load level which can be withstood by the insulator when tested under the ~~prescribed~~ specified conditions in accordance with IEC 62231

3.20
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

3.21
specified tension load
STL
tension load which can be withstood by the insulator when tested under the ~~prescribed~~ specified conditions in accordance with IEC 62231

3.22
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

3.23
specified compression load
SCoL
compression load ~~which can~~ to be withstood by the insulator when tested under the ~~prescribed~~ specified conditions in accordance with IEC 62231

3.24
buckling load
compression load that induces buckling of the insulator core in accordance with IEC 62231

3.25
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~~

3.26
failing load of a composite hollow core station post insulator
load at ultimate failure of the insulator, maximum load that can be reached when the insulator is tested under the ~~prescribed~~ specified conditions (valid for bending or pressure tests)

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

3.27
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.

3.28
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.~~

3.29
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.

3.30
overpressure
pressure above ambient pressure within a pressurized enclosure

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

3.31
maximum service pressure
MSP
~~difference between the maximum absolute internal pressure at maximum operational temperature and the normal outside pressure~~

maximum overpressure in service which is specified by the equipment manufacturer

3.32
specified internal pressure
SIP
internal overpressure 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.~~

~~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).~~

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.

3.33
pressurized insulator
insulator permanently filled with gas or liquid whose maximum service pressure is greater than 0,05 MPa overpressure

3.34
unpressurized insulator
insulator is an insulator permanently filled with gas or liquid whose maximum service pressure is smaller than or equal to 0,05 MPa overpressure

3.35
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.

3.36
manufacturer
individual or organization producing the composite hollow core station post insulator

3.37
equipment manufacturer
individual or organization producing the electrical equipment utilizing the composite hollow core station post insulator

3.38
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 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 document. 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, formulation 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.

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

IF the change in insulator design concerns:		**THEN** the following tests shall be repeated: a)											
		Design tests										**Type tests**	
		IEC 62772:-, 8.2	IEC 62772:-, 8.3.1	IEC 62772:-, 8.4 Tests on shed and housing material					IEC 62772:-, 8.5 Tests on the tube material		IEC 62772:-, 8.6 Tests on tube with housing	IEC 62772:-, 9.4	IEC 62772:-, 9.1, 9.2, 9.3
		Interfaces and connections of end fittings	Assembled core load test	Hardness test	Accelerated weathering test	Tracking and erosion test	Flammability test	Hydrophobicity transfer test	Porosity test (Dye penetration test)	Water diffusion test	Water Diffusion Test on Core with Housing	Electrical type tests	Mechanical type tests
1	Housing												
1a	Materials, formulation or manufacturing process[1]	X		Xd)	X d)	X	X d)	Xe)			X a)		
1b	Assembly process[2]	Xc)				X							
1c	Profile					Xb)						X	
2	Tube												
2a	Material, formulation or manufacturing process[3]	X	X						X	X	X a)		X
2b	Design[4]		X						X	X			X
3	End fitting												
3a	Material or assembly process	X	X										X
3b	End fitting connection zone design	X											X
4	Interface												
4a	Primer material and application method	X									X a)		
4b	Tube and end-fitting assembly process[5]	X	X										X
4c	Tube/housing/end fitting interface design[5]	X	X			X						X	
5	Filling material or method[6]	X										X	

Explanation a) to e): Additional information for which specific changes testing needs to be done	a) Not necessary if it can be demonstrated that the change has no influence on the property considered in the test; material tests could be used to show the equivalence b) Not necessary if thickness of the housing surrounding the core (including a sheath where used) is equal or greater than that of the parent insulator. Following relative numbers as tolerances are provided as reference, which do not constitute a change of the profile: – overhang: ±10 % – thickness at base and tip: ±15 % – spacing: ±15 % – shed inclinations: ±3° – shed repetition: identical. These relatively small tolerances serve as reference, however cause a high test demand due to the variety of today`s profiles. Alternatively, a technical agreement between manufacturer and user in agreement with chapter 9.1 is possible if the equivalence of the profile evaluated in the tracking and erosion test to the profile in question can be shown. A possible method is the interpolation of results with different profiles. c) Not necessary if it can be demonstrated that the change has no influence on the property considered in the test. d) Not necessary for change in manufacturing process without material change e) Applicable to materials that shall show this property
Explanation 1 to 6: Technical explanation of hollow core insulator components	1 Housing manufacturing process: General manufacturing method such as injection moulding, modular process etc. 2 Housing assembly process: If shed and sheath are mounted separately to the tube, incl. type and method of bonding shed-sheath 3 Tube manufacturing method: Pultrusion, wet filament winding, vacuum impregnation, including surface preparation 4 Liner and winding angle 5 See Annex C for further explanation 6 See Annex A for further explanation

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,

– arcing and field grading devices, if equipped.

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

• ~~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.~~

– the length (only for the compression and buckling withstand load test),

– the tube inner diameters,

– the wall thicknesses of the tube,
– the tube lamination parameters,
– the method of attachment,
– the material of insulator,
– the material of the metal end fittings,
– the manufacturing process.

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~~ lots 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.

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 to be carried out after design changes 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 document.

8.2 Tests on interfaces and connections of end fittings

8.2.1 General

See IEC 62217:2012, 9.2.1.

See Clause A.4.

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

The test sequence consists of:

– reference disruptive-discharge dry power frequency voltage test
– pre-stressing tests
– verification tests

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 disruptive- discharge dry power frequency voltage 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.~~

This test is applicable for pressurized composite hollow core station post insulators only.

8.3 Assembled core load tests

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

8.3.1.1 General

~~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.~~

If a manufacturer has no further experience, MDCL is considered to be equal with 1,25 times MML as determined by the type test as determined in IEC 61462. See Annex B.

8.3.1.2 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~~ specified 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).

8.3.1.3 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~~ specified 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~~ specified 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~~ Hardness test

See IEC 62217.

8.4.2 Accelerated weathering test

See IEC 62217.

8.4.3 Tracking and erosion ~~test~~ – 1 000 h salt fog AC voltage test

See IEC 62217.

8.4.4 Flammability test

See IEC 62217.

8.4.5 Hydrophobicity transfer test

See IEC TR 62039.

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 Porosity test (Dye penetration test)

See IEC 62217 and Annex A.

~~This test is carried out with solid filler material.~~.

8.5.3 Water diffusion test

See IEC 62217 and Annex A. ~~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.~~

8.6 Water diffusion test on core with housing

See IEC 62217.

9 Type tests

9.1 Internal pressure test

See IEC 61462.

9.2 Bending test

See IEC 61462.

NOTE For more information to load philosophies and relationships, see Annex B.

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.~~

9.4.1 General

The following tests shall be performed on AC and DC insulators, as applicable, once only for a given post insulator.

If arcing and field grading devices are used in service, they shall be used in the tests. Interpolation of electrical test results may be used for insulators of intermediate length as long as the factor between the arcing distances of the insulators whose results form the end points of the interpolation range is less than or equal to 1,5. Extrapolation is not allowed.

In case of insulators for DC application the power frequency withstand voltage tests shall be replaced by specified DC withstand voltage tests.

The test values and procedures depend on the application (e.g. indoor or outdoor, part of electrical equipment or stand-alone) and are therefore to be applied according customer agreement. IEC 60071-1 or IEC 60273 may also be used for guidance.

9.4.2 Mounting arrangements for electrical tests

The mounting arrangements for electrical tests on post insulators depend on whether switching-impulse tests are required and on whether service conditions are to be reproduced.

See IEC 60168.

9.4.3 Dry lightning impulse withstand voltage test

The post insulator shall be tested in accordance with IEC 60168.

9.4.4 Dry or wet switching impulse withstand voltage test

The post insulator shall be tested in accordance with IEC 60168. Dry test is applicable only to post insulators for indoor use and wet test is applicable only to post insulators for outdoor use.

9.4.5 Dry power-frequency withstand voltage test

The post insulator shall be tested in accordance with IEC 60168.

This test is applicable only to post insulators for indoor use.

In case of insulators for DC application the power frequency withstand voltage test shall be replaced by specified DC withstand voltage tests.

9.4.6 Wet power-frequency withstand voltage test

The post insulator shall be tested in accordance with IEC 60168.

This test is applicable only to post insulators for outdoor use.

In case of insulators for DC application the power frequency withstand voltage test shall be replaced by specified DC withstand voltage tests.

~~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

11.2.1 General

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.

11.2.2 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 minutes. 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 minutes.

11.2.3 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~~ acceptable leakage rate limit of $F_{rel,p}$ per year is calculated as follows:

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

NOTE 365 days × 24 hours × 60 minutes × 60 seconds = 31536000 seconds per year

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.

Annexe A
(informative)

~~Water diffusion test~~ Qualification of fillers

A.1 General

Composite hollow core station post insulators contain a filler. Some examples for types of fillers are gases, liquids, gels, or solid fillers (e.g. foam). The filler prevents inner flashovers over the lifetime, especially caused by condensation on the inside of the tube. To achieve this, the purpose, the nature, consequently the physics and properties of a filler, can be widely different.

The filler must cope with a certain amount of moisture ingress. The amount of moisture ingress is depending on the design and the ambient conditions over lifetime. To maintain its function, the filler should always fulfil the criteria of IEC TR 62039 e.g. in respect of electrical withstand and heat breakdown. Fillers should also only be tested within their specified temperature range.

Following, the ideal proof for the filler is to test it as an integral part in the station post. An (accelerated) life-time test may be necessary, but as of today, there is nothing useful available. Nevertheless, this Annex presents some tests, which are under discussion. They are intended to prove certain properties of the filler, necessary for the respective concept.

A.2 Dye penetration test with solid filler

This test is only applicable for solid fillers.

The test is performed according to IEC 62217, but with filler.

A.3 Water diffusion test with solid filler

This test is only applicable for solid fillers specified for temperatures above boiling.

The test is performed according to IEC 62217, but with filler.

If the filler is foam, the samples sizes for the prestressing 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 Figure A.1.

A.4 Tests on interfaces and connections of end fittings with filler

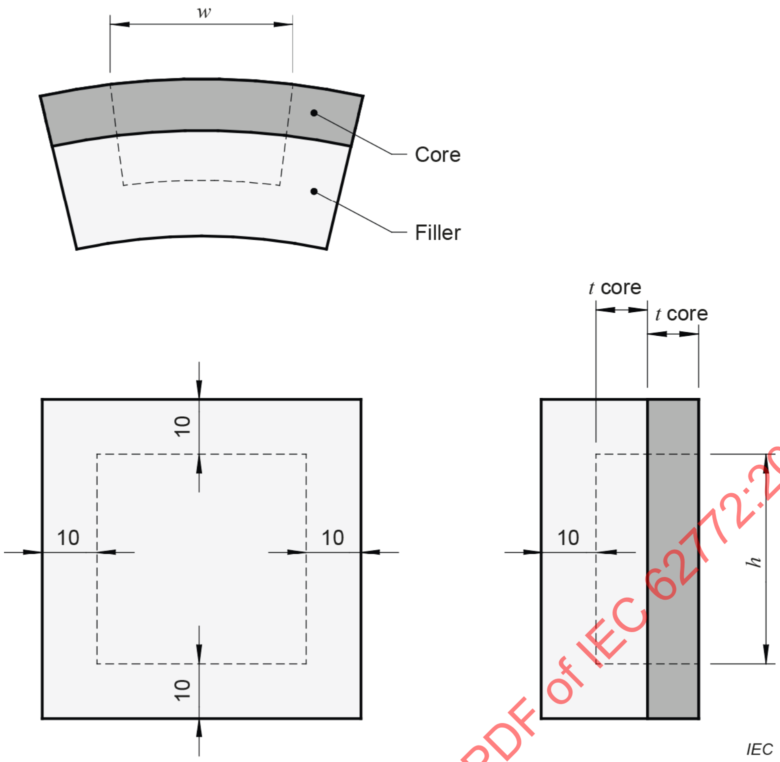
This test is applicable to all kind of fillers (including gases) specified for temperatures above boiling. For others, instead of water immersion prestressing, alternative procedures, e.g. conditioning in climate chamber, may be applied.

The test is performed according to 8.2.

For further information, the dry power frequency voltage tests can be extended by a partial discharge (PD) measurement before and after pre stressing with the insulator in dry condition.

~~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

Annexe B
(informative)

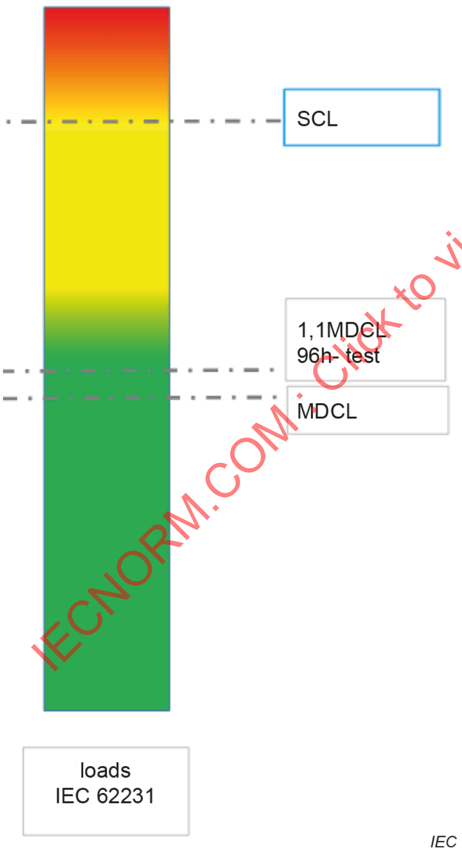
Load definitions, relationship of loads

Composite hollow core insulators are described and defined in IEC 61462 "composite hollow insulators". Composite (solid core) station post insulators are described and defined in IEC 62231. "Composite station post insulators".

This document (IEC 62772) describes and defines the structural elements of IEC 61462, basically a hollow-core based design, in a particular application, the station post insulator, using and introducing the terms and definitions of IEC 62231 which deals with solid core station post applications, and applying them to the hollow core insulating tubes according to their respective standards.

Since the structural elements in both maternity standards are different, the consideration of a relationship between the load-defining terms and definitions contained in both standards is based on the respective definition and proof of the damage limit for both different designs.

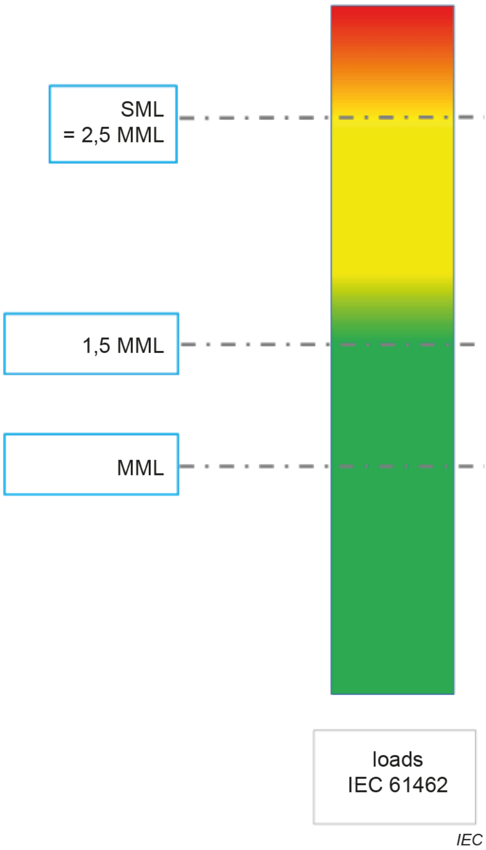
Figure B.1 shows the definitions according to IEC 62231, on composite (solid core) station post insulators:



As described under 8.3.1 "Test for the verification of the maximum design cantilever load (MDCL)", a cantilever load of 1,1 times MDCL is applied to the test specimen for a duration of 96 hours. After this period, the test specimen is observed against the acceptance criteria, in which the appearance of any cracks and/or delaminations, detected by dye penetration investigations on cut halves of the insulators loaded end, will constitute a failing of the test. Thus, the test is confirming, with the given parameters of time and temperature, a load of 1,1 times MDCL causing no deterioration to the insulator.

Figure B.1 – Definitions according to IEC 62231

Figure B.2 shows the definitions according to IEC 61462, on composite hollow (core) insulator:



The damage limit is defined to be equal or higher a load level of 1,5 times MML, compare Figure B.1 of IEC 61462 (reproduced below). As described under 8.5 "Bending test", the insulator is subjected to a cantilever bending test in several stages. After the load stage at 1,5 times MML, the residual tube strain must not be larger than 5 %, which in this case confirms the integrity of the test specimen, thus the damage limit is higher.

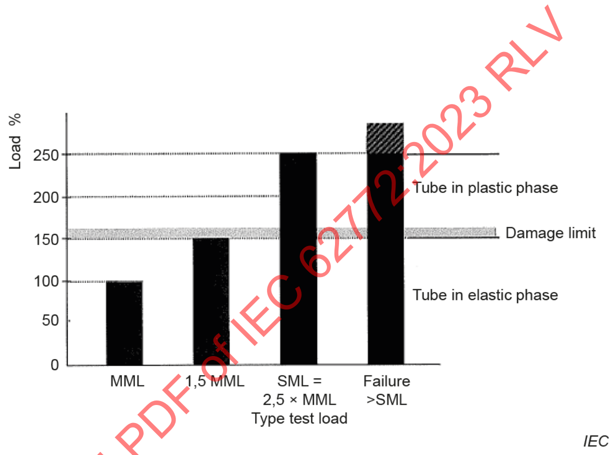


Figure B.2 – Definitions according to IEC 61462

Figure B.3 shows a comparison of the two philosophies, and the two loads proving the integrity of the test specimens:

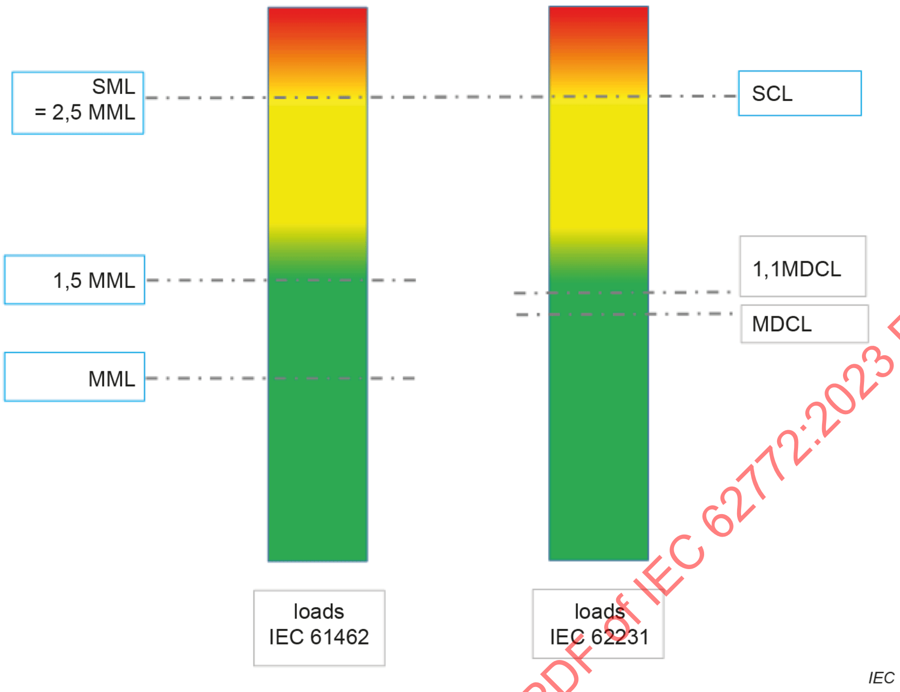


Figure B.3 – Comparison of definitions IEC 61462 vs. IEC 62231

In the IEC 62231 philosophy, the MDCL value is dependent to the individual insulator design, and there is no fixed relationship to its SCL. However, SML and SCL can be assumed as equal, both are choosen below, often close to, the minimum cantilever bending breakdown value of the respective design.

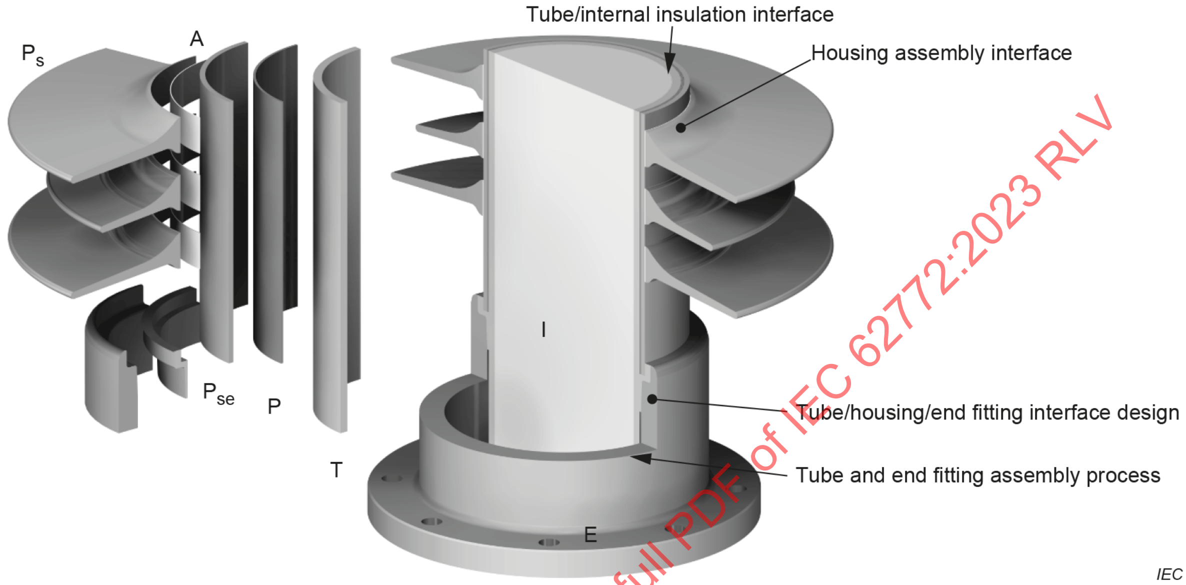
In IEC 61462, the ratio between MML and SML is defined to be 2,5.

Since the "damaging zones" for FRP-based products do not show sharp transition, and some parameters between the tests described above are differing, it appears that a reasonable relationship between MML and MDCL is in the range of MDCL = 1,0....1,5 × MML. Finally, if a manufacturer has no further experience, a factor of MDCL = 1,25 could be a starting point, unless higher ratios have been proven by design testing.

Annexe C
(informative)

Principle sketch of hollow insulators design assembly

Figure C.1 shows the interface description for insulator with housing made by modular assembly:



Interface description for insulator with housing made by modular assembly

P_s = Polymer shed,

A = Adhesive,

P_{se} = Polymer sheath,

P = Primer,

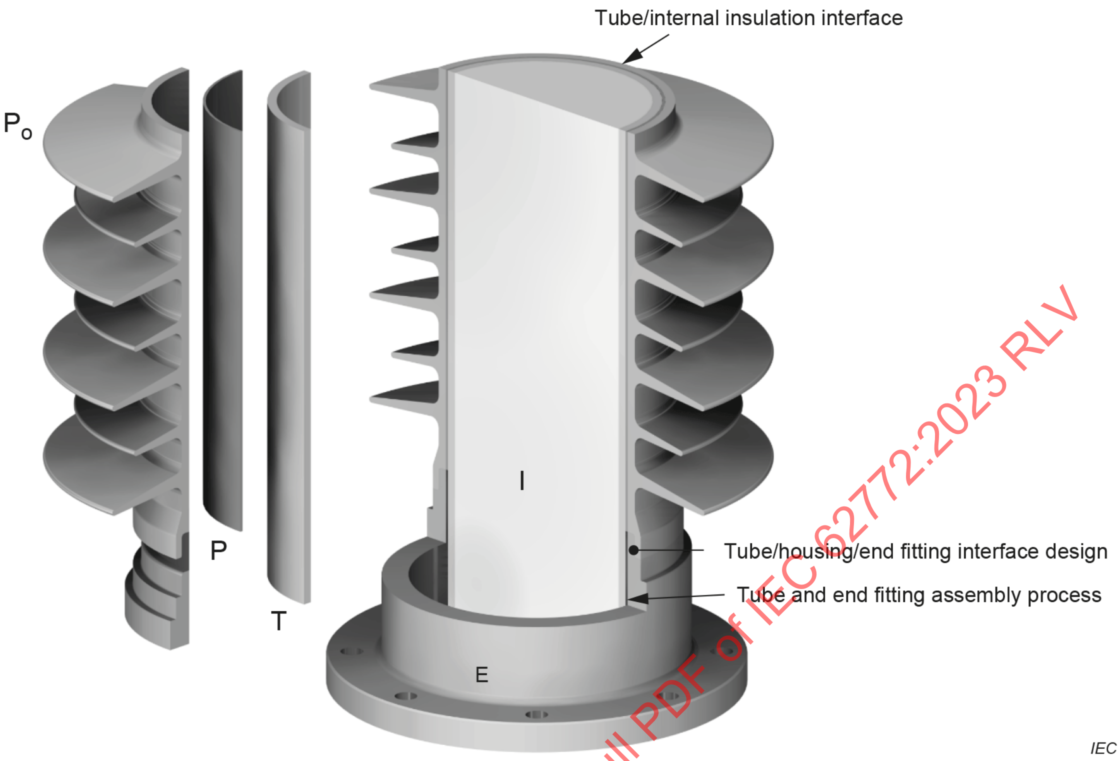
T = Tube (FRP),

E = End fitting,

I = Internal insulation

Figure C.1 – Interface description for insulator with housing made by modular assembly

Figure C.2 shows the interface description for insulator with housing made by injection moulding and ouvermold end fitting:



Interface description for insulator with housing made by injection moulding and ouvermold end fitting

Po = Polymer,

P = Primer,

T = Tube (FRP),

E = End fitting,

I = Internal insulation

NOTE The primer is usually not visible

Figure C.2 – Interface description for insulator with housing made by injection moulding and ouvermold end fitting

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[6] IEC TS 60815-3, *Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 3: Polymer insulators for a.c. systems*

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IEC 62772

Edition 2.0 2023-11

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

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

Isolateurs supports composites creux 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 62772:2023-11(en-fr)

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

____

COMPOSITE HOLLOW CORE STATION POST INSULATORS WITH AC VOLTAGE GREATER THAN 1 000 V AND DC VOLTAGE GREATER THAN 1 500 V – DEFINITIONS, TEST METHODS AND ACCEPTANCE CRITERIA

FOREWORD

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

This second edition cancels and replaces the first edition published in 2016. 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) harmonization of Table 1 (Required design and type tests) with other product standards;
d) update of Annex A (Qualification of fillers);
e) addition of a new informative Annex B (Load definitions, relationship of loads).

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

Draft	Report on voting
36/569/FDIS	36/587/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.

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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 document 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 AC 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 despite the intended operating voltage limit for substations.

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. 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.

Composite hollow core station post 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 standard 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 [8][1]. 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.

[1] Numbers in square brackets refer to the Bibliography.

COMPOSITE HOLLOW CORE STATION POST INSULATORS WITH AC VOLTAGE GREATER THAN 1 000 V AND DC VOLTAGE GREATER THAN 1 500 V – DEFINITIONS, TEST METHODS AND ACCEPTANCE CRITERIA

1 Scope

This document, which is an International Standard, applies to composite hollow core station post insulators consisting of a load-bearing insulating tube (core) made of resin impregnated fibres, insulating filler material (solid, liquid, gaseous – pressurized or unpressurized), a housing (outside the insulating tube) made of polymeric material (for example silicone or ethylene-propylene) and 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 DC.

The object of this document is:

– to define the terms used;

– to specify test methods;

– to specify acceptance criteria.

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 are characteristic of the apparatus of which the composite hollow core station post insulator ultimately may form a part (e.g. disconnector switch, reactor support, HVDC valves).

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 60168, *Tests on indoor and outdoor post insulators of ceramic material or glass for systems with nominal voltages greater than 1000 V*

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

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*

IEC 62217, *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 AC voltages greater than 1 000 V up to 245 kV – 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 core station post insulator
post insulator, consisting of at least three insulating parts, namely a tube, a housing with or without sheds, and an internal filler

Note 1 to entry: End fittings are attached to the insulating tube. The housing, with or without sheds, may be omitted in case of specific environmental conditions (e.g. indoor).

Note 2 to entry: A hollow insulator can be made from one or more permanently assembled insulating elements

3.2
post insulator
insulator intended to give rigid support to a live part which is to be insulated from earth or from another live part

Note 1 to entry: A post insulator may be an assembly of a number of post insulator units (stack).

Note 2 to entry: Post insulators for substations are also known as station post insulators.

[SOURCE: IEC 60050-471:2007, 471-04-01, modified – addition of "(stack)" in Note 1 to entry]

3.3
tube (core)
central internal insulating part of a composite hollow core station post insulator which provides the mechanical characteristics

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

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.

3.4
filler
insulating material filling the entire internal space (solid, liquid, gaseous – pressurized or unpressurized) of the hollow core station post insulator

3.5
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]

3.6
coupling
part of the end fitting which transmits the load to the accessories external to the insulator

[SOURCE: IEC 62217:2012, 3.14]

3.7
connection zone
zone where the mechanical load is transmitted between the insulating body and the end fitting

[SOURCE: IEC 62217:2012, 3.13]

3.8
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, 3.7]

3.9
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]

3.10
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]

3.11
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.

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

3.12
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]

3.13
interface
contact surface between the different materials

Note 1 to entry: Various interfaces occur in most composite insulators (cf. Annex C), e.g.

- between housing and end fittings,
- between various parts of the housing; e.g. between sheds, or between sheath and sheds,
- between tube and housing
- between tube and filler.

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

3.14
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).

3.15
maximum mechanical load
MML
highest cantilever bending 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 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 station post insulators with regard to external loads.

3.17
specified cantilever load
SCL
cantilever load to be withstood by the insulator when tested under the specified conditions in accordance with IEC 62231

3.18
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: For more information to load philosopies and relationships, see Annex B.

3.19
specified torsion load
SToL
torsion load level which can be withstood by the insulator when tested under the specified conditions in accordance with IEC 62231

3.20
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

3.21
specified tension load
STL
tension load which can be withstood by the insulator when tested under the specified conditions in accordance with IEC 62231

3.22
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

3.23
specified compression load
SCoL
compression load to be withstood by the insulator when tested under the specified conditions in accordance with IEC 62231

3.24
buckling load
compression load that induces buckling of the insulator core in accordance with IEC 62231

3.25
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

3.26
failing load of a composite hollow core station post insulator
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 to the tube is likely to occur at loads lower than the insulator failing load.

3.27
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.

3.28
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

3.29
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.

3.30
overpressure
pressure above ambient pressure within a pressurized enclosure

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

3.31
maximum service pressure
MSP
maximum overpressure in service which is specified by the equipment manufacturer

3.32
specified internal pressure
SIP
internal overpressure specified by the 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.

3.33
pressurized insulator
insulator permanently filled with gas or liquid whose maximum service pressure is greater than 0,05 MPa overpressure

3.34
unpressurized insulator
insulator is an insulator permanently filled with gas or liquid whose maximum service pressure is smaller than or equal to 0,05 MPa overpressure

3.35
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.

3.36
manufacturer
individual or organization producing the composite hollow core station post insulator

3.37
equipment manufacturer
individual or organization producing the electrical equipment utilizing the composite hollow core station post insulator

3.38
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 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 document. 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, formulation 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.

Table 1 – Required design and type tests

IF the change in insulator design concerns:		**THEN** the following tests shall be repeated: a)											
		Design tests										**Type tests**	
		IEC 62772:-, 8.2	IEC 62772:-, 8.3.1	IEC 62772:-, 8.4 Tests on shed and housing material					IEC 62772:-, 8.5 Tests on the tube material		IEC 62772:-, 8.6 Tests on tube with housing	IEC 62772:-, 9.4	IEC 62772:-, 9.1, 9.2, 9.3
		Interfaces and connections of end fittings	Assembled core load test	Hardness test	Accelerated weathering test	Tracking and erosion test	Flammability test	Hydrophobicity transfer test	Porosity test (Dye penetration test)	Water diffusion test	Water Diffusion Test on Core with Housing	Electrical type tests	Mechanical type tests
1	Housing												
1a	Materials, formulation or manufacturing process[1]	X		X d)	X d)	X	X d)	X e)			X a)		
1b	Assembly process[2]	X c)				X							
1c	Profile					X b)						X	
2	Tube												
2a	Material, formulation or manufacturing process[3]	X	X						X	X	X a)		X
2b	Design[4]		X						X	X			X
3	End fitting												
3a	Material or assembly process	X	X										X
3b	End fitting connection zone design	X											X
4	Interface												
4a	Primer material and application method	X									X a)		
4b	Tube and end-fitting assembly process[5]	X	X										X
4c	Tube/housing/end fitting interface design[5]	X	X			X						X	
5	Filling material or method[6]	X										X	

Explanation a) to e): Additional information for which specific changes testing needs to be done	a) Not necessary if it can be demonstrated that the change has no influence on the property considered in the test; material tests could be used to show the equivalence b) Not necessary if thickness of the housing surrounding the core (including a sheath where used) is equal or greater than that of the parent insulator. Following relative numbers as tolerances are provided as reference, which do not constitute a change of the profile: – overhang: ±10 % – thickness at base and tip: ±15 % – spacing: ±15 % – shed inclinations: ±3° – shed repetition: identical. These relatively small tolerances serve as reference, however cause a high test demand due to the variety of today`s profiles. Alternatively, a technical agreement between manufacturer and user in agreement with chapter 9.1 is possible if the equivalence of the profile evaluated in the tracking and erosion test to the profile in question can be shown. A possible method is the interpolation of results with different profiles. c) Not necessary if it can be demonstrated that the change has no influence on the property considered in the test. d) Not necessary for change in manufacturing process without material change e) Applicable to materials that shall show this property
Explanation 1 to 6: Technical explanation of hollow core insulator components	1 Housing manufacturing process: General manufacturing method such as injection moulding, modular process etc. 2 Housing assembly process: If shed and sheath are mounted separately to the tube, incl. type and method of bonding shed-sheath 3 Tube manufacturing method: Pultrusion, wet filament winding, vacuum impregnation, including surface preparation 4 Liner and winding angle 5 See Annex C for further explanation 6 See Annex A for further explanation

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 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,
– arcing and field grading devices, if equipped.

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

– the length (only for the compression and buckling withstand load test),
– the tube inner diameters,
– the wall thicknesses of the tube,
– the tube lamination parameters,
– the method of attachment,

– the material of insulator,
– the material of the metal end fittings,
– the manufacturing process.

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 lots 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.

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 to be carried out after design changes 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 document.

8.2 Tests on interfaces and connections of end fittings

8.2.1 General

See IEC 62217:2012, 9.2.1.

See Clause A.4.

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

The test sequence consists of:

– reference disruptive-discharge dry power frequency voltage test
– pre-stressing tests
– verification tests

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 disruptive- discharge dry power frequency voltage 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 applicable for pressurized composite hollow core station post insulators only.

8.3 Assembled core load tests

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

8.3.1.1 General

If a manufacturer has no further experience, MDCL is considered to be equal with 1,25 times MML as determined by the type test as determined in IEC 61462. See Annex B.

8.3.1.2 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 specified 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).

8.3.1.3 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 specified 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 specified 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 Hardness test

See IEC 62217.

8.4.2 Accelerated weathering test

See IEC 62217.

8.4.3 Tracking and erosion – 1 000 h salt fog AC voltage test

See IEC 62217.

8.4.4 Flammability test

See IEC 62217.

8.4.5 Hydrophobicity transfer test

See IEC TR 62039.

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 Porosity test (Dye penetration test)

See IEC 62217 and Annex A.

8.5.3 Water diffusion test

See IEC 62217 and Annex A.

8.6 Water diffusion test on core with housing

See IEC 62217.

9 Type tests

9.1 Internal pressure test

See IEC 61462.

9.2 Bending test

See IEC 61462.

NOTE For more information to load philosopies and relationships, see Annex B.

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

9.4.1 General

The following tests shall be performed on AC and DC insulators, as applicable, once only for a given post insulator.

If arcing and field grading devices are used in service, they shall be used in the tests. Interpolation of electrical test results may be used for insulators of intermediate length as long as the factor between the arcing distances of the insulators whose results form the end points of the interpolation range is less than or equal to 1,5. Extrapolation is not allowed.

In case of insulators for DC application the power frequency withstand voltage tests shall be replaced by specified DC withstand voltage tests.

The test values and procedures depend on the application (e.g. indoor or outdoor, part of electrical equipment or stand-alone) and are therefore to be applied according customer agreement. IEC 60071-1 or IEC 60273 may also be used for guidance.

9.4.2 Mounting arrangements for electrical tests

The mounting arrangements for electrical tests on post insulators depend on whether switching-impulse tests are required and on whether service conditions are to be reproduced.

See IEC 60168.

9.4.3 Dry lightning impulse withstand voltage test

The post insulator shall be tested in accordance with IEC 60168.

9.4.4 Dry or wet switching impulse withstand voltage test

The post insulator shall be tested in accordance with IEC 60168. Dry test is applicable only to post insulators for indoor use and wet test is applicable only to post insulators for outdoor use.

9.4.5 Dry power-frequency withstand voltage test

The post insulator shall be tested in accordance with IEC 60168.

This test is applicable only to post insulators for indoor use.

In case of insulators for DC application the power frequency withstand voltage test shall be replaced by specified DC withstand voltage tests.

9.4.6 Wet power-frequency withstand voltage test

The post insulator shall be tested in accordance with IEC 60168.

This test is applicable only to post insulators for outdoor use.

In case of insulators for DC application the power frequency withstand voltage test shall be replaced by specified DC withstand voltage tests.

10 Sample tests

See IEC 61462.

11 Routine tests

11.1 General

See IEC 61462.

11.2 Routine seal leak rate test

11.2.1 General

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.

11.2.2 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 minutes. 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 minutes.

11.2.3 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 acceptable leakage rate limit of $F_{\text{rel,p}}$ per year is calculated as follows:

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

NOTE 365 days × 24 hours × 60 minutes × 60 seconds = 31536000 seconds per year

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)

Qualification of fillers

A.1 General

Composite hollow core station post insulators contain a filler. Some examples for types of fillers are gases, liquids, gels, or solid fillers (e.g. foam). The filler prevents inner flashovers over the lifetime, especially caused by condensation on the inside of the tube. To achieve this, the purpose, the nature, consequently the physics and properties of a filler, can be widely different.

The filler must cope with a certain amount of moisture ingress. The amount of moisture ingress is depending on the design and the ambient conditions over lifetime. To maintain its function, the filler should always fulfil the criteria of IEC TR 62039 e.g. in respect of electrical withstand and heat breakdown. Fillers should also only be tested within their specified temperature range.

Following, the ideal proof for the filler is to test it as an integral part in the station post. An (accelerated) life-time test may be necessary, but as of today, there is nothing useful available. Nevertheless, this Annex presents some tests, which are under discussion. They are intended to prove certain properties of the filler, necessary for the respective concept.

A.2 Dye penetration test with solid filler

This test is only applicable for solid fillers.

The test is performed according to IEC 62217, but with filler.

A.3 Water diffusion test with solid filler

This test is only applicable for solid fillers specified for temperatures above boiling.

The test is performed according to IEC 62217, but with filler.

If the filler is foam, the samples sizes for the prestressing 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 Figure A.1.

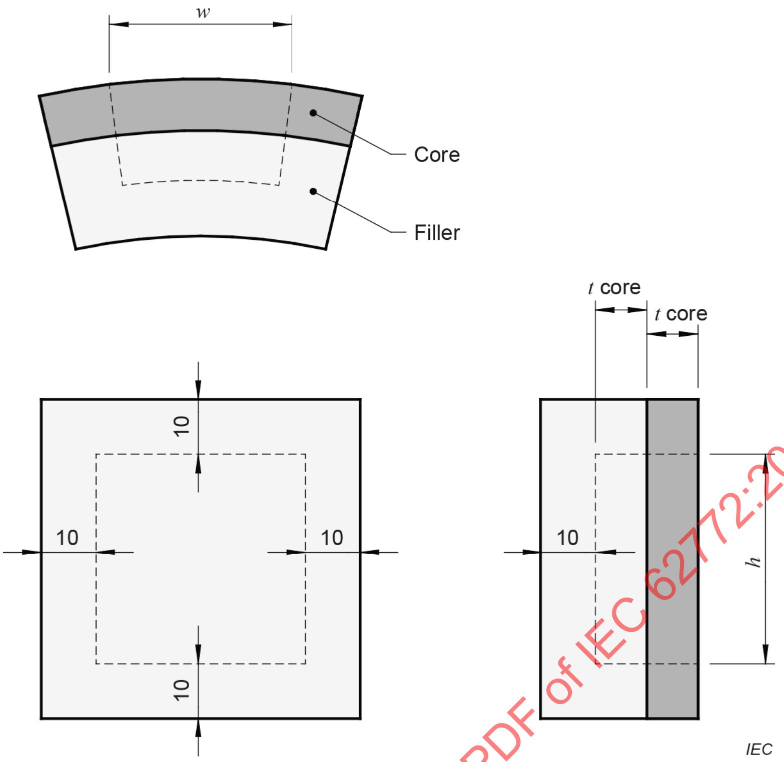
A.4 Tests on interfaces and connections of end fittings with filler

This test is applicable to all kind of fillers (including gases) specified for temperatures above boiling. For others, instead of water immersion prestressing, alternative procedures, e.g. conditioning in climate chamber, may be applied.

The test is performed according to 8.2.

For further information, the dry power frequency voltage tests can be extended by a partial discharge (PD) measurement before and after pre stressing with the insulator in dry condition.

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

Annex B
(informative)

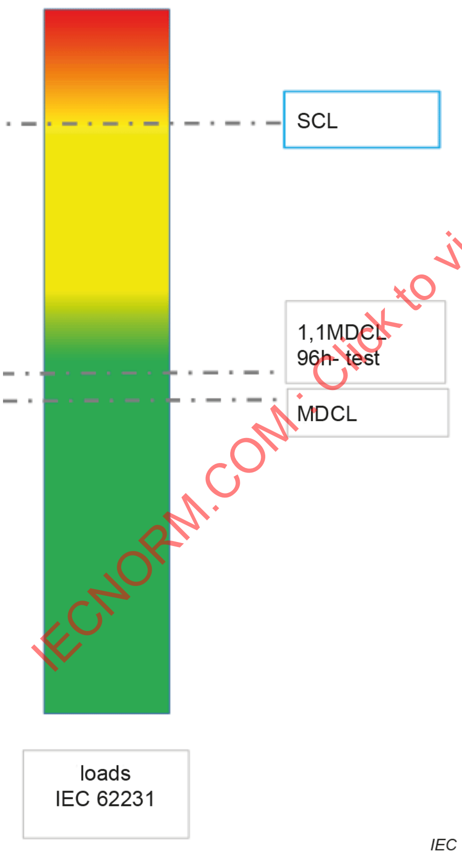
Load definitions, relationship of loads

Composite hollow core insulators are described and defined in IEC 61462 "composite hollow insulators". Composite (solid core) station post insulators are described and defined in IEC 62231. "Composite station post insulators".

This document (IEC 62772) describes and defines the structural elements of IEC 61462, basically a hollow-core based design, in a particular application, the station post insulator, using and introducing the terms and definitions of IEC 62231 which deals with solid core station post applications, and applying them to the hollow core insulating tubes according to their respective standards.

Since the structural elements in both maternity standards are different, the consideration of a relationship between the load-defining terms and definitions contained in both standards is based on the respective definition and proof of the damage limit for both different designs.

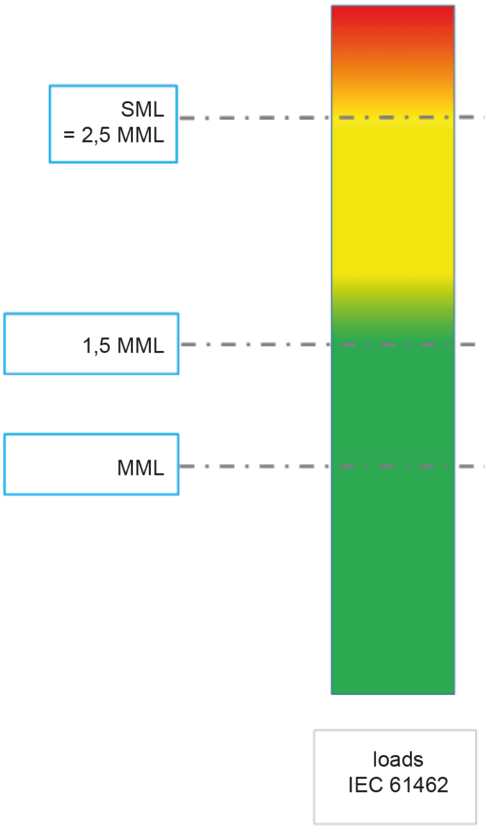
Figure B.1 shows the definitions according to IEC 62231, on composite (solid core) station post insulators:



As described under 8.3.1 "Test for the verification of the maximum design cantilever load (MDCL)", a cantilever load of 1,1 times MDCL is applied to the test specimen for a duration of 96 hours. After this period, the test specimen is observed against the acceptance criteria, in which the appearance of any cracks and/or delaminations, detected by dye penetration investigations on cut halves of the insulators loaded end, will constitute a failing of the test. Thus, the test is confirming, with the given parameters of time and temperature, a load of 1,1 times MDCL causing no deterioration to the insulator.

Figure B.1 – Definitions according to IEC 62231

Figure B.2 shows the definitions according to IEC 61462, on composite hollow (core) insulator:



The damage limit is defined to be equal or higher a load level of 1,5 times MML, compare Figure B.1 of IEC 61462 (reproduced below). As described under 8.5 "Bending test", the insulator is subjected to a cantilever bending test in several stages. After the load stage at 1,5 times MML, the residual tube strain must not be larger than 5 %, which in this case confirms the integrity of the test specimen, thus the damage limit is higher.

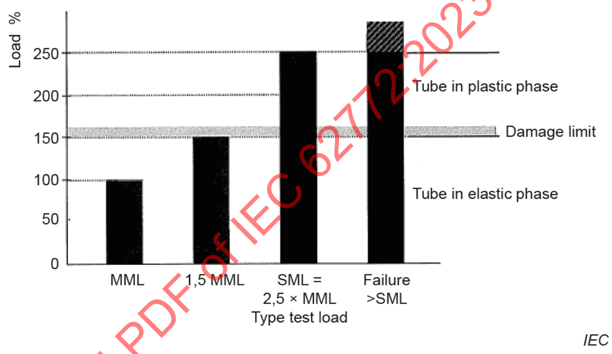


Figure B.2 – Definitions according to IEC 61462

Figure B.3 shows a comparison of the two philosophies, and the two loads proving the integrity of the test specimens:

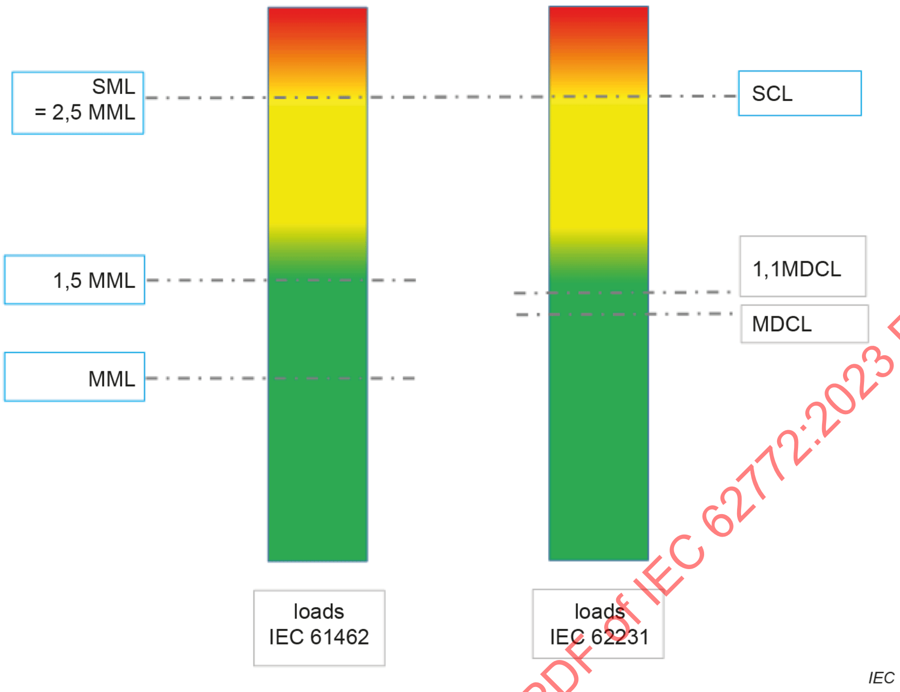


Figure B.3 – Comparison of definitions IEC 61462 vs. IEC 62231

In the IEC 62231 philosophy, the MDCL value is dependent to the individual insulator design, and there is no fixed relationship to its SCL. However, SML and SCL can be assumed as equal, both are choosen below, often close to, the minimum cantilever bending breakdown value of the respective design.

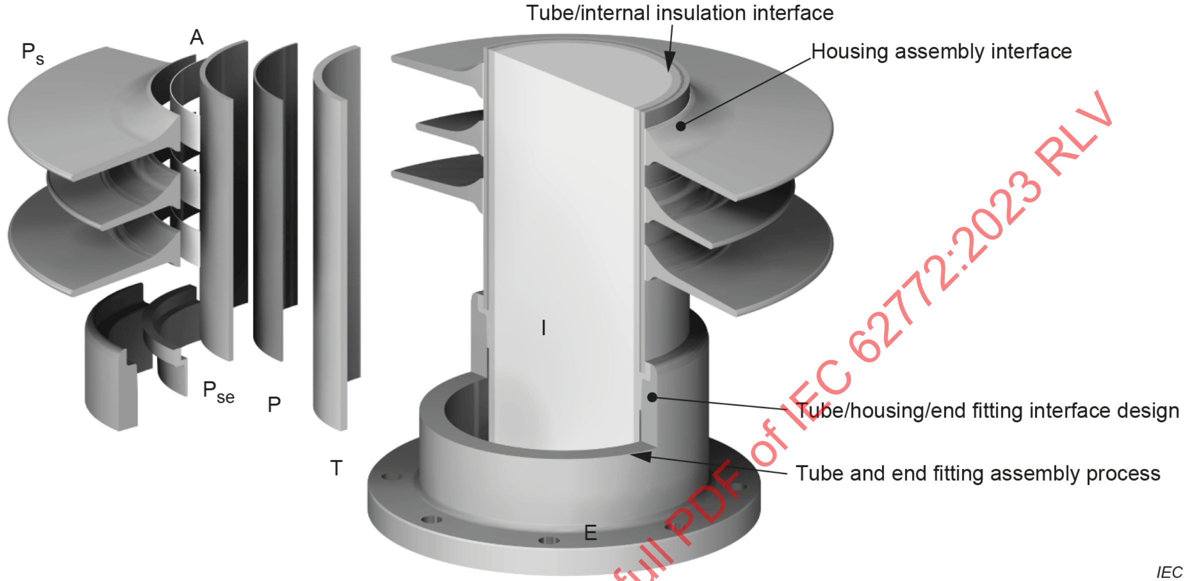
In IEC 61462, the ratio between MML and SML is defined to be 2,5.

Since the "damaging zones" for FRP-based products do not show sharp transition, and some parameters between the tests described above are differing, it appears that a reasonable relationship between MML and MDCL is in the range of MDCL = 1,0....1,5 × MML. Finally, if a manufacturer has no further experience, a factor of MDCL = 1,25 could be a starting point, unless higher ratios have been proven by design testing.

Annex C
(informative)

Principle sketch of hollow insulators design assembly

Figure C.1 shows the interface description for insulator with housing made by modular assembly:



Interface description for insulator with housing made by modular assembly

P_s = Polymer shed,

A = Adhesive,

P_{se} = Polymer sheath,

P = Primer,

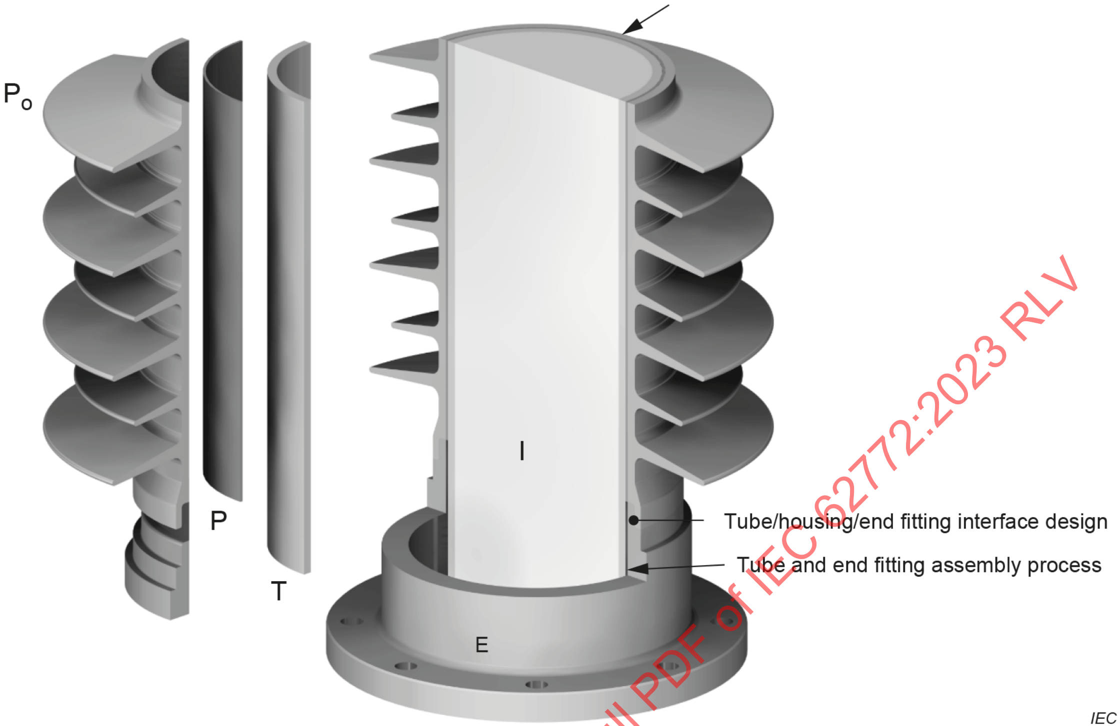
T = Tube (FRP),

E = End fitting,

I = Internal insulation

Figure C.1 – Interface description for insulator with housing made by modular assembly

Figure C.2 shows the interface description for insulator with housing made by injection moulding and ouvermold end fitting:



Interface description for insulator with housing made by injection moulding and ouvermold end fitting

Po = Polymer,

P = Primer,

T = Tube (FRP),

E = End fitting,

I = Internal insulation

NOTE The primer is usually not visible

Figure C.2 – Interface description for insulator with housing made by injection moulding and ouvermold end fitting

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 (IEV) – Part 471: Insulators*

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

[6] IEC TS 60815-3, *Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 3: Polymer insulators for a.c. systems*

[7] IEC TS 60815-4, *Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 4: Insulators for d.c. systems*

[8] CIGRÉ Technical Brochure 611, *Feasibility Study for a DC Tracking and Erosion Test* – 03/2015

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

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SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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ISOLATEURS SUPPORTS COMPOSITES CREUX 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

AVANT-PROPOS

L'IEC 62772 a été établie par le comité d'études 36 de l'IEC: Isolateurs. Il s'agit d'une Norme internationale.

Cette deuxième édition annule et remplace la première édition parue en 2016. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) modification des termes et définitions;
b) modifications des procédures d'essai incluses dans l'IEC TR 62039 et l'IEC 62217 (Essai de transfert d'hydrophobicité; Essai de pénétration d'eau sur noyau avec revêtement);
c) harmonisation du Tableau 1 (Essais de conception et essais de type exigés) avec d'autres normes de produits;
d) mise à jour de l'Annexe A (Qualification des charges internes);
e) ajout d'une nouvelle Annexe B informative (Définition des charges et relations entre elles).

Le texte de cette Norme internationale est issu des documents suivants:

Projet	Rapport de vote
36/569/FDIS	36/587/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/publications.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous webstore.iec.ch dans les données relatives au document recherché. À cette date, le document sera

- reconduit,
- supprimé,
- remplacé par une édition révisée, ou
- amendé.

IMPORTANT – Le logo "colour inside" qui se trouve sur la page de couverture de ce document indique qu'elle contient des couleurs qui sont considérées comme utiles à une bonne compréhension de son contenu. Les utilisateurs devraient, par conséquent, imprimer cette publication en utilisant une imprimante couleur.

INTRODUCTION

Les isolateurs supports composites creux sont constitués d'un noyau creux isolant (tube), supportant la charge mécanique et protégé par un revêtement polymère; la charge mécanique est transmise au noyau par l'intermédiaire des armatures d'extrémité. Le noyau creux est entièrement rempli de matériau isolant. Le noyau est composé de fibres de verre imprégnées de résine.

Les isolateurs supports composites creux sont en général utilisés comme supports isolants dans les postes. Pour procéder aux essais de conception, l'IEC 62217 est à appliquer aux matériaux et interfaces de l'isolateur. Des essais regroupés sous la dénomination "Essais de conception" sont réalisés une fois seulement pour les isolateurs satisfaisant aux mêmes conditions de conception. Pour tous les essais de conception réalisés sur des isolateurs supports composites creux, les articles communs définis dans l'IEC 62217 s'appliquent. Pour autant que cela soit applicable, l'influence du temps sur les propriétés électriques et mécaniques des composants (matériau du noyau, revêtement, interfaces, etc.) et de l'isolateur support composite creux complet a été prise en compte dans la spécification des essais de conception, afin d'assurer une durée de vie satisfaisante dans des conditions de contrainte normalement connues en service.

Le présent document fait référence à l'IEC 61462, *Isolateurs composites creux – Isolateurs avec ou sans pression interne pour utilisation dans des appareillages électriques de tensions nominales supérieures à 1 000 V – Définitions, méthodes d'essais, critères d'acceptation et recommandations de conception*, ainsi qu'à l'IEC 62231, *Isolateurs supports composites rigides à socle destinés aux postes à courant alternatif de tensions supérieures à 1 000 V jusqu'à 245 kV – Définitions, méthodes d'essai et critères d'acceptation*. Les essais et exigences décrits dans l'IEC 62231 peuvent être utilisés malgré la limitation de tension de service prévue pour les postes.

Il est préférable d'utiliser un revêtement en polymère présentant un caractère hydrophobe et un mécanisme de transfert d'hydrophobicité (HTM, Hydrophobicity Transfer Mechanism) pour les isolateurs supports composites creux. Cela est dû au fait que le diamètre peut avoir une influence significative pour les surfaces hydrophiles (voir également l'IEC 60815-3). Par exemple, le caoutchouc de silicone est reconnu comme étant un moyen efficace de lutter contre les conditions de service sous pollution sévère. Pour l'heure, l'essai de cheminement et d'érosion en courant alternatif de 1 000 h de l'IEC 62217 est utilisé pour établir une exigence minimale pour la résistance au cheminement et à l'érosion, à la fois en courant alternatif et en courant continu.

Les isolateurs supports composites creux sont utilisés dans les applications en courant alternatif et les applications en courant continu. Avant que la norme appropriée pour les applications en courant continu soit publiée, la majorité des essais énumérés dans la présente norme peuvent également s'appliquer aux isolateurs en courant continu. Malgré cela, le développement d'une procédure d'essai de résistance au cheminement et à l'érosion pour les applications en courant continu, en qualité d'essai de conception, est toujours à l'étude. Des informations sur la différence entre un essai d'érosion en courant alternatif et en courant continu pour un matériau peuvent être consultées dans la brochure technique 611 du Conseil International des Grands Réseaux Electriques (CIGRE) [8][1]. Pour l'heure, l'essai de cheminement et d'érosion en courant alternatif de 1 000 h de l'IEC 62217 est utilisé pour établir une exigence minimale pour la résistance au cheminement et à l'érosion.

[1] Les chiffres entre crochets renvoient à la Bibliographie.

ISOLATEURS SUPPORTS COMPOSITES CREUX 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

1 Domaine d'application

Le présent document, qui est une Norme internationale, s'applique aux isolateurs supports composites creux qui sont constitués d'un tube (noyau) isolant en fibres imprégnées de résine supportant la charge mécanique, d'un matériau de charge interne (solide, liquide, gaz, sous pression ou pas), d'un revêtement en polymère à l'extérieur du tube isolant (par exemple silicone ou éthylène-propylène) et de dispositifs de fixation à ses extrémités. Les isolateurs supports composites creux, tels que définis dans la présente norme, sont destinés à l'utilisation générale dans les postes, tant en extérieur qu'en intérieur. Ils fonctionnent avec une tension alternative assignée de plus de 1 000 V en courant alternatif et à une fréquence maximale de 100 Hz, ou sont utilisés dans les systèmes à courant continu avec une tension assignée supérieure à 1 500 V en courant continu.

Le présent document a pour objet:

– de définir les termes utilisés;
– de spécifier des méthodes d'essai;
– de spécifier les critères d'acceptation.

À l'exception de l'essai thermomécanique, tous les essais du présent document sont réalisés à température ambiante normale. Le présent document ne spécifie pas d'essais qui sont caractéristiques de l'appareillage dont l'isolateur support composite creux peut former un élément constitutif (par exemple interrupteur-sectionneur, support de réactance, valves de courant continu haute tension (CCHT)).

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60168, *Essais des supports isolants d'intérieur et d'extérieur, en matière céramique ou en verre, destinés à des installations de tension nominale supérieure à 1 000 V*

IEC 61109, *Isolateurs pour lignes aériennes – Isolateurs composites de suspension et d'ancrage destinés aux systèmes à courant alternatif de tension nominale supérieure à 1 000 V – Définitions, méthodes d'essai et critères d'acceptation*

IEC 61462, *Isolateurs composites creux – Isolateurs avec ou sans pression interne pour utilisation dans des appareillages électriques de tensions nominales supérieures à 1 000 V – Définitions, méthodes d'essais, critères d'acceptation et recommandations de conception*

IEC 62217, *Isolateurs polymériques à haute tension pour utilisation à l'intérieur ou à l'extérieur – Définitions générales, méthodes d'essai et critères d'acceptation*

IEC 62231:2006, *Isolateurs supports composites rigides à socle destinés aux postes à courant alternatif de tensions supérieures à 1 000 V jusqu'à 245 kV – Définitions, méthodes d'essai et critères d'acceptation*

IEC TR 62039, *Selection guidelines for polymeric materials for outdoor use under HV stress* (disponible en anglais seulement)

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse http://www.electropedia.org/
- ISO Online browsing platform: disponible à l'adresse http://www.iso.org/obp

3.1
isolateur support composite creux
isolateur support composé d'au moins trois parties isolantes, à savoir un tube, un revêtement avec ou sans ailettes, et une charge interne

Note 1 à l'article: Des armatures d'extrémité sont fixées sur le tube isolant. Le revêtement avec ou sans ailettes peut être ignoré dans le cas de conditions d'environnement spécifiques (par exemple en intérieur).

Note 2 à l'article: Un isolateur creux peut être constitué d'un ou plusieurs éléments d'isolateurs assemblés d'une façon permanente.

3.2
isolateur support
isolateur servant à la fixation rigide d'une pièce sous tension qui doit être isolée de la terre ou d'une autre pièce sous tension

Note 1 à l'article: Un isolateur support peut être un assemblage d'éléments de support isolant (pile).

Note 2 à l'article: Cette Note ne s'applique qu'au texte anglais.

[SOURCE: IEC 60050-471:2007, 471-04-01, modifié – ajout de "(pile)" dans la Note 1 à l'article]

3.3
tube (noyau)
partie isolante interne d'un isolateur support composite creux qui assure les caractéristiques mécaniques

Note 1 à l'article: Le revêtement, le matériau de charge interne et les ailettes ne font pas partie du noyau.

Note 2 à l'article: Les fibres imprégnées de résine sont structurées de manière à atteindre une résistance mécanique suffisante. Des couches de fibres différentes peuvent être utilisées pour satisfaire à des exigences particulières.

3.4
charge interne
matériau isolant remplissant tout l'espace interne (solide, liquide, gaz, sous pression ou pas) de l'isolateur support composite creux

3.5
dispositif de fixation (armature d'extrémité)
dispositif, faisant partie d'un isolateur, qui sert à fixer celui-ci à une structure de support, à un conducteur, à une partie d'un équipement ou à un autre isolateur

Note 1 à l'article: Lorsque le dispositif de fixation est métallique, l'appellation "armature métallique" est normalement utilisée.

[SOURCE: IEC 60050-471:2007, 471-01-06, modifié – ajout de "dispositif de fixation" dans le terme]

3.6
couplage
partie de l'armature de fixation qui transmet la charge au matériel externe à l'isolateur

[SOURCE: IEC 62217:2012, 3.14]

3.7
zone de connexion
zone où la charge mécanique est transmise entre le corps isolant et l'armature d'extrémité

[SOURCE: IEC 62217:2012, 3.13]

3.8
revêtement
partie isolante externe d'un isolateur support composite creux, qui assure la ligne de fuite nécessaire et protège le tube de l'environnement

Note 1 à l'article: Si une gaine intermédiaire est utilisée, elle fait partie intégrante du revêtement.

[SOURCE: IEC 62217:2012, 3.7]

3.9
ailette
partie isolante en saillie sur le fût d'un isolateur, destinée à augmenter la ligne de fuite

Note 1 à l'article: Une ailette peut être avec ou sans ondulations.

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

3.10
fût d'un isolateur
partie isolante centrale d'un isolateur située entre les ailettes

Note 1 à l'article: Cette note ne s'applique qu'au texte anglais.

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

3.11
ligne de fuite
distance la plus courte ou somme des distances les plus courtes le long de la surface d'un isolateur entre deux parties conductrices qui supportent normalement la tension de service entre elles

Note 1 à l'article: La surface de toute matière de scellement non isolante n'est pas considérée comme faisant partie de la ligne de fuite.

[SOURCE: IEC 60050-471:2007, 471-01-04, modifié – suppression de la Note 2 à l'article]

3.12
distance d'arc
plus courte distance dans l'air à l'extérieur de l'isolateur entre les parties métalliques sur lesquelles on applique normalement la tension de service

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

3.13
interface
surface de contact entre les différents matériaux

Note 1 à l'article: La plupart des isolateurs composites présentent plusieurs interfaces (voir l'Annexe C), à savoir:

– entre le revêtement et les armatures d'extrémité;
– entre les diverses parties du revêtement, par exemple entre les ailettes ou entre les ailettes et la gaine;
– entre le tube et le revêtement;
– entre le tube et la charge interne.

[SOURCE: IEC 62217:2012, 3.11, modifié – ajout de "contact"]

3.14
limite d'endommagement du tube sous contrainte mécanique
limite, sous laquelle les charges mécaniques peuvent être appliquées, à température ambiante normale, sans apparition d'endommagements microscopiques sur les tubes en composite

Note 1 à l'article: Au-dessous de la limite d'endommagement, le tube est sollicité dans le domaine élastique réversible. Lorsque la limite d'endommagement est franchie, le tube est sollicité dans le domaine plastique irréversible, ce qui se traduit par un endommagement permanent du tube qui peut ne pas être visible à un niveau macroscopique (une définition plus précise est donnée à l'Annexe C de l'IEC 61462).

3.15
charge mécanique maximale
CMM
charge de flexion la plus élevée qu'il est prévu d'appliquer aux isolateurs supports composites creux selon l'IEC 61462

Note 1 à l'article: La CMM de l'isolateur support composite creux est spécifiée par le fabricant de l'isolateur.

3.16
charge mécanique spécifiée
CMS
charge de flexion spécifiée par le fabricant, qui est utilisée pour les essais mécaniques et qui est validée lors d'un essai de type à température ambiante normale

Note 1 à l'article: La CMS constitue la base du choix des isolateurs supports composites creux par rapport aux charges externes.

3.17
charge de flexion spécifiée
CFS
charge de flexion qui peut être supportée par l'isolateur lorsqu'il est soumis à essai dans les conditions spécifiées par l'IEC 62231

3.18
charge de flexion maximale de conception
CFMC
niveau de charge au-dessus duquel le dommage sur l'isolateur intervient et qu'il convient de ne pas dépasser en service selon l'IEC 62231

Note 1 à l'article: Pour plus d'informations sur les principes et relations applicables aux charges, voir l'Annexe B.

3.19
charge de torsion spécifiée
CToS
niveau de la charge de torsion auquel l'isolateur peut résister lorsqu'il est soumis à essai dans les conditions spécifiées par l'IEC 62231

3.20
charge de torsion maximale de conception
CToMC
niveau de charge au-dessus duquel le dommage sur l'isolateur intervient et qu'il convient de ne pas dépasser en service selon l'IEC 62231

3.21
charge de traction spécifiée
CTS
charge de traction à laquelle l'isolateur peut résister lorsqu'il est soumis à essai dans les conditions spécifiées par l'IEC 62231

3.22
charge de traction maximale de conception
CTMC
niveau de charge au-dessus duquel le dommage sur l'isolateur intervient et qu'il convient de ne pas dépasser en service selon l'IEC 62231

3.23
charge de compression spécifiée
CCoS
charge de compression qui peut être supportée par l'isolateur lorsqu'il est soumis à essai dans les conditions établies par l'IEC 62231

3.24
charge de flambage
charge de compression qui induit le flambage du noyau de l'isolateur selon l'IEC 62231

3.25
charge de compression maximale de conception
CCoMC
niveau de charge au-dessus duquel le dommage sur l'isolateur intervient et qu'il convient de ne pas dépasser en service selon l'IEC 62231

3.26
charge de rupture d'un isolateur support composite creux
charge correspondant à la rupture ultime de l'isolateur, charge maximale qui peut être atteinte lorsque l'isolateur est soumis à essai dans les conditions spécifiées (valable pour les essais de flexion ou de pression)

Note 1 à l'article: L'endommagement sur le tube est susceptible de se produire aux charges inférieures à la charge de rupture de l'isolateur.

3.27
flèche sous charge de flexion
déplacement d'un point d'un isolateur, mesuré perpendiculairement à son axe, sous l'effet d'une charge appliquée perpendiculairement à cet axe

Note 1 à l'article: Les relations flèche/charge sont déterminées par le fabricant.

3.28
flèche résiduelle
différence entre la flèche initiale d'un isolateur support composite creux avant l'application de la charge de flexion et la flèche finale obtenue après le relâchement de la charge

3.29
déplacement angulaire résiduel
différence entre le déplacement angulaire initial, le cas échéant, d'une des armatures d'extrémité de l'isolateur par rapport à l'autre armature d'extrémité de l'isolateur, mesuré avant l'application de la charge de torsion, et le déplacement angulaire final mesuré après relâchement de la charge de torsion

Note 1 à l'article: Le déplacement angulaire résiduel peut dépendre de la durée d'application de la charge de torsion et du temps entre le relâchement de la charge de torsion et la mesure du déplacement.

3.30
surpression
pression supérieure à la pression ambiante à l'intérieur d'une enveloppe à surpression interne

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

3.31
pression maximale de service
PMS
surpression maximale en conditions de service, spécifiée par le fabricant d'équipement

3.32
pression interne spécifiée
PIS
surpression interne spécifiée par le fabricant, qui est contrôlée par un essai de type réalisé à température ambiante normale

Note 1 à l'article: La PIS est spécifiée comme étant la limite de tenue à court terme de conception, en dessous de laquelle la structure de l'isolateur reste intacte, mais des dommages peuvent déjà survenir. Elle peut être supérieure à 4 fois la valeur de la PMS.

3.33
isolateur avec pression interne
isolateur rempli en permanence de gaz ou de liquide, dont la pression maximale de service est supérieure à une surpression de 0,05 MPa

3.34
isolateur sans pression interne
isolateur rempli en permanence de gaz ou de liquide, dont la pression maximale de service est inférieure ou égale à une surpression de 0,05 MPa

3.35
température spécifiée
températures maximale et minimale admises pour l'isolateur support composite creux

Note 1 à l'article: La température spécifiée est stipulée par le fabricant.

3.36
fabricant
personne ou organisation produisant les isolateurs supports composites creux

3.37
fabricant d'équipement
personne ou organisation produisant l'équipement électrique dans lequel les isolateurs supports composites creux sont utilisés

3.38
lot
groupe d'isolateurs offert pour acceptation en provenance d'un même fabricant, d'une même conception et fabriqué selon les mêmes conditions de production

Note 1 à l'article: Un ou plusieurs lots peuvent être offerts pour acceptation; le ou les lots offerts peuvent être constitués de tout ou partie de la quantité commandée.

[SOURCE: IEC 62155:2003, 3.22, modifié – suppression de "creux" et de "ou corps d'isolateur creux"]

4 Identification et marquage

Le plan du fabricant doit indiquer les dimensions appropriées et les valeurs nécessaires à l'identification et l'essai de l'isolateur conformément au présent document. Le plan doit également indiquer les tolérances de fabrication applicables. De plus, la désignation IEC pertinente, le cas échéant, doit être indiquée sur le plan.

Chaque isolateur support composite creux doit être marqué avec le nom ou la marque commerciale du fabricant et l'année de fabrication. De plus, chaque isolateur support composite creux doit porter la marque du type et le numéro de série pour en permettre l'identification. La charge mécanique de conception maximale doit au moins être également marquée sur chaque isolateur, par exemple: CFMC: 4 kN. Ces marquages doivent être lisibles et indélébiles.

5 Conditions d'environnement

Voir la description dans l'IEC 62217.

6 Informations relatives au transport, au stockage et à l'installation

Voir la description dans l'IEC 62217.

7 Classification des essais

7.1 Généralités

Les essais sont divisés en groupes, répartis comme suit.

7.2 Essais de conception

Ces essais ont pour but de vérifier que la conception, les matériaux et la technologie de fabrication sont appropriés.

Une conception d'isolateur support composite creux est définie par:

– les matériaux, la formulation et la conception du tube, le revêtement, la charge interne et la méthode de fabrication;
– le matériau des armatures d'extrémité, leur conception et la méthode de fixation;
– l'épaisseur du revêtement recouvrant le tube (y compris la gaine, le cas échéant).

Pour les nouvelles conceptions, et lorsque des modifications de conception ont lieu, une requalification doit être effectuée conformément au Tableau 1.

Tableau 1 – Essais de conception et essais de type exigés

SI la modification de la conception de l'isolateur concerne:		**ALORS** les essais suivants doivent être répétés: a)											
		Essais de conception										**Essais de type**	
		IEC 62772:-, 8.2	IEC 62772:-, 8.3.1	IEC 62772:-, 8.4 Essais du matériau des ailettes et du revêtement					IEC 62772:-, 8,5 Essais sur le matériau du tube		IEC 62772:-, 8,6 Essais sur le tube avec revêtement	IEC 62772:-, 9,4	IEC 62772:-, 9.1, 9.2, 9.3
		Int	Ess	Es	Es	Es	Es	Es	Es	Es	Essa…	Essa	Ess
1	Revêtement												
1a	Matériaux, formulation ou procédé de fabrication[1]	**X**		**X**d)	**X** d)	**X**	**X** d)	**X**e)			**X** a)		
1b	Processus d'assemblage[2]	**X**c)				**X**							
1c	Profil					**X**b)						**X**	
2	Tube												
2a	Matériau, formulation ou procédé de fabrication[3]	**X**	**X**						**X**	**X**	**X** a)		**X**
2b	Conception[4]		**X**						**X**	**X**			**X**
3	Armature d'extrémité												
3a	Matériau ou processus d'assemblage	**X**	**X**										**X**
3b	Conception de la zone de connexion des armatures d'extrémité	**X**											**X**
4	Interface												
4a	Primaire utilisé et méthode d'application	**X**									**X** a)		
4b	Processus d'assemblage du tube et des armatures d'extrémité[5]	**X**	**X**										**X**
4c	Conception de l'interface tube-revêtement-armature d'extrémité[5]	**X**	**X**			**X**						**X**	
5	Matériau ou méthode de remplissage[6]	**X**										**X**	