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Composite insulators with integrated optical fibres for AC voltages greater than 1 000 V and DC voltage greater than 1 500 V - Definitions, test methods and acceptance criteria

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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Composite insulators with integrated optical fibres for AC voltages greater than 1 000 V and DC voltage greater than 1 500 V - Definitions, tests methods and acceptance criteria

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IEC TS 63264 has been prepared by IEC technical committee 36: Insulators. It is a Technical Specification.

The text of this Technical Specification is based on the following documents:

Draft	Report on voting
36/633/DTS	36/651/RVDTS

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 Technical Specification 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– withdrawn, or
– revised.

INTRODUCTION

Composite insulators with integrated optical fibres, herein after referred to as "fibre optic composite insulators", consist of an insulating tube or core, bearing the mechanical load and protected by a polymeric housing. In addition, optical fibres (fibre optic elements) are incorporated into the insulator to transfer electromagnetic waves (e.g. light), energy, data (information), or other types of signals. Despite these common features, the materials used, and the design details employed by different manufacturers may differ. The mechanical load is transmitted to the core by metallic end fittings. When implementing a fibre optic element within the insulator, the electrical integrity of the element needs to be ensured by the manufacturer and it will not be tested and verified within this document in lifetime aspects. This document considers three design principles:

– Implementation of the fibre optic element into the polymeric housing,

– Implementation of the fibre optic element into the load-bearing core, or

– Implementation of the fibre optic element into the inner volume of a hollow core.

The grouping of the tests in this document follows the structure of IEC 62217 and the product standards. It provides additions and modifications to design-, type-, sample and routine tests to be considered when optical elements are incorporated into the respective fibre optic product.

Fibre optic composite insulators need to take into consideration the specific product application or standards, such as IEC 61109 for composite Long Rod insulators or IEC 61462 for composite hollow-core insulators. For easier use, Annex A offers an overview on the applicability of tests on the respective fibre optic composite insulator design. Guidance on the application of fibre optic elements in some examples are given in Annex B.

1 Scope

This Technical Specification applies to composite insulators equipped with optical fibres (fibre optic element), consisting of a load-bearing insulating core or tube, a housing (surrounding the insulating core) made of polymeric material, a fibre optic element integrated into the core or housing, or embedded in a filling media inside the inner volume of a hollow core, and end fittings permanently attached to the insulating core.

The object of this document is to

– define the terms used,

– specify additional test methods and provide additions and modifications to tests referred,

– specify acceptance criteria.

This document is to be used in addition to the respective product standard applicable to the product, application and design to which the fibre optic element has been added. Furthermore, this document does not include requirements dealing with the choice of insulators for specific operating conditions or environments.

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 60050-471, *International Electrotechnical Vocabulary (IEV) - Part 471: Insulators*

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

IEC 61300-2-18, *Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 2-18: Tests - Dry heat*

IEC 61300-2-22, *Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 2-22: Tests - Change of temperature*

IEC 61300-3-4, *Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 3-4: Examinations and measurements - Attenuation*

IEC 61462, *Composite hollow insulators - Pressurized and unpressurized insulators for use in electrical equipment with AC rated voltage greater than 1 000 V AC and D.C. voltage greater than 1500V - Definitions, test methods, acceptance criteria and design recommendations*

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

3 Terms, definitions and designations

3.1 Terms and definitions

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

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

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

3.1.1
polymeric insulator
insulator whose insulating body consists of at least one organic based material

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

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

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

3.1.2
composite insulator
insulator made of at least two insulating parts, namely a core and a housing, equipped with metal fittings

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

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

3.1.3
core (of a composite insulator)
central insulating part of an insulator which provides the mechanical characteristics

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

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

3.1.4
tube
core
central internal insulating part of a composite hollow insulator which provides the mechanical characteristics

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

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

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

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

3.1.5
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]

3.1.6
housing
external insulating part of a composite insulator providing the necessary creepage distance and protecting core from environment

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

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

3.1.7
shed (of an insulator)
insulating part, projecting from the insulator trunk, intended to increase the creepage distance

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

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

3.1.8
interfaces
surface between the different materials

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

– between housing and end fittings;

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

– between core and housing.

3.1.9
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, in general the term "metal fitting" is used.

[SOURCE: IEC 60050-471:2007, 471-01-06]

3.1.10
coupling
part of the end fitting which transmits the load to the accessories external to the insulator

[SOURCE: IEC 62217:2012, 3.14, modified – "fixing device" replaced by "end fitting", "hardware" replaced by "accessories"]

3.1.11
filling medium
material to fill the space or void inside the insulator core and fibre optic elements

3.1.12
fibre optic element
element consisting of one or more optical fibres to transfer light, which can be used as energy or information (binary data or other types of signals) which can be additionally protected by non-conductive materials

Note 1 to entry: Fibre optic cables can also be considered as fibre optic elements, which consist of optical fibre(s), and other sub-elements embedded in a cable filling medium and covered by protective cable sheath (see also Figure 1).

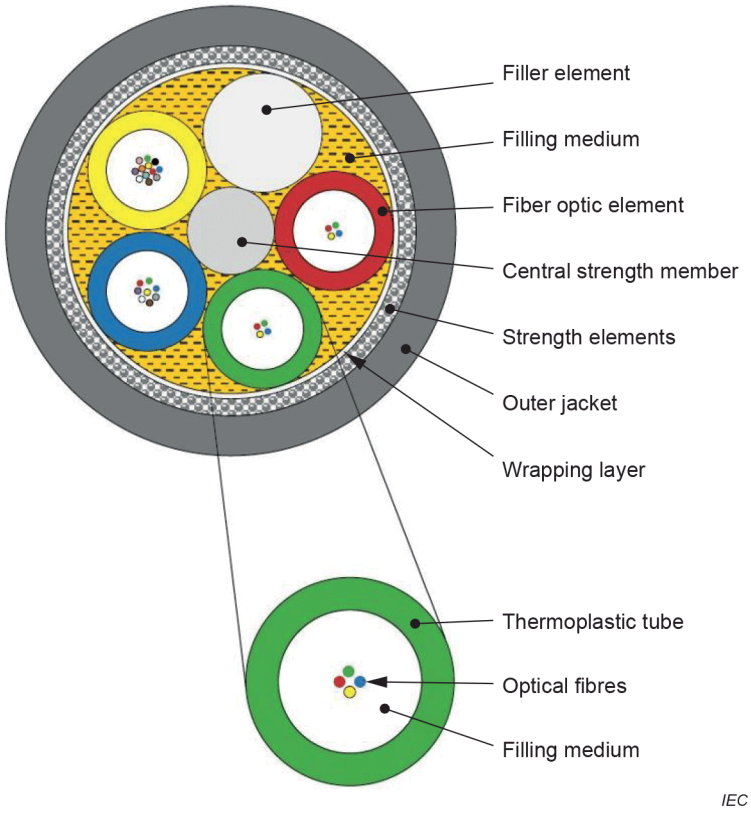


Figure 1 – Generic cross-section of a fibre optic cable with fibre optic elements (sub-elements) and a filler element

3.1.13
fibre optic cable
assembly comprising one or more optical fibres or fibre bundles inside a common covering designed to protect them against mechanical stresses and other environmental influences while retaining the transmission quality of the fibres

Note 1 to entry: For this kind of application only non-conductive materials shall be used.

[SOURCE: IEC 60050-731:1991, 731-04-01, modified – Note to entry modified]

3.1.14
fibre optic composite insulator
composite insulator (IEC 60050-471) with integrated fibre optic element

Note 1 to entry: This can be done by

– implementation of the fibre optic element into the polymeric housing,
– implementation of the fibre optic element into the load-bearing core or
– implementation of the fibre optic element into the inner volume of a hollow core.

3.1.15
attenuation
measure of the decreasing transmission light power in a fibre at a given wavelength in a fibre optic element

Note 1 to entry: This includes the transmission loss caused by light scattering and absorption. It can also include the transmission loss introduced by splices and connectors.

The definition is:

$A(\lambda)$ = l 10 lg ($P1(\lambda)$ l $P2(\lambda)$)l

Where

$A(\lambda)$ is the attenuation, in dB, at wavelength λ;

$P1(\lambda)$ is the transmission light power traversing one cross-section (marker 1);

$P2(\lambda)$ is the transmission light power traversing a second cross-section (marker 2).

Note 2 to entry: It depends on the nature and length and condition of the fibre and is also affected by measurement conditions.

Note 3 to entry: The term loss is used synonymously with attenuation in this document.

[SOURCE: IEC/IEEE 62582-5:2015, 3.5, modified – "in a fibre optic element" added in definition, Notes to entry modified]

3.1.16
dummy element
element representing the fibre optic cable during tests and prestressing procedures if the included components such as fibres and filling medium cannot withstand the proposed prestressing or testing procedures

Note 1 to entry: The dummy element shall be made of the same surface material as the fibre optic cable which is used at the final application to ensure comparable interface conditions.

Example If in the final application a Ø 5 mm polyethylene tube with a silicone filling gel and encapsulated fibre optic is used, and the filling gel does not withstand the water immersion prestressing procedure proposed in Clause 9, a solid polyethylene profile with identical material and diameter can be used.

Note 2 to entry: Where an internal component of the insulator is removed for testing purposes it can be replaced with a dummy element, also referred to as "filler" or "cable dummy".

3.1.17
optical fibres
multimode or single-mode optical fibres for signal or power transmission

Note 1 to entry: Optical fibres are usually coated with an additional protective layer (primary and secondary coating, also considered as buffer (see also Figure 2) that can also be coloured.

Note 2 to entry: In the context of this technical specification, the coating or coatings are considered as parts of the optical fibre.

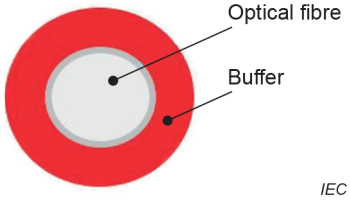


Figure 2 – Generic cross-section of an optical fibre

3.1.18
failing load
maximum load that is reached before failure, when the insulator is tested under the prescribed conditions before failure

3.1.19
damage limit
limit below which mechanical loads (tensile, pressure, bending load) can be applied, at normal ambient temperature, without micro damage to the core/ tube material

[SOURCE: IEC 61462:2007, 3.15, modified – "tensile" added, Note 1 to entry removed]

3.1.20
feedthrough
design element (e.g. cable gland) permitting the introduction of one or more fibre optic elements into an electrical equipment to maintain the relevant type of protection and provide a degree of strain relief.

[SOURCE: IEC 60050-426-04-18, modified]

3.2 Designations

The following designations are used in this document:

HTV, EPDM, LSR, RTV	Designations of housing materials for polymeric insulators such as High temperature vulcanizing rubber (HTV), Ethylene-propylene-diene-monomer (EPDM), liquid silicone rubber (LSR) and room temperature vulcanizing rubber (RTV)

4 Identification

In addition to the requirements of IEC 62217, each insulator shall be marked according to the relevant product standard.

5 Environmental conditions

The normal environmental conditions to which insulators are submitted in service are defined in IEC 62217.

6 Transport, storage and installation

In addition to the requirements of IEC 62217 and CIGRE TB184, specific manufacturer guidance relative to the application shall be considered for the protection of the fibre optic element.

7 Tolerances

Tolerances relevant to the insulator (insulator length, dimensions of fittings, etc.) are given in the respective product standard.

Tolerances relevant to the fibre optic element: (cable length, attenuation, etc.) shall be specified separately.