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

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMPOSITE STATION POST INSULATORS FOR SUBSTATIONS WITH AC VOLTAGES GREATER THAN 1000 V UP TO 245 kV – DEFINITIONS, TEST METHODS AND ACCEPTANCE CRITERIA

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International Standard IEC 62231 has been prepared by subcommittee 36C: Insulators for substations, of IEC technical committee 36: Insulators.

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

FDIS	Report on voting
36C/159/FDIS	36C/160/RVD

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

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

This standard is to be read in conjunction with IEC 62217.

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

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- withdrawn;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

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

Composite station post insulators consist of a cylindrical solid insulating core made of resin impregnated fibres, bearing the mechanical load, protected by an elastomer housing, the loads being transmitted to the core by metal fittings. Despite these common features, the materials used and the construction details employed by different manufacturers may be different.

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

The approach for mechanical testing under bending loads used in this Standard is based on IEC 61952. This approach uses the concept of a damage limit that is the maximum stress that can be developed in the insulator before damage begins to occur. Work is underway to validate the acoustic emission technique to determine the inception of damage.

In some cases, station post insulators can be subjected to a combination of loads. In order to give some guidance, Annex B explains how to calculate the equivalent bending moment in the insulators resulting from the combination of bending, tensile and compression loads.

Pollution tests, as specified in IEC 60507 and IEC 61245, are not included in this document, their applicability to composite station post insulators having not been proven. Such pollution tests performed on composite insulators do not correlate with experience obtained from service. Specific pollution tests for composite insulators are under consideration.

It has not been considered useful to specify a power arc test as a mandatory test. The test parameters are manifold and can have very different values depending on the configurations of the network and the supports and on the design of arc-protection devices. The heating effect of power arcs should be considered in the design of metal fittings. Critical damage to the metal fittings, resulting from the magnitude and duration of the short-circuit current can be avoided by properly designed arc-protection devices. This standard, however, does not exclude the possibility of a power arc test by agreement between the user and the manufacturer. IEC 61467 gives details of a.c. power arc testing of insulator sets.

Impulse (mechanical) loads in substation are typically caused by short-circuits. Post insulators are affected by forces due to the interaction of the currents circulating in conductors/busbars supported by insulators.

The impulse load or peak load may be evaluated using guidance found in the IEC 60865 series.

Work is in progress in CIGRE ESCC (Effects of Short-Circuit Currents) task force to review impulse loads caused by short-circuit currents in substations. The aim of this work is to introduce a new concept: the ESL factor (Equivalent Static Load factor) which is frequency dependent. The actual peak load may be replaced, in a first approximation, by the peak load times the ESL factor. This new value may be used as the MDCL in this document for the determination of the cantilever strength.

Radio interference and corona tests are not specified in this standard since the radio interference and corona performances are not characteristics of the insulator alone.

Composite hollow core station post insulators are currently not dealt with in this standard. IEC 61462 gives details of tests on hollow core composite insulators, many of which can be applied to such station post insulators.

COMPOSITE STATION POST INSULATORS FOR SUBSTATIONS WITH AC VOLTAGES GREATER THAN 1 000 V UP TO 245 kV – DEFINITIONS, TEST METHODS AND ACCEPTANCE CRITERIA

1 Scope and object

This International Standard applies to composite station post insulators consisting of a load bearing cylindrical insulating solid core made of resin impregnated fibres, a housing (outside the insulating solid core) made of elastomer material (e.g. silicone or ethylene-propylene) and end fittings attached to the insulating core. Composite station post insulators covered by this standard are subjected to cantilever, torsion, tension and compression loads. They are intended for substations with a.c. voltages greater than 1 000 V up to 245 kV.

The object of this standard is

– to define the terms used,

– to prescribe test methods,

– to prescribe acceptance or failure criteria.

This standard does not include requirements dealing with the choice of insulators for specific operating conditions.

2 Normative references

The following referenced documents are indispensable for the application 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) – Chapter 471: Insulators*

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

IEC 60168:1994, *Tests on indoor and outdoor post insulators of ceramic material or glass for systems with nominal voltages greater than 1 000 V*

IEC 62217: —, *Polymeric insulators for indoor and outdoor use with a nominal voltage greater than 1000 V – General definitions, test methods and acceptance criteria*

ISO 1101, *Technical drawings – Geometrical tolerancing – Tolerancing of form, orientation, location and run-out – Generalities, definitions, symbols, indications on drawings*

ISO 3452, *Non-destructive testing – Penetrant inspection – General principles*

3 Terms and definitions

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

3.1
composite station post insulator
post insulator consisting of a solid load bearing cylindrical insulating core, a housing and end fittings attached to the insulating core

3.2
core (of an insulator)
central insulating part of an insulator which provides the mechanical characteristics

NOTE The housing and sheds are not part of the core.

[IEV 471-01-03]

3.3
housing
external insulating part of composite insulator providing necessary creepage distance and protecting core from environment

NOTE An intermediate sheath made of insulating material may be part of the housing.

[IEV 471-01-09]

3.4
housing profile
shape and dimensions of the housing of the composite station post insulator which include the following:

– shed overhang(s)
– shed thickness at the base and at the tip
– shed spacing
– shed repetition
– shed inclination(s)

3.5
shed (of an insulator)
insulating part, projecting from the insulator trunk, intended to increase the creepage distance. The shed can be with or without ribs

[IEV 471-01-15]

3.6
insulator trunk
central insulating part of an insulator from which the sheds project

NOTE Also known as shank on smaller insulators.

[IEV 471-01-11]

3.7
creepage distance
shortest distance or the sum of the shortest distances along the surface on an insulator between two conductive parts which normally have the operating voltage between them

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

NOTE 2 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.

[IEV 471-01-04]

3.8
arcing distance
shortest distance in air external to the insulator between the metallic parts which normally have the operating voltage between them

[IEV 471-01-01]

NOTE The term "dry arcing distance" is also used.

3.9
interfaces
surface between the different materials

NOTE Various interfaces occur in most composite insulators, e.g.

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

[IEC 62217]

3.10
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 Where the end fitting is metallic, the term "metal fitting" is normally used.

[IEV 471-01-06, modified]

3.11
connection zone
zone where the mechanical load is transmitted between the insulating body and the end fitting

[IEC 62217]

3.12
coupling
part of the fixing device which transmits load to the hardware external to the insulator

[IEC 62217]

3.13
tracking
process which forms irreversible degradation by formation of conductive paths (tracks) starting and developing on the surface of an insulating material

NOTE These paths are conductive even under dry conditions.

[IEC 62217]

3.14
erosion
irreversible and non-conducting degradation of the surface of the insulator that occurs by loss of material which can be uniform, localized or tree-shaped

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

[IEC 62217]

3.15
delamination (of the core)
loss of bonding between fibres and matrix

3.16
crack
any internal fracture or surface fissure of depth greater than 0,1 mm

[IEC 62217]

3.17
specified cantilever load
SCL
cantilever load which can be withstood by the insulator when tested under the prescribed conditions

3.18
maximum design cantilever load
MDCL
cantilever load level above which damage to the insulator begins to occur and that should not be exceeded in service

3.19
specified torsion load
SToL
torsion load level which can be withstood by the insulator when tested under the prescribed conditions

3.20
maximum design torsion load
MDToL
torsion load level above which damage to the insulator begins to occur and that should not be exceeded in service

3.21
specified tension load
STL
tension load which can be withstood by the insulator when tested under the prescribed conditions

3.22
maximum design tension load
MDTL
tension load level above which damage to the insulator begins to occur and that should not be exceeded in service

3.23
specified compression load
SCoL
compression load which can be withstood by the insulator when tested under the prescribed conditions

3.24
buckling load
compression load that induces buckling of the insulator core