Composite insulators for a.c. overhead lines with a nominal voltage greater than 1 000 V – Definitions, test methods and acceptance criteria

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Composite insulators for a.c. overhead lines with a nominal voltage greater than 1 000 V – Definitions, test methods and acceptance criteria

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International Electrotechnical Commission
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMPOSITE INSULATORS FOR A.C. OVERHEAD LINES
WITH A NOMINAL VOLTAGE
GREATER THAN 1 000 V –
DEFINITIONS, TEST METHODS AND ACCEPTANCE CRITERIA

FOREWORD

1) The formal decisions or agreements of the IEC on technical matters, prepared by Technical Committees on which all the National Committees having a special interest therein are represented, express, as nearly as possible, an international consensus of opinion on the subjects dealt with.

2) They have the form of recommendations for international use and they are accepted by the National Committees in that sense.

3) In order to promote international unification, the IEC expresses the wish that all National Committees should adopt the text of the IEC recommendation for their national rules in so far as national conditions will permit. Any divergence between the IEC recommendation and the corresponding national rules should, as far as possible, be clearly indicated in the latter.

This International Standard has been prepared by IEC Technical Committee No. 36: Insulators.

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

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

Annexes A, B, C and D are for information only.
INTRODUCTION

Composite insulators consist of an insulating core, bearing the mechanical load protected by a polymeric housing, the load 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 quite different.

Some tests have been grouped together as "Design tests", to be performed only once on insulators which satisfy the same design conditions. 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 insulators has been considered in specifying the design tests to ensure a satisfactory life-time under normally known stress conditions of transmission lines.

The pollution tests, according to IEC 507, are not included in this Standard as being generally not applicable. Even if the electric strength under pollution conditions decreases during the life-time, the withstand and flashover voltages will still be, in most cases, high enough for service operation at the correct string length. However, the ageing effects of pollution discharges on the surface of the composite insulator have been covered by a long duration test (tracking and erosion test). Besides pollution, other factors such as intense solar radiation and frequent temperature inversions with condensation can influence the ageing of the housing of the insulator.

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 design of arc-protection devices. Moreover, power arc tests on several composite insulators have shown no reduction of the mechanical strength of the core. Also, there is no permanent change in the properties of the housing materials used. In the design of metal fittings the heating effect of power arcs should be considered. Any possible damage to the metal fittings, resulting from the magnitude and duration of the short circuit-current should 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 manufacturer. A standard power arc test procedure is at present being considered by Sub-Committee 36 B: Insulators for overhead lines.

Some types of metal fittings are prone to reveal a certain slip between the metal part and the core when submitted to a tensile load. A suitable test to control the slip and its possible effects such as cracks or separation between the metal fitting and the housing is still under study.

A suitable flammability test has not yet reached specification stage and cannot, therefore, be considered in this standard.

The mechanism of brittle fracture, experienced so far on a limited number of insulators of particular design, is still under investigation by the CIGRE®, so that no test procedure can be specified at the present stage.

* International Conference on Large High Voltage Electric Systems.
This standard does not include radio interference tests. For information only, reference may be made to IEC 437.

In some cases – pollution or corona – field grading devices may have to be considered for composite insulators.

Torsion withstand tests for insulators whose couplings do not give total rotational freedom are not yet included in this standard.

The possibility of an interface test as a sampling test (for instance a steep front impulse test) has been considered. A reliable test has not been found so far.

The above mentioned problems are the object of further consideration by Technical Committee No. 36: Insulators.

Principles of mechanical tensile load-time tests for selection of composite insulators are presented in annex A.
COMPOSITE INSULATORS FOR A.C. OVERHEAD LINES
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1 Scope and object

This International Standard is applicable to composite insulators for use as suspension/tension line insulators, but it is to be noted that these insulators can occasionally be subjected to compression or bending, for example when used as phase-spacers. Composite insulators designed primarily to resist bending loads, e.g. line post insulators, are not included in the scope of this Standard.

This standard deals with those composite insulators which include a “core” and a “housing”. The core is usually made of resin-impregnated glass fibres. The housing can be manufactured from a variety of materials including elastomers (e.g. silicone, ethylene-propylene); resins (e.g. cycloaliphatic epoxy); or fluorocarbons (e.g. polytetrafluoroethylene).

The object of this Standard is to:
- define the terms used;
- prescribe test methods;
- prescribe acceptance criteria.

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

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60-1: 1989, High-voltage test techniques - Part 1: General definitions and test requirements.

IEC 120: 1984, Dimensions of ball and socket couplings of string insulator units.

IEC 383: 1983, Test on insulators of ceramic material or glass for overhead lines with a nominal voltage greater than 1 000 V.


IEC 507: 1991, Artificial pollution tests on high-voltage insulators to be used on an a.c. system.
3 Definitions

For the purpose of this International Standard, the following definitions apply:

3.1 composite insulator: A composite insulator is one made of at least two insulating parts, namely a core and a housing equipped with metal fittings. 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.

3.2 core of a composite insulator: The core is the internal insulating part of a composite insulator and is designed to ensure the mechanical characteristics. The core usually consists of glass fibres which are positioned in a resin-based matrix in such a manner as to achieve maximum tensile strength.

3.3 core diameter: The core diameter is either:
   - the geometric diameter of a core of circular section, or,
   - $2 \sqrt{A/n}$ for a core with non-circular cross section of area $A$.

3.4 housing and sheds of a composite insulator: The housing is the external insulating part of an insulator which provides the necessary creepage distance and protects the core from the weather. An intermediate sheath made of insulating material is a part of the housing. A shed is a projecting part of the housing intended to increase the creepage distance. The sheds can be with or without ribs.

3.5 interfaces of a composite insulator: An interface is the surface between the different materials or parts of the composite insulator. Various interfaces occur in most composite insulators, e.g.:
   - between glass fibres and impregnating resin;
   - between filler particles and polymer;
   - between core and housing;
   - between various parts of the housing; between sheds, or between sheath and sheds;
   - between housing, core and metal fittings.

3.6 metal fitting of a composite insulator: The metal fitting is a device forming part of a composite insulator, intended to connect it to a supporting structure, or to a conductor, or to an item of equipment, or to another insulator.

3.7 connection zone: Zone where the mechanical load is transmitted between the rod and the metal fitting.


Withdrawn