IEC 61952

Edition 2.0 2008-05

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Insulators for overhead lines – Composite line post insulators for A.C. systems with a nominal voltage greater than 1 000 V – Definitions, test methods and acceptance criteria

Isolateurs pour lignes aériennes – Isolateurs composites rigides à socle pour systèmes à courant alternatif de tension nominale supérieure à 1 000 V – Définitions, méthodes d'essai et critères d'acceptation

IEC 61952:2008

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX U

ICS 29.080.10; 29.240.20

ISBN 2-8318-9784-X

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

FOREWORD

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International Standard IEC 61952 has been prepared by subcommittee 36B: Insulators for overhead lines, of IEC technical committee 36: Insulators.

This second edition cancels and replaces the first edition published in 2002. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

– removal of tests procedures now given in IEC 62217,
– inclusion of clauses on tolerances, environmental conditions, transport, storage and installation,
– changes in the parameters determining the need to repeat design and type tests,
– clarification of the mounting arrangements for electrical type tests,
– modification of the specification of load application in bending tests to simplify testing,

– additional requirements for the visual examination,
– removal of the annex explaining the concept of classes for design tests.

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

FDIS	Report on voting
36B/273/FDIS	36B/275/RVD

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

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

The committee has decided that the contents of this publication will remain unchanged until the 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.

INTRODUCTION

Composite line post insulators consist of a cylindrical solid insulating core, bearing the mechanical load, protected by a polymeric 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 on insulators which satisfy the same design conditions. All the design tests defined in IEC 62217 are applied for composite line post insulators; additional specific mechanical tests are given in this standard. 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.

Composite insulators are used in both a.c. and d.c. applications. In spite of this fact a specific tracking and erosion test procedure for d.c. applications as a design test has not yet been defined and accepted. The 1 000 h a.c. tracking and erosion test of IEC 62217 is used to establish a minimum requirement for the tracking resistance of the housing material.

The approach for mechanical testing under bending loads used in this standard is based on the work of CIGRE [1][1]. This approach uses the concept of a damage limit which is the maximum stress which can be developed in the insulator before damage begins to occur. Annex A gives some notes on the mechanical loads and tests used in this standard.

Line post insulators are often used in braced structures whose geometry varies from line to line. A combined loading test to reproduce the complex loading cases in such structures is outside the scope of this standard and it would be very difficult to specify a general test which covers the majority of geometry and loading cases. In order to give some guidance, Annex B explains how to calculate the moment in the insulators resulting from combined loads. This moment can then be equated to an equivalent bending load or stress for design purposes. Further information is available from CIGRE [2].

Compression load tests are not specified in this standard. The mechanical loads expected from service stress acting on line post insulators are mostly combined loads. These loads will cause some deflection on the insulator. Compression loads applied on pre-deflected insulators will lead to results largely dependent on the pre-deflection. Therefore a pure compression test has little meaning since the deflection prior to the cantilever load test cannot be specified.

Pollution tests, as specified in IEC 60507 [3], are not included in this standard, their applicability to composite line post insulators not having been proven. Such pollution tests performed on insulators made of non-ceramic materials do not correlate with experience obtained from service. Specific pollution tests for non-ceramic insulators are under consideration.

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1 Figures in square brackets refer to the bibliography.

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 manufacturer. IEC 61467 [4] gives details of a.c. power arc testing of insulator sets.

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

Composite hollow core line post insulators are currently not dealt with in this standard. IEC 61462 [5] gives details of tests on hollow core composite insulators, many of which can be applied to such line post insulators.

Torsion loads are not dealt with in this standard since they are usually negligible in the configuration in which line post insulators are generally used. Specific applications where high torsion loads can occur are outside the scope of this standard.

The application of this standard to hybrid line post insulators (e.g. those having a core made of a material other than resin impregnated fibres) has not been fully studied. For example, in general the load-time mechanical tests and tests for core material are not applicable to porcelain cores. It is therefore recommended that this standard be considered as a provisional standard for hybrid line post insulators, using an agreed selection of tests from this standard and from IEC 60383-1.

Wherever possible, IEC Guide 111 [6] has been followed for the drafting of this standard.

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

1 Scope

This International Standard applies to composite line post insulators consisting of a load-bearing cylindrical insulating solid core consisting of fibres – usually glass – in a resin-based matrix, a housing (outside the insulating core) made of polymeric material and end fittings permanently attached to the insulating core.

Composite line post insulators covered by this standard are subjected to cantilever, tensile and compressive loads, when supporting the line conductors. They are intended for use on a.c. overhead lines with a rated voltage greater than 1 000 V and a frequency not greater than 100 Hz.

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 60383-1, *Insulators for overhead lines with a nominal voltage above 1 000 V – Part 1: Ceramic or glass insulator units for a.c. systems – Definitions, test methods and acceptance criteria*

IEC 60383-2, *Insulators for overhead lines with a nominal voltage above 1 000 V – Part 2: Insulator strings and insulator sets for a.c. systems – Definitions, test methods and acceptance criteria*

IEC 62217, Polymeric *insulators for indoor and outdoor use with a nominal voltage above 1 000 V – General definitions, test methods and acceptance criteria*

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.

NOTE Certain terms from IEC 62217 are reproduced here for ease of reference. Additional definitions applicable to insulators can be found in IEC 60050(471) [7]).

3.1
composite line post insulator
insulator consisting of a load-bearing cylindrical insulating solid core, a housing and end fittings attached to the insulating core. It is intended to be subjected to cantilever, tensile and compressive loads

3.2
core of a composite insulator
the internal insulating part of a composite insulator which is designed to ensure the mechanical characteristics. The core usually consists of either fibres (e.g. glass) which are positioned in a resin-based matrix or a homogeneous insulating material (e.g. porcelain or resin)

[IEV 471-01-03, modified]

3.3
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]

3.4
housing
external insulating part of a composite insulator providing the necessary creepage distance and protecting core from the environment

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

[IEV 471-01-09]

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
interfaces
surface between the different materials. 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, definition 3.10]

3.7
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]

3.8
connection zone
zone where the mechanical load is transmitted between the insulating body and the end fitting

[IEC 62217, definition 3.12]

3.9
coupling
part of the end fitting which transmits the load to the accessories external to the insulator

[IEC 62217, definition 3.13 modified]

3.10
delamination of the core
irreversible loss of bonding within fibre laminates perceivable by the naked eye

3.11
failing load
maximum load that is reached when the insulator is tested under the prescribed conditions

3.12
specified cantilever load
SCL
cantilever load which can be withstood by the insulator at the line end fitting when tested under the prescribed conditions. This value is specified by the manufacturer

3.13
maximum design cantilever load
MDCL
load level above which damage to the core begins to occur and which is the ultimate limit for service loads. This value and direction of the load are specified by the manufacturer

3.14
specified tensile load
STL
tensile load which can be withstood by the insulator when tested under the prescribed conditions. This value is specified by the manufacturer

4 Abbreviations

The following abbreviations are used in this standard:

E1, E2	Sample sets for sample tests
MDCL	Maximum design cantilever load
SCL	Specified cantilever load
STL	Specified tensile load

5 Identification

In addition to the requirements of IEC 62217, each insulator shall be marked with the MDCL or with the relevant IEC designation.

It is recommended that each insulator be marked or labelled by the manufacturer to show that it has passed the routine mechanical test.

NOTE At present, there is no IEC standard giving designations of composite line post insulators.

6 Environmental conditions

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

7 Transport, storage and installation

In addition to the requirements of IEC 62217, information on handling of composite insulators can be found in CIGRE Technical Brochure 184 [8]. During installation composite insulators may be submitted to torsion loads for which they are not designed. In the absence of specific guidance from the manufacturer, torsion loads leading to stress in the core above 15 MPa shall be avoided.

8 Tolerances

Unless otherwise agreed, a tolerance of

$\pm$ (0,04 $\times$ d + 1,5) mm when $d \leq 300$ mm,

$\pm$ (0,025 $\times$ d + 6) mm when $d > 300$ mm with a maximum tolerance of $\pm$ 50 mm,

shall be allowed on all dimensions for which specific tolerances are not requested or given on the insulator drawing (d being the dimension in millimetres).

The measurement of creepage distances shall be related to the design dimensions and tolerances as determined from the insulator drawing, even if this dimension is greater than the value originally specified. When a minimum creepage is specified, the negative tolerance is also limited by this value.

In the case of insulators with creepage distance exceeding 3 m, it is allowed to measure a short section around 1 m long of the insulator and to extrapolate.

9 Classification of tests

9.1 Design tests

These tests are intended to verify the suitability of the design, materials and method of manufacture (technology). A composite line post insulator design is defined by the following elements:

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

When changes in the design occur, re-qualification shall be carried out in accordance with Table 1.

When a composite line post insulator is submitted to the design tests, it becomes a parent insulator for a given design and the results shall be considered valid for that design only. This tested parent insulator defines a particular design of insulators which have all the following characteristics:

a) same materials for the core and housing and same manufacturing method;

b) same material of the fittings, the same connection zone design, and the same housing-to-fitting interface geometry;

c) same or greater minimum layer thickness of the housing over the core (including a sheath where used);

d) same or smaller stress under mechanical loads;

e) same or greater diameter of the core;

f) equivalent housing profile parameters, see footnote [a)] in Table 1.

9.2 Type tests

These tests are intended to verify the main characteristics of a composite line post insulator which depend mainly on its shape and size. Type tests shall be applied to composite insulators, the class of which has passed the design tests. They shall be repeated only when the type or material of the composite insulator is changed (see Clause 11).

9.3 Sample tests

The sample tests are for the purpose of verifying other characteristics of composite insulators, including those which depend on the quality of manufacture and on the materials used. They are made on insulators taken at random from lots offered for acceptance.

9.4 Routine tests

These tests are intended to eliminate composite line post insulators with manufacturing defects. They shall be made on every composite line post insulator offered for acceptance.

Table 1 – Tests to be carried out after design changes

IF the change in insulator design concerns:...		**THEN** the following design tests shall be repeated:									
		Design tests								**Type tests**	
		IEC 62217	IEC 61952	IEC 62217 Tests on housing material				IEC 62217 Tests on the core material		IEC 61952	
		Interfaces and connections of end fittings	Assembled core load tests	Hardness test	Accelerated weathering test	Tracking and erosion test	Flammability test	Dye penetration test	Water diffusion test	Electrical type tests	Mechanical type tests
1	Housing materials	X	X[b)]	X	X	X	X				
2	Housing profile[a)]	X				X				X	
3	Core material	X	X					X	X		X
4	Core diameter	X	X					X	X		X
5	Core and end-fitting manufacturing process	X	X					X	X		X
6	Core and end-fitting assembly process	X	X								X
7	Housing manufacturing process	X	X[b)]	X	X	X	X				X[b)]
8	Housing assembly process	X	X[b)]			X					X[b)]
9	End fitting material	X	X								X
10	End fitting connection zone design	X	X								X
11	Base end fitting coupling design		X								X[b)]
12	Core/housing/end fitting interface design	X	X[b)]			X					X[b)]

a) Variations of the profile within following tolerances do not constitute a change:
Overhang: ± 10 %
Diameter: $^{+15}_{0}$ %
Thickness at base and tip: ± 15 %
Spacing: ± 15 %
Mean shed inclination: ± 3°
Shed repetition: Identical

b) Not necessary if it can be demonstrated that the change has no influence on the assembled core strength.

10 Design tests

10.1 General

These tests consist of the tests prescribed in IEC 62217, as listed in Table 2 below, and a specific assembled core load-time test. The design tests are performed only once and the results are recorded in a test report. Each part can be performed independently on new test specimens, where appropriate. The composite line post insulator of a particular design will be qualified only when all insulators or test specimens pass the design tests.