

Insulators for overhead lines — Composite line post insulators for alternative current with a nominal voltage $> 1\,000\text{ V}$

The European Standard EN 61952:2003 has the status of a British Standard

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National foreword

This British Standard is the official English language version of EN 61952:2003. It is identical with IEC 61952:2002.

The UK participation in its preparation was entrusted by Technical Committee PEL/36, Insulators for power systems, to Subcommittee PEL/36/2, Line insulators, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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**Insulators for overhead lines -
Composite line post insulators for alternative current
with a nominal voltage > 1 000 V
(IEC 61952:2002)**

Isolateurs pour lignes aériennes -
Isolateurs composites rigides à socle
pour courant alternatif
de tension nominale > 1 000 V
(CEI 61952:2002)

Isolatoren für Freileitungen -
Verbund-Freileitungsstützer
für Wechselspannungsfreileitungen
mit einer Nennspannung über 1 000 V
(IEC 61952:2002)

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CENELEC

European Committee for Electrotechnical Standardization
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Foreword

The text of document 36B/208/FDIS, future edition 1 of IEC 61952, prepared by SC 36B, Insulators for overhead lines, of IEC TC 36, Insulators, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61952 on 2002-12-01.

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with the EN have to be withdrawn (dow) 2005-12-01

Annexes designated "normative" are part of the body of the standard.

Annexes designated "informative" are given for information only.

In this standard, annex ZA is normative and annexes A, B and C are informative.

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61952:2002 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following note has to be added for the standard indicated:

IEC 60507	NOTE	Harmonized as EN 60507:1993 (not modified).
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CONTENTS

INTRODUCTION.....	4
1 Scope and object.....	6
2 Normative references	6
3 Definitions	7
4 Identification.....	9
5 Classification of tests	9
5.1 Design tests	9
5.2 Type tests	11
5.3 Sample tests	11
5.4 Routine tests	11
6 Design tests	11
6.1 General	11
6.2 Tests on interfaces and connections of end fittings.....	11
6.3 Assembled core load tests.....	13
6.4 Tests of shed and housing material	14
6.5 Tests for the core material.....	17
7 Type tests	18
7.1 Verification of dimensions.....	19
7.2 Electrical tests.....	19
7.3 Mechanical tests	20
8 Sample tests	21
8.1 General rules	21
8.2 Verification of dimensions (E1 + E2).....	21
8.3 Galvanizing test (E1 + E2).....	21
8.4 Verification of the SCL (E1).....	21
8.5 Re-testing procedure	22
9 Routine tests	22
9.1 Tensile load test.....	22
9.2 Visual examination.....	22
Annex A (informative) Notes on the mechanical loads and tests.....	26
Annex B (informative) Determination of the equivalent bending moment caused by combined loads	28
Annex C (informative) Explanation of the concept of classes for the design tests	31
Annex ZA (normative) Normative references to international publications with their corresponding European publications	32
Bibliography.....	34
Figure 1 – Thermal-mechanical pre-stressing test –Typical cycles	23
Figure 2 – Example of a boiling container for the water diffusion test	24
Figure 3 – Electrodes for the voltage test.....	25
Figure 4 – Typical circuit for the voltage test.....	25
Figure B.1 – Combined loads applied to unbraced insulators	29
Figure B.2 – Combined loads applied to braced insulators	30

INTRODUCTION

Composite line post insulators consist of a cylindrical solid insulating core, 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. Design tests are performed in order to eliminate designs and materials not suitable for high-voltage applications. The influence of time on the electrical and mechanical properties of the complete composite line 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 the work of CIGRE. 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.

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, 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.

The tracking and erosion test given in this standard is based on the test specified in IEC 61109. However, when this standard was drafted, it had been decided to study the possibility of preparing a general standard on tracking, erosion and ageing tests for all types of composite insulators. The prescriptions concerning the 1 000 h and alternative tests for severe environmental conditions are therefore given as a temporary measure until such time as the general standard is issued by the IEC.

For insulators intended for use in severe environmental conditions, a supplementary multi-stress ageing test may be considered (such as the 5 000 h ageing test in annex C of IEC 61109). However CIGRE and IEC are currently studying the representativity, repeatability and reproducibility of ageing tests and will issue guidance in the future. In the meantime, it is recommended that particular care be taken when specifying the type and parameters of such tests.

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 if agreed between the user and manufacturer. IEC 61467 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 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.

INSULATORS FOR OVERHEAD LINES – COMPOSITE LINE POST INSULATORS FOR ALTERNATIVE CURRENT WITH A NOMINAL VOLTAGE >1 000 V

1 Scope and object

This International Standard applies to composite line post insulators consisting of a load-bearing, cylindrical, insulating solid core made up of fibres – usually glass – in a resin-based matrix, a housing (outside the insulating core) made of elastomer material (e.g. silicone or ethylene-propylene) 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,
- prescribe test methods,
- 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 60060-1:1989, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60383-1:1993, *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 60383-2:1993, *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 60695-11-10:1999, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

ISO 868:1985, *Plastics and ebonite – Determination of indentation hardness by means of a durometer (Shore hardness)*

ISO 3274:1996, *Geometrical Product Specifications (GPS) – Surface texture: Profile method – Nominal characteristics of contact (stylus) instruments*
ISO 3274:1996/Cor. 1:1998

ISO 3452 (all parts), *Non-destructive testing – Penetrant inspection*

ISO 4287:1997, *Geometrical Product Specifications (GPS) – Surface texture: Profile method – Terms, definitions and surface texture parameters*
ISO 4287:1997/Cor. 1:1998

ISO 4892-1:1999, *Plastics – Methods of exposure to laboratory light sources – Part 1: General guidance*

ISO 4892-2:1994, *Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc sources*

ISO 4892-3:1994, *Plastics – Methods of exposure to laboratory light sources – Part 3: Fluorescent UV lamps*

3 Definitions

For the purposes of this International Standard, the following definitions apply.

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

internal insulating part of a composite line post insulator designed to ensure the mechanical characteristics. The core usually consists of glass-fibres in a resin-based matrix

3.3

housing

external insulating part of composite line post insulator providing necessary creepage distance and protecting core from environment. An intermediate sheath made of insulating material may be part of the housing

3.4

housing profile

shape and dimensions of the housing 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**

projecting part of the housing intended to increase the creepage distance

3.6**interface**

surface between different materials. Various interfaces occur in most composite line post insulators, e.g.

- between glass fibres and impregnating resin,
- between core and housing,
- between various parts of the housing, e.g. between sheds or between sheds and sheath,
- between housing, core and end fittings

3.7**end fittings of a composite line post insulator**

devices forming an integral and permanent part of the insulator intended to connect it to a supporting structure or to conductor hardware. The base end fitting of a composite line post insulator is where the maximum cantilever stress usually occurs. The line end fitting is where the cantilever load is usually applied

3.8**connection zone**

zone where the mechanical load is transmitted between the core and the end fitting

3.9**coupling zone**

part of the end fitting which transmits the load to the hardware external to the composite line post insulator

3.10**tracking**

irreversible degradation consisting of the formation of conductive paths starting and developing on the surface of an insulating material. These paths are conductive even under dry conditions. Tracking can occur on surfaces in contact with air and also on the interfaces between different insulating materials

3.11**erosion**

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

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

3.12**delamination of the core**

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

3.13**crack**

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

3.14

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

3.15

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

3.16

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

3.17

failing load of a composite line post insulator

maximum load that is reached when tested under the prescribed conditions

NOTE Damage to the core is likely to occur at loads lower than the insulator failing load.

4 Identification

The manufacturer's drawing shall show the relevant dimensions and values necessary for identifying and testing the insulator in accordance with this standard. The drawing shall also show applicable manufacturing tolerances. In addition, the relevant IEC designation shall figure on the drawing.

Each insulator shall be marked with the name or trade mark of the manufacturer and the year of manufacture. In addition, each insulator shall be marked with the MDCL or with the relevant IEC designation. These markings shall be legible and indelible.

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

5 Classification of tests

The tests are divided into four groups as follows:

5.1 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

- materials of the core, housing and manufacturing method,
- material of the end fittings, their design and method of attachment,
- 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.

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:							
		6.2	6.3	6.4.1	6.4.2	6.4.3	6.4.4	6.5.1	6.5.2
		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
1	Housing materials	x		x	x	x	x		
2	Housing profile ^a	x ^b				x			
3	Core material	x	x					x	x
4	Core diameter	x	x					x	x
5	Manufacturing process	x	x	x	x	x		x	x
6	End fitting material	x	x						
7a	End fitting connection zone design	x	x						
7b	Base end fitting coupling design		x						
7c	Core/housing/end fitting interface design	x							
8	End fitting method of attachment to core	x	x						
^a Variations of the profile within following tolerances do not constitute a change: Overhang: $\pm 15\%$ Diameter: $+15\%$ 0 Thickness at base and tip: $\pm 15\%$ Spacing: $\pm 25\%$ Mean shed inclination: $\pm 3\%$ Shed repetition: Identical									
^b Except 6.2.2.1 and 6.2.3.3.									

When a composite line post insulator is submitted to the design tests, it becomes a parent insulator for a design class and the results shall be considered valid for the whole class. Annex C gives information on the design class concept. This tested parent insulator defines a design class of insulators which have the following characteristics:

- A same materials for the core and housing and same manufacturing method;
- B same material for the end fittings, same design and same method of attachment;
- C same or greater minimum layer thickness of the housing over the core (including an intermediate sheath where used) within a tolerance of $\pm 15\%$;
- D same or smaller ratio of all mechanical loads to the smallest core diameter between fittings;
- E same or greater diameter of the core;
- F same housing profile parameters within a tolerance of $\pm 15\%$, except for spacing where the tolerance is $\pm 25\%$.