



BSI Standards Publication

Insulators for overhead lines with a nominal voltage above 1000 V

Part 1: Ceramic or glass insulator units for a.c. systems —
Definitions, test methods and acceptance criteria

National foreword

This British Standard is the UK implementation of EN IEC 60383-1:2023. It is identical to IEC 60383-1:2023. It supersedes BS EN 60383-1:1998, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PEL/36, Insulators for power systems.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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Date	Text affected
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English Version

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 60383-1:2023)

Isolateurs pour lignes aériennes de tension nominale
supérieure à 1 000 V - Partie 1: Éléments d'isolateurs en
matière céramique ou en verre pour systèmes à courant
alternatif - Définitions, méthodes d'essai et critères
d'acceptation
(IEC 60383-1:2023)

Isolatoren für Freileitungen mit einer Nennspannung über
1 000 V - Teil 1: Keramik- oder Glas-Isolatoren für
Wechselstromsysteme - Begriffe, Prüfverfahren und
Annahmekriterien
(IEC 60383-1:2023)

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European Committee for Electrotechnical Standardization
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Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

The text of document 36/564/FDIS, future edition 5 of IEC 60383-1, prepared by IEC/TC 36 "Insulators" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 60383-1:2023.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2024-05-11
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2026-08-11

This document supersedes EN 60383-1:1996 and all of its amendments and corrigenda (if any).

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Endorsement notice

The text of the International Standard IEC 60383-1:2023 was approved by CENELEC as a European Standard without any modification.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60060-1	-	High-voltage test techniques - Part 1: General definitions and test requirements	EN 60060-1	-
IEC 60120	-	Ball and socket couplings of string insulator units - Dimensions	EN IEC 60120	-
IEC 60305	-	Insulators for overhead lines with a nominal voltage above 1000 V - Ceramic or glass insulator units for AC systems - Characteristics of insulator units of the cap and pin type	EN IEC 60305	-
IEC 60372	-	Locking devices for ball and socket couplings of string insulator units - Dimensions and tests	EN IEC 60372	-
IEC 60433	-	Insulators for overhead lines with a nominal voltage above 1000 V - Ceramic insulators for AC systems - Characteristics of insulator units of the long rod type	EN IEC 60433	-
IEC 60437	-	Radio interference test on high-voltage insulators	EN 60437	-
IEC 60471	-	Clevis and tongue couplings of string insulator units - Dimensions	EN IEC 60471	-
IEC 61211	-	Insulators of ceramic material or glass for overhead lines with a nominal voltage greater than 1 000 V - Impulse puncture testing in air	EN 61211	-
ISO 1459	1973	Metallic coatings - Protection against corrosion by hot dip galvanizing - Guiding principles	-	-
ISO 1460	-	Metallic coatings - Hot dip galvanized coatings on ferrous metals - Determination of the mass per unit area - Gravimetric method	EN ISO 1460	-

EN IEC 60383-1:2023 (E)

ISO 1461	-	Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test Methods	EN ISO 1461	-
ISO 1463	-	Metal and oxide coatings - Measurement of coating thickness - Microscopical method	EN ISO 1463	-
ISO 2064	-	Metallic and other inorganic coatings - Definitions and conventions concerning the measurement of thickness	EN ISO 2064	-
ISO 2178	2016	Non-magnetic coatings on magnetic substrates - Measurement of coating thickness - Magnetic method	EN ISO 2178	2016

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Insulators for overhead lines with a nominal voltage above 1000 V –
Part 1: Ceramic or glass insulator units for a.c. systems – Definitions, test
methods and acceptance criteria**

**Isolateurs pour lignes aériennes de tension nominale supérieure à 1 000 V –
Partie 1: Éléments d’isolateurs en matière céramique ou en verre pour systèmes
à courant alternatif – Définitions, méthodes d’essai et critères d’acceptation**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INSULATORS FOR OVERHEAD LINES
WITH A NOMINAL VOLTAGE ABOVE 1 000 V –****Part 1: Ceramic or glass insulator units for AC systems –
Definitions, test methods and acceptance criteria**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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IEC 60383 has been prepared by IEC technical committee 36: Insulators. It is an International Standard.

This fifth edition cancels and replaces the fourth edition published in 1993. This edition constitutes a technical revision.

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

- a) The complete document has been revised and updated. The layout of the document has been changed in order to increase readability;
- b) RIV test has been added (Clause 14);
- c) Impulse puncture test in air has been added (15.2);
- d) Residual strength test has been added (Clause 21);

- e) Zinc sleeve test has been added (Clause 28);
- f) Impact test has been added (Clause 30);
- g) Annex C, coatings on ceramic and glass insulators has been added;
- h) Annex D, impact test has been added.

The text of this International Standard is based on the following documents:

Draft	Report on voting
36/564/FDIS	36/571/RVD

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 International Standard 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.

A list of all parts in the IEC 60383 series, published under the general title *Insulators for overhead lines with a nominal voltage above 1 000 V*, can be found on the IEC website.

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,
- replaced by a revised edition, or
- amended.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

This part of IEC 60383 deals with four different types of insulators:

- Pin insulators
- Line post insulators
- String insulator units
- Insulators for overhead electric traction lines

Certain clauses of this document contain general requirements and other clauses contain specific tests relevant to each of the above-mentioned insulators.

INSULATORS FOR OVERHEAD LINES WITH A NOMINAL VOLTAGE ABOVE 1 000 V –

Part 1: Ceramic or glass insulator units for AC systems – Definitions, test methods and acceptance criteria

1 Scope

This part of IEC 60383 applies to insulators of ceramic material or glass for use on AC overhead power lines and overhead traction lines with a nominal voltage greater than 1 000 V and a frequency not greater than 100 Hz. It also applies to insulators for use on DC overhead electric traction lines.

This document applies to string insulator units, rigid overhead line insulators and to insulators of similar design when used in substations.

It does not apply to insulators forming parts of electrical apparatus or to parts used in their construction or to post insulators which are covered by IEC 60168, *Tests on indoor and outdoor post insulators of ceramic material or glass for systems with nominal voltages greater than 1 000 V*.

Tests on insulator strings and insulator sets (for example, wet switching impulse voltage) are dealt with in IEC 60383-2.

The object of this document is:

- to define the terms used
- to define insulator characteristics and to prescribe the conditions under which the specified values of these characteristics shall be verified
- to prescribe test methods
- to prescribe acceptance criteria.

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

Specific requirements on the use of coatings on ceramic or glass insulators are described in the informative Annex C.

Numerical values for insulator characteristics are specified in IEC 60305, IEC 60433 and IEC 60720.

NOTE A guide for the choice of insulators under polluted conditions has been published, see IEC 60815-1 and -2.

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

IEC 60120, *Ball and socket couplings of string insulator units – Dimensions*

IEC 60305, *Insulators for overhead lines with a nominal voltage above 1000 V – Ceramic or glass insulator units for AC systems – Characteristics of insulator units of the cap and pin type*

IEC 60372, *Locking devices for ball and socket couplings of string insulator units – Dimensions and tests*

IEC 60433, *Insulators for overhead lines with a nominal voltage above 1000 V – Ceramic insulators for AC systems – Characteristics of insulator units of the long rod type*

IEC 60437, *Radio interference test on high-voltage insulators*

IEC 60471, *Clevis and tongue couplings of string insulator units – Dimensions*

IEC 61211, *Insulators of ceramic material or glass for overhead lines with a nominal voltage greater than 1 000 V – Impulse puncture testing in air*

ISO 1459:1973, *Metallic coatings – Protection against corrosion by hot dip galvanizing – Guiding principles*

ISO 1460, *Metallic coatings – Hot dip galvanized coatings on ferrous metals – Determination of the mass per unit area – Gravimetric method*

ISO 1461, *Hot dip galvanized coatings on fabricated iron and steel articles – Specifications and test Methods*

ISO 1463, *Metal and oxide coatings – Measurement of coating thickness – Microscopical method*

ISO 2064, *Metallic and other non-organic coatings – Definitions and conventions concerning the measurement of thickness*

ISO 2178:2016, *Non-magnetic coatings on magnetic substrates – Measurement of coating thickness – Magnetic method*

3 Terms and definitions

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

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

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1

insulator string

one or more string insulator units coupled together and intended to give flexible support to conductors and stressed mainly in tension

3.2

rigid insulator

insulator intended to give rigid support to an overhead line conductor and to be stressed mainly by bending and compressive loads

3.3**long rod insulator**

rigid insulator intended to be subjected to tensile loads, comprising an insulating part having an approximately circular cylindrical shank, with or without sheds, and external or internal fixing devices attached to each end

3.4**cap and pin insulator**

insulator comprising an insulating part usually having the form of a disk or bell, with or without ribs on its surface, and end fittings consisting of an outside cap and an inside pin attached axially

3.5**pin insulator**

rigid insulator consisting of an insulating component intended to be mounted rigidly on a supporting structure by means of a pin passing up inside the insulating component which consists of one or more pieces of insulating material permanently connected together

Note 1 to entry: The pin can have two basic shapes. With one shape, the insulating component is fixed to the end of the pin and does not allow contact of the insulating component with the supporting structure. With the other shape, the insulating component is fixed by means of the pin in contact with the supporting structure either directly or with a plate in between, the plate being either a separate washer or part of the pin (sometimes referred to as a pin post insulator).

3.6**line post insulator**

rigid insulator intended to be subjected to cantilever, tensile and compressive loads, constructed with one or more insulating materials and assembled on a metal base that is intended to be mounted rigidly on a supporting structure

3.7**traction insulator**

insulator or insulator set intended to give flexible or rigid support for overhead electric traction lines. All types of overhead line insulators may be used for this purpose.

3.8**annealed glass**

glass which has been treated to eliminate internal stresses

3.9**toughened glass**

glass in which pre-stresses have been created in order to improve its mechanical characteristics

3.10**lot**

group of insulators offered for acceptance from the same manufacturer, of the same design and manufactured under presumed similar conditions of production

Note 1 to entry: One or more lots may be offered together for acceptance; the lot(s) offered may consist of the whole, or part, of the quantity ordered.

3.11**flashover (of an insulator)**

disruptive discharge external to the insulator, and over its surface, connecting those parts which normally have the operating voltage between them

3.12**impulse withstand voltage**

highest peak value of impulse voltage of prescribed form and polarity which does not cause breakdown of insulation under specified conditions

3.13

power frequency withstand voltage

RMS value of sinusoidal power frequency voltage that the insulation of the given equipment can withstand during tests made under specified conditions and for a specified duration

3.14

electromechanical failing load

maximum load reached when a string insulator unit is tested under the prescribed conditions of the test

3.15

mechanical failing load

maximum load reached when an insulator is tested under the prescribed conditions of test

3.16

specified mechanical failing load, SFL

mechanical load that causes the loss of mechanical characteristics of any part of an insulator, when tested according to the relevant standard

Note 1 to entry: SFL can also be used for specified electromechanical failing load.

3.17

puncture (of an insulator)

disruptive discharge passing through the solid insulating material of the insulator which produces a permanent loss of dielectric strength

3.18

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

Note 2 to entry: 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.

Note 3 to entry: Insulators with grooves e.g. pin insulators, the creepage measurements shall start at the centre of the side groove.

3.19

minimum creepage distance

defined minimum allowed creepage distance which cannot be subject to a specified negative tolerance

3.20

nominal creepage distance

value of the creepage distance which can also be subject to a specified positive or negative tolerance

3.21

minimum nominal creepage distance

defined minimum allowed creepage distance which can also be subject to a specified negative tolerance

Note 1 to entry: Minimum nominal creepage distance is a definition that normally applies to cap and pin insulators.

3.22**displacements****axial displacement**

maximum positional variation, parallel to the insulator axis, of a definite point on the circumference of the considered insulator during one complete revolution around the insulator axis

radial displacement

maximum positional variation, perpendicular to the insulator axis, of a definite point on the circumference of the considered insulator during one complete revolution around the insulator axis

angular displacement

angular deviation around the insulator axis between corresponding planes of the two coupling pieces

3.23**short standard string**

string used to verify characteristics of a unit which are significant only to an insulator string

<for cap and pin units> insulator string of 5 insulator units

<for long rod insulator units> insulator string between 1 m and 2 m in length for long rod insulator units intended to be assembled in a string

Note 1 to entry: For long rod insulators less than 1 m long intended to be used as a string, the unit itself is considered as a short standard string.

Note 2 to entry: The definition short standard string is different to the definition of short string in IEC 61467.

Note 3 to entry: For systems with insulator string with less than 5 insulators, must be considered the string with the real number of insulators.

3.24**specified characteristic**

<domain> numeric value of a voltage or of a mechanical load or any other characteristic specified in an IEC international standard

<domain> numeric value of any such characteristic agreed between the purchaser and the manufacturer

4 Classification, types of insulators and insulating materials**4.1 Insulator classes**

Insulators for overhead lines are divided into two classes according to their design:

Class A: an insulator or string insulator unit in which the length of the shortest puncture path through solid insulating material is at least equal to half the arcing distance. An example of a class A insulator is a long rod insulator with external fittings.

Class B: an insulator or string insulator unit in which the length of the shortest puncture path through solid insulating material is less than half the arcing distance. An example of a class B insulator is a cap and pin insulator.

4.2 Insulator types

For the purposes of this part of IEC 60383, overhead line insulators are divided into the four following types:

- pin insulators
- line post insulators
- string insulator units, divided into two sub-types:
 - cap and pin insulators
 - long rod insulators
- insulators for overhead electric traction lines.

NOTE Insulators for overhead traction lines are normally insulators of one of the first three types above, with or without special adaptations of the metal fittings, designed for use on overhead electric traction lines.

4.3 Insulating materials

The insulating materials of overhead line insulators covered by this part are:

- ceramic material, porcelain
- annealed glass, being glass in which the mechanical stresses have been relaxed by thermal treatment
- toughened glass, being glass in which controlled mechanical stresses have been induced by thermal treatment.

NOTE 1 Further information on the definition and classification of ceramic and glass insulating materials can be found in IEC 60672-1 and IEC 60672-3.

NOTE 2 The term "ceramic material" is used in this part to refer to porcelain materials and, contrary to North American practice, does not include glass.

5 Identification of insulators

Each insulator shall be marked, either on the insulating component or on a metal part, with the name or trademark of the manufacturer and the year of manufacture. In addition, each string insulator unit shall be marked with the specified electromechanical or mechanical failing load whichever is applicable. These markings shall be legible and indelible.

The designations included in IEC 60305, IEC 60433 and IEC 60720 may be used.

6 Classification of tests

6.1 Type tests

Type tests are intended to verify the main characteristics of an insulator which depend mainly on its design. They are usually carried out on a small number of insulators and only once for a new design or manufacturing process of insulator and then subsequently repeated only when the design, material (described on the manufacture's drawings) or manufacturing process is changed. When the change affects only certain characteristics, only the test(s) relevant to these characteristics need to be repeated. Moreover, it is not necessary to perform the electrical and mechanical type tests on a new design of insulator if a valid test certificate is available on an insulator of equivalent design and same manufacturing process. The meaning of equivalent design is given in the relevant clauses when applicable. The results of type tests are certified either by test certificates accepted by the purchaser or by test certificates confirmed by a qualified organization.

For dimensional and mechanical tests (electromechanical failing load test, mechanical failing load test, thermal-mechanical performance test, residual strength test and impact test), the certificate shall be valid for ten years from the date of issue. There is no time limit for the validity of certificates for electrical type tests (dry lightning impulse withstand voltage, wet power frequency withstand voltage, RIV test, puncture withstand test, impulse puncture test in air).

Within the above limits, the type test certificates remain valid while there is no significant disparity between the results of the type tests and subsequent corresponding sample tests. A method for comparing type and sample test results is given in Annex A.

Type tests shall be carried out only on insulators from a lot which meets the requirements of all the relevant routine tests.

6.2 Sample tests

Sample tests are carried out to verify the characteristics of an insulator which can vary with the manufacturing process and the quality of the component materials of the insulator. Sample tests are used as acceptance tests on a sample of insulators taken at random from a lot which has met the requirements of the relevant routine tests.

NOTE The acceptance coefficients and sample sizes used in this part of IEC 60383 for the statistical evaluation of results by variables have been chosen to reproduce as closely as possible the operating characteristic (OC) curves of the method by attributes used in former editions of IEC 60383 for usual lot sizes. For other lot sizes, the OC curves will be different. Further information on the statistical evaluation of test results and calculation of OC curves can be found in ISO 2859-2017, ISO 2859/1-1999, ISO 2859/2-1985: Sampling procedures and tables for inspection by attributes and ISO 3951-2013: Sampling procedures for inspection by variables.

6.3 Routine tests

Routine tests are intended to eliminate defective units and are carried out during the manufacturing process. Routine tests are carried out on every insulator.

NOTE When, in certain cases, the type, sample and routine tests are carried out as a whole on a new design of insulator, they are referred to as "prototype tests". Some tests are repeated during type, sample and routine tests and could thereby be omitted. Which tests to be omitted are upon agreement.

7 Cross-reference tables for tests to be performed

7.1 Pin insulators

The following tests are applicable to pin insulators. Certain tests are applicable only to certain classes of insulator or materials. To determine the tests which are applicable to pin insulators, reference should be made to the cross-reference table (Table 1).

The numbers on the first line in each square represent the quantity of insulators to be submitted to each test; the codes E1 and E2 correspond to the references given to the samples in 8.2. The second line in each square (figures in italics) indicates the clauses and/or subclauses which are applicable to the insulator and test in question.

The applicable type tests are to be performed once only for a given insulator (see 6.1 for more details). No comparison of type and sample test results can be satisfactorily made for the mechanical failing load test on pin insulators.

The applicable sample tests are performed on the samples E1 or E2 as indicated in the cross-reference table. The sizes of these samples shall be determined in accordance with 8.2. The sample tests shall be performed in the order indicated below; however, it is possible to carry out the tests which apply only to sample E1 (or E2) before those which apply to the other sample, after having carried out those tests which apply to both samples.

The applicable routine tests shall be performed on every insulator.