
Insulators of ceramic material or glass for overhead lines with a nominal voltage greater than 1000 V

Part 1. Methods of test

Isolateurs en céramique ou verre pour lignes aériennes ayant une tension nominale supérieure à 1000 V
Partie 1. Méthodes d'essai

Isolatoren aus Keramik oder Glas für Freileitungen mit einer Nennspannung über 1000 V
Teil 1. Prüfverfahren

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Foreword

This revision of BS 137 : Part 1 : 1970 has been prepared under the direction of the Power Electrical Engineering Standards Committee. It is based on IEC Publication 383 : 1976 'Tests on insulators of ceramic material or glass for overhead lines with a nominal voltage greater than 1000 V', together with Amendment No 1 : 1980, published by the International Electrotechnical Commission (IEC).

This Part of this standard supersedes BS 137 : Part 1 : 1970 which is therefore now withdrawn.

The purpose of this revision is to implement the IEC Publication as far as possible technically and in keeping with UK practice. Changes and improvements include the removal of references to agreement between purchaser and manufacturer because they are of a contractual nature and not appropriate to this British Standard.

The IEC clause numbering has been retained from clause 3 onward with the following main changes.

(a) 25.2 has been deleted because it deals with rigid insulators composed of annealed glass which are not used in the UK; subsequent subclauses in clause 25 have therefore had to be renumbered.

(b) The original clause 31 'Galvanizing test' of IEC Publication 383, which included a test by immersion in copper sulphate, has been retained, with alterations, as an alternative test and renumbered 31.2 in this standard. The standard galvanizing test as given in Amendment No. 1 : 1980 to IEC Publication 383 : 1976 has been included as 31.1.

For ease of production it has been found convenient to reproduce the figures from IEC Publication 383, with alterations, for the figures in this standard.



Amendment No. 1
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**Insulators of ceramic material or glass
for overhead lines with a nominal voltage
greater than 1000 V
Part 1. Methods of test**

Correction

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Clause 23. General

Delete the existing first table and substitute the following:

Number of insulators in the batch (n)	Number of samples
$500 \leq n \leq 20\,000$	$4 + \frac{1.5n}{1000}$
$n > 20\,000$	$19 + \frac{0.75n}{1000}$

PEL/70

British Standard

Insulators of ceramic material or glass for overhead lines with a nominal voltage greater than 1000 V

Part 1. Methods of test

Section one. General

1. Scope

This Part of this British Standard describes methods of test for insulators of ceramic material or toughened glass for use on a.c. overhead power and traction lines with a nominal voltage greater than 1000 V and a frequency not greater than 100 Hz.

It gives the electrical and mechanical characteristics of the insulator and the conditions under which the specified values of these characteristics are verified.

This Part applies to string insulator units, insulator strings, insulator sets and rigid overhead line insulators and to insulators of similar design when used in sub-stations. 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 BS 3297 : Part 1.

Numerical values for insulator characteristics are specified in BS 137 : Part 2.

2. References

The titles of the standards publications referred to in this standard are listed on the inside back cover.

3. Definitions

For the purpose of this British Standard the following definitions apply.

3.1 string insulator unit. An insulator consisting of insulating material with the necessary interconnecting metal-work to enable it to be flexibly attached to other string insulator units.

Unless otherwise stated, for string insulator units with ball and socket couplings the term includes the locking device and for units with clevis and tongue couplings it includes the pin and other parts necessary for the coupling.

3.2 insulator string. An insulator string consists of one or more insulator units intended to give flexible support to overhead line conductors.

NOTE. An insulator string is intended to be stressed mainly in tension.

Insulator strings consisting of one unit, for use on electric traction lines, may also be stressed by bending and compressive loads.

3.3 insulator set. An insulator set consists of one insulator string or two or more insulator strings suitably connected together complete with fittings for flexible attachment to a supporting structure.

This term includes metal parts and accessories (for instance, stress control fittings or arcing horns) considered as essential parts of the insulator set.

3.3.1 suspension insulator set. An insulator set complete with fittings to carry a line conductor or conductors at its lower end.

3.3.2 tension insulator set. An insulator set complete with fittings to secure a line conductor or conductors in tension.

3.4 rigid insulator. A rigid insulator is intended to give rigid support to overhead line conductors and to be stressed mainly by bending and compressive loads. Two main types of rigid insulators may be distinguished: pin insulators and line post insulators.

3.4.1 pin insulator. A rigid insulator consisting of a single piece of ceramic or glass or of two or more ceramic or glass components permanently connected together and intended to be mounted rigidly on a supporting structure by an insulator pin passing up inside the insulator. Unless otherwise stated, this term does not include the insulator pin.

3.4.2 line post insulator. A rigid insulator consisting of one or more ceramic or glass parts permanently secured in a metal base and intended to be mounted rigidly on a supporting structure by means of a stud or bolts attached to the base. Unless otherwise stated, this term includes the stud or bolts.

3.5 batch. The number of insulators from the same manufacturer and of the same design offered for acceptance; a batch may consist of the whole, or part, of the quantity ordered.

3.6 flashover. A disruptive discharge (see BS 923 : Part 1) external to the insulator, connecting those parts which normally have the operating voltage between them.

NOTE. The term 'flashover' used in this standard includes a flashover across the insulator surface as well as disruptive discharges by sparkover through air adjacent to the insulator. Disruptive discharges should only occur occasionally elsewhere (e.g. to other structures or to earth), in which case they should not be regarded as 'flashovers' for the purposes of this standard.

3.7 puncture. A disruptive discharge (see BS 923 : Part 1) passing through the solid insulating material of an insulator. A fragment breaking away from the rim of a shed or damage to the insulator due to the heat of a surface discharge is not considered a puncture.

3.8 dry lightning impulse withstand voltage. The lightning impulse voltage that the insulator withstands dry, under specified conditions of test.

3.9 50 % dry lightning impulse flashover voltage. The value of the lightning impulse voltage that, under specified conditions of test, has a 50 % probability of producing flashover on the insulator, dry.

3.10 wet switching impulse withstand voltage.

The switching impulse voltage that the insulator withstands wet under specified conditions of test.

3.11 50 % wet switching impulse flashover voltage.

The value of the switching impulse voltage that, under specified conditions of test, has a 50 % probability of producing flashover on the insulator, wet.

3.12 wet power-frequency withstand voltage. The power-frequency voltage that the insulator withstands wet, under specified conditions of test.

3.13 wet power-frequency flashover voltage. The arithmetic mean of the measured voltages that cause flashover of the insulator under specified conditions of test.

3.14 electro-mechanical failing load. The maximum load without mechanical or electrical failure that can be reached when a string insulator unit is tested under specified conditions of test.

3.15 mechanical failing load. The maximum load without mechanical failure that can be reached when a string insulator unit or a rigid insulator is tested under specified conditions of test.

3.16 puncture voltage. The voltage that causes puncture of a string insulator unit or a rigid insulator under specified conditions of test.

3.17 creepage distance of an insulator. The shortest distance or the sum of the shortest distances along the contours of the external surfaces of the ceramic or glass insulating parts of the insulator between those parts that normally have the operating voltage between them. A distance measured over the surface of cement or other conducting jointing material is not considered as forming part of creepage distance.

If high-resistance coatings are applied to parts of the insulator, such coatings are considered as effective creepage surfaces and the distance over them is included in the creepage distance.

NOTE. The surface resistivity of such high-resistance coatings is usually about $10^6 \Omega$ but may be as low as $10^4 \Omega$.

4. Classification

Overhead line insulators are divided into two types according to their construction:

Type A: an insulator or an insulator unit in which the length of the shortest puncture path through solid insulating material is at least equal to half the length of the shortest flashover path through air outside the insulator.

Type B: an insulator or an insulator unit in which the length of the shortest puncture path through solid insulating material is less than half the length of the shortest flashover path through air outside the insulator.

5. Values of voltage

In accordance with BS 923 : Part 2, lightning and switching impulse withstand voltages shall be expressed by their prospective peak values and power-frequency voltages shall be expressed as peak values divided by $\sqrt{2}$.

6. Values which characterize a string insulator unit or a rigid insulator

A string insulator unit or a rigid insulator is characterized by the following values, where applicable:

- (a) the specified dry lightning impulse withstand voltage;
- (b) the specified wet power-frequency withstand voltage;
- (c) the specified electro-mechanical failing load (for type B string insulator units only);
- (d) the specified mechanical failing load (for type A string insulator units and those of type B for which the electro-mechanical failing load test is not applicable and for rigid insulators);
- (e) the specified puncture voltage (for type B insulators only);
- (f) the specified significant dimensions, including the creepage distance.

NOTE. Service voltage is not to be considered as a characteristic of a string insulator unit or a rigid insulator.

7. Values which characterize an insulator string or an insulator set

An insulator string or an insulator set is characterized, in addition to the values which characterize the units, by the following values:

- (a) the specified dry lightning impulse withstand voltage;
- (b) the specified wet switching impulse withstand voltage;
- (c) the specified wet power-frequency withstand voltage.

Wet switching impulse voltage shall be specified only for a.c. systems with highest voltage of equipment equal to or above 300 kV.

NOTE 1. Service voltage is not to be considered as a characteristic of an insulator string or an insulator set.

NOTE 2. The flashover and withstand voltages of insulators under service conditions may differ from the flashover and withstand voltages under standard conditions. This effect has been recognized with lightning impulse testing, especially for very high voltages of equipment, but the effect of ambient conditions and the arrangement of insulators and associated metal-work is much greater with switching impulses, due to the differences in electric field distribution between standard test arrangement and the mounting arrangement in service.

The switching impulse withstand voltage of an insulator string or an insulator set is not necessarily a definite characteristic because the switching impulse withstand voltage is determined to a large extent by the tower structure and the field configuration which depends on the shape and relative positions of all the metal parts. Therefore, the verification of the specified switching impulse withstand voltage is generally required with a mounting arrangement which closely represents the service conditions.

NOTE 3. On overhead lines for highest voltage for equipment up to and including 420 kV experience has shown that with the levels of the lightning impulse voltage used at the present time, the switching impulse withstand voltage is not critical in determining the dimensions of insulators. Therefore, a switching impulse test for this voltage range is not normally required.

8. Marking

Each string insulator unit or rigid insulator shall be marked