

BS 3288-1:2014



BSI Standards Publication

Insulator and conductor fittings for overhead power lines

Part 1: Performance and general requirements

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Foreword

Publishing information

This part of BS 3288 is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 31 December 2014. It was prepared by Technical Committee PEL/11, *Overhead lines*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This part of BS 3288 supersedes BS 3288-1:1997, which is withdrawn.

Information about this document

BS 3288 applies primarily to fittings for overhead electric power lines. The various parts of BS 3288 specify the performance, general requirements and dimensional requirements for insulator and conductor fittings. The general and dimensional requirements may be applied to similar fittings used on overhead railway electrification systems and in substations. This British Standard is not applicable to fittings exclusively intended for use on aerial bundled conductor systems or to low voltage connectors.

BS 3288-1 is part of a series that contains the following current parts:

- Part 2: *Specification for a range of fittings;*
- Part 3: *Dimensions of ball and socket couplings of string insulator units.*

The original suite of standards also contained BS 3288-4 but this has been superseded by BS EN 60372.

Use of this document

It has been assumed in the preparation of this part of BS 3288 that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Requirements in this standard are drafted in accordance with *Rules for the structure and drafting of UK standards*, subclause J.1.1, which states, "Requirements should be expressed using wording such as: 'When tested as described in Annex A, the product shall ...'". This means that only those products that are capable of passing the specified test will be deemed to conform to this standard.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

1 Scope

This British Standard specifies performance and general requirements for insulator and conductor fittings for use on overhead power lines. It defines the relevant tests and test procedures together with the acceptance criteria.

The tests and test procedures may also be applied to similar fittings, outside the scope of this standard, intended for use in:

- the overhead equipment of electric traction lines;
- substations.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 3288-2, *Insulator and conductor fittings for overhead power lines – Part 2: Specification for a range of fittings*

BS 3288-3, *Insulator and conductor fittings for overhead power lines – Part 3: Dimensions of ball and socket couplings for string insulator units*

BS 4727, *Glossary of electrotechnical, power, telecommunications, electronics, lighting and colour terms*

BS 4872-1:1982, *Specification for approval testing of welders when welding procedure is not required – Part 1: Fusion welding of steel*

BS EN 1562, *Founding – Malleable cast irons*

BS EN 1563, *Founding – Spheroidal graphite cast irons*

BS EN 60372:2004, *Locking devices for ball and socket couplings of string insulator units – Dimensions and tests*

BS EN 61284, *Overhead lines – Requirements and tests for fittings*

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

BS EN ISO 15620, *Welding – Friction welding of metallic materials*

PD 970, *Wrought steels for mechanical and allied engineering purposes – Requirements for carbon, carbon manganese and alloy hot worked or cold finished steels*

3 Terms and definitions

For the purposes of this British Standard, the definitions given in BS 4727 and the following apply.

3.1 cap and pin insulator

insulator comprising an insulating part having the form of a disc or bell, with or without ribs on its lower surface, and fixing devices consisting of an outside cap and an inside pin attached axially

3.2 clamp

any fitting which can be fixed onto a conductor

3.3 earth conductor fitting

any component of an assembly for attaching an earth conductor to a supporting structure other than a suspension clamp, a tension termination or a mechanical protective fitting

3.4 electrical control fitting

any device for controlling the electrical characteristics of an insulator (i.e. arcing horn, combined corona arcing device, etc.)

3.5 factory formed helical conductor fitting

fitting in which the force necessary to grip the conductor is provided by helical wires which are self-tightening on the conductor

3.6 insulator pin

rigid fitting for attaching a pin insulator to a supporting structure

3.7 insulator set

assembly of one or more insulator strings suitably connected together, complete with fixing and protective devices as required in service

3.8 insulator set fitting

any component of a suspension or tension insulator set, other than a string insulator unit, a suspension clamp, a tension termination, an electrical control fitting or a mechanical protective fitting

3.9 insulator string

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

3.10 long rod insulator

insulator comprising an insulating part having an approximately cylindrical core, with or without sheds, and external or internal fixing devices attached to each end

3.11 mechanical protective fitting

any device attached to a conductor for its mechanical protection

3.12 mid-span tension joint

joint inserted between two lengths of a conductor to provide electrical and mechanical continuity of the conductor

NOTE A dead end tension joint may additionally provide facilities for the connection of droppers or jumpers. Some types, e.g. bolted and wedge type might not need this facility. The joint can also be used on an earth conductor.

3.13 non-tension joint

fitting for the connection of two consecutive pieces of conductor which are to be held, but not at line tension

3.14 non-tension T-joint

fitting for the connection of the end of one conductor to a point on the length of a second conductor

NOTE The connection is not subject to line tension although the conductor to which the fitting is applied on its length may be at line tension.

- 3.15 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
- 3.16 repair sleeve**
special fitting which can be installed over a damaged conductor in order to restore its electrical and mechanical properties
- 3.17 rigid insulator**
insulator intended to give rigid support to an overhead line conductor and which is stressed mainly by bending and compressive loads
- 3.18 spacer**
device which keeps apart the sub-conductors of a bundle in a given geometrical configuration
- 3.19 specified minimum failing load**
mechanical falling load specified by the purchaser or declared by the supplier as a design characteristic of the fitting
- 3.20 string insulator unit**
cap and pin insulator or long rod insulator the fixing devices of which are suitable for flexible attachment to other similar string insulator units or to connecting accessories
- 3.21 suspension clamp**
fitting which attaches a conductor to a suspension insulator set or an earth conductor fitting
- 3.22 tension set**
insulator set complete with all fittings and accessories to secure a conductor or a bundle of conductors in tension
- 3.23 vibration damper**
device attached to a conductor in order to suppress or minimize vibrations due to wind

4 General requirements

4.1 General

All insulator fittings, unless otherwise specified by the purchaser [see item b) of Annex C], shall conform to the coupling dimensions specified in BS 3288-3 and BS EN 60372.

When conductor fittings are installed for test as specified in Clause 7, Clause 8 and Clause 9, the fittings shall not damage the conductor except for any deformation necessary to attach the fitting. Fittings shall be made of material of sufficient ductility that the fittings can withstand the dynamic mechanical loads to which they are likely to be subjected in service. The fitting shall not give rise to the generation of visible or audible corona discharge at the specified test voltage.

The selection of materials and the design of security devices shall conform to BS EN 60372:2004, 10.3.

4.2 Protection against corrosion

All parts of insulator, conductor and earth wire fittings shall be either inherently resistant to atmospheric corrosion or be suitably protected against corrosion, such as can occur in transport, storage and in service. All ferrous parts which will be exposed to the atmosphere in service, except those made of appropriate stainless steel, shall be protected by hot dip galvanizing in accordance with BS EN ISO 1461 or other means giving equivalent protection.

Moreover, unless special measures are taken, there shall never be contact between metals for which the difference in electrochemical potential can give rise to galvanic corrosion capable of impairing the efficiency of the whole equipment.

NOTE This applies especially to those parts of the fittings that are in direct contact with the conductor.

All external threads shall be cut or rolled before hot dip galvanizing.

Internal threads can be cut before or after hot dip galvanizing but if cut after galvanizing, they shall be oiled or greased.

4.3 Classification of tests

In the following clauses, in which the requirements for the various types of fittings are given, the tests are divided into three groups:

- a) *Type tests.* Type tests are intended to establish design characteristics. They are normally made once only and repeated only when the design or the material of the fitting is changed.
- b) *Sample tests.* Sample tests are intended to verify the quality of materials and workmanship. They are made on fittings taken at random from batches offered for acceptance.
- c) *Routine tests.* Routine tests are intended to eliminate defective fittings. They are made on every fitting for which routine tests are specified in later clauses.

4.4 General requirements for tests

COMMENTARY ON 4.4

Additional non-destructive testing may be agreed between purchaser and supplier.

Tests might include: magnetic, eddy current, radiograph, ultrasonic, proof load, dye penetrant and hardness.

4.4.1 Type tests

Test certificates giving the results of the appropriate type tests, made on not less than three fittings identical in all essential details with those to be supplied, shall be regarded as evidence of conformity.

NOTE If alternative arrangements apply, this should be stated by the purchaser at the time of enquiry and order [see item c) of Annex C].

4.4.2 Sample tests

When the order is for one hundred or more identical fittings, the number of samples for these tests shall be p or the nearest whole number greater than p , as given by the following formulae, in which n is the number of fittings in the batch offered for inspection.

$$p = 4 \text{ when } 100 \leq n < 500$$

$$p = 4 + \frac{1.5n}{1000} \text{ when } 500 \leq n \leq 20\,000$$

$$p = 19 + \frac{0.75n}{1000} \text{ when } n > 20\,000$$

For batches of fewer than one hundred identical fittings, four samples shall be submitted to the specified non-destructive sample tests.

The samples shall be selected at random from fittings which have passed the appropriate routine test (if any).

NOTE 1 The purchaser has the right to make the selection.

If these samples meet the test requirements, the batch shall be deemed to conform to the requirements of the standard. In the event of a sample not meeting the test requirements, twice the original number of new samples shall be tested. If all these new samples meet the test requirements, the batch shall be deemed to conform to the requirements of the standard, but if any fail to do so the batch shall be deemed not to conform to the requirements of the standard.

NOTE 2 Any sampling tests not defined in this standard should be agreed between the purchaser and supplier.

4.4.3 Routine tests

Where routine tests are specified in the following clauses, they shall be applied to every fitting.

4.5 Verification of dimensions and materials

It shall be verified either that the test samples conform to the requirements of BS 3288-2 (if relevant) or that they are in accordance with the contract drawings, particularly as regards any dimensions to which special tolerances apply and details affecting interchangeability (e.g. dimensions for which gauges are specified).

The tolerances given in Table 1 shall be used on all dimensions to which special tolerances do not apply.

Table 1 Tolerances

Dimension	Tolerance
mm	
Up to and including 35	±0.7 mm
Over 35	±2%

NOTE Dimensions given in brackets in BS 3288-2 are given for guidance only and are not subject to strict tolerances. These dimensions might vary by twice the tolerances specified in Table 1.

Measuring devices/gauges shall be selected with regard to the required precision and accuracy. Documentary evidence of calibration of such devices shall be provided on request.

Type and sample tests shall also include verification of materials to ensure that they are in accordance with contract documents. This verification shall normally be carried out by the purchaser inspecting the supplier's documentation relative to material purchasing specifications, certificates of conformity or other quality documentation. When agreed between purchaser and supplier, material verification shall include tests appropriate to the material specification.

4.6 Verification of markings

It shall be verified that the marking on the test samples conforms to the requirements of BS EN 61284 for the standard range of fittings or is in accordance with the contract drawing.

4.7 Welding

All welds for ferritic steel or austenitic stainless steel fabrications shall be in accordance with BS 4872-1. All friction welds shall be in accordance with BS EN ISO 15620.

5 Requirements for insulator pins

5.1 General

Insulator pins and nuts shall be made of steel, or any other material capable of conforming to the requirements of 5.2 and 5.3.

The collar, if integral with the pin, shall be finished with a radius not exceeding 2 mm between it and the shank. The collar shall bed down on to a cross-arm when fixed to it through a hole having a diameter 2 mm greater than the diameter of the shank.

5.2 Mechanical type tests

The shank of the insulator pin shall be rigidly attached to the testing machine. A rigid metal extension piece shall be attached direct to the head of the pin. A load shall be applied to the extension piece 25 mm above the top of the pin. The load, applied at right angles to the axis of the insulation pin, shall be increased to the specified minimum failing load at a steady rate. When the specified minimum failing load has been reached, the deflection measured at the top of the pin head shall not exceed 20% of the distance of this point from the support.

5.3 Sample tests

5.3.1 Verification of dimensions

The dimensions of the samples shall be verified as specified in 4.5.

5.3.2 Mechanical tests

This test shall be the same as the type test specified in 5.2.

5.3.3 Galvanizing test

Galvanized parts shall be tested in accordance with BS EN ISO 1461 and shall conform to the requirements of that standard.

5.4 Routine tests

No routine tests are specified for insulator pins.

6 Insulator set fittings and earth conductor fittings

6.1 General requirements

Insulator set fittings and earth conductor fittings shall conform to the requirements of the following tests. Ferrous castings shall be made either of malleable cast iron conforming to the requirements of BS EN 1562, or of cast iron containing spheroidal or nodular graphite, conforming to the requirements of BS EN 1563. Forged steel fittings shall be made from steel of a suitable grade, conforming to the requirements of PD 970.

NOTE If the purchaser or supplier uses other materials, they should state that at the time of enquiry and order [see item d) of Annex C].

6.2 Mechanical type test

The fitting shall be held in a tensile testing machine and the load shall be gradually increased until it reaches the specified minimum damage load (70% of the minimum failure load). This load shall be kept constant for a maximum of 60 s (or as agreed between the purchaser and supplier). It shall then be removed and the measurement of the permanent deformation of the fitting carried out. The dimensions shall remain within the tolerances stated on the drawing. Then the load shall be gradually increased until it reaches the specified minimum failure load (SMFL) at which it shall be kept constant for 60 s. Then the load shall be increased until the failure of the fitting occurs.

NOTE If the failure load exceeds 1.2 times the SMFL, the test may be stopped with the agreement of all parties in order to safeguard equipment and/or operators.

6.3 Sample tests

6.3.1 Verification of dimensions

The dimensions of the samples shall be verified as specified in 4.5.

6.3.2 Mechanical test

This test shall be the same as the type test specified in 6.2 with the minimum damage load part of the test waived.

6.3.3 Galvanizing test

Galvanized parts shall be tested in accordance with BS EN ISO 1461 and shall conform to the requirements of that standard.

6.4 Mechanical routine tests

This test shall be applied only to castings and to fittings which are fabricated by welding, in which the weld is stressed when the fitting is in service. A tensile load equal to 50% of the specified minimum failing load shall be applied to the fittings and maintained for 30 s. The fitting shall not be damaged by the test.

7 Tension joints and tension clamps

7.1 General requirements

Tension joints and tension clamps shall be so designed that they meet the requirements of the following tests.

NOTE 1 Attention is drawn to the need for the designer to take into account the effects of vibration.