

Insulator and conductor fittings for overhead power lines —

Part 1: Performance and general requirements

ICS 29.080.10; 29.120.20; 29.240.20

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW



Document Sharing Hub

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee PEL/11, Overhead lines, upon which the following bodies were represented:

- Aluminium Federation
- Association of Consulting Engineers
- BECCAMA (BEAMA Electrical Cable Conductor Accessory Manufacturers' Association)
- British Non-Ferrous Metals Federation
- British Railways Board
- Department of Trade and Industry
- Electrical and Electronic Insulation Association (BEAMA Ltd.)
- Electricity Association
- Overhead Transmission Line Contractors (BEAMA Ltd.)

This British Standard, having been prepared under the direction of the Electrotechnical Sector Board, was published under the authority of the Standards Board and comes into effect on 15 March 1997

© BSI 12-1998

First published November 1960
Second edition October 1973
Third edition March 1997

The following BSI references relate to the work on this standard:
Committee reference PEL/11
Draft for comment 91/32512 DC

ISBN 0 580 27087 4

Amendments issued since publication

Amd. No.	Date	Comments

Contents

	Page
Committees responsible	Inside front cover
Foreword	ii
1 Scope	1
2 References	1
3 Definitions	1
4 General requirements	3
5 Requirements for insulator pins	4
6 Insulator set fittings and earth conductor fittings	5
7 Tension joints and tension clamps	5
8 Non-tension joints	8
9 Suspension clamps	11
10 Electrical control fittings	11
11 Mechanical protective fittings	12
Annex A (informative) Diagrammatic representation of electrical type test sequence	15
Annex B (normative) Mathematical acceptance criterion	17
Annex C (normative) Information to be supplied by the purchaser	19
Figure A.1 — Diagrammatic representation of electrical type test sequence	16
Table 1 — Tolerances	4
Table 2 — Longitudinal slip	13
Table 3 — Torsional slip	13
Table B.1 — Designation of resistance measurements	18
List of references	Inside back cover

Foreword

This Part of BS 3288 has been prepared by Technical Committee PEL/11 and supersedes BS 3288-1:1973 which is withdrawn.

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. The Standard is not applicable to fittings exclusively intended for use on aerial bundled conductor systems or to low voltage connectors.

BS 3288 is published in four Parts. The other Parts are as follows.

- *Part 2: Specification for a range of fittings;*
- *Part 3: Dimensions of ball and socket couplings of string insulator units;*
- *Part 4: Locking devices for ball and socket couplings of string insulator units: dimensions and tests.*

This edition of Part 1 introduces technical changes but it does not reflect a full review or revision of the standard which will be undertaken in due course.

Product certification. Users of this British Standard are advised to consider the desirability of third party certification of product conformity with this British Standard based on testing and continuing product surveillance which may be coupled with assessment of a supplier's quality systems against the appropriate standard in the BS EN ISO 9000 series.

Enquiries as to the availability of third party certification schemes are forwarded by BSI to the Association of British Certification Bodies. If a third party certification scheme does not already exist, users should consider approaching an appropriate body from the list of Association members.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 20, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This Part of BS 3288 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 References

2.1 Informative references

This Part of BS 3288 incorporates, by dated or undated reference, provisions from other publications. These normative references are made at the appropriate places in the text and the cited publications are listed on the inside back cover. For dated references, only the edition cited applies; any subsequent amendments to or revisions of the cited publication apply to this Part of BS 3288 only when incorporated in the reference by amendment or revision. For undated references, the latest edition of the cited publication applies, together with any amendments.

2.2 Informative references

This Part of BS 3288 refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this standard are listed on the inside back cover, but reference should be made to the latest editions.

3 Definitions

For the purposes of this British Standard the definitions given in BS 4727 apply together with the following.

3.1

mechanical failing load

the maximum load which can be applied to a fitting when it is tested under specified conditions of test

3.2

specified minimum failing load

the mechanical failing load specified by the purchaser or declared by the supplier as a design characteristic of the fitting

3.3

rigid insulator

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

3.4

pin insulator

a 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

3.5

insulator pin

a rigid fitting for attaching a pin insulator to a supporting structure

3.6

line post insulator

a rigid insulator consisting of one or more components of insulating material permanently assembled with a metal base and intended to be mounted rigidly on a supporting structure

3.7

cap and pin insulator

an 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

3.8

long rod insulator

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

3.9

composite insulator

an insulator made of at least two insulating parts, namely a core and an external housing

NOTE Composite insulators, for example, can consist either of individual sheds mounted on the core, with or without an intermediate sheath, or alternatively, of the complete housing with sheds directly moulded or cast in one or several pieces onto the core.

3.10

string insulator unit

a 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

3.11

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

3.12
insulator set

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

3.13
suspension set

an insulator set complete with all fittings and accessories to support a conductor or a bundle of conductors at its lower end

3.14
tension set

an insulator set complete with all fittings and accessories to secure a conductor or a bundle of conductors in tension

3.15
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

3.16
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

3.17
electrical control fitting

any device for controlling the electrical characteristics of an insulator

3.18
mechanical protective fitting

any device attached to a conductor for its mechanical protection

3.19
factory formed helical conductor fitting

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

3.20
clamp

any fitting which can be fixed onto a conductor

3.21
suspension clamp

a fitting which attaches a conductor to a suspension insulator set or an earth conductor fitting

3.22
tension clamp: dead-end clamp

a clamp which attaches a conductor to a tension insulator set or to a support and designed to withstand the conductor tension

3.23
dead-end tension termination

a tension clamp inserted at the end of a conductor for attachment to an insulator tension set, designed to carry full current and to provide mechanical termination of the conductor

3.24
mid-span tension joint

a 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 may not need this facility. The joint can also be used on an earth conductor.

3.25
non-tension joint

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

3.26
non-tension T-joint

a 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.

3.27
non-tension termination

a fitting for application to the end of a conductor not subject to line tension to permit connection to equipment or other fittings

3.28
bi-metallic fitting

a fitting which is suitable for the connection of conductors of different materials

3.29
repair sleeve

a special fitting which can be installed over a damaged conductor in order to restore its electrical and mechanical properties

3.30
patch sleeve

a special fitting which can be installed over a damaged conductor in order to restore its electrical properties

3.31**spacer**

a device which keeps apart the sub-conductors of a bundle in a given geometrical configuration

3.32**spacer damper**

a flexible device which keeps apart the sub-conductors of a bundle in a given geometrical configuration and is able to reduce aeolian vibrations and subspan oscillations of the sub-conductors

3.33**jumper lug**

the part of a joint or of another fitting which permits electrical continuity with another conductor

3.34**jumper terminal**

the termination of a conductor which permits electrical continuity with a jumper lug

3.35**counterweight (to a suspension insulator set)**

a mass attached to a suspension clamp to provide an increase in the vertical load applied to the clamp

NOTE The effect of the counterweight is to reduce the angle of swing of the suspension insulator set under the influence of wind or in the case of flying angle supports. It also prevents radio-interference caused by bad contacts between metallic parts.

3.36**vibration damper**

a device attached to a conductor in order to suppress or minimize vibrations due to wind

3.37**night warning light (for conductor)**

a device which becomes luminous generally by capacitive induction from the live conductor to which it is attached

3.38**aircraft warning marker (for conductor and earth wire)**

a warning device visible during the day, used on conductors or earth wires

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 3288-4.

When conductor fittings are installed for test as specified in clauses 7, 8 and 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.

4.2 Protection against corrosion

All parts of insulator and conductor fittings shall be either inherently resistant to atmospheric corrosion or be suitably protected against corrosion, such as may occur in transit, storage and in service. All ferrous metal parts which will be exposed to the atmosphere in service, except those made of stainless steel, shall be protected by hot dip galvanizing or other means giving equivalent protection. The threads of nuts and tapped holes shall be cut after galvanizing and shall be well oiled or greased. All other threads shall be formed before galvanizing.

All fittings shall be so designed that bi-metallic corrosion within or between fittings or between a fitting and the conductor does not occur.

The selection of materials and the design of security devices shall conform to 10.3 of BS 3288-4:1989.

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**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.

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

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

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

For batches of less 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). 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.

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

It shall be verified either that the test samples conform to the requirements of Part 2 of this standard (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 are allowed on all dimensions to which special tolerances do not apply.

Table 1 — Tolerances

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

NOTE Dimensions given in brackets in Part 2 of this standard are given for guidance only and are not subject to strict tolerances. These dimensions may vary by twice the tolerances specified in Table 1.

4.6 Verification of markings

It shall be verified that the marking on the test samples conforms to the requirements of Part 2 of this standard for the standard range of fittings or is in accordance with the contract drawing.

4.7 Welding

All welds shall be in accordance with BS 4872-1.

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 729 and shall conform to the requirements of that standard.

5.4 Routine tests

No routine tests are specified for insulator pins.