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BUREAU OF INDIAN STANDARDS
DRAFT FOR COMMENTS ONLY

Draft Indian Standard

CONDUCTORS AND EARTHWIRE ACCESSORIES FOR OVERHEAD LINES PART 4 NON-TENSION JOINTS – SPECIFICATION

Conductors and Accessories for Overhead Lines Sectional Committee, ETD 37

Last date of receipt of comments**:** 10 June 2024

FOREWORD

This draft Indian Standard (Second Revision) will be adopted by the Bureau of Indian Standards, after the draft finalized by the Conductors and accessories for Overhead Lines Sectional Committee had been approved by the Electrotechnical Division Council.

The use of ACSR and all aluminium conductors for power transmission is now well established. As a natural consequence, special type of fittings are required to be used for such power lines. This standard has been prepared with a view to ensure uniform requirements of the various types of fittings and to provide necessary guidance to the manufacturers and the buyers.

This standard was first published in 1962 and later revised in 1992. The second revision has been taken up to keep pace with the latest technological developments and international practices.

This Indian Standard is published in 4 parts. The other parts in this series are:

Part 1 Specification for conductors and earth wire accessories for overhead power lines: Part 1 armour rods, binding wires and tapes for conductors;

Part 2 Specification for conductors and earth wire accessories for overhead power lines: Part 2 mid - Spain joints and repair sleeves - For conductors;

Part 3 Conductors and earthwire accessories for overhead lines: Part 3 accessories for earthwire - Specification.

Parallel groove connectors for use in the substations and generating stations are covered in IS 5561 'Electric power connectors'. This standard has been prepared to cover the requirements of parallel groove lamps intended to be used on overhead transmission lines.

NOTE — At present, dimensions and materials of accessories are not covered in the standard. Details are, therefore, solicited on these two aspects with a view to cover them in the standard

If agreed between the purchaser and the supplier the conductor and earth wire accessories may also be made suitable for application for hot line techniques.

In the preparation of this standard assistance has been derived from BS 3288: Part I: 2014‘Specification for insulator and conductor fittings for overhead power lines: Part I Performance and general requirements’ issued by the British Standards Institution.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2: 2022 ‘Rules for rounding of numerical values (*second revision*). . The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1 SCOPE

1.1 This standard (Part 4) covers performance and general requirements for non-tension joints for joining ACSR, all aluminium and aluminium alloy conductors.

2 REFERENCES

2.1 The standards given below contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below.

IS No	*Title*
2121(Part 1): 1988	Conductors and earthwires accessories for overhead power lines: Part 1 Armour rods, binding wires and tapes for conductors *(first revision)*
2633 : 1986	Method of testing uniformity of coating on zinc coated articles *(second revision)*
6745:1972	Methods for determination of mass of zinc coating on zinc coated iron and steel articles

3 TERMINOLOGY

3.0 For the purpose of this standard, the definitions given in IS 2121 (Part 1): 1981, and the following shall apply.

3.1 Non-Tension Joint

A joint for electrical connection not subjected to line tension.

3.2 Parallel Groove Clamp

A connector designed for the purpose of connecting two or more conductors whose axes are parallel to each other.

3.3 Tee Connector

A connector designed for the purpose of connecting two conductors whose axes are per-pendicular to each other.

3.4 Type Tests

Tests intended to prove that the quality and design of a given type of article are in accordance with the specification.

3.5 Acceptance Tests

Tests carried out on samples taken from a lot for the purpose of acceptance of the lot.

3.6 Routine Tests

Tests carried out 'on each fitting to check the requirements which are likely to vary during production.

4 CONSTRUCTIONAL AND GENERAL REQUIREMENTS

4.1 Non-tension joints (including tee joints) shall be designed so that they meet the appropriate requirements specified in this standard. The manufacturer may assign a rated current tea joint, which shall then be the basis for the electrical type test **[*see* 6.6.2.3(a)]**. Other- wise, the joint shall be tested as specified in **6.6.2.3(b).**

4.1.1 Fitting intended to connect conductors of two dissimilar metals shall be designed to avoid harmful bimetallic corrosion when erected in accordance with the manufacturer's recommendations.

4.2 The following information shall be specified by the purchaser or, if not, declared by the manufacturer:

a) Conductor size, type, breaking load and appropriate standard;
b) Whether conductor is ungreased, partly greased or wholly greased;
c) Material or materials from which the non-tension fitting is made;
d) The dimension of dies to be used if a compression type non-tension fitting is specified; and
e) The recommended bolt tightening torque if bolted type fitting is specified.

NOTE — Any other requirements such as corona, radio influence voltage, vibration performance and corrosion resistance, are to be specified by the purchaser.

4.3 Materials

Fittings may be made from any material or combination of materials acceptable to the purchaser which enables the fittings to reach its specified capability. Components shall be compatible with other components and the conductor with which they will be in contact. The purchaser shall give due regard to any relevant statutory regulations governing the nominated holding tensions, failing load and nominated conductor tension.

Plastic materials shall be adequately protected from the effects of exposure to solar radiation.

5. MARKING

5.1 The fittings shall be marked with the data given below:

a) Manufacturer’s name or trade-mark;
b) Conductor name or diameter;
c) Year of manufacture;
d) Compression dia size; and
e) Any other marking as agreed between customer and supplier.

5.2 BIS Certification Marking

The product may also be marked with Standard Mark.

5.2.1 The use of the Standard Mark is governed by the provisions of Bureau of Indian Standards Act, 2016 and the Rules and Regulations made there under. The details of the conditions under which the licence for use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

6 TESTS

6.1 Classification of Tests

6.1.1 *Type Tests*

The following shall constitute the type tests:

a) Visual examination (*See* **6.2**),
b) Verification of dimensions (*See* **6.3**),
c) Mechanical tests on joints other than tee joints (*See* **6.4**),

d) Mechanical tests on tee joints where applicable (*See* **6.5**),
e) Electrical test (*See* **6.6**), and
f) Galvanizing test where applicable (*See* **6.7**).

6.1.2 Acceptance Tests

The following shall constitute the acceptance tests:

a) Visual examination (*See* **6.2**),
b) Verification of dimensions (*See* **6.3**),
c) Mechanical tests (*See* **6.4** and **6.5**),
d) Electrical tests (*See* **6.6**),

NOTE — For the purpose of acceptance test, the mechanical and electrical tests shall not be made on non-tension joint except by special agreement between the purchaser and the supplier. When required such tests shall be same as the type tests specified in 6.4 to 6.6; and

e) Galvanizing test (*See* **6.7**).

6.1.3 *Routine Test*

Visual examination (*See* **6.2**).

6.2 Visual Examination

All fittings shall be checked visually for good workmanship and smooth finish.

6.3 Verification of Dimensions

The dimensions shall be checked as per the approved drawings.

6.4 Mechanical Tests

6.4.1 *Mechanical Tests on Joints Other Than Tee Joints*

6.4.1.1 *General*

When specified by the purchaser, non-tension joints other than the joints shall comply with the requirements of the following test.

6.4.1.2 *Test assembly*

The joint shall be assembled in accordance with the manufacturer's recommendations on conducters of the sizes and types with which it is to be used. The assembly shall be mounted in a tensile testing machine and anchored in such a way that the test force is applied along the axis of the conductor.

6.4.1.3 *Procedure*

The procedure shall be as follows:

a) Conductors less than 12 kN breaking load

When breaking load is less than 12 kN, a tensile force of about 5 percent of the breaking load shall be applied and the conductor shall be marked in such a way that movement relative to the fitting can be detected easily. Without any subsequent adjustment of the fitting, the force shall be steadily increased to 10 percent of the breaking load. This force shall be maintained for 1 minute; and

b) Conductors 12 kN or more breaking load

Where the breaking load is 12 kN or more, a tensile force of 0'6 kN shall be applied and the conductor shall be marked in such a way that movement relative to the fitting can be detected easily. Without any subsequent adjustment of the fitting, the force shall be steadily increased to 12 kN. This force shall be maintained for 1 minute.

6.4.1.4 ***Requirement***

There shall be no movement of the conductor relative to the fitting due to slip during the 1-minute period and no failure of the fitting.

6.5 Mechanical Tests on Tee foints

6.5.1 *Tensile and Slip Test*

6.5.1.1 *General*

When specified by the purchaser, non-tension tee joints shall comply with the requirements of this test.

6.5.1.2 *Test assembly*

The tee joint shall be assembled on a tee conductor of the size and type with which it is to be used in accordance with the manufacturer's recommendation.
The assembly shall be mounted in a tensile testing machine and anchored in such a way that the test force is applied axially to the tee conductor.

6.5.1.3 *Procedure*

a) Tee conductors less than 12 kN breaking load

Where the breaking load of the tee conductor is less than 12 kN, a tensile force of about 5 percent of the breaking load shall be applied to the conductor and the conductor marked in such a way that any movement relative to the fitting may be detected. Without further adjustment of the fitting, the force shall be gradually increased to 10 percent of the breaking load and maintained for 1 minute; and

b) Tee conductors 12 kN or more breaking load

Where the breaking load of the conductor is 12 kN or more, a tensile force of 0.6 kN shall be applied by the conductor and the conductor marked in such a way that any movement relative to the fitting may be detected.

Without further adjustment of the fitting, the force shall be gradually increased to 12 kN and maintained for 1 minute.

6.5.1.4 *Requirement*

There shall be no movement of the tee conductor relative to the fitting during the 1-minute period.

6.6 Electrical Type Test

6.6.1 *General*

Electrical type tests shall be carried out on all types of non-tensioned fittings, including tee joints and shall comprise the heating-cycle test specified in **6.6.2** and the short-time current test specified in **6.6.3**, using the

test assembly of fitting and conductors specified in **6.6.2.2**. The tests shall be made with alternating current at power frequency.

6.6.2 Heating Cycle Test

6.6.2.1 *General*

The heating-cycle test shall be carried out on an assembly of conductor(s) and fitting(s), assembled in accordance with the manufacturer's recommendations and heated by passing a current through the assembly. Assessment of the fitting is made by reference to measurements of resistance taken both before and after the heating cycle test and by visual examination of the opened fitting(s) after the test.

NOTE—Some fittings are intended to be used in groups of two or more. In such cases, the heating cycle test should be made on a complete assembly, as used in service. The test certificate should show clearly the arrangement used in the test.

6.6.2.2 *Test assembly*

The fitting shall be assembled in accordance with the manufacturer's recommendations on conductors of the size and type with which it is to be used. When measured from the outlet of the fitting, the length of each conductor shall be not less than 50 times the diameter of the conductor.

The assembly shall be erected indoor so that air may circulate freely around it. It shall not be exposed to draughts. The conductor(s) shall be approximately horizontal and tensioned by a force of approximately 2'5 percent of the breaking load.

NOTE—A space is considered draught-free if the conductor temperature is 75°C to 80°C above ambient temperature at the end of each heating period.

Current connections made to the conductors shall make effective contact with all those strands of the conductors which would be taken into account in calculating their equivalent resistances.

6.6.2.3 *Test current*

The test current shall be determined as follows:

a) Test current of fittings to which a rated current has been assigned
The test current for fittings to which a rated current has been assigned shall be rated current multiplied by $\sqrt{2}$. For tee fittings the test current shall be the rated currect multiplied by $11\sqrt{2}$ (1.55).

b) Test current for fitting to which no rated current has been assigned
The test current for fittings to which no rated current has been assigned, shall be that current which raised the surface temperature of the reference conductor connector 40°C above the ambient temperature and maintains that temperature at a steady level.

The reference conductor connector shall be that one of the conductors associated with the fitting in the test which reaches the highest temperature when carrying the same test current. The minimum length of conductor used for determining this current shall be 50 times the diameter of the conductor and the temperature shall be measured near the centre of this test length.

6.6.2.4 *Procedure*

The procedure shall be as follows:

a) Electrical resistance

i. *Method* — The resistance of the assembly shall be measured between points on the conductor either side or just clear of the fitting and this measurement recorded. The measurement may be made with direct current or with alternating current at any convenient frequency or by any other suitable means; and

ii. *Requirement* — The resistance measured shall not exceed 75 percent of the measured resistance of the equivalent length of conductor. For a tee fitting, this shall be the resistance of the equivalent length of the tee conductor.

b) Heating cycle

The test current(s) shall be passed through the assembly continuously for a period of 30 min.

The test current shall then be interrupted and the assembly allowed to cool to 5°C above the ambient temperature.

This sequence of operation shall be repeated for 250 cycles of heating and cooling. The fitting shall not be tightened or adjusted during the test; and

c) Fitting temperature

During the last five temperature cycles, the temperature of the fitting shall be measured while the test current is flowing.

6.6.2.5 *Requirement*

During the last five temperature cycles, the maximum temperature at any point on the surface of the fitting, shall not exceed that of the conductor, or for a tee fitting the conductor with the higher temperature. At the end of the test, the resistance shall be measured again as in **6.6.2.4** (a), and this resistance shall not exceed 130 percent of the initial value.

The fitting shall then be opened and there shall be no sign of local heating, burning or fusing of any part of the fitting or of the conductor.

6.6.3 *Short-Time Current Test*

6.6.3.1 *Test assembly*

Fitting(s) and conductors shall be assembled as specified in **6.6.2.2** and erected indoors with the conductors approximately horizontal.

6.6.3.2 *Procedure*

The short-time current shall be passed through the assembly using the conductors that are not continuous, for example for a tee fitting the current shall flow through the main conductor and the tee conductor.

The short-time current shall be maintained for a period of 2 seconds.

NOTE — See Annex A for calculation of short- time current rating.

6.6.3.3 *Requirement*

Following the test, the fitting shall be opened and there shall be no sign of local heating, burning or fusing of any part of the fitting or the conductor.

6.7 *Galvanizing Test*

Galvanized parts shall be tested in accordance with IS 2633: 1986 for uniformity, and IS 6745:1972 for weight of zinc coating, and shall meet the requirements of these standards.

ANNEX A

(Clause 6.6.3.3)

METHOD OF CALCULATING TEST CURRENT FOR SHORT-TIME CURRENT TEST (INITIAL CONDUCTOR TEMPERATURE 50°C)

A-1 To obtain the current in amperes multiply the appropriate cross-sectional area expressed in square millimeters of the conductor by the constant given in table 1. For homogenous conductors, the whole cress-sectional area should be used. For ACSR conductors only should be used.

Table 1 Conductor Type and Multiplier Constant

Sl. No.	Conductor Type	Multiplier Constant for Test Current
1.	**(1)**	**(2)**
2.	Hard-drawn copper	104
3.	SC/AC	70
4.	All aluminium AA	62
5.	All aluminium alloy AAA	61
6.	6/1 ACSR	64
7.	6/7 ACSR	64
8.	30/7 ACSR	65
9.	54/7 ACSR	62
10.	54/19 ACSR	62
11.	4/3 ACSR	64
12.	3/4 ACSR	61
13.	Steel SC/GZ	40

NOTE — The conductor cross-sectional area is calculated from the number of strands multiplied by the area of each wire, that is, it is not the equivalent aluminium area.