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IS 2121-3 (1992): Conductors and earth wire accessories for overhead power lines, Part 3: Accessories for earth wire [ETD 37: Conductors and Accessories for Overhead Lines]



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IS 2121 (Part 3) : 1992

भारतीय मानक

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(पहला पुनरीक्षण)

Indian Standard

CONDUCTORS AND EARTHWIRE ACCESSORIES
FOR OVERHEAD LINES

PART 3 ACCESSORIES FOR EARTHWIRE — SPECIFICATION

(*First Revision*)

UDC 621.316.992 : 621.315.1

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BUREAU OF INDIAN STANDARDS
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FOREWORD

This Indian Standard was 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.

Indian Standard Specification for fittings for aluminium and steel cored aluminium conductors for overhead lines, IS : 2121 was first published in 1962. This revision has been undertaken to upgrade many of the essential performance requirements for various types of accessories for conductors and earthwires used on overhead lines. The revised standard on conductors and earthwire accessories for overhead power lines covers various requirements in the following four parts:

IS 2121 (Part 1) : 1981 Armour rods, binding wires and tapes for conductors (*first revision*)

IS 2121 (Part 2) : 1981 Mid span joints and repair sleeves for conductors (*first revision*)

IS 2121 (Part 3) : 1992 Accessories for earthwire (*first revision*)

IS 2121 (Part 4) : 1992 Non—tension joints (*first revision*)

In the preparation of this Indian Standard, assistance has been derived from the following standards:

BS 3288 : Part 1 : 1983 Specification for insulator and conductor fittings for overhead power lines — Part 1 : Performance and general requirements. British Standards Institution.

AS 1154.1 : Part 1 : 1985 Insulator and conductor fittings for overhead power lines — Part 1 : Performance and general requirements. Standards Association of Australia.

*Indian Standard***CONDUCTORS AND EARTHWIRE ACCESSORIES
FOR OVERHEAD LINES****PART 3 ACCESSORIES FOR EARTHWIRE — SPECIFICATION***(First Revision)***1 SCOPE**

1.1 This standard covers the requirements for accessories for earthwire for use on overhead power lines and includes:

- a) earthwire suspension clamp assembly,
- b) earthwire tension clamp assembly,
- c) flexible copper bond for earthwire, and
- d) mid span compression joints for earthwire and repair sleeves.

1.2 Earthwire is a conductor which is earthed and which is normally situated above the phase conductors. They are normally used for transmission line voltages greater than or equal to 33 kV.

1.3 For the purpose of this Indian Standard the terms 'accessory' and 'fitting' have been interchangeably used.

2 REFERENCES

2.1 The following Indian Standards are necessary adjuncts to this standard :

<i>IS No.</i>	<i>Title</i>
2108 : 1977	Blackheart malleable iron castings (<i>first revision</i>)
2121 (Part 1) : 1981	Conductors and earthwire accessories for overhead power lines : Part 1 Armour rods, binding wires and tapes for conductors (<i>first revision</i>)
2121 (Part 2) : 1981	Conductors and earthwire accessories for overhead power lines : Part 2 Mid span joints and repair sleeves for conductors (<i>first revision</i>)
2500 (Part 1) : 1973	Sampling inspection tables : Part 1 Inspection by attributes and by count of defects (<i>first revision</i>)
2629 : 1985	Recommended practice for hot-dip galvanizing on iron and steel (<i>first revision</i>)
2633 : 1986	Methods of testing uniformity of coating on zinc coated articles (<i>second revision</i>)

IS No.

5358 : 1969

6745 : 1972

9567 : 1980

Title

Hot dip galvanized coatings on fasteners [Superseded by IS 1367 (Part 13) : 1982]

Methods for determination of weight of mass of zinc coating on zinc coated iron and steel articles

Tin or tin-lead coated copper wire

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 Anchor and Tension Fittings

Fittings capable of anchoring or joining earth wire.

3.2 Earthwire

A new current carrying conductor which is fully earthed or partly insulated and generally situated above the phase conductor.

3.3 Earthwire Fitting

Any component of an assembly for attaching an earthwire to a supporting structure other than a support fitting or anchor fitting.

4 GENERAL REQUIREMENTS**4.1 General**

4.1.1 The accessories shall be free from defects which would likely render them unsatisfactory in service.

4.1.2 Accessories which are attached to the earth wire, and shall be designed so that the effects of vibration, both on the conductor and the accessories itself, are minimized.

4.1.3 Accessories intended to connect earth wire of two dissimilar metals shall be designed to avoid harmful corrosion when erected in accordance with the manufacturer's recommendations.

4.2 Material

4.2.1 Earthwire fittings shall be made of any of the materials specified in 4.3 to 4.6 and shall comply with the requirements of the relevant Indian Standards.

4.3 Earthwire Suspension Clamp Assembly

Earthwire suspension clamp assembly is used to support the earthwire at suspension towers. It shall be of free-centre type made of malleable cast iron conforming to IS 2108 : 1977. The keeper and the clamp body are clamped together by two inverted type U-bolts. One limb of one U-bolt is made long enough to accommodate the lug of the flexible copper bond. Standard shackles with orientations as per the customers requirements, are supplied along with the suspension clamp for attaching to the tower hanger plate.

The complete assembly shall have a slip strength of not less than 18 percent and not more than 25 percent of UTS of the earthwire.

NOTES

1 The customer must specify the orientation of eyehooks from either of the followings:

- a) Orientation A : Opening of hook perpendicular to the clamp.
- b) Orientation B : Opening of hook parallel to the clamp.

2 Normally U-bolts are not included in suspension clamps and, if required by the customer, these should be specifically mentioned.

4.4 Earthwire Tension Clamp Assembly

Compression type tension clamps are used to hold the earthwire of tension towers. The clamps (along with jumper tube and plates) shall be made of mild steel which is hot dip galvanized or encased in aluminium sleeve made of 99.5 percent purity aluminium. In the later design, filler aluminium sleeves are also provided at the end of the steel sleeve and at the jumper location.

The slip strength of the tension clamp shall not be less than 95 percent of the UTS of the earthwire. The resistance of the earthwire fitted with the tension clamp assembly shall not exceed 75 percent of the measured resistance of the equivalent length of the earthwire. The compression type earthwire clamp shall have necessary provision for attaching flexible earthing bond.

4.5 Flexible Copper Bond

The flexible copper bond serves as the earthing bond for which provisions are made in the earthwire, suspension and tension clamps for attaching with the tower.

The flexible copper bond shall have a circular cross section.

It shall be laid up as 7 stranded ropes, each rope consisting of a bunch of tinned copper wires. The tinning shall be as per IS 9567 : 1980. Two tinned copper lugs, each suitable for taking a mild steel dip-galvanized bolt, shall be press jointed to either end of the copper cable. The complete assembly also includes one extra mild steel bolt, hot-dip galvanized along with nut and lock washer. Dimensional details of the flexible copper bond and related accessories shall be as specified in Table 1.

4.6 Mid Span Compression Joint for Earthwire

Mid span compression joints, used for joining two lengths of earthwire shall be made of mild steel which shall be either hot dip galvanized or shall be provided with aluminium sleeve. In the later design, filler aluminium sleeves shall be provided at both ends of the steel sleeve. The aluminium shall be of at least 99.5 percent purity.

The slip strength of the compression joint shall not be less than 95 percent of the UTS of the earthwire. The resistance of the earthwire fitted with the mid span compression joint shall not exceed 75 percent of the measured resistance of the equivalent length of the earthwire.

4.7 Marking

4.7.1 Each earthwire accessory shall be indelibly marked with the following information:

- a) Indicating the source of manufacture,
- b) Minimum failing load,
- c) Material,
- d) Year of manufacture, and
- e) Country of manufacture.

4.7.2 The accessories for earthwire may also be marked with the Standard Mark.

5 TESTS

5.1 Classification of Tests

5.1.1 Type Tests (see Table 2)

5.1.2 Acceptance Tests (see Table 3)

5.1.3 Routine Test

The following shall constitute the routine test:

- a) Visual examination (see 5.2).

5.1.4 Sampling Plan and Criteria for Acceptance

5.1.4.1 Lot

In a consignment all the earthwire accessories manufactured from the same material under similar conditions of production shall be grouped together to constitute a lot.

5.1.4.2 Sample size and criteria for conformity

Unless otherwise agreed to between the supplier and the purchaser, the procedure given in IS 2500 (Part 1) : 1973 shall be followed for sampling inspection for this purpose, a single sampling plan with inspection level IV and AQL of 2.5 percent as given in Tables 1 and 2 of IS 2500 (Part 1) : 1973 shall be followed for all the acceptance tests.

5.2 Visual Examination and Dimensional Verification

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

Table 1 Dimensional Details of Flexible Copper Bond and Related Accessories
(Clause 4.5)

No. of Tinned Copper Wire per Rope	Dia of Tinned Copper Wires	Overall Dimensions of Circular Copper Bond Consisting of 7 Stranded-Ropes		Diameters of Bolts for Copper Connecting Lugs		Dimensions of the Extra Bolt		Minimum Slip Strength of Copper Bond
		Equivalent Copper Area, Min	Length Min	Dia	Dia	Dia	Length	
(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(J)
(1)	mm	sq mm	mm	mm	mm	mm	mm	kN
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
37	0.417	35	500	12	16	16	40	30

Table 2 Type Tests
(Clause 5.1.1)

Sl No.	Test	Clause Reference of Test for				
		Earthwire Suspension Clamp Assembly	Earthwire Tension Clamp Assembly	Flexible Copper Bond	Mid Span Joint	Compression Joint
1.	Visual examination and dimensional verification	5.2	5.2	5.2		5.2
2.	Electrical resistance test	*	5.3	*		5.3
3.	Slip strength test	5.4	*	5.4		5.4
4.	Mechanical strength test	5.5	5.5	*		*
5.	Chemical composition test	5.8	5.8	5.8		5.8
6.	Galvanizing test	5.7	5.7	5.7		5.7

* Test not applicable

Table 3 Acceptance Tests
(Clause 5.1.2)

Sl No.	Test	Clause Reference of Test for				
		Earthwire Suspension Clamp Assembly	Earthwire Tension Clamp Assembly	Flexible Copper Bond	Mid Span Joint	Compression Joint
1.	Visual examination and dimensional verification	5.2	5.2	5.2		5.2
2.	Chemical composition test	5.8	5.8	5.8		5.8
3.	Mechanical strength test	5.5	5.5	*		*
4.	Galvanizing Test	5.7	5.7	*		5.7

* Test not applicable

The dimensions shall be checked as per the approved drawings.

5.3 Electrical Resistance Test

5.3.1 The measurement of resistance shall be carried out to an accuracy of one part in thousand by means of a suitable method of test.

5.3.2 The test may be carried out with dc or ac at any convenient power frequency. The electrical connections shall be so made that effective contact is made with all those strands of the earthwire which would be taken into account in calculating its equivalent resistance.

5.3.3 The electrical resistance shall be measured between points on the earthwire on either side and

just near to the fitting and shall not exceed 75 percent of the measured resistance of the equivalent length of the earthwire.

5.4 Slip Strength Test for Clamps

a) **Suspension Clamp** — The suspension clamp shall be vertically suspended by means of some flexible attachment. A suitable length of the specified earth wire shall be fixed in the clamp with bolts and nuts tightened with the specified torque. A load shall then, be gradually applied at one end of the earthwire and the value of the load of which the earthwire clamp begins to slip shall be noted. The earthwire should not slip at a load less than the maximum working tension to be specified by the customer.

b) Tension Clamps — Tension clamp shall be held by means of some suitable attachment. A suitable length of the earthwire shall be fixed in the clamp with bolts and nuts tightened with the specified torque suitably or compressed in compression clamps. A tensile load of about 50 percent of the breaking load of the earthwire shall be applied and the earthwire shall be marked in such a manner that the movement relative to the clamp can easily be detected. Without any subsequent adjustment of the clamp, the load shall be specially increased to 95 percent of the breaking load of the earthwire and then reduced to 90 percent of the breaking load and maintained for one minute. There shall be no movement of the conductor relative to the clamp during this one minute period and no failure of clamp.

c) Earthing Bond

On applying a pull of 300 kg between the two ends of the bond the stranded cable shall not come out of the connecting lugs and none of its strands shall be damaged. After the test, the lugs shall be cut open to ascertain that gripping of cable has not affected.

The earthwire fitting shall be assembled on earthwire of the size and type with which it is to be used in accordance with the manufacturer's recommendations.

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 earthwire. A tensile force of about 50 percent of the specified breaking load shall be applied to the earthwire and the earthwire shall be marked in such a way that any movement relative to the fitting may be detected. Without any subsequent adjustment of the fitting, the load shall be steadily increased to 95 percent of the specified breaking load and maintained for one minutes. There shall be no movement of the earthwire relative to the fitting during this one minute period and no failure of the fitting also.

5.5 Mechanical Strength Test

Each earthwire fitting shall be held in a tensile testing machine in a manner approximating as nearly as possible the arrangement to be used in service.

A tensile force equal to 50 percent of the specified minimum failing load shall be applied and maintained for 1 min. The force shall then be removed and the fitting examined for signs of permanent distortion. There shall be no permanent distortion.

The assembly shall then be reassembled and loaded to 50 percent of UTS and the load shall be further increased at a steady rate until failure occurs. The eventual failure shall be of a ductile nature and shall occur at a load not less than the specified minimum failing load.

The load shall then be re-applied and increased at a steady rate until failure occurs. The eventual failure shall be of a ductile nature and shall occur at a load not less than the specified minimum failing load.

In the event of failure occurring in the test rig at a load above the specified minimum failing load, elongation of the test fitting shall be such as shall indicate that it is manufactured from a ductile material.

5.6 Hardness Test

Where specified by the purchaser, the Brinell hardness value of the fittings shall be measured 2 mm under the galvanized surface in an area which has not been unduly stressed and where the thickness before such stressing is not less than 10 mm.

5.7 Galvanizing Test

Galvanized parts shall be tested in accordance with IS 2633 : 1982 for uniformity and IS 6745 : 1972 for weight of zinc coating, and shall comply with the requirements of these standards. Galvanization of ferrous material shall conform to the relevant standards.

5.8 Chemical Composition Test

The chemical composition of the material shall be tested in accordance with the relevant specification. In case of castings, the test shall be done on test bar as well as on the sample fitting. Material shall conform to the requirement specified in the relevant specification. In case of fittings which are not castings, the test shall be co-ordinated on the sample fittings.

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