SECTION-V

SECTION-V

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TECHNICAL SPECIFICATION
(SECTION-V)

1.0 Galvanised Steel Earth wire

1.1 Details of Earth wire

1.1.1 The galvanised steel earth wire shall generally conform to the specification of ACSR core wire as mentioned in IEC:60888/ IS:398 (Part-II)-1976/ **IS:12776** except where otherwise specified herein.

1.1.2 Standard Technical Particulars

The standard Technical Particulars (STP) of Earthwire is enclosed at Annexure-A of this section. The values indicated in the STP are the minimum and/or maximum values required to be met by the supplier.

1.2 Workmanship

1.2.1 All steel strands shall be smooth, uniform and free from all imperfections, such as spills and splits, die marks, scratches, abrasions and kinks after drawing and also after stranding.

1.2.2 The finished material shall have minimum brittleness as it will be subjected to appreciable vibration while in use.

1.2.3 The steel strands shall be hot dip galvanized and shall have minimum Zinc coating after stranding, as stipulated in Standard Technical Particulars attached with. The zinc coating shall be smooth, continuous, of uniform thickness, free from imperfections. The steel wire rod shall be of such quality and purity that, when drawn to the size of the strands specified and coated with zinc, the finished strands shall be of uniform quality and have the same properties and characteristics as prescribed in ASTM designation B498-M.

1.2.4 The steel strands shall be preformed and post formed in order to prevent spreading of strands while cutting of composite earth wire. Care shall be taken to avoid damage to galvanization during performing and post forming operation.

1.2.5 To avoid susceptibility towards wet storage stains (white rust), the finished material shall be provided with a protective coating of boiled linseed oil.

1.3 Joints in Wires

There shall be no joint of any kind in the finished steel wire strand entering into the manufacture of the earth wire. There shall be no strand joints or strand splices in any length of the completed stranded earth wire.

1.4 Tolerances

The manufacturing tolerance to the extent of the limits as stipulated in Standard Technical Particulars attached with this specification shall only be permitted in the diameter of the individual steel strands and lay length of the earth wire:

1.5 Materials

1.5.1 Steel

The steel wire strands shall be drawn from high carbon steel rods and the chemical composition shall conform to the requirements as stipulated in Standard Technical Particulars attached with.

1.5.2 Zinc

The zinc used for galvanising shall be electrolytic High Grade Zinc and shall conform to the requirements of IS:209.

1.6 Standard Length

1.6.1 The standard length of the earth wire shall be as stipulated in Standard Technical Particulars attached with, with the specified tolerance on standard length.

1.6.2 Random length will be accepted provided no length is less than 70% of standard length and the total quantity of random lengths is not more than ten (10) percent of the total quantity in each shipment.

2.0 Tests and Standards

2.1 Type Tests on Earthwire

The following tests shall be conducted on a sample / samples of earthwire required under the package from each stranding machine from which the earthwire is to be manufactured & supplied:

a) UTS test : As per Annexure - B

b) DC resistance test : As per Annexure - B

2.1.1 Type tests specified under Clause 2.1 shall not be required to be carried out if supplier has conducted these tests earlier on the same type of earthwire and

valid type test certificates are available. The test certificate shall be considered valid if,

i) Tests conducted earlier is either conducted in accredited laboratory (accredited based on ISO/IEC vide 25/17025 or EN 45001 by the National accreditation body of the country where laboratory is located) or witnessed by the representative(s) of POWERGRID or utility and

ii) Tests conducted on the samples of earthwire manufactured from same stranding machine within 3 (three) years prior to the date of commencement of manufacturing for the package. However, the manufacturing of the earthwire for the package can be carried till 3 (three) years from the date of type testing.

In case the tests have been conducted earlier than the above stipulated period or carried out on another stranding machine or in the event of any discrepancy in the test report (i.e., any test not applicable due to any design/manufacturing change including substitution of components or due to non-compliance with the requirement stipulated in the Technical Specifications), the tests shall be conducted by the supplier at no extra cost to the purchaser. Also, in case, manufacturing (scheduled/actual) is beyond the 3 (three) years from the date of type testing, supplier has to repeat the above type tests at no extra cost to the purchaser.

2.2 Acceptance Tests on Earthwire

a)	Visual and dimensional check on drum	: As per Annexure - **B**
b)	Visual check for joints scratches etc. and lengths of earthwire	: As per Annexure - **B**
c)	Dimensional check	: As per Annexure - **B**
d)	Lay length check	: As per Annexure - **B**
e)	Galvanising test	: As per Annexure - **B**
f)	Torsion test	: As per Annexure - **B**
g)	Elongation test	: As per IS:398 (Part-II)
h)	Wrap test	: As per IS:398 (Part-II)

	i)	DC resistance test	: As per IS:398 (Part-II)
	j)	Breaking load test	: As per IS:398 (Part-II)
	k)	Chemical Analysis of steel	: As per Annexure - **B**

2.3 Routine Tests on Earthwire

	a)	Check for correctness of stranding	: As per Annexure - **B**
	b)	Check that there are no cuts, fins etc. on the strands.	: As per Annexure - **B**
	c)	Check that drums are as per Specification.	: As per Annexure - **B**

2.4 Tests During Manufacture Earthwire

	a)	Chemical analysis of zinc used for galvanising	: As per Annexure - **B**
	b)	Chemical analysis of steel	: As per Annexure - **B**

2.5 Testing Expenses

2.5.1 In the event of type testing, bidders shall indicate the laboratories in which they propose to conduct the type tests. They shall ensure that the tests can be completed in these laboratories within the time schedule.

2.5.2 In case of failure in any type test the Contractor is either required to manufacture fresh sample lot and repeat the entire test successfully once or repeat that particular type test three times successfully on the sample selected from the already manufactured lot at his own expenses. In case fresh lot is manufactured for testing then the lot already manufactured shall be rejected. The decision of the Employer in this regard shall be final and binding on Contractor.

2.5.3 The entire cost of testing for the type**,** acceptance and routine tests and tests during manufacture specified herein shall be treated as included in the quoted unit price except for the expenses of the inspector/ Employer's representative.

2.5.4 In case of failure in any type test, repeat type tests are required to be conducted, then all the expenses for deputation of Inspector/ Employer

representative shall be to the supplier's account. Also , if on receipt of the Contract's notice of testing the Employer's representative/Inspector does not find the test samples or testing facilities/equipments ready for testing, the expenses incurred by the Employer for re-deputation shall be to the supplier's account.

2.6 Additional Tests

2.6.1 The Employer reserves the right of having at his own expenses any other test(s) of reasonable nature carried out at Contractor's premises, at site, or in any other place in addition to the aforesaid type, acceptance and routine tests to satisfy himself that the materials comply with the Specifications.

2.6.2 The Employer also reserves the right to conduct all the tests mentioned in this specification at his own expense on the samples drawn from the site at Contractor's premises or at any other test center. In case of evidence of non compliance, it shall be binding on the part of Contractor to prove the compliance of the items to the technical specifications by repeat tests, or correction of deficiencies, or replacement of defective item all without any extra cost to the Employer.

2.7 Sample Batch For Type Testing

2.7.1 In case the type tests are required to be carried out, the samples for type testing shall be manufactured in accordance with the Standard Manufacturing Quality Plan.

2.7.2 The Contractor shall offer at least three drums for selection of sample required for conducting all the type test.

2.7.3 The Contractor is required to carry out all the Acceptance tests successfully in presence of Employer's representative before sample selection.

2.8 Test Reports

2.8.1 In case type tests have been carried out earlier by the supplier and valid type test reports are available as specified in clause 2.1.1 above, the supplier shall submit one copy of the test report along with approval letter issued by POWERGRID or utility.

2.8.2 In case fresh type tests have been carried out under the package, type test reports shall be furnished in original alongwith two copies. One copy will be returned duly certified by the Employer.

2.8.3 The commercial production of the earthwire can be taken up by the supplier after clearance from the purchaser.

2.8.4 Record of routine test reports shall be maintained by the Contractor at his works for periodic inspection by the Employer's representative.

2.8.5 Test Certificates of tests during manufacture shall be maintained by the Contractor. These shall be produced for verification as and when desired by the Employer.

2.9 Inspection

2.9.1 The Employer 's representative shall at all times be entitled to have access to the works and all places of manufacture, where earth wire shall be manufactured and representative shall have full facilities for unrestricted inspection of the Contractor's works, raw materials and process of manufacture for conducting necessary tests as detailed herein.

2.9.2 The Contractor shall keep the Employer informed in advance of the time of starting and of the progress of manufacture of earth wire in its various stages so that arrangements can be made for inspection.

2.9.3 No material shall be dispatched from its point of manufacture before it has been satisfactorily inspected and tested, unless the inspection is waived off by the Employer in writing. In the latter case also the earth wire shall be dispatched only after satisfactory testing for all tests specified herein have been completed.

2.9.4 The acceptance of any quantity of material shall in no way absolve the Contractor of any of his responsibilities for meeting all requirements of the Specification, and shall not prevent subsequent rejection if such material is later found to be defective.

2.10 Test Facilities

2.10.1 The following test facilities shall be available at the Contractor's works:

a) Various testing and measuring equipment for carrying out specified acceptance tests, routine tests and tests during manufacture inter alia including tensile testing machine, resistance measurement facilities, torsion & wrap testing machine, dimension checking instruments viz. digital vernier and micrometer etc., galvanizing test instruments viz. digital elcometer and standard preece test etc., burette, digital thermometer, barometer etc.
b) Digital milli/micro ohm meter along with standard resistance for calibration of resistance bridges.
c) Finished Earth wire shall be checked for length verification and surface finish on separate rewinding machine at reduced speed (variable from 8

to 16 meters per minute). The rewinding facilities shall have appropriate clutch system and free of vibrations, jerks etc., with traverse laying facilities.

2.11 Packing for Earth wire

2.11.1 The Earth wire shall be supplied in non-returnable, strong, wooden drums and provided with lagging of adequate strength, constructed to protect the Earth wire against all damage and displacement during transit, storage and subsequent handling and stringing operations in the field. The Contractor shall be responsible for any loss or damage during transportation handling and storage due to improper packing. The drums shall generally conform to IS:1778-1980, except as otherwise specified hereinafter.

2.11.2 The drums shall be suitable for wheel mounting and for letting off the earth wire under a minimum controlled tension of the order of 5 kN

2.11.3 The standard drawing of the drum for earthwire is enclosed with the specification. The Bidder shall supply the earthwire in the drum conforming to the specification drawing.

2.11.4 For Earth wire, two standard lengths shall be wound on each drum.

2.11.5 For Earth wire, each strand shall be individually welded to prevent parting of two lengths at a tension less than 15 kN. The two ends where the first length finishes and the second length starts, shall be clearly marked with adhesive tape and no weld should be present outside these marks. The length between the two marks shall be treated as scrap and will not be taken into account for measurement purposes.

2.11.6 All wooden components shall be free from defects that may materially weaken the component parts of the drums. Preservative treatment shall be applied to the entire drum with preservatives of a quality which is not harmful to the earth wire.

2.11.7 As an alternative to non-returnable wooden drums, bidder may supply the earthwire in returnable steel drum. However, for bid evaluation purpose, both types of drums shall be treated at par and bidder may quote accordingly.

2.11.8 The empty steel drums shall be taken back by the contractor/ supplier as & when these are available after usage of earthwire. However, 2% of the total drums shall not be returned to the contractor/ supplier as these may be used for storage of spare earthwire by the purchaser.

2.11.9 The steel drums may get damaged and/or wear & tear during transportation, normal handling & operation at site, which shall be rectified by the supplier before re-use.

2.11.10 Solid Polypropylene sheet of minimum 5mm thickness shall be used for outer covering of earthwire in steel drum. Outside the covering, there shall be minimum two binders consisting of hoop iron/ galvanised steel wire. Two numbers of additional binders per drum shall also be supplied for re-wrapping the polypropylene sheet with each lot of earthwire and 5 nos. crimping machines with the first lot of earthwire for crimping the binders at site. As an alternative, supplier may use wooden lagging of minimum 50 mm thickness for outer covering of earthwire without any extra financial implication to the purchaser.

2.11.11 Before reeling, cardboard or double corrugated or thick bituminous waterproof bamboo paper shall be secured to the drum barrel and inside of flanges of the drum by means of a suitable commercial adhesive material over which HDPE sheet to be provided. After reeling the earth wire, the exposed surface of the outer layer of earth wire shall be wrapped with self-adhesive plastic sheet to preserve the earth wire from ingress of water dirt, grit and damage during storage transport and handling.

2.11.12 The earth wire ends shall be properly sealed and secured on the side of one of the flanges to avoid loosening of the earth wire layers during transit and handling.

2.12 Marking

Each drum shall have the following information stenciled on it in indelible ink along with other essential data

a) Contract/Award letter number.
b) Name and address of consignee.
c) Manufacturer's name and address.
d) Drum number
e) Size of earth wire
f) Length of earth wire in meters
g) Gross weight of drum with earth wire & lagging
h) Weight of empty drum with lagging
i) Arrow marking for unwinding
j) Position of the earth wire ends
k) Number of turns in the outer most layer
l) Barrel diameter at three locations and an arrow marking at the location of measurement
m) CIP/MICC No.

2.13 Verification of Earth wire Length

The Employer reserves the right to verify the length of earth wire after unreeling. The quantity for verification shall be between a minimum of five percent (5%) to a maximum of ten percent (10%) in a lot offered for inspection. The actual quantity will be discussed and mutually agreed to by the supplier & purchaser.

2.14 Standards

The earth wire shall conform to the following Indian/ International Standards, which shall mean latest revisions, amendments/changes adopted and published, unless otherwise in the Specification.

In the event of the supply of earth wire conforming to standards other than specified, the Contractor shall confirm in his bid that these standards are equivalent to those specified. In case of award salient features of comparison between the standards proposed by the Contractor and those specified in these documents will be provided by the Contractor to establish their equivalence.

Sl. No.	Indian Standard	Title	International Standard
1.	IS: 209-1992	Specification for zinc	BS:3436-1986
2.	IS: 398-1990	Specification for Aluminium Conductors for Overhead Transmission Purposes	IEC:1089-1991 BS:215-1970
3.	IS:398-1998 Part-II	Aluminum Conductor Galvanised Steel Reinforced	BS;215-1970 IEC:1089-1991
4.	IS :398-1996 Part-IV	Aluminum Alloy stranded conductor	BS-3242-1970 ASTM-8399 M86 IEC:1089-1991
5.	IS:398-1992 Part-V	Aluminum Conductor Galvanised Steel- Reinforced For Extra High Voltage (400 KV) and above	IEC:1089-1991 BS:215-1970
6.	IS : 1778-1997	Reels and Drums for Bare Conductors	BS:1559-1949
7.	IS : 1521-1991	Method of Tensile Testing of Steel Wire	ISO 6892-1984
8.	IS : 2629-1990	Recommended Practice for Hot Dip Galvanising of Iron and Steel	
9.	IS : 2633-1992	Method of Testing Uniformity of Coating on Zinc Coated Articles	

10.	IS : 4826-1992	Galvanised Coating on Round Steel Wires	IEC : 888-1987 BS:443-1969
11.	IS : 6745-1991	Methods of Determination of Weight of Zinc Coating of Zinc Coated Iron and Steel Articles	BS:433-1969 ISO 1460 - 1973
12.	IS : 8263-1991	Method of Radio Interference Tests on High Voltage Insulators	IEC:437-1973 NEMA:107-1964 CISPR
13.	IS : 9997-1991	Aluminium Alloy Redraw Rods	IEC 104 - 1987
14.		Zinc Coated steel wires for stranded Conductors	IEC : 888-1987
15.		Hard drawn Aluminium wire for overhead line conductors	IEC : 889-1987

The standards mentioned above are available from:

Reference Abbreviation	**Name and Address**
BS	British Standards, British Standards Institution 101, Pentonvile Road, N - 19-ND UK
IEC/CISPR	International Electro technical Commission, Bureau Central de la Commission, electro Technique international, 1 Rue de verembe, Geneva SWITZERLAND
BIS/IS	Beureau Of Indian Standards. Manak Bhavan, 9, Bahadur Shah Zafar Marg, New Delhi - 110001. INDIA
ISO	International Organisation for Standardization. Danish Board of Standardization Danish Standardizing Sraat, Aurehoegvej-12 DK-2900, Heeleprup, DENMARK.

NEMA	National Electric Manufacture Association, 155, East 44th Street. New York, NY 10017 U.S.A.

3.0 Manufacturing Quality Plan

Earthwire manufacturing shall be carried out in accordance with Standardized Manufacturing Quality plan as given in the Appendix -I of this section.

ANEXURE-A

Sl. no.	Description	Unit	7/3.15 mm GS Earth wire	7/3.66 mm GS Earth wire
1.0	Raw Materials			
1.1	Steel wires / rods			
a)	Carbon	%	Not more than 0.55	Not more than 0.55
b)	Manganese	%	0.40 to 0.90	0.40 to 0.90
c)	Phosphorous	%	Not more than 0.04	Not more than 0.04
d)	Sulphur	%	Not more than 0.04	Not more than 0.04
e)	Silicon	%	0.15 to 0.35	0.15 to 0.35
1.2	Zinc			
a)	Minimum purity of Zinc	%	99.95	99.95
2.0	Steel strands			
2.1	Diameter			
a)	Nominal	mm	3.15	3.66
b)	Maximum	mm	3.20	3.74
c)	Minimum	mm	3.10	3.58
2.2.	Minimum breaking load of strand			
a)	After stranding	KN	8.55	10.58
2.3	Galvanising			
a)	Minimum weight of zinc coating per sq.m. after stranding	Gms.	275	275
b)	Minimum number of dips that the galvanized strand can withstand in the standard preece test	Nos.	3 dips of 1 minute and one dip of ½ minute	3 dips of 1 minute and one dip of ½ minute
c)	Minimum number of twists in a gauge length equal to 100 times diameter of wire which the strand can withstand in the torsion test, after stranding	Nos.	18	18
3.0	Stranded Earth wire			
3.1	UTS of Earth wire	KN	56 (min.)	68 (min.)
3.2	Lay length of outer steel layer			
a)	Standard	mm	160	181

b)	Maximum	mm	175	198
c)	Minimum	mm	145	165
3.3	Maximum DC resistance of earth wire at 20^0 C	Ohm/km	3.375	2.5
3.4	Standard length of earth wire	M	~~2000~~ **2300**	2000
3.5	Tolerance on standard length	%	±5	±5
3.6	Direction of lay for outside layer		Right hand	Right hand
3.7	Linear mass			
a)	Standard	Kg/km	428	583
b)	Maximum	Kg/km	441	600
c)	Minimum	Kg/km	414	552

ANEXURE-B

1.0 Tests on Earth wire

1.1 UTS Test

Circles perpendicular to the axis of the earth wire shall be marked at two places on a sample of earth wire of minimum 5 m length suitably compressed with dead end clamps at either end. The load shall be increased at a steady rate up to 50% of UTS and held for one minute. The circles drawn shall not be distorted due to relative movement of strands. Thereafter the load shall be increased at steady rate to 100% of UTS and held for one minute. The earth wire sample shall not fail during this period. The applied load shall then be increased until the failing load is reached and the value recorded.

1.2 D.C. Resistance Test

On a earth wire sample of minimum 5m length two contact clamps shall be fixed with a predetermined bolt torque. The resistance shall be measured by a Kelvin double bridge by placing the clamps initially at zero meter and subsequently one meter apart. The test shall be repeated at least five times and the average value recorded. The value obtained shall be corrected to the value at 20°C. The resistance corrected at 20°C shall conform to the requirements of this Specification.

1.3 Chemical Analysis of Zinc

Samples taken from the zinc ingots shall be chemically/ spectrographically analysed. The same shall be in conformity to the requirements stated in the Specification.

1.4 Chemical Analysis of Steel

Samples taken from the steel ingots/coils/strands shall be chemically/ spectrographically analysed. The same shall be in conformity to the requirements stated in this Specification.

1.5 Visual and Dimensional Check on Drums and its barrel strength test.

The drums shall be visually and dimensionally checked to ensure that they conform to the requirements of this Specification. The details regarding barrel strength test will be discussed and mutually agreed to by Contractor and Employer in the quality assurance programme.

1.6 Visual Check for Joints, Scratches etc. and Length of Earth wire

Ten percent drums from each lot shall be rewound in the presence of the Employer. The Employer shall visually check for scratches, joints etc. and see that the earth wire generally conforms to the requirements of this Specification. The length of earth wire wound on the drum shall be measured with the help of counter meter during rewinding.

1.7 Dimensional Check

The individual strands shall be dimensionally checked to ensure that they conform to the requirement of this Specification.

1.8 Lay Length Check

The lay length shall be checked to ensure that they conform to the requirements of this Specification.

1.9 Galvanising Test

The test procedure shall be as specified in IS:4826- 1979. The material shall conform to the requirements of this Specification. The adherence of zinc shall be checked by wrapping around a mandrel four times the diameter of steel wire.

1.10 Torsion Test

The minimum number of twists which a single steel strand shall withstand during torsion test shall be eighteen for a length equal to 100 times the standard diameter of the strand. In case test sample length is less or more than 100 times the stranded diameter of the strand the minimum number of twists will be proportioned to the length and if number comes in the fraction then it will be rounded off to next higher whole number.