TECHNICAL SPECIFICATIONS

“For the transformer repairing materials, materials for maintenance of distribution substation, 3 and ½ core L.T XLPE un-armoured aluminum cables and 11KV XLPE insulated PVC sheated ACSR rabbit conductor required for operation & maintenance of MSPDCL”
1. SCOPE:

This specification covers the manufacture, testing, supply and delivery of the following material:
- Super Enameled Aluminium winding with medium covering type-1
- Double paper covered annealed Aluminium winding wire with ordinary paper covering.

The material is required for use in repair of Transformers.

2. STANDARD:

As regards materials design, manufacture and testing etc. they will strictly comply with requirements of the IS standards as mentioned hereunder:

<table>
<thead>
<tr>
<th>SI No.</th>
<th>Material</th>
<th>IS No. with latest edition/amendments, if any</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.</td>
<td>Super Enameled Aluminium Winding Wire</td>
<td>IS:13778-1993</td>
</tr>
<tr>
<td>II.</td>
<td>D.P.C. Aluminium Winding Wire</td>
<td>6162 (Part-I)-1980 &amp; 4026-1968</td>
</tr>
</tbody>
</table>

The various application ISS referred in the specification shall be of the latest edition and amendments, if any.

The material bearing ISI certification mark may, however, be preferred.

3. CLIMATE CONDITIONS:

The material to be supplied against this specification shall be suitable for satisfactory operation under the following climate conditions

<table>
<thead>
<tr>
<th>SI No.</th>
<th>Location</th>
<th>At various Locations in the State of Orissa</th>
</tr>
</thead>
<tbody>
<tr>
<td>i.</td>
<td>Maximum ambient temperature (°C)</td>
<td>60</td>
</tr>
<tr>
<td>ii.</td>
<td>Minimum ambient air temperature(°C)</td>
<td>-5</td>
</tr>
</tbody>
</table>
iii. Maximum average daily ambient temperature (°C)  
iv. Maximum yearly weighed average ambient temperature (°C)  
v. Maximum altitude above mean sea level (m)  
vi. Minimum Relative Humidity (%)  
vii. Maximum Relative Humidity (%)  
viii. Average no of Rainy days/year  
ix. Average annual rain fall  
x. Maximum wind pressure

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>iii</td>
<td>Maximum average daily ambient temperature (°C)</td>
<td>40</td>
</tr>
<tr>
<td>iv</td>
<td>Maximum yearly weighed average ambient temperature (°C)</td>
<td>32</td>
</tr>
<tr>
<td>v</td>
<td>Maximum altitude above mean sea level (m)</td>
<td>1000</td>
</tr>
<tr>
<td>vi</td>
<td>Minimum Relative Humidity (%)</td>
<td>26</td>
</tr>
<tr>
<td>vii</td>
<td>Maximum Relative Humidity (%)</td>
<td>95</td>
</tr>
<tr>
<td>viii</td>
<td>Average no of Rainy days/year</td>
<td>120</td>
</tr>
<tr>
<td>ix</td>
<td>Average annual rain fall</td>
<td>900 mm</td>
</tr>
<tr>
<td>x</td>
<td>Maximum wind pressure</td>
<td>195 kg/m sq.</td>
</tr>
</tbody>
</table>

The material shall be for use in moderately hot and humid tropical climate conducive to rust and fungus growth.

4. TECHNICAL PARTICULARS:

The technical particulars of the material will be as below:

**4.1 SUPER ENAMELED (SE) ALUMINIUM WINDING WIRE**

4.1.1 CONDUCTORS:

The conductor shall be electrolytic high conductivity annealed Aluminium, strictly

4.1.1.1 RESISTANCE:

The resistance at 20°C of annealed conductor if one meter in length and of uniform cross sectional area of one square millimeter shall be taken as 0.0280 ohm.

4.1.1.2 DENSITY:

The density of annealed Aluminium at temperature of 20°C shall be taken as 2.703 g/cm³.

4.1.1.3 COEFFICIENT OF LINEAR EXPANSION:

The coefficient of linear expansion of annealed Aluminium at a temperature of 20°C shall be taken as 23 x 10⁻⁶ per degree Celsius.

4.1.1.4 CONSTANT MASS TEMPERATURE COEFFICIENT OF RESISTANCE:
At a temperature of 20°C the constant mass temperature coefficient of resistance of annealed Aluminium measures between two potential points rigidly fixed to the conductor, the metal being allowed to expand freely, be taken as 0.04 per degree Celsius.

Note: for any temperature „to” above 0°C, the temperature, coefficient resistance is:

\[
\frac{1}{230 + to}
\]

4.1.2 ENAMEL:

The conductor shall be completely and uniformly covered with durable flexible and synthetic enamel. The enamel should have a smooth surface free from embedded particulars of dust and other deleterious materials.

The modified polyesters type insulating varnished used for enameling of wire shall be enamel Terbec 101.36 manufactured by Dr. Beck & Co. Mumbai, or M/s Micro Links Ltd, Daman or M/s Herman Bawa (P) Ltd, New Delhi or any other reputed Firm.

4.1.3 DIAMETERS:

4.1.3.1 MAXIMUM OVERALL DIAMETER:

The maximum overall diameter shall not exceed the value given in table-I of IS: 13778. For intermediate nominal conductor diameter, the minimum increase in diameter for the next higher standard size shall be applicable.

4.1.3.2 TOLERANCE OF CONDUCTOR DIAMETER

(For all nominal diameter of conductor)

The conductor diameter shall not differ from nominal diameter by more than the limits given in Table-I of IS: 13778.

4.1.3.3 OUT OF ROUNDNESS OF CONDUCTOR:

(For all nominal diameter of conductor)

The out of roundness shall not be more than 50 percent of the total value for tolerance given in Table-I of IS: 13778 (Para-I).

4.1.4 RESISTANCE (FOR ALL NOMINAL DIAMETER OF CONDUCTOR):

The resistance at 20°C shall be within the limits given in Table-I of IS: 13778 (Para-I). For sizes higher than 1.00 mm, the limits shall be calculated from nominal values. Similarly for intermediate sizes, the corresponding value shall be calculated from next higher standard size.
4.1.5 ELONGATION:

The elongation at fracture shall be not less than the value in Table-I of IS: 13778 (Para-II). For intermediate sizes, the value for the next higher standard size shall be applicable.

4.1.6 FREEDOM FROM DEFECTS:

The conductor shall be finished clean a smooth and shall substantially free from silvers, spills, cracks & other defects.

4.1.7 TESTING:

Material will be tested in accordance with provision of IS:

   i. Maximum overall diameter of conductor & out of roundness
   ii. Resistance at 20°C.
   iii. Measurement of overall diameter.
   v. Flexibility and adherence
   vi. Resistance to Abrasion (Unidirectional Scrap Test)
   vii. Heat shock test
   viii. Cut through test
   ix. Solvent test in transformer oil as per IS:335-1983 with latest edition/amendment
   x. Wrapping test as per IS: 6162 Part-I after removing enamel by suitable method.
   xi. Breakdown voltage test.

The test result will indicate the actual values obtained during testing. The tender should, therefore specifically indicate availability of testing facility/equipment at their work.

4.1.8 PACKING AND MARKING:

4.1.8.1 The reels used for packing shall be conforming to IS: 482-1981. The wire shall be wound compactly and evenly on reel.

4.1.8.2 The wires wound on each reel should be of continuous length and free from joints.

4.1.8.3 The label, which is to be securely attached to the reel, shall have the following information: -

   i. A reference to the Indian Standard
   ii. Manufacture’s name or trade mark if any
   iii. Type of enamel covering
   iv. Type of covering
   v. Diameter of wire
   vi. Gross weight of reel
   vii. Weight of wire
   viii. Identification/Serial Number of reel, if any
   ix. Number of lengths....................Single length

The label may also be marketed with ISI certification mark of the product, where applicable.
4.2 DOUBLE PAPER COVERED (DPC) ALUMINIUM WINDING WIRES:

4.2.1 CONDUCTOR:

The conductor shall be manufactured from EC grade Aluminium and got conforming to IS: 4026 and shall be of „O” conditions and shall have physical constants as given here under:-

4.2.2.1 RESISTANCE:

The resistance at 20°C of an Aluminium conductor 1m in length and of uniform cross-section area of 1mm sq. Shall be 0.0280 ohm.

4.2.2.2 DENSITY

The density at 20°C shall be taken as 2.703 g/cm$^3$.

4.2.2.3 COEFFICIENT OF LINEAR EXPANSION:

The constant mass temperature coefficient of resistance at 20°C measured between two potential points rigidly fixed to the conductor shall be taken as 0.004 per degree Celsius.

Note: for any temperature „to” above 0°C, the temperature, coefficient resistance is:

\[
\frac{1}{230 + to}
\]

4.2.3 PAPER

4.2.3.1 GRADE OF PAPER

The paper, before application, shall be free from metallic and other injurious inclusions shall have no deleterious effects on insulting oil and shall be of such quality that it will satisfy all the requirements of paper specified in IS: 6162 (Part-I). It will be of Bellapur make or any other make from reputed Firm.

4.2.3.2 APPLICATION OF PAPER:

i. To prevent the inclusion of Aluminium dust or other extraneous matter under the paper covering, the conductor shall be fully cleaned by felt pads or other suitable means immediately before entering the paper covering machine. Each layer of paper shall be continuous, firmly applied substantially free from creases. No bonding or adhesive material shall be used except to anchor the ends of paper. Any such bonding or adhesive material shall have no deleterious effects on transformers oil, insulting paper the electric strength of the covering.

ii. WIDTH OF PAPER

The width of paper for lapping shall not exceed three times the diameter of the conductor with a maximum of 12mm and a minimum of 3mm.
iii. THICKNESS OF PAPER
The thickness of paper used shall be between the limits of 0.025 and 0.075mm both inclusive.

iv. ARRANGEMENT OF LAYERS
Both the layers shall be overlap wound in the opposite directions. Further, each paper tape shall be wound with each turn overlapping the proceeding turn by not less than 25 % of paper width.

4.2.4 DIAMETER
The overall diameter of wire, the increase in diameter and tolerance on dia of conductor shall be as specified in table of IS: 6162 (Part-I) for ordinary covering. The corresponding values for intermediate size shall be those applicable for immediately next higher standard size.

4.2.5 RESISTANCE
The resistance of the conductor shall be as the resistance at 20°C. The method used shall provide an accuracy of 0.5 percent.

One measurement shall be made.

If the resistance \( R_t \) is measured at a temperature \( t \) other than 20°C, the resistance \( R_{20} \) at 20°C, shall be calculated by means of the formula:

\[
R_{20} = \frac{R_t}{1 + 0.004 (t - 20)}
\]

It is actual temperature in °C during the measurement.

4.2.6 TENSILE STRENGTH AND ELONGATION:
A sample of conductor 250mm long between grips shall be steadily stretched at a rate not more than 100mm/min until the conductor fractures. The tensile strength and elongation at fracture shall comply with the requirements of Table 2 to IS: 6162 (Part-I).

4.2.7 FREEDOM FROM DEFECTS:
The conductor shall be finished clean and smooth and shall be substantially free from spills, dust, cracks and other defects.

4.2.8 TESTING
Material shall be tested in accordance with provisions of IS: 6162 (Part-I).

4.2.8.1 ACCEPTANCE TESTS
The following tests shall be carried out as acceptance tests for which supplier must possess the testing facilities equipment at their works.
i. Dimensional test
ii. Measurement of tensile strength and elongation if conductor
iii. Measurement of resistance of conductor
iv. Measurement of resistance of conductor
v. Measurement of tensile strength of paper in machine direction
vi. Oil absorption test (The available width of paper shall be taken instead of minimum 50mm specified).
vii. Wrap test of conductor

The test result will indicate the actual values obtained during testing. The tenders should, therefore, specifically indicate availability of testing facility/equipment at their works.

4.2.9 PACKING AND MARKING:

4.2.9.1 The reels used for packing shall conform to IS: 482-1981. The wire shall be tightly & evenly wound in reels in such a direction that when unrolled, the exposed edge of the overlap of the outer layer of the paper is towards the reel.

4.2.9.2 Each roll shall contain one continuous length of wire, free from joints.

4.2.9.3 The label, which is to be securely attached to the reel, shall have the following information:

- a) A reference to the Indian Standard
- b) Manufacture’s name or Trade mark, if any
- c) Grade of covering
- d) Goss weight of reel
- e) Tare weight of reel
- f) Weight of wire.

5. Technical Specification of Silica Gel Breathers used in repaired Distribution Transformers

1. The Silica Gel Breather required for distribution transformers shall be Transparent acrylic type containing 100/250/500 gms. of Silica Gel conforming to ISS 3401/1992 with its latest amendments and it should be suitable for connecting to ¾” pipe thread/1/2” pipe thread.

2. The general dimensions/features of required Silica Gel Breathers shall as per applicable standard.

3. Material of breather Body & Parts

(i) Fabricated from high quality aluminum alloy LM-6 and powder coated for corrosion resistance.

(ii) Special grade nitrile gasket to ensure water proof and air tight joints.

(iii) The glass/transparent polycarbonate window for visualizing Silica Gel & oil level should be fixed by screws to the main body with gasket to prevent leakage of oil.
4. **Following details should be provided on name plates**

   Following details should be provided on each breather.

1. Name of manufacturer and type of materials.

2. Mass of silica gel

5. **Silica Gel:** The Silica Gel required for distribution transformers shall be conforming to ISS 3401/1992 with its latest amendments.

   5.1. The material shall be solid with grainy porous structure free from extraneous impurities. The indicating type gel should be odorless, non toxic & non corrosive with stable chemical and thermal characteristics. The inter connected pores form a vast surface area; silica gel should absorb moisture 40% or more of its weight at 100% humidity.

   5.2. Bulk Density: The bulk density of the material shall be more than 0.6 gm/ml.

   5.3. Particle Size & Colour: The material shall be blue in colour and its size should be from 4 to 6 mm.

   5.4. Loss on Drying: The material when tested according to the method prescribed in ISS shall not lose more than 5% of its mass.

   5.5. Adsorption capacity: The material when tested according to the method prescribed in ISS 3401-1992 shall adsorb minimum 27% of moisture on the basis of its mass.

   5.6. pH Value: The pH of aqueous extract of the material when determined by the method prescribed is ISS 3401-1992 shall be not more than 8 and not less than 3.5.

   5.7. Loss on attrition: When subjected to the test according to the method prescribed in aforesaid ISS not more than 2.5% of the material shall pass through the test sieve.

   5.8. Chemical Requirements: The gel shall also comply with the requirement prescribed in the ISS 3401-1992.

**TECHNICAL SPECIFICATION FOR SUPER ENAMELED COPPER WINDING WIRE**

1. **SCOPE:**

   This specification covers the manufacture, testing, supply and delivery of the following material:

   Super Enamed Copper winding with medium covering type-1

   The material is required for use in repair of Transformers.

2. **STANDARD:**

   As regards materials design, manufacture and testing etc. they will strictly comply with requirements of the IS standards as mentioned hereunder:
<table>
<thead>
<tr>
<th>S1 No.</th>
<th>Reference Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IS:13730 (Part-0/Sec1) with latest version</td>
<td>Indian Standard Specifications for Particular types of Winding Wire  Part 0: General Requirements  Section 1: Enamelled Round Copper Wire</td>
</tr>
</tbody>
</table>

The various application ISS referred in the specification shall be of the latest edition and amendments, if any.

The material bearing ISI certification mark may, however, be preferred.

3. CLIMATE CONDITIONS:

The material to be supplied against this specification shall be suitable for satisfactory operation under the following climate conditions:

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<th>S1 No.</th>
<th>Location</th>
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<td>Maximum ambient temperature (°C)</td>
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<td>Minimum ambient air temperature(°C)</td>
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<tr>
<td>iii.</td>
<td>Maximum average daily ambient temperature (°C)</td>
<td>40</td>
</tr>
<tr>
<td>iv.</td>
<td>Maximum yearly weighed average ambient temperature (°C)</td>
<td>32</td>
</tr>
<tr>
<td>v.</td>
<td>Maximum altitude above mean sea level (m)</td>
<td>1000</td>
</tr>
<tr>
<td>vi.</td>
<td>Minimum Relative Humidity (%)</td>
<td>26</td>
</tr>
<tr>
<td>vii.</td>
<td>Maximum Relative Humidity (%)</td>
<td>95</td>
</tr>
<tr>
<td>viii.</td>
<td>Average no of Rainy days/year</td>
<td>120</td>
</tr>
<tr>
<td>ix.</td>
<td>Average annual rain fall</td>
<td>900 mm</td>
</tr>
<tr>
<td>x.</td>
<td>Maximum wind pressure</td>
<td>195 kg/m sq.</td>
</tr>
</tbody>
</table>

The material shall be for use in moderately hot and humid tropical climate conducive to rust and fungus growth.
4. TECHNICAL PARTICULARS

The technical particulars of the wire will be as below:

SUPER ENAMELED (SE) COPPER WINDING WIRE

CONDUCTORS: The conductor shall be electrolytic high conductivity annealed Copper, strictly

4.1 Dimensions: It shall be as per clause 5 of IS 13730(Part 0/Sec 1) & IS 13730(Part13).

4.2 Electrical Resistance: It shall be as per clause 5 of IS 13730(Part 0/Sec 1) & IS 13730(Part13).

4.3 Elongation: It shall be as per clause 6 of IS 13730(Part 0/Sec 1) & IS13730(Part13).

4.4 Springiness: It shall be as per clause 7 of IS 13730(Part 0/Sec 1) & IS 13730(Part13).

4.5 Flexibility & Adherence: It shall be as per clause 8 of IS 13730(Part 0/Sec 1) & IS13730(Part13).

4.6 Heat Shock: It shall be as per clause 9 of IS 13730(Part 0/Sec 1) & IS 13730(Part13).

4.7 Cut-through: It shall be as per clause 10 of IS 13730(Part 0/Sec 1) & IS 13730(Part13).

4.8 Resistance to Abrasion: It shall be as per clause 11 of IS 13730(Part 0/Sec 1) & IS 13730(Part13)

4.9 Resistance to Solvents: It shall be as per clause 12 of IS 13730(Part 0/Sec 1) & IS 13730(Part13).

4.10 Breakdown voltage: It shall be as per clause 13 of IS 13730(Part 0/Sec 1) & IS 13730(Part13).

4.11 Continuity of insulation: It shall be as per clause 14 of IS 13730(Part 0/Sec 1) & IS 13730(Part13)

4.12 Temperature Index: It shall be as per clause 15 of IS 13730(Part 0/Sec 1) & IS 13730(Part13).

4.13 Enamel Base coat: with Polyesterimide enamel Terebec MT 533.39A/Terebec TR 543.38 of M/s Elantas Beck India Ltd

OR with type of enamel as specified in product catalogue of M/s Elantas Beck India Ltd for dual coated winding wire of class 200 as per IS 13730

Intermediate corona coat: with Voltron E 3597/98 enamel of M/s DUPONT

Top coat: with Allotherm 602-35S/602L-31S of M/s Elantas Beck India Ltd OR with type of enamel as specified in product catalogue of M/s Elantas Beck India Ltd for dual coated winding wire of class 200 as per IS 13730.
5. TEST & TEST CERTIFICATES:

5.1 The following tests shall be carried out as per relevant IS at the manufacturer’s premises or at Govt. Approved testing agency. All the tests as indicated below shall be conducted on each lot and the results evaluated.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Tests</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dimension measurement</td>
<td>As per IS 13778(Part 2).</td>
</tr>
<tr>
<td></td>
<td>i. Overall Diameter Measurement.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ii. Bare conductor diameter Measurement</td>
<td></td>
</tr>
<tr>
<td></td>
<td>iii. Increase in dimension due to coatings</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Electrical Resistance</td>
<td>As per IS 13778(Part 5).</td>
</tr>
<tr>
<td>3</td>
<td>Elongation test</td>
<td>As per IS 13778(Part 3).</td>
</tr>
<tr>
<td>4</td>
<td>Springiness test</td>
<td>As per IS 13778(Part 3).</td>
</tr>
<tr>
<td>5</td>
<td>Flexibility and Adherence tests.</td>
<td>As per IS 13778(Part 3).</td>
</tr>
<tr>
<td></td>
<td>a. Mandrel Winding test</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. Peel test</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Heat Shock Test</td>
<td>As per IS 13778(Part 6).</td>
</tr>
<tr>
<td>7</td>
<td>Cut-through test</td>
<td>As per IS 13778(Part 6).</td>
</tr>
<tr>
<td>8</td>
<td>Resistance to Abrasion test.</td>
<td>As per IS 13778(Part 3).</td>
</tr>
<tr>
<td>9</td>
<td>Resistance to Solvents test</td>
<td>As per IS 13778(Part 4).</td>
</tr>
<tr>
<td>10</td>
<td>Break Down Voltage</td>
<td>As per IS 13778(Part 5)</td>
</tr>
<tr>
<td></td>
<td>a. At room temperature</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. At elevated temperature</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Continuity of Insulation</td>
<td>As per IS 13778(Part 5).</td>
</tr>
<tr>
<td>12</td>
<td>Temperature Index*</td>
<td>As per IS 13778(Part 6).</td>
</tr>
<tr>
<td>13</td>
<td>Voltage Endurance Test</td>
<td>As per clause 5.2 Of this specification</td>
</tr>
</tbody>
</table>

The test marked with an asterisk are periodic conformance tests. These tests along with other tests are to be carried out during prototype testing OR when there is any change in the material from earlier approved Bill of materials OR change in process of manufacturing OR during renewal of registration. All tests other than asterisk mark are to be carried out 100%.

5.2 Voltage Endurance Test

10 samples are to be prepared as per Clause 13.0 of IS 13730(Pt 0/Sec1) and IS 13778 Pt 5 and subjected to voltage of 2 kV at 50 Hz at room temperature and maintained till break down occurs. At least 8 samples shall withstand for 75 hours without breakdown. The break down voltage shall be measured as per clause 4.0 of IS 13778 Pt 5:1993.

5.3 For coatings, manufacturer’s test certificates shall be produced.
6.0 PACKING & MARKING:

The wires shall be tightly and evenly wound on reels in such a direction that when unrolled, the exposed edge of the over lap of the outer layer is towards the drum. The reels shall conform to IS-482/1981.

The label which is to be attached to the reels shall have the following information.

1. Property of MSPDCL, Manipur
2. P.O No. and Date.
3. Name of the Manufacturer & Trade Mark.
4. Drum / Crate No.
5. Size and type of conductor.
7. Weight of the empty drum.

7. GUARANTEED TECHNICAL PARTICULARS:

The technical particulars as specified in the relevant IS shall be guaranteed, wherever not specified in the Guaranteed Technical Particulars annexed.

8. INSPECTION:

The representative of the MSPDCL shall have access to the suppliers or his sub-contractor’s works at any time during working hours for the purpose of inspecting the materials during manufacturing of the plant and equipment testing and may select test samples from the materials going into plant and equipment.

Inspection will be conducted at the premises of the supplier by the authorized representative of MSPDCL for conducting acceptance test as per relevant IS or may waive out by the purchaser.

9. ISI CERTIFICATION/MARKING:

Tenderers shall indicate whether they have ISI certificate/marking or not. Tenderers whose products bear ISI marking may be given preference.

11. GUARANTEE : The material shall be guaranteed by you for satisfactory operation for a period of 12 months from the date of receipt.

TECHNICAL SPECIFICATION FOR DPC COPPER WINDING WIRE

1. SCOPE :-

This specification provides for the manufacturing, testing and supply of Double Paper covered round copper winding wire for making transformer coils.

2. STANDARDS :-
The conductor shall conform to the following Indian Standard specifications which shall mean latest revisions with amendments / changes adopted and published unless specifically stated otherwise in the specification.

4. IS: 191-1967 : For ETP, FRHC or FRTP grade Copper.

3. MATERIAL AND WORKMANSHIP:

Materials used in manufacture of the conductor shall be of the highest quality of its kinds obtainable and except where modified by the specification, shall comply in all respect with the standards laid down by Indian Standard Institution.

The Copper conductor shall be hard drawn from electrolytic Copper rod preferably made from Hindustan Copper Ltd., HINDALCO, STERLITE or reputed make only purity not less than 99.5%. Test certificates of Copper Manufacturers in respect of impurity content of Copper conductivity etc. shall have to be furnished in order to assess its quality.

All the Copper conductors shall be reasonable smooth, uniform and shall be free from all defects such as die marks, scratches, abrasions and kinks etc. after drawing and also after paper covering the surface should be smooth.

The finished conductor shall have a smooth surface without any surface dents, abrasions, scuff marks and shall be free from dirt grit etc.

Particular care has therefore, to be taken during the manufacture, handling, packing and transportation of the conductor, to see that the surface is not dented, cut or damaged in any way.

4. JOINTS :

4.1 There shall be no joint of any kind in the conductor.

4.2 A certificate shall be recorded by the supplier on each and every invoice / bill and challan as follows.

“Certified that there is no joints of any kind in the conductor”.

5.0 PAPER :

The paper shall be free from metallic & other injurious inclusions and shall conform to IS: 7404 (Part-I)-1974. It should be of ITC (UBIL) electrical grade or Padumjee make. The thickness of the paper used shall be between the limits 0.025 and .075 mm. The paper shall be applied in two layers; both of them shall be overlap wound in the opposite directions.

6.0 PACKING & MARKING

6.1 The conductor shall be supplied on strong non-returnable wooden drum so that it is not damaged during transit and can withstand all the transit and weather hazards. The supplier/manufacturer shall be responsible for any damage to the material during transit due to improper/inadequate packing. The drum shall be painted on the inside and
outside with Copper paints and fitted with strong cast iron bushings. All drums shall have layer of a waterproof paper under the lagging. The conductor drums shall conform to IS: 1778/1980. The drums shall be strapped with steel wire. Each drum shall have the following information marked on it with indelible ink along with other essential data.

1. Property of MSPDCL, Manipur
2. P.O No. and Date.
3. Name of the Manufacturer & Trade Mark.
4. Drum / Crate No.
5. Size and type of conductor.
7. Weight of the empty drum.
9. ISI mark.

6.2 The Drums shall be constructed in such a way to ensure delivery of conductor in the store free from displacement and damage and should be able to withstand all stresses due to handling and the stringing operation so that conductor surface is not dented, scratched or damaged in any way during transport and erection.

6.3 All wooden components shall be transform worthily and free from defects that may materially weaken the component parts of the drum. Wood preservative of treatment shall be supplied to the entire drum with preservative of such quality, which is not harmful to the conductor.

6.4 The gross weight of each packing shall not exceed 40-60 Kg. Net weight 35-50 Kg.

7. TOLERANCE OF QUANTITIES

The total permissible variation for the entire quantity ordered shall be subject to limit of ± 2% for overall quantity. However, the permissible variation in case of individual consignment may be ±5%.

8. TESTING:

The conductor shall be subjected to the following tests in accordance with IS: 7404 (Part-I)-1974 and other relevant IS:

8.1 Check for cross sectional area of Copper conductor.
8.2 Breaking load tests on Copper.
8.3 Wrapping test on Copper.
8.4 Electrical resistance test on Copper conductor.
8.5 Checking of conductors surface & declared weight.
8.6 Visual Examination test on conductor drums as per IS: 1778/1980.
8.7 The rejection & retest procedure shall be followed as stipulated in IS.
8.8 Checking for double paper covering as per IS: 7404 (Part-I)-1974
9. TESTING AND TEST CERTIFICATE

The conductor shall be subject to all tests laid down in the relevant ISS at contractor’s work or at Govt. approved test laboratory at contractor’s cost. Certified copies of test certificate in respect of tensile test of Copper, quality of Copper and paper used for covering and all other tests as prescribed in the relevant ISS shall be furnished by contractor in triplicate for approval.

10. CHECKING OF CONDUCTOR SURFACE/DECLARED WEIGHT

The supplier/manufacturer shall arrange for the inspection of conductors by the representative of the purchaser specially authorized for this purpose. At least 5% of the total number of drum of conductor taken at random shall be checked to ascertain the surface, declared weight of conductor for each size.

TECHNICAL PARTICULARS FOR DOUBLE PAPER COVER ROUND COPPER WINDING WIRE

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Particulars</th>
<th>Minimum Guaranteed Value</th>
<th>Offered Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Code name of conductor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(i)</td>
<td>DPC Copper. winding wire 2.20 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ii)</td>
<td>DPC Copper. winding wire 2.90 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Tolerance on standard size</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Maximum resistivity of conductor at 20°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Density at 20°C</td>
<td>As per relevant ISS</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Paper</td>
<td></td>
<td></td>
</tr>
<tr>
<td>i)</td>
<td>Overlap wound</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ii)</td>
<td>Thickness of paper</td>
<td></td>
<td></td>
</tr>
<tr>
<td>iii)</td>
<td>Tensile strength</td>
<td></td>
<td></td>
</tr>
<tr>
<td>iv)</td>
<td>Increase in conductor dimension due to covering</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
11. INSPECTION:

The representative of the MSPDCL shall have access to the suppliers or his sub-contractor’s works at any time during working hours for the purpose of inspecting the materials during manufacturing of the plant and equipment testing and may select test samples from the materials going into plant and equipment.

Inspection will be conducted at the premises of the supplier by the authorized representative of MSPDCL for conducting acceptance test as per relevant IS or may waive out by the purchaser.

12. ISI CERTIFICATION/MARKING:

Tenderers shall indicate whether they have ISI certificate/markings or not. Tenderers whose products bear ISI marking may be given preference.

13. GUARANTEE: The material shall be guaranteed by you for satisfactory operation for a period of 12 months from the date of receipt.

LT & HT BUSHINGS:

The bushings shall conform to the relevant standards specified and shall be of outdoor type. The bushing rods and nuts shall be made of brass material for both HT and LT bushings. The tests as per latest IS 2099 and IS 7421 shall be conducted on the transformer bushings.

Bushing can be of porcelain/epoxy material. Polymer insulator bushings conforming with relevant IEC can also be used.

Dimensions of the bushings of the voltage class shall conform to the Standards specified and dimension of clamping arrangement shall be as per IS 4257.

The bushings shall be of reputed make supplied by those manufacturers who are having manufacturing and testing facilities for insulators.

TECHNICAL SPECIFICATION FOR LT XLPE UN-ARMOURED CABLES:

i. Materials: 3 and ½ core aluminum XLPE Un-armoured Cables conductor, XLPE insulated Cables and shall conform to IEC 60502

ii. Conductor: Plain circular, compacted or shaped stranded aluminum conductor, and conform to IEC 60228 Class 2

iii. Insulation: XLPE cross-linked polyethylene rated at 90°C

iv. Bedding: PVC or Polyethylene

v. Sheath: PVC type ST2 and conform to IEC 60502, colour black

vi. Application: The Cables shall be designed for general use including underground burial and should not suffer mechanical damages.

vii. Preferred make shall be Polycab/Incab/Gloster/CCI/Schneider.
### 3.5 CORE L.T ALUMINIUM XLPE UNARMOURED POWER CABLES

<table>
<thead>
<tr>
<th>No. of wires &amp; cross sectional area</th>
<th>Min. No. of Wires</th>
<th>Thickness of insulation (Nom.) mm</th>
<th>Min. Thickness of inner sheath mm</th>
<th>Nom. Thickness of outer sheath mm</th>
<th>Overall Diameter (Approx) mm</th>
<th>Net Wt. of Cable (Approx) Kg/Km</th>
<th>Max. D.C. Resistance at 20°C Ohm/Km</th>
<th>Max. A.C. Resistance at 90°C Ohm/Km</th>
<th>Approx. Reactance at 50 Hz mF/Km</th>
<th>Approx. Capacitance mF/Km</th>
<th>CURRENT RATINGS</th>
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<tbody>
<tr>
<td>3.5Cx25</td>
<td>6/6</td>
<td>0.9/0.7</td>
<td>0.3</td>
<td>0.2</td>
<td>22.4</td>
<td>587</td>
<td>1.2000</td>
<td>1.5400</td>
<td>0.080</td>
<td>0.20</td>
<td>97</td>
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<tr>
<td>3.5Cx35</td>
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<td>0.9/0.7</td>
<td>0.3</td>
<td>0.2</td>
<td>24.1</td>
<td>694</td>
<td>0.8680</td>
<td>1.1100</td>
<td>0.080</td>
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<tr>
<td>3.5Cx50</td>
<td>6/6</td>
<td>1.0/0.9</td>
<td>0.3</td>
<td>0.2</td>
<td>27.3</td>
<td>890</td>
<td>0.6410</td>
<td>0.8200</td>
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<tr>
<td>3.5Cx70</td>
<td>12/6</td>
<td>1.1/0.9</td>
<td>0.4</td>
<td>2.20</td>
<td>31.9</td>
<td>1215</td>
<td>0.4430</td>
<td>0.5670</td>
<td>0.077</td>
<td>0.26</td>
<td>167</td>
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<tr>
<td>3.5Cx95</td>
<td>15/6</td>
<td>1.1/1.0</td>
<td>0.4</td>
<td>2.20</td>
<td>35.5</td>
<td>1540</td>
<td>0.3200</td>
<td>0.4100</td>
<td>0.074</td>
<td>0.29</td>
<td>199</td>
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<tr>
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<td>15/12</td>
<td>1.2/1.1</td>
<td>0.4</td>
<td>2.20</td>
<td>37.8</td>
<td>1875</td>
<td>0.2530</td>
<td>0.3250</td>
<td>0.072</td>
<td>0.29</td>
<td>227</td>
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<tr>
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<td>15/12</td>
<td>1.4/1.1</td>
<td>0.5</td>
<td>2.40</td>
<td>42.8</td>
<td>2271</td>
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<td>0.29</td>
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<tr>
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<td>30/15</td>
<td>1.6/1.1</td>
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<td>2.60</td>
<td>46.4</td>
<td>2805</td>
<td>0.1640</td>
<td>0.2110</td>
<td>0.072</td>
<td>0.29</td>
<td>287</td>
</tr>
<tr>
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<td>30/15</td>
<td>1.7/1.2</td>
<td>0.6</td>
<td>2.80</td>
<td>52.4</td>
<td>3599</td>
<td>0.1250</td>
<td>0.1620</td>
<td>0.072</td>
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<td>333</td>
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<tr>
<td>3.5Cx300</td>
<td>30/15</td>
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<td>3.00</td>
<td>56.4</td>
<td>4348</td>
<td>0.1000</td>
<td>0.1300</td>
<td>0.071</td>
<td>0.33</td>
<td>375</td>
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<td>3.5Cx400</td>
<td>53/30</td>
<td>2.0/1.6</td>
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<td>65.3</td>
<td>5629</td>
<td>0.0778</td>
<td>0.1023</td>
<td>0.070</td>
<td>0.33</td>
<td>426</td>
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</tbody>
</table>
2) **SCOPE:**

This section provides for manufacture, testing before dispatch, supply and delivery F.O.R. destination of 11KV XLPE Insulated PVC Sheathed ACSR Rabbit Conductor suitable for working voltage up to and including 11000 Volts. The HT Insulated PVC Sheathed ACSR Rabbit Conductor shall be conforming to IS:398(Pt.2)/1996, IS:7098(Pt.2)/1985 and IS:5831(1984) with latest amendments. Preferred make shall be Polycab/Incab/Gloster/CCI/Schneider.

The bidders should be a manufacturer of ACSR RABBIT Conductor and also of 11KV XLPE Insulated PVC Sheathed Aerial Bunched / Power Cables. The Offers from sole selling agents / authorized dealer shall not be entertained. The firms (manufacturers) must posses valid ISI License for the ACSR Rabbit Conductor as per IS:398(Pt.2)/1996 as well as XLPE Insulated PVC Sheathed Power Cable suitable for working voltage up to and including 11000 volts As per IS:7098(Pt.2)/1985 with latest amendment.

4.1.1.5 **STANDARDS:**

Unless otherwise stipulated in this specification the following standards with latest amendments shall be applicable for 11KV XLPE Insulated PVC Sheathed ACSR Rabbit Conductor.

4.1.3.4 IS:398 (Pt.2)/1996 : Specification for Aluminum Conductor for over-head transmission line.

2 IS:7098(Pt-2)/1985 : Specification for Cross linked Polyethylene Insulated PVC Sheathed cables from working Voltage 3.3. KV up to & including 33 KV.

iii) IS: 5831 : PVC Insulation and sheath of Electrical Cables

iv) IS:10810 : Methods of test for cables.

v) IS:10418 : Drums for Electric Cables

3. **CLIMATIC CONDITIONS:**

i) Peak ambient temperature in shade. 50 Deg.C

ii) Maximum average ambient temperature in a 24 hours period in shade. 40 Deg.C

iii) Min. ambient air temperature in shade (-)5 Deg.C

iv) Maximum temperature attainable by an object exposed to sun. 60 Deg.C

v) Maximum relative humidity 100%
vi) Average number of thunder storm days per annum  
   40

vii) Average number of rainy days per annum.  
    100

viii) Average annual rainfall  
     10 to 100 cm

ix) Number of months of tropical monsoon conditions  
   4 months

x) Maximum wind pressure.  
   100 Kg/ Sq. mm

xi) Altitude not exceeding  
    1000

4. GENERAL REQUIREMENT OF 11KV XLPE INSULATED PVC SHEATHED ACSR RABBIT CONDUCTOR:

a) FOR ACSR RABBIT CONDUCTOR

The material offered shall be of the best quality and workmanship. The conductor shall be constructed of hard drawn aluminum and galvanized steel wires which have the mechanical and electrical properties specified in IS: 398 (Part.2)/1996 with latest amendment, if any, the Zinc coating on the galvanized steel wires may be applied by the hot process in accordance with IS:4826/1979 with latest amendment if any. The ACSR RABBIT to be used shall be BIS marked.

b) FOR XLPE INSULATION

The Conductor shall be provided with cross linked polyethylene insulation applied by extrusion conforming to the requirement given in Table-1 of IS:7098(Part-2)/1985 with latest amendment. The insulation shall be so applied that it fits closely on the conductor and it shall be possible to remove it without damaging the conductor. The nominal thickness of insulation shall be of 3.60 mm, as per Clause No.11 of IS:7098(Part-2)/1985 and the smallest of measured value of thickness of insulation shall be 3.14 mm as per Clause No.11.3 of IS:7098(Part-2)/1985.

c) OUTER SHEATH INSULATION

The outer sheath shall be of polyvinyl chloride (PVC) compound confirming to requirement to type ST-2 of IS:5831/ 1984. The nominal thickness of insulation shall be of 2.0 mm, as per Clause No.17.3.1 of IS:7098(Part-2)/1985 and the smallest of measured value of thickness of insulation shall be 1.4 mm as per Clause No.17.3.1 of IS:7098(Part-2)/1985. The colour of outer sheath shall be black.

ii. TEST AND TYPE TEST CERTIFICATES:


4.2.8.2 The material offered shall be fully type tested as per relevant standard of specification of IS:398(Pt.II)/1996, IS:7098(Part-2)/1985 and IS:5831 / 1984 with all subsequent amendments issued time to time. The bidder shall furnish valid type test report or of similar rating and design of tendered material along with bid as detailed at Schedule-III A “Pre Qualification Requirement”.

The following shall constitute type tests as per requirement of IS–398 Part 2/1996 and IS-7098(Pt-2)/1985 amended up to date.
4.2.10 ACSR RABBIT CONDUCTOR (IS-398 Part-2/1996) AMENDED UP TO DATE

4.2.9.1 Measurement of Diameter for individual Aluminum and steel wires
4.2.9.2 Measurement of lay ratio
4.2.9.3 Breaking Load of individual Wires.
4.2.9.4 Ductility test
4.2.9.5 Wrapping test
4.2.9.6 Resistance Test
4.2.9.7 Galvanizing test.

4.2.11 ON XLPE INSULATION AND PVC SHEATHING IS-7098(Pt-2)/1985 AND IS:5831/1984 AMENDED UPTO DATE

f) Test for thickness of insulation and sheath.

2 Physical tests for insulation:
  - Tensile strength and elongation at break
  - Ageing in air oven
  - Hot set test
  - Shrinkage test
  - Water absorption (gravimetric)

6. Insulation resistance (volume resistivity test)
IV) High Voltage Test
V ) Flammability
VI) Physical Tests for outer sheath:
  - Tensile strength and elongation at break
  - Ageing in air oven
  - Loss of mass in air oven
  - Shrinkage test
  - Hot deformation
  - Heat shock test
  - Thermal stability

(iv) The bidder must also clearly indicate various testing facilities available at their works for testing the material as per relevant standards. In case of otherwise particulars of the place where such testing is proposed to be conducted during the course of inspection shall be indicated with the offer.

iii. INSPECTION:

6.1 The inspection may be carried out by the purchaser at any stage of manufacture. The successful bidder shall grant free access to the purchaser’s representative at a reasonable time when the work is in progress. Inspection and acceptance of any equipment / material under this specification by the purchaser shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specification and shall not prevent subsequent rejection if the equipment / material is found to be defective.

Following acceptance tests shall be done as per IS:7098(Pt-2)/1985 for XLPE Insulation and PVC Sheathing suitable for working voltage up to & including 11000 Volts as per Clause No.18.2 of IS:7098(Pt-2)/1985, As per clause No.14.2 of IS:398 (Pt-2)/1996 for ACSR Conductor and shall be conducted in presence of the purchaser’s authorized representative / agency on each lot of offered insulated ACSR Conductor. The sampling shall be done as per Appendix-A (Clause No.18.2.1) of IS:7098(Pt-2)/1985 for finished Insulated ACSR Conductor suitable for working voltage up to & including 11000 Volts. Further cold bend /cold impact test(IS-5831/1984) on outer sheath shall constitute the optional test and shall be conducted on first lot or from other lot of the offered insulated conductor as per clause no 18.4 of IS-7098(Pt -2)/1985.
(A) FOR XLPE INSULATION AND PVC SHEATH:

5. Test for thickness of Insulation and sheath.
6. Tensile Strength & elongation at Break Test for Insulation and sheath.
7. Hot Set for Insulation.
8. Insulation Resistance Test.
10. Cold impact test

(B) FOR ACSR RABBIT CONDUCTOR:

5. Breaking Load of Individual wires.
6. Ductility Test.
7. Wrapping Test.

The routine test certificates to be furnished to the Inspecting Officer at works as per IS-398 Part-2/1996 and as per IS:7098(Pt-2)/1985 amended up to date for verification.

5.3. The supplier shall keep the purchaser informed in advance about the manufacturing programme so that arrangement can be made for inspection.

6.3. At least 5% of total nos. of drums subject to minimum of one (1) in any lot put up for inspection shall be selected at random to ascertain the length of insulated conductor by the following method:

“At the works of the manufacturer the insulated conductor shall be transferred from one drum to another for checking any manufacturing defects in the insulated conductor, at the same time measuring its length with the help of the graduated pulley & cyclometer. The difference in average length thus obtained from the declared length by the supplier in the packing list shall be applied to all the drums if the insulated conductor is found short during checking the sample lot(s).”

6.4 The supplier shall present the latest Calibration Certificate(s) of testing instruments / equipments to be used for the testing of the material covered in the Purchase Order to the authorized inspecting officer / inspecting agency of the purchaser. The testing instruments / meters/ apparatus etc. should be got calibrated by the supplier from time to time from Govt. or Independent test laboratory / house having valid accreditation from National Accreditation Board for Testing and Calibrating Laboratories for the testing equipments or original manufacturer having traceability to NABL / NPL or equivalent accredited lab.

6. STANDARD LENGTH:

7. The standard length of the HT XLPE Insulated PVC Sheathed ACSR RABBIT conductor drum shall be 1000 meters. A tolerance of (+/-) 5% on the standard length offered by the Bidder shall be permitted. All length outside this limit of tolerance shall be treated as random lengths.

8. Random lengths will be accepted provided no length is less than 80% of the standard length and the total quantity of such random length shall not be more than 5% of the total quantity ordered.

9. The maximum length in one drum shall be 3000 meter.

2 REWINDING AT STORES:
The purchaser has every right for rewinding of Insulated ACSR RABBIT conductor drums at stores / site in part or full after receipt of material. If at any time, shortage in lengths observed in any of the drum of the particular lot, the maximum length of shortage so observed in rewound drums shall be deducted from all the drums inspected / dispatch lot. However, the purchaser shall intimate in advance to the supplier programme of rewinding to depute their representative to witness rewinding, if supplier desires so. If the supplier does not depute their authorized representative, the rewinding shall be done by store organization in presence of representative of purchaser nominated by this office. During rewinding in store if any defect / shortage is found the purchaser shall have every right to deduct the cost of defective / short material or reject the entire lot.

10. PACKING AND MARKING:

The HT XLPE Insulated PVC Sheathed ACSR RABBIT Conductor shall be wound on a non returnable wooden drum conforming to IS: 10418/1982 of suitable size.

The conductor drums shall carry the following information either stenciled or painted.
1. Manufacturer’s name, Brand or trade mark.
2. Type of Insulated Conductor and voltage grade.
4. Length of Insulated Conductor on the drum.
5. Number of lengths on the drum (if more than one).
6. Direction of rotation of drum (by means of an arrow).
6.5 Gross mass.
6.6 Year of manufacture.
6.8 Purchase order / tender No. and Name of Consignee.

11. GUARANTEED TECHNICAL PARTICULARS:

The bidder shall furnish guaranteed technical particulars in the Performa of GTP enclosed.

12. MANUFACTURER:

The bidder should be a manufacturer of ACSR Rabbit Conductor and XLPE Insulated Aerial Bunched / Power Cables size 50 Sq.mm and above. The inspection / Testing shall be carried out at manufacturer works.

13. IDENTIFICATION:

2. The manufacturer shall be identified throughout the length of HT XLPE Insulated PVC Sheathed ACSR Rabbit Conductor by providing legible Embossing as under:

12. EMBOSSSING

The HT XLPE Insulated PVC Sheath ACSR Rabbit Conductor shall also be required to be embossed with the word Manufacturer’s Name or Trade Mark, Electric, Voltage Grade,
, Size of Conductor & year of manufacture at every meter length for which no extra charge shall be paid.

iii) MARKING

The progressive length of HT XLPE Insulated PVC Sheathed ACSR Rabbit Conductor in meter shall be marked on every meter length of HT XLPE Insulated PVC Sheathed ACSR Rabbit Conductor.
14. **QUANTITY TOLERANCE:**

The ordered quantity of the Insulated Conductor can be supplied with quantity tolerance of \((-/+2\%\)."

### Guarantee Technical Particulars of 11KV XLPE Insulated ACSR Rabbit Conductor:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Parameters</th>
<th>Unit</th>
<th>Provided Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Manufacturer Name &amp; Address</td>
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<td></td>
</tr>
<tr>
<td>2.0</td>
<td>Item Name</td>
<td></td>
<td>11KV XLPE Insulated ACSR Rabbit Conductor</td>
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<tr>
<td>3.0</td>
<td>Conductor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>Aluminium Composition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>i)</td>
<td>Minimum Purity of Aluminium</td>
<td>%</td>
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</tr>
<tr>
<td>ii)</td>
<td>Maximum Copper Content</td>
<td>%</td>
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</tr>
<tr>
<td>b</td>
<td>Steel Composition</td>
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</tr>
<tr>
<td>i)</td>
<td>Carbon</td>
<td>%</td>
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<tr>
<td>ii)</td>
<td>Manganese</td>
<td>%</td>
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</tr>
<tr>
<td>iii)</td>
<td>Phosphorus</td>
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<tr>
<td>iv)</td>
<td>Sulphur</td>
<td>%</td>
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<tr>
<td>v)</td>
<td>Silicon</td>
<td>%</td>
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<tr>
<td>c</td>
<td>Minimum Purity of Zinc</td>
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<tr>
<td>d</td>
<td>No. of Strand</td>
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<tr>
<td>e</td>
<td>Strand Diameter</td>
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<tr>
<td>f</td>
<td>Tolerance in strand</td>
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<tr>
<td>g</td>
<td>Minimum breaking load (after stranding)</td>
<td>KN</td>
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<tr>
<td>h</td>
<td>Minimum Elongation on Steel Strand</td>
<td>%</td>
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</tr>
<tr>
<td>i</td>
<td>Mass of Zinc coating of steel Strand (minimum)</td>
<td>Gm/m²</td>
<td></td>
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<td>j</td>
<td>Dip test on steel Strand (after stranding)</td>
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<tr>
<td>k</td>
<td>Resistance of Aluminium Starand (max) at 20°C</td>
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<td>l</td>
<td>Calculated Resistance at 20°C</td>
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<td>Approximate calculated Breaking toad</td>
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<td>Approximate mass</td>
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<td>Nominal Aluminium Area</td>
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<td>q</td>
<td>Maximum Current Carrying Capacity at ambient Temp. 45°C (Temp rise 300 Above ambient temp.)</td>
<td>Amp</td>
<td></td>
</tr>
<tr>
<td>r</td>
<td>Co-efficient of linear expansion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>i)</td>
<td>Aluminium</td>
<td>/C</td>
<td></td>
</tr>
<tr>
<td>ii)</td>
<td>Steel</td>
<td>/C</td>
<td></td>
</tr>
<tr>
<td>s</td>
<td>Modules of Elasticity</td>
<td>CN/m²</td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>Lay Ratio</td>
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</tr>
<tr>
<td>u</td>
<td>Standard Length</td>
<td>meter</td>
<td></td>
</tr>
<tr>
<td>v</td>
<td>Maximum drum Length can be manufactured</td>
<td>meter</td>
<td></td>
</tr>
<tr>
<td>w</td>
<td>No of Standard length in a drum (max)</td>
<td>No.</td>
<td></td>
</tr>
<tr>
<td>4.0</td>
<td>Insulation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>Material</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>Colour</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>Minimum Thickness</td>
<td>mm</td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>Minimum Tensila Strength</td>
<td>N/mm²</td>
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</tr>
<tr>
<td>e</td>
<td>Minimum Elongation at break</td>
<td>%</td>
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<tr>
<td>5.0</td>
<td>Approx. Dia Over Insulated Conductor</td>
<td>mm</td>
<td></td>
</tr>
<tr>
<td>6.0</td>
<td>Approx. Gross Weight of Insulated Conductor with drum</td>
<td>Kg</td>
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<td>7.0</td>
<td>Type of Curing (Insulation)</td>
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<td>8.0</td>
<td>Reference Documents for Manufacturing &amp; Testing</td>
<td></td>
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