

**TECHNICAL SPECIFICATION FOR**  
**SUPER ENAMELED ROUND ALUMINUM WINDING WIRE**

1. **SCOPE :-** This specification provides for the manufacturing, testing and supply of super enameled round aluminum winding wire for making transformer coils with **Grade-2 insulation covering and Class-130**.
2. **STANDARDS :-** The Super Enameled (S.E.) Annealed Aluminium winding wire shall strictly conform the following Indian Standard specifications or any other relevant IS, which shall mean latest revisions with amendments / changes adopted and published unless specifically stated otherwise in the specification, as regards material, design, manufacture and testing etc.

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|----|---------------|---|--------------------------------------------------------------------|
| 1. | IS: 1778:1980 | : | Specification for Reels and Drums for Bare Conductors.             |
| 2. | IS: 482-1981  | : | Specification for reels for covered round electrical winding wires |
| 3. | IS: 4026-1969 | : | Specification for EC grade aluminium rod.                          |
| 4. | IS: 13730     | : | Specification for Enameled round winding wires.                    |
| 5. | IS: 13778     | : | Specification for Winding Wire test method.                        |

3. **CONDUCTOR:**

- 3.1 **Material:** The conductor shall be manufactured from EC Grade Aluminium rod and strictly conforming to relevant IS and shall be Annealed condition.

Material used in manufacturing 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 Aluminium conductor shall be hard drawn from electrolytic Aluminium rod made from HINDALCO, NALCO, BALCO make only purity not less than 99.5%. Test certificates of Aluminium Manufacturer in respect of impurity content of Aluminium conductivity etc. shall have to be furnished in order to assess its quality.

3.2 **Physical Constants for Aluminium:**

- (i) **Resistivity-** The resistivity at 20°C of a conductor of one meter in length and of a uniform cross sectional area of one square millimeter shall be 0.0280 ohm.
- (ii) **Density-** The density of the conductor at a temperature of 20°C shall be taken as 2.703 gm/cm<sup>3</sup>.
- (iii) **Co-Efficient Of Linear Expansion-** The co-efficient of linear expansion of the conductor at a temperature of 20°C shall be taken as  $23 \times 10^{-6}$  per degree Celsius.
- (iv) **Constant Mass' Temperature Co-Efficient Of Resistance-** At a temperature of 20°C the 'constant mass' temperature co-efficient of resistance of the conductor measured between two potential points rigidly fixed to the conductor be taken 0.004 per degree Celsius.

**NOTE:** For any temperature to above 0°C the temperature coefficient of resistance is:—  $1/(230+t_0 \text{ } ^\circ\text{C})$ .

- 3.3 **Diameter of Conductor :** The diameter and tolerance on conductor diameter shall be as given in Table-1 of IS: 13730 (Part-0/Sec-3).
- 3.4 **Joints :** There shall be no joint of any kind in the conductor. 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”.

**4. GRADE OF INSULATION:**

The super enameled insulation shall be of Grade-2.

**5. ENAMEL INSULATION:**

5.2 **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 particles of dust and other deleterious materials. The modified polyester type insulating varnish for enameling of wire shall be used.

5.3 **Thickness of insulation:** Thickness of insulation should be of Grade-2 as per Table-1 of IS:13730 (Part-0/Sec-3) with latest amendments, and shall correspond to series R-20.

5.4 **Class of Insulation:** The super enameled aluminium winding wires shall be of Class-130. Class 130 is a thermal class that requires a minimum temperature index of 130 and a heat shock temperature of at least 155°C as per IS: 13730 (Part-9).

**6. OVERALL DIAMETER AND INCREASE IN DIAMETER :**

The overall diameter of wire, the increase in diameter due to insulation shall be in accordance with Table-1 of IS: 13730 (Part-0/Sec-3). The corresponding value for intermediate size shall be those applicable for immediately next higher standard size.

**7. WORKMANSHIP:**

All the Aluminium 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 insulation 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

**8. PACKING & MARKING**

8.1 The conductor shall be supplied on strong non-returnable plastic reel 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 plastic reel used for packing shall conform to IS:482-1981. The reel 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. All reels shall have layer of a waterproof paper over inner barrel. The filled reels shall also be covered with a waterproof paper to protect the conductor wrapped on it from moisture and other rough surfaces. The wire shall be wound compactly and evenly on reel. The conductor should not bulge or be projected outside the rim of the reel so as to ensure the conductor protection. The conductor should remain half inch below the outer periphery of reel.

**Each reel shall have the Name of manufacturer/supplier and details of Purchaser engraved/embossed necessarily on it** and the remaining information from the following shall be marked on reel with indelible ink or on paper sticker pasted on reel along with other essential data. The sticker shall be of good quality paper, well fixed on reel and not easily removable.

1. Name of Manufacturer.
2. Name of Discom (Paschimanchal Vidyut Vitran Nigam Ltd.)
3. Identification/Serial no. of reel.
4. Contract/Specification number.
5. Size and type of conductor.
6. Gross weight of the reel.
7. Weight of the empty reel.
8. Net weight of conductor.

8.2 The gross weight of each reel (with material) shall not exceed the weight given below

size	Max Gross weight (approx.)
1.32mm – 2.03mm	18 Kg

9. **TESTING:**

The super enameled aluminium conductor and wire shall be subjected to the following tests in accordance with relevant IS –

- 9.1 Checking of dimension of Aluminium conductor.
- 9.2 Measurement of increase in diameter due to insulation.
- 9.3 Electrical resistance test on Aluminium conductor.
- 9.4 Elongation test
- 9.5 Tensile Strength Test
- 9.6 Flexibility and adherence test.
  - (i) Mandrel winding test.
  - (ii) Stretching Test
  - (iii) Jerk Test
- 9.7 Heat shock test.
- 9.8 Resistance to solvent test.
- 9.9 Breakdown voltage test at room temperature.
- 9.10 Checking of wire surface and declared weight.
- 9.11 Visual Examination test on wire drums as per IS.
- 9.12 The rejection & retest procedure shall be followed as stipulated in IS.

The purchaser reserves the right of carrying out some other additional test as per IS if required to ensure the quality of material as he may decide, such test will be carried out at contractor's work or at approved test laboratory at contractor's cost.

10. **TESTING AND TEST CERTIFICATE**

The conductor shall be subject to all tests laid down in the relevant ISS at contractor's work or at approved test laboratory at contractor's cost. Certified copies of test certificate in respect of tensile test of Aluminium, quality of Aluminium and insulation used for covering and all other tests as prescribed in the relevant ISS shall be furnished by contractor in triplicate, one copy to respective consignee officer second copy to SE (MM-I), PVVNL Victoria Park, Meerut. The inspection of the conductor offered will be arranged by the SE (MM-I), PVVNL Victoria Park, Meerut.

**11. CALIBRATION OF TESTING EQUIPMENTS :**

The tensile testing machine and Kelvin's Bridge machine etc. shall be got checked from the competent authority for calibration once in a year. Calibration certificates, when demanded by the Inspecting Officer, shall be produced for verification purposes. In case of dispute regarding calibration, the instruments shall be jointly sealed and sent to institutions, lab or deputed for calibration at the cost of supplier. The result of such checking shall be binding on the supplier.

**12. 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.

**13. TOLERANCE OF QUANTITIES**

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

**14. GUIDELINES FOR MANUFACTURING AND INSPECTION**

- 14.01 The firm shall manufacture the material ensuring the technical specification and IS strictly.
- 14.02 The firm shall use the aluminum rod purchased from BALCO/NALCO/HINDALCO as raw material for manufacturing of tendered item.
- 14.03 When the material is ready for dispatch, the firm shall send offer notice to the Superintending Engineer (MM-I) PVVNL Victoria Park Meerut, so that the inspection of the material may be carried out at the supplier's premises before dispatch.
- 14.04 When the material is offered for inspection, the same shall be kept ready dully packed for dispatch. Inspecting officer shall make random selection from this lot of material according to the terms of the agreement or relevant ISS as the case may be.
- 14.05 The firm shall produce the Invoices and test certificate of raw material (Aluminum rod) purchased during last 4 months of inspection offer, to the inspecting team at the time of inspection/testing of material.
- 14.06 At the time of Inspection, the Firm shall produce the account statement as well as invoices of raw material and finished product, to the Inspecting Authority with the following details ensuring that the offered material is manufactured from the Aluminum Rod purchased from BALCO/NALCO/HINDALCO.
  - (i) Purchase of raw material from BALCO/NALCO/HINDALCO during last 4 months.
  - (ii) Sale of finished product manufactured from above material during last 4 months.
  - (iii) Finished product which is manufactured from above material but still laying at manufacturer's premises.
  - (iv) Raw material balance at manufacturer's premises.
- 14.07 The inspection team shall verify the above statement with the invoices of raw material to ensure that the offered material is manufactured from the Aluminum Rod purchased from BALCO/NALCO/HINDALCO. In case of any discrepancy found on this account, the material shall not be accepted. The inspection team has to attach all such documents with inspection report.

- 14.08 The Inspection team shall conduct the inspection/testing as per TS/GTP confirming the relevant IS. Supplier shall also render necessary assistance to the Inspecting Officers in making random sampling whenever considered necessary.
- 14.09 The Inspection team shall ensure the packing and marking of offered material as per TS/GTP, in their presence.
- 14.10 The Inspection team shall ensure the sealing of offered material after inspection/testing, in their presence. The material approved for dispatch after inspection shall be duly marked, packed or sealed by the supplier as considered necessary by the Inspecting Officer.
- 14.11 The firm has to strictly abide by the guideline laid down regarding packing and marking of material as is provision of TS of this tender as well as of relevant IS before offering the inspection of finished product to S.E (MM-I). In case of any discrepancy found by inspecting authority during inspection or at the time of receipt of inspected material the material shall be rejected and futile journey charges as per terms condition shall be imposed on the firm. In case of any discrepancy found in material quality, packing and marking at the time of receipt of material, the material shall be rejected and the firm shall offer fresh inspection offer of material in place of rejected material. On repetition of such activity the firm may be blacklisted/debarred.
- 14.12 Notwithstanding the inspection carried out by the Officers of PVVNL, or their authorized representative, the firm shall be responsible to ensure correct supply of material at the destination both in terms of quantity as well as quality as per order.
- 14.13 The Inspecting Officer shall have the right for checking of records pertaining to receipt and issue of all major raw materials and you shall have also to submit the requisite test certificates, if any, for each and every consignment of major items of raw material.
- 14.14 No material shall be dispatched, without inspection and testing by the representative of Superintending Engineer (DQC) PVVNL Meerut. Testing charges, if any shall be borne by the supplier.