

**TECHNICAL SPECIFICATION**  
*for*  
**DOUBLE PAPER COVERED RECTANGULAR ALUMINIUM CONDUCTORS**

**1. SCOPE :-**

This specification provides for the manufacturing, testing and supply of Double Paper covered Annealed rectangular Aluminium **Strip** for making transformer LT 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.

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| 1. IS: 6160-1971<br>(with amendment, 3 July 1987) | : Specification for Rectangular Conductors for Electrical Machines. |
| 2. IS: 6162 (Part-II)- 1971 (2003)                | : Specification for Paper covered aluminium conductors.             |
| 3. IS: 1778:1980                                  | : Specification for Reels and Drums for Bare Conductors.            |
| 4. IS: 4026-1969                                  | : Specification for EC grade aluminium rod.                         |

**3. CONDUCTOR:**

- 3.1 **Materials:** The conductor shall be manufactured from EC Grade Aluminium rod and strictly conforming to relevant IS:4026-1969 and shall be of "**Annealed-O**" condition

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 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 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 **Radius On Corners:** The conductor shall have radius corners. The radius of curvature nature being in accordance with table-3 of IS:6160. The arc shall merge smoothly into the flat and the conductor shall be free from sharp, rough and projecting edges. The specified radii shall be maintained within  $\pm 25$  percent.

**Note: Tolerance on dimensions shall be as per table 3 of IS: 6160.**

- 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 COVERING:**

The Grade of covering shall be **Double paper covering**.

**5. PAPER :**

- 5.1 **Grade of Paper:** The paper used shall be electrical grade insulating paper. The paper, before application, shall be free from metallic and other injurious inclusions, shall have no deleterious effects on insulating oil and shall be of such quality that it will satisfy all the requirement of paper specified in IS:6162 (Part-II).
- 5.2 **Width of Paper:** The width of paper used for lapping shall be within a limit of maximum 12mm and minimum 3mm suitable as per dimension of strip.
- 5.3 **Thickness:** The thickness of paper used shall be between the limits of 1 MIL (0.0254mm) and 5 MIL (0.13mm) both inclusive with a total minimum increase in dimension of 0.25mm due to covering. The measurement of thickness shall be done in accordance with 7 of IS: 1060 (Part-I).
- 5.4 **Arrangement of Layers:** Double paper covering shall be used. Both the layers shall be overlap wound in the opposite direction. Further the paper tape wound with each turn overlapping the preceding turn by not less than 25 percent of the paper width.
- 5.5 **Application of Paper:** 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 and 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 transformer oil, insulating paper, or electric strength of covering.

**6. INCREASE IN CONDUCTOR DIMENSION DUE TO COVERING :**

The increase in dimensions due to covering shall not exceed the specified nor it shall be less than the specified by more than the appropriate tolerance stated in Table- 2 of IS:6162 (Part-II).

**7. WORKMANSHIP :-**

All the Aluminium conductor 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.

**8. PACKING & MARKING**

- 8.1 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 Aluminum 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.
- 8.2 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.

## **Tender Specification No. : PVVNL-MT/MM/4/24-25**

- 8.3 All wooden components shall be manufactured out of seasoned wood, preferably soft wood 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.
- 8.4 Each drum shall have the following information marked on it with indelible ink along with other essential data. The conductor should remain half inch below the outer periphery of drum.
1. Name of manufacturer
  2. Name of Purchaser Discom (Paschimanchal Vidyut Vitran Nigam Ltd.)
  3. Identification/ Serial no. of Drum No.
  4. Contract/Specification number.
  5. Size and type of conductor.
  6. Number and length of each conductor in the drum.
  7. Gross weight of the drum.
  8. Weight of the empty drum.
  9. Net weight of conductor.
- 8.5 The gross weight of each drum packing (with material) shall not exceed the weight given below

size	Max. Gross weight (approx)
Various sizes	70 Kg

### **9. TESTING:**

The conductor shall be subjected to the following tests in accordance with relevant IS: -

- 8.1 Checking of dimension of Aluminium conductor.
- 8.2 Increase in size due to covering.
- 8.3 Electrical resistance test on Aluminium conductor.
- 8.4 Breaking load tests on Aluminium.
- 8.5 Elongation test on Aluminium.
- 8.6 Checking of conductors surface, declared length and weight.
- 8.7 Visual Examination test on conductor drums as per IS: 1778/1980.
- 8.8 The rejection & retest procedure shall be followed as stipulated in IS.
- 8.9 Checking for double paper covering as per IS: 6162 (Part-II)

### **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 paper 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 AND 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 and 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.

**Tender Specification No. : PVVNL-MT/MM/4/24-25**

- 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.