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***Draft Indian Standard***

**Paper - Covered Flexible/Stranded Copper Conductors for Transformer Leads —  
Specification**

*(Second Revision of IS 8572)*

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Winding Wire Sectional  
Committee, ETD 33

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**FOREWORD**

(Formal clauses of the draft will be added later)

This standard specifies the requirements of paper covered high conductivity annealed copper flexible/stranded conductors to be used as transformer connecting leads.

First revision of this standard was undertaken in 1993. This revision has been undertaken to align it with the international practices to the extent possible

Revision of this standard has been taken up to update, mainly the requirements of paper and to align it with the present practices followed in the industry.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2: 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Draft Indian Standard*

**PAPER - COVERED FLEXIBLE/STRANDED COPPER CONDUCTORS FOR  
TRANSFORMER LEADS — SPECIFICATION**

*(Second Revision)*

**1 SCOPE**

This draft standard covers the requirements of multiple paper covered high conductivity annealed copper flexible/stranded conductors for use in transformers as connecting leads.

**2 REFERENCES**

The provisions in following documents become the provisions of this part through reference in this part. All standards at the time of publication the edition indicated were valid. All standards are subjected to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

<i>IS No.</i>	<i>Title</i>
IS 8130: 2013	Conductors for insulated electric cables and flexible cords ( <i>first revision</i> )
IS 9335 Part 3/Sec 1) : 1984	Cellulosic papers for electrical purposes Part 3 Specifications for individual materials, Section 1 General purpose electrical paper

**3 TERMINOLOGY**

For the purpose of this standard, the following definitions shall apply.

**3.1 Stranded Conductor**

A conductor made up of a number of wires twisted together in concentric layers (when the conductor consists of more than one layer alternate layers are normally twisted in opposite direction).

**3.2 Bunched Conductor**

A stranded conductor in which all wires are twisted together in the same direction and with the same lay throughout.

**3.3 Bunched and Rope Stranded Conductor**

A number of bunched wires as in 3.2 above are stranded together as in 3.1 usually unidirectionally, that is, with the same direction of lays as individual bunch.

**3.4 Increases in Diameter Due to Covering**

The difference between the diameter over paper insulation and the diameter of the conductor.

### **3.5 Butt-Wound**

Paper applied helically in tape form in such a manner that the edge of each turns butts against the edge of the preceding turn.

NOTE — In order to avoid a possible gap between two successive turns of paper, and overlap of up to 1 mm is permissible.

### **3.6 Overlap Wound**

Paper tape helically wound with each turn overlapping the preceding turn by not less than 25 percent of the width of paper tape.

### **3.7 Group of Papers**

Two, three, four or more layers of paper applied in one operation from a single paper lapping head.

## **4 GENERAL TEST CONDITIONS**

**4.1** Unless otherwise specified, all tests shall be carried out within a temperature range of 15° to 30° C and at a relative humidity range of 45 to 75 percent. Before measurements are made, the specimens shall be preconditioned under these atmospheric conditions for a time sufficient to allow specimens to reach stability.

**4.2** The wire to be tested shall be removed from the packaging in such a way that it shall not be subjected to tension or unnecessary bends.

**4.3** Before each test sufficient length of wire shall be discarded to ensure that any damaged wire is not included in the test specimens.

**4.4** When no specific range of sizes is given for a test, the test is applicable to all sizes.

## **5 CONDUCTORS**

The conductor shall be composed of plain annealed high conductivity copper wires complying with IS 8130.

## **6 PAPER**

### **6.1 Grade of 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 a quality that it will satisfy the requirements of IS 9335 ( Part 3/Sec 1 ).

## **7 APPLICATION OF PAPER**

### **7.1 General**

To prevent the inclusion of copper 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 effect on transformer oil, insulating paper or the electric strength of the covering. Where papers of different thickness are used, the outermost paper shall be the thickest.

**7.2 Width of Paper**

Unless otherwise agreed between the manufacturer and the purchaser, the width of the paper used shall not exceed three times the diameter of the conductor.

**7.3 Arrangement of Layers**

All the layers shall be applied in the same direction and all except the outermost layer shall be butt wound, and the outermost layer shall be overlap wound. Within each group of papers the position of the butt joints of any layer relative to the layer below shall be progressively displaced by approximately 30 percent of the paper width.

NOTE — Layer arrangements differing from that specified in this clause may be adopted by arrangement between the manufacturer and the purchaser provided that the covered conductor meets all the other requirements of this standard.

**8 INCREASE OF CONDUCTOR DIAMETER DUE TO COVERING**

**8.1 Increases in Diameter**

The increase in diameter due to covering shall not exceed that specified nor shall be less than that specified by more than the appropriate tolerance stated in Table 1.

**Table 1 Increase in Diameter Due to Covering**

*(Clause 8.1)*

Sl No.	Increase in Diameter Due to the Covering		Tolerance
	Over	Up to and Including	
(1)	(2) mm	(3) mm	(4) percent
i)	—	0.5	10
ii)	0.3	1.5	7.5
iii)	1.3	5	5

**8.2 Measuring Equipment**

The measurement shall be made with accuracy better than 0.002 mm. If a micrometer is used, it shall be ensured that the measuring force is in the range of 0.75 to 3.0 N. Alternatively, a force of 1 to 3 N may be used. The spindle and the anvil of the micrometer shall have a diameter of 5 to 8

mm.

## **9 MEASURING METHOD**

### **9.1 Overall Diameter**

Approximately 1.5 m length of the wire from the reel shall be discarded and the diameter shall be determined over the paper covering. Three measurements at 60° angular displacement shall be made around the circumference of the wire at each of the two places 1 mm apart. The measurement shall include at least one overlap.

The average of the six results shall be reported as 'Overall diameter'.

### **9.2 Conductor Diameter**

The paper covering shall be removed at two circumferences of the conductor at the places where overall diameter are determined. Three measurements at 60° angular displacement shall be made around the circumference of the conductor at these places.

The average of the six results for the bare diameter shall be reported as 'conductor diameter'.

## **10 PACKING AND MARKING**

**10.1** The covered conductor shall be wound on reel/drum or in coil as required and wrapped.

**10.1.1** The label, which shall be securely attached to reel/drum/coil, shall bear the information given below. When drum is used stenciling may be done in place of label.

- a) Manufacturer's name or trade-mark;
- b) Number and nominal diameter of single conductor;
- c) Cross-sectional area of the conductors;
- d) Diameter of covered conductor;
- e) Mass of conductor;
  - 1) Cross, and
  - 2) Net; and
- f) Number of lengths, if there is more than one length in one drum.