	CORPORATE PURCHASING SPECIFICATION	AA 28144
		REV NO. 03
		PREFACE SHEET

POLYESTERIMIDE ENAMELLED RECTANGULAR COPPER CONDUCTORS (TEMPERATURE INDEX 155)

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REMOVE THIS PREFACE BEFORE ISSUE TO SUPPLIERS

Comparable Standards:

1. **INDIAN : IS:13730-Pt. 16 -1996** Î
2. **INTERNATIONAL : IEC 60317 – 16 : 1990** Î

USER PLANTS REFERENCES

1. **BHOPAL : PS 31430**

Revision : Cl.34.1.19 of MOM of MRC- E			**APPROVED :** INTER PLANT MATERIAL RATIONALISATION COMMITTEE- MRC (E)		
Rev.No. 03	**Amd.No.**	**Reaffirmed**	**Prepared** BHOPAL	**Issued** Corp. R&D	**Dt.of Ist Issue** Dec. 1977
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POLYESTERIMIDE ENAMELLED RECTANGULAR COPPER CONDUCTORS (TEMPERATURE INDEX 155)

1. GENERAL:

This specification governs the quality requirements of rectangular copper conductors, insulated with flexible enamel based on polyesterimide base fine and medium covering with a temperature index of at least 155.

2. APPLICATION:

Used in the windings of Rotating Electrical Machines. Î

3. COMPLIANCE WITH NATIONAL STANDARDS:

This specification conforms to the following Standards and shall also meet the alternate / additional requirements of this specification. Î

IS:13730 Pt 16 1996 : Specification for particular types of winding wire- Polyester enameled rectangular copper wires clause 155. Î

IEC : 60317– 0–2 : Specification for particular types of winding wire Pt. 0 - General Requirements - Section 2 Enamelled Rectangular Copper Wire. Î

4. SIZES :

The conductor shall be supplied to the sizes specified in our order.
The sizes shall be preferably selected from Cl. 4 of IS : 13730 Pt . 16 Î

5. JOINTS :

No joint shall be made in the copper conductor after it is drawn.
Any joint made during the drawing process shall be resistance welded only.

6. CONDUCTOR :

6.1 Conductor Material :

The conductor shall be manufactured from ETP grade copper , conforming to IS : 191 Part 5 , and shall be of high conductivity, annealed copper .

6.2 TOLERANCES ON NOMINAL DIMENSIONS :

Width of Conductor mm			Tolerance on thickness ± mm			
Over	Up to & incld.	Tol.(±)	Up to 1	Over 1 & Incld. 3	Over 3 & Upto 6	Over 6 & up to 10
-	3	0.03	0.02	0.03	-	-
3	6	0.04	0.02	0.03	0.04	-
6	10	0.07	0.02	0.03	0.04	0.07
10	18	0.10	0.02	0.03	0.04	0.07
18	25	0.10	0.03	0.04	0.06	0.08

6.3 Radius on Corners :

The conductor shall have radius corners, the radius of curvature together with the Tolerances being as given below. The arc shall merge smoothly in to the flat and the conductor shall be free from sharp, rough and projected edges.

Thickness of strip, mm		Nominal Radius on edges in mm	Tolerances (± mm)
Over	up to & incl.		
-	1.2	0.4	0.06
1.2	1.7	0.5	0.08
1.7	2.5	0.6	0.09
2.5	4.0	0.8	0.12
4.0	10.0	1.0	0.15

6.4 Tensile Strength & Elongation :

A sample of conductor 250 mm long between the grips shall be steadily elongated at a rate of 60 to 300 mm/minute until the conductor fractures. The tensile strength and elongation at fracture shall comply with the following requirements :

Nom. Conductor Thickness in mm		Tensile Strength Max.	Elongation at 200 mm G.L.
Over	Up to & incld.	N / m^2	% Min.
0.8	2.5	265	30
2.5	10.0	255	35

6.5 Hardness :

Hardness on finished conductor shall not exceed 60 HV.

6.6 Resistance :

The resistance at 20 ° C of a conductor of one meter length and of uniform cross sectional area of 1 mm ^{2} shall be taken as 0.01737 ohm max.

7.0 Increase In Dimensions Due To Covering :

The increase in dimensions due to the enamel covering, shall conform to the values given below :

Grade	Increase in Dimension, mm	
	Minimum	Maximum
Fine	0.06	0.11
Medium	0.11	0.16

8.0 ENAMEL COVERING:

8.1 General :

The conductor shall be completely and uniformly covered with a durable, flexible synthetic enamel polyesterimide base . The enameled conductor shall have a smooth surface, free from embedded particles of dust and other deleterious materials.

8.2 Flexibility And Adherence:

Separate samples of conductors above 2 mm thickness shall be bent,one on edge and one on flat, through 180º round a mandrel of diameter 4 times the bare width of the conductor when bent on edge or four times the bare thickness when bent on flat.

Conductors of upto and including 2 mm thickness shall be pre-elongated by 10 percent and bent through 180° round a mandrel of diameter 9 times the thickness as per the standard procedure.

After bending the samples shall show no cracks and peeling off when examined under a magnification of approximately 10-15 times .

8.3 Prolonged Heat Shock Test :

Samples of conductor above 2 mm thickness shall be bent, on flat, through 180 º round a mandrel of diameter 4 times the bare thickness of the conductor.

Conductors upto and including 2 mm thickness shall be pre-elongated by 10% and bent through 180 ° round a mandrel of diameter 9 times the thickness in accordance with the standard procedure.

The samples prepared as above shall be placed in an electrically heated forced air circulation oven at a temperature of 180 ± 2º C for 48 hours. After removal from the oven, the samples shall be allowed to cool to room temperature and shall show no cracks when examined under a magnification of approximately 10-15 times.

8.4 Thermal Endurance Test :

The manufacturer shall certify that the enameled wire has been made using materials and process that have been shown to give a product which will meet the following requirement.

When tested by the method given in IS : 13778 Pt. 6 / IEC -851 Pt. 6 , temperature Î corresponding to an extrapolated life 20,000 hours shall be not less than 155 ° C.

8.5 Hardness of Enamel :

When tested under a thrust of 500 gf the hardness of the pencil which just fails to scrape off the enamel to the bare conductor shall be 5 H minimum.

8.6 Resistance of Enamel to Varnish Solvent :

Six samples of enameled conductors immersed in the solvents xylole butanol (approx. 9 : 1) solvent naphtha, toluene, White spirit, methylated spirit (when specially demanded) butanol, butyl acetal for 24 hours at 10° to 40°C and allowed to dry for 30 minutes after removal. The hardness of enameled conductor so obtained shall not be reduced when compared to that specified in clause 8.5.

8.7 Resistance of Enamel to Insulating Oil :

The enameled conductor bent on flat as described in clause 8.2 & then immersed in oil conforming to IS:335 for 6 hours at 110 ± 2º C and allowed to cool to room temperature. The hardness of enameled conductor so obtained shall not be reduced when compared to that specified in clause 8.5.

8.8 Cure Test :

A sample of the enameled wire shall be conditioned by baking at 130 ± 2°C. for 10 minutes and allowed to cool to room temperature. Not less than 100 mm of the sample shall then be immersed, without bending for 5 minutes in a boiling mixture 30% commercial grade toluene and 70% denatured ethyl alcohol by volume. On removal from the liquid the enamel film shall show no visible swelling or blistering except on the last 10 mm of the immersed end.

8.9 Electric Strength :

When tested at 155 ± 2° C by the method specified in IS:13730 Pt. 16 the enameled conductor shall not breakdown at a voltage less than specified below : Î

Grade of covering	Breakdown Voltage Min
Fine	750
Medium	1500

9.0 TEST CERTIFICATES:

Unless otherwise stated, three copies of test certificates shall be supplied along with each consignment . In addition, the supplier shall ensure to enclose one copy of test certificate along with their dispatch documents to facilitate quick clearance of the material. Î Î Î

The test certificate shall bear the following
AA 28144 : Polyesterimide Enamelled Rectangular Copper Conductors
(Rev.No 03) : Conductors. (Temp. Index 155) Î

BHEL Order No.
Manufacturer's/Supplier's Name.
Batch / Lot No.
Sizes and Quantity Supplied.
Test results / certificate of compliance with clause 6 to 8

Note: On first consignment for establishment of material, the supplier shall indicate the type and make of enamel used for the conductors, with their life time characteristics, for BHEL's approval. The approved enamel as identified by IR spectroscope or any other suitable instrumental method shall only be used. On subsequent orders, supplier shall furnish a certificate that only the approved enamel have been used. Î Î

10. PACKING AND MARKING:

The covered conductor shall be wound on Drum No. 4520 (Dia. Of flange to IS:2069 = 450 MM and approximate capacity = 55 Kgs.) . In all the cases, the covered strip shall be protected against possible damages from the inner faces of the flanges of the drums by lining each flange with stout paper or card.

Each drum shall be marked with the following :
AA 28144 : Polyesterimide Enamelled rectangular Copper conductors (Temp. Index 155).

BHEL Order No.
Suppliers Name
Size of the Conductor
Quantity

11. Referred Standards (Latest Publications Ind. Amdts) Î

1. IS : 13730 Pt.16	**2. IEC 60317-0-2**	**3. IS : 191**
4. IS : 13778 Pt. 6	**5. IEC 851 Pt. 6**	**6. IS:335**
7. IS : 2069		