

ENAMELLED AND PAPER COVERED COPPER CONDUCTOR

1. GENERAL:

This Specification governs the quality requirement of copper conductors insulated with PVA enamel. The Conductor shall meet the requirement of our Specifications AA 28125/ AA 28128 as applicable except that proof stress value shall be as specified in order. The copper conductors shall be either individually insulated by paper covering or radially or axially bunched with individual and combined paper covering as specified in order.

The enamelled conductor shall comply with grade 1 or 2 as specified in order and as per Cl. 4.4 of IEC: 60317-0-2. Increase in dimensions due to enamelling shall be as per Cl. 4.4 of IEC: 60317-0-2. Joints shall not be made in the conductor after it is drawn. Any joint made during the drawing process shall be resistance welded and subsequently cold worked.

Insulating paper used shall conform to our Specification AA 21111 except that conductivity of Aqueous extract shall be 4.5 milli S/m max.

2. APPLICATION:

Use for windings of transformers.

3. COMPLIANCE WITH NATIONAL STANDARDS:

Assistance has been taken from the following National / International standard.

IEC: 60317-0-2-1997: General requirements – Enamelled rectangular copper wire.

IEC: 317-18-1990 : Specification for Polyvinyl acetal enamelled rectangular copper wire Class 120.

IS: 13730 (Part-18) 1996 : Specification for Polyvinyl acetal enamelled rectangular copper wire class.

4. DIMENSION OF CONDUCTORS:

The conductor dimensions shall be as per Specification No. AA 28125 / AA 28128 as applicable.

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02	05.02.04	Ckd <i>[Signature]</i> Appd. <i>[Signature]</i>	01	7.2.03	Ckd & Appd Sd. TKG				
Cl.6.1 Revised in line with IS 13730. Cl.18 revised			Spec. completely revised & updated			Prep.	R.K.SINGH	Sd	7.11.94
						Ckd & Appd	S.N.AGARWAL	Sd	7.11.94

5. TOLERANCE AND DIMENSIONS OF CONDUCTORS:

TABLE 1

Nominal width or thickness of the conductor mm		Tolerance ±
Over	Up to and including	mm
-	3.15	0.030
3.15	6.30	0.050
6.30	12.50	0.070
12.50	16.00	0.100

The increase in width or thickness due to enamelling shall be as under:

TABLE 2

Grade	Increase in dimensions mm		
	Minimum	Nominal	Maximum
1.	0.06	0.085	0.11
2.	0.12	0.145	0.17

6. OVERALL DIMENSIONS:

6.1 OVERALL DIMENSIONS:

The overall dimensions shall not exceed the sum of maximum bare dimensions given in Table -1 and maximum increase in dimensions permitted in Table-2 of Cl.5 above.

6.2 INCREASE IN DIMENSIONS DUE TO COVERING :

The increase in dimensions due to paper covering shall be as per AA 28125 / AA 28128 as applicable and tolerance on covering shall be as per applicable Specification AA 28125 / AA 28128.

7. RADIUS ON CORNERS:

The radius on corners shall be as per applicable Specification AA 28125 / AA 28128.

8. ELONGATION / PROOF STRESS :

Refer Specification No. AA 28125 / AA 28128 as applicable

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9. ELECTRICAL RESISTIVITY :

The resistance of the wire shall be expressed as the d.c. resistance at 20 °C. The resistivity shall conform to specification No. AA 28125 / AA 28128 as applicable.

10. PAPER AND ITS APPLICATION :

Refer relevant Specification No. AA 28125 / AA 28128.

11. WAX COATING :

Refer Specification No. AA 28125 / AA 28128 as applicable.

12. MEASURING EQUIPMENT AND METHOD AND COUNTER CHECK :

Refer Specification No. AA 28125 / AA 28128 as applicable.

13. SPECIFIC REQUIREMENTS FOR BUNCHED CONDUCTORS/WIRE:

Refer Specification AA 28125 / AA 28128 as applicable.

14. TESTS ON ENAMELLED CONDUCTOR :

14.1 FLEXIBILITY AND ADHERENCE

14.1.1 MANDREL WINDING TEST

The coating shall show no crack after the wire has been bent flat wise on a mandrel with a diameter as specified in table 3.

TABLE 3 – MANDREL WINDING

Wire bent on		Mandrel diameter
Thickness	All sizes	2 x thickness
Width	Sizes up to and including 10 mm	2 x width
	Sizes over 10 mm	3 x width

14.1.2 ADHERENCE TEST / STRETCHING TEST:

The wire shall be stretched by 20 %. The distance of loss of adherence shall be less than 1 x width.

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15. HEAT SHOCK :

The coating shall show no crack after the wire has been bent flat wise on a mandrel with a diameter of six times the thickness and the minimum heat shock temperature shall be 155 °C and the test to be conducted as per IEC: 60317-0-2-1997 & IEC: 317-18-1990.

16. RESISTANCE TO SOLVENTS:

Standard solvent. Using a pencil of hardness "H" the coating shall not be removed.

17. BREAKDOWN VOLTAGE:

When tested at room temperature at least four of the five specimens tested shall not break down at a voltage less than or equal to that given in Table 4, and the fifth shall not break down at less than 50% of the values specified. The wire shall also be tested at the elevated temperature of 120 °C.

TABLE 4 – BREAKDOWN VOLTAGE

Grade	Minimum breakdown voltage	
	KV rms	
	Room temperature	Elevated temperature (120 °C.
1.	1 000	750
2.	2 000	1500

18. TESTING

Finished conductor shall meet the electric strength test as per Cl.11 of AA 28128. Further, insulation test shall be conducted at 250 V AC for 1 minute on , all drums and charging current (Leakage current between enamelled strips due to capacitive effect) shall not exceed 100 milli Amp/km length instead of Cl. 12.2 of AA 28128.

18.1 Bunched PICC With Grade-2 Enamel & With Individual Paper Covering On Strands: In case of bunched conductors having grade 2 enamel insulation and with individual paper covering and overall paper covering or where individual enameled strands are separated by epoxy bonded Nomex strip and provided with overall paper insulation each drum shall be tested for isolation between strands for at least 2 seconds at 2 kV AC and charging current shall be noted and indicated in the test report. In case of single enamelled strand the test voltage shall be 1 kV AC.

18.2 Bunched PICC With Grade-1 Enamel & With Individual Paper Covering On Strands: In case of bunched conductors having grade 1 enamel insulation and with individual paper covering and overall paper covering or where individual enameled strands are separated by epoxy bonded Nomex strip and provided with overall paper insulation each drum shall be tested for isolation between strands for at least 2 seconds at 1 kV AC and charging current shall be noted and indicated in the test report. In case of single enamelled strand the test voltage shall be 0.5 kV AC.

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- 18.3 **Bunched Pice With Grade-1/2 Enamel & Without Individual Paper Covering On Strands:** For bunched conductors without any paper covering on individual strand the test voltages shall be 50 % of the levels specified above for respective enameling grades.

19. PACKING AND MARKING:

All other requirement including Test Certificates, Packing, marking etc. shall be as per AA 28125 and AA 28128.

20. TEST CERITIFICATES:

Three copies of test certificates shall be supplied alongwith each consignment giving the following information:

TRE – 078 & / or TRE – 151 - Enamelled Rectangular Copper Conductor.

Conductor Size.

Overall Conductor size,

Increase in dimensions due to enamelling, individual & overall paper covering, Number of layers, paper thickness.

BHEL Order No.

Manufacturers /Supplier's Name

No . of Drums / Net Weight.

Batch No / Lot no.

Test results obtained for tests on conductor and wire as per clauses 3 to 18 of TRE - 078

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