

	INSULATION SKETCH	IN. SK. 46085
	INSULATION SYSTEMS ENGINEERING	Rev. No.: 03
	Enameled and Polyester Film Backed Mica Paper Taped Rectangular Copper Wire	Rev. Dt.: 08/05/2018 Sht. 1 of 7 shts.

1. GENERAL

INSULATION CLASS - F

This specification governs the quality requirements of rectangular copper conductors insulated with enamel and one layer of polyester film backed Mica Paper Tape. The polyester film shall be on outside surface of the insulated conductor. The insulated conductor has a temperature index of at least 155.

2. APPLICATION

These conductors are used for stator coils of high voltage A.C. Machines. The insulation should be able to withstand the stresses generated during loop winding and coil pulling / shaping operations.

3. COMPLIANCE WITH NATIONAL STANDARDS

There is no Indian Standard covering this type of material.

4. SIZES

The conductors shall be supplied to the size specified on the order.

5. TEST METHOD

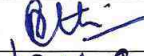
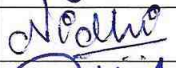
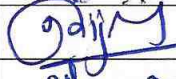
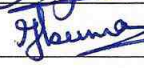
As stated against each clause.

6. SAMPLE FOR TEST

5-meter-long sample of enameled and mica taped copper conductor of this specification shall be supplied for testing and approval purpose.

7. 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.

Distribution:	Date of Rev. 00:30/04/2016	Name	Signature
CIM (Turbo Coil Shop)	Prepared by	Abha Otti	
CIM (Turbo Coil Planning)	Checked by	Nidhi Gupta	
QCI	Approved by	Anirudha Tijare	
AME	Issued by	Gautam Kumar	
TSD			
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8. CONDUCTORS:

8.1 Conductor material:

The bare conductors shall be manufactured from high conductivity copper complying with BHEL standard AA 12030 "Rectangular Copper Conductor-Annealed, controlled oxygen". There should be no sharp edges, corners etc. on the bare conductor surface.

NOTE: It is preferable to manufacture conductor from continuous cast copper bars provided all other acceptance parameters and conditions remain same. Copper to be procured from BHEL Bhopal approved sources only.

It is not allowed to produce the conductor using Conform technology.

8.2 Insulation Covering

8.2.1. Enamel Covering

8.2.1.1 To prevent the deposition of copper dust or other extraneous matter on the conductor, the conductor shall be fully cleaned by felt pads or other suitable means before enameling.

8.2.1.2 Enamel covering shall be a durable, flexible, synthetic type based on polyesterimide.

The make & grade of enamel shall be as follows:

Approved source	M/s Elantas Beck
Approved grade	Terebec MT 533-36 PA

No alternate enamel is allowed.

8.2.1.3 Thermal index of enamel used shall conform to atleast Class 'H' (180°C Class).

8.2.1.4 The conductor shall be completely and uniformly covered with the enamel layer. The enamel shall have a smooth surface free from embedded dust particles or other foreign deleterious material and there should be no sharp edges/ corners.

8.2.1.5 Increase in dimensions due to enamel shall be as given below:

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Minimum : 0.06 mm

Maximum : 0.11 mm

8.2.2 Mica Paper Tape Covering

8.2.2.1 The enameled conductor then shall be taped with one half lap layer (lapping 42% to 50%) of 0.09 x 12 wide Polyester film backed mica paper tape to BHEL Bhopal spec BP 25185 with mica side of the tape touching the enameled conductor. Mica paper tape shall be firmly applied to the conductor. The covering shall be smooth with no tendency to open out at bends during processing and shall have uniform thickness throughout with minimum joints. The processed conductors shall not be tacky so that they do not hinder further processing. The mica from the tape should not come out as flakes and outer surface must be free from visual defects.

Tape layer shall be continuous, firmly applied and substantially free from creases. No adhesive material shall be used except to anchor ends of tape. Any such bonding or adhesive material should have no deleterious effect on the properties of insulation.

The mica tape to be procured from BHEL approved tape sources and grades only as per list below:

Material - 0.09 X 12 mm Polyester Film Backed Mica Paper Tape BP25185	BHEL Approved Sources & Grades
BHEL approved sources for polyester film backed epoxy mica paper tape to BHEL Bhopal spec BP-25185	M/s Lakshmanan Isola Pvt. Ltd., Bangalore (As per BHEL Bhopal spec. BP25185)
	M/s Cogebi, Malaysia (Supplier Grade - KALASTIK 45.030)
	M/s Isovolta, Austria (Supplier Grade - CONDUCTOFOL 2009)
	M/s Von Roll, Switzerland (Supplier Grade - SAMICAFILM 315.14)
	M/s Krempel, Germany (Supplier Grade - KREMICA.FLEX K1034-09)

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8.2.2.2 The increase in dimension due to mica paper covering shall be:

Minimum : 0.32 mm

Maximum : 0.36 mm

8.2.3 Total Insulation Thickness:

The total insulation thickness (i.e. increase in dimensions) due to insulation covering (including enamel & mica paper tape) shall be as below:

Minimum : 0.38 mm

Maximum : 0.47 mm

In addition, vendors should maintain,

Final Insulated Width: $\leq$ Nominal bare width + 0.45mm

Final Insulated Depth: $\leq$ Nominal bare depth + 0.45mm

9.0 TESTS (On enameled conductor):

9.1 TENSILE STRENGTH & ELONGATION:

A sample of the enameled conductor, 250 mm long held between grips shall be steadily stretched at a rate of approximately 50 mm / min until the conductor breaks. The maximum tensile strength and the minimum elongation at break shall be as given in Table I.

TABLE - I

THICKNESS	THICKNESS UPTO & INCLUDING	ELONGATION	TENSILE STRENGTH
ABOVE		MINIMUM	MAXIMUM
-	2.5 mm	30%	265 N /mm ²
2.5 mm	5.6 mm	35%	255 N /mm ²

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9.2 FLEXIBILITY TEST (AT ROOM TEMP.):

Samples of the enameled conductor shall be bent through 180° around a mandrel having a diameter 8 times the bare width of the conductor when it is bent on the edge or 8 times the bare thickness when it is bent on flat. Separate samples shall be bent two on edge and two on the flat and when so tested the covering shall not open sufficiently so as to expose the bare conductor when examined under diffused light by normal eye-sight.

9.3 FLEXIBILITY TEST (AFTER HEAT AGEING):

Samples which have been heated for 16 hours in an oven at a temperature of 175°C to 180 °C and then allowed to cool to room temperature shall pass the test for flexibility specified in 9.2. Bending shall be done after cooling of samples to room temperature.

10.0 TESTS (On enameled & mica taped conductor):

10.1 PROOF VOLTAGE TEST (AT ROOM TEMPERATURE):

Two samples approx. 250 mm long each shall be laid along the widths and taped together closely with woven glass tape. The two ends of the conductors shall be parted and the insulation covering shall be removed. A power frequency (50 Hz) supply shall be applied between the two ends. The voltage shall be raised @ 100 volts / sec (approx.) to a value of 6 KV. This voltage shall be maintained for 1 minute. There should be no breakdown.

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10.2 BREAKDOWN VOLTAGE TEST AFTER HEATING AT 155 °C

The Electrical Breakdown voltage test (AC) shall be conducted on 5 samples. The samples shall be heated in an oven at 155 +/- 3 deg. C for 15 minutes and shall be cooled down to room temperature. These shall be bent edgewise on a mandrel of 50mm diameter. On visual examination, no damages / cracks should appear on insulated conductor surface after bending. The insulation shall be stripped off at ends for electrical connection. The samples shall be placed in a metal vessel filled with steel balls of 1 to 3 mm diameter and vessel solidly connected to earth. A sinusoidal AC voltage of 50HZ frequency is applied and increased from zero with uniform rate of approximately 200 volts per second until breakdown occurs. The electrical breakdown voltage (AC) shall not be less than 6 kV.

11.0 TEST CERTIFICATE:

Unless otherwise specified three copies of the test certificate shall be supplied along with each consignment.

In addition, the supplier shall enclose one copy of the test certificate along with their dispatch documents to facilitate quick clearance of the material

The test certificate shall bear the following information:

IN.SK.46085: Enameled and polyester film backed Mica Paper Taped Rectangular copper conductor

BHEL Order No.

Batch No.

Test values obtained & certificate of compliance with clause 8 to 10.

12.0 PACKING AND MARKING

The covered conductor shall be wound on drums generally conforming to IS:2069. About 60 kg of covered conductor shall be supplied in each drum. If cross section of covered conductor exceeds 15 sq.mm., bobbin dia shall be 400 to 450 mm otherwise it shall be around 300 mm. Flange dia to suit above bobbin dia shall be selected.

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The conductor shall be protected against possible damage, from the inner faces of the flanges of the drums by lining each flange with thick paper or card-board. Paper spacers shall be filled in the empty space between conductor and flange of the drum. A layer of packing paper shall be inserted between each layer of conductor during winding on drums. Each drum shall be marked with the following: IN.SK.46085: Enameled and polyester film backed Mica Paper Taped Rectangular copper conductor BHEL Order No. Supplier`s Name. Size of Conductor. Weight of Conductor drum (i) Gross (ii) Net. 13.0 CHANGES DUE TO REVISION 1. Clause 8.2.1.2 & 8.2.1.3 modified. 2. Spec. reviewed & updated.		
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