

RDSO SPECN. NO. ELRS/SPEC/TM / 0035 (REV '0')



**GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS**

TECHNICAL SPECIFICATION

FOR

**POLYIMIDE FILM BACKED UNIFORM MICA
TAPE**

**FOR USE ON TRACTION MOTORS
OF
ELECTRIC LOCOMOTIVES AND EMUS**

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RESEARCH, DESIGNS & STANDARDS ORGANISATION

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POLYIMIDE FILM BACKED UNIFORM MICA TAPE (PUMT)

1. Scope :

This specification covers the technical requirements of silicone resin bonded Polyimide film backed mica paper tape, hereinafter referred to as "PUMT". The material shall be made out of reconstituted mica paper backed with Polyimide film on one side and evenly impregnated with silicone resin. The composite insulation produced after pressing and curing shall have temperature index of at least 200.

This material shall be used as armature coil insulation in class 200 insulated armatures and other parts of Traction Machines of Electric Locomotives/EMUs.

2. REFERENCES

S.No.	Specification/standards	Description
1	IEC 60371-2	Specification for Insulating Materials based on Mica - Methods of test
2	JIS C 2116	Testing Methods for Electrical Insulating Mica Products.

3. QUALITY ASSURANCE PLAN (QAP)

Manufacturer shall furnish detailed QAP for the product. It shall include sourcing and testing of all input materials, quality checks during manufacturing and tests on finished product.

The manufacturer shall include testing of input materials in the QAP. The test schedule shall include tests mentioned in Clause 8.

The QAP shall be submitted to RDSO for scrutiny and verification before carrying out Type test. After approval of prototype, Manufacturer shall furnish to RDSO any subsequent changes in QAP and get RDSO's approval for the same. RDSO shall have right to verify the QAP at any time by deputing their representative.

4. RAW MATERIALS AND COMPOSITION

4.1 Basic Materials:

- (i) Reconstituted muscovite mica paper with aramid fibril content of 5%
- (ii) Polyimide film
- (iii) Catalysed silicone resin used for binding , having minimum thermal index 200°C.

4.2 IR spectrograph of polyimide film

The Infrared spectrograph of polyimide film used shall be done during type testing and shall be preserved as a reference for comparison with bulk supplies. A copy of IR

spectrum for each lot shall be done and preserved by the manufacturer for comparison and verification with prototype spectrum during acceptance tests.

4.3 IR spectrograph of silicone binder

The Infrared spectrograph of silicone binder resin shall be done during type testing and shall be preserved as a reference for comparison with bulk supplies. A copy of IR spectrum for each lot shall be done and preserved by the manufacturer for comparison and verification with prototype spectrum during acceptance tests.

4.4 Aramid fibre content in mica paper

The Quality Assurance Plan (QAP) of the manufacturer should include verification of aramid fibre content in the mica paper before its processing with polyimide film for each lot. Aramid fibre content shall be measured as per IEC 60371-2 Clause 7. The measurement shall form a part of prototype testing. For acceptance tests, records as per QAP shall be made available for verification.

4.5 The finished product shall have following composition:

Total Weight	120 ± 15 g/m ²
Mica content	56 ± 4 %
Binder content	10 ± 3 %
Aramid Fibrid content	3 ± 1 %

5. DIMENSIONS AND TOLERANCES

Dimensions and tolerances are given in Table-1.

Table – 1

Standard thickness (mm)	Standard Width (mm)	Length/Roll (m)	Tolerance		
			Thickness (mm)	Width (mm)	Length (m)
0.10	25	30	+0.02 - 0.03	±0.5	+1.0 -0.0

Thickness, width and length shall be as stated as per individual requirements. However, for special applications, any other size may be ordered.

6. PROPERTIES AND CHARACTERISTICS

6.1 General Properties

- 6.1.1 The material should be tack-free, smooth and free from wrinkles & cuts.
- 6.1.2 The material shall not be blocking within the roll after storing at 27^oC for 24 hrs and it should be capable of being unreeled in a manner so as not to allow separation of mica paper from the Polyimide film.
- 6.1.3 It should not show any sign of deterioration like swelling, becoming hard for a period of at least Shelf life.

6.1.4 The tape shall be sufficiently flexible. When wound on a mandrel of rectangular cross section 16 mm x 6 mm with Polyimide film side up at room temperature there should be no signs of cracks wrinkles or delamination.

6.1.5 Electrical coils after winding and application of PUMT are put for Vacuum Pressure Impregnation. Enhanced Varnish retention by the coil during VPI depends on the varnish retention capacity of insulation tape. A Varnish Retention Test as mentioned in Clause 9 shall be carried out on the PUMT as part of testing. The varnish retention capacity shall not be less than 15g/m^2 .

6.1.6 Material shall be supplied in continuous lengths as stated in the purchase order; no joint on rolls is permitted.

6.2 Electrical Properties

6.2.1 The breakdown voltage of the tape shall be as follows;

- Average BDV : 5.5 kV (min)
- Minimum BDV : 4.5 kV (min)

6.3 Mechanical Properties

6.3.1 Tensile strength : 4 kgf/cm width (min)

6.3.2 Elongation at break : 15% (min)

7. TESTING

7.1 Type Test :

Type tests shall be conducted on the prototype samples as per tests mentioned in Clause 8. Successful completion of the type tests is mandatory for product/firm approval.

Type tests shall be repeated every 3 years as a part of Quality Audit. In case of any change in the material or design, the complete type tests shall be repeated.

RDSO reserve the right to conduct the whole or a part of type tests at any time in case of any doubt in material's quality or failure.

7.2 Routine Tests :

Routine tests shall be carried out by the manufacturer on all finished products on lot basis to ensure consistency of the product. The supplier shall maintain records of Routine Test results. These results shall be handed over to the purchaser before despatch of the materials to Railways. RDSO may, however, carry out these tests on samples sealed at random as per the relevant specification to verify the results observed by the manufacturer.

7.3 Acceptance Tests :

Acceptance tests shall be carried out on samples selected randomly from a lot ready for despatch for the purpose of acceptance of the lot by the purchaser as per the tests marked as acceptance tests in Table-2. The supplies offered for tests shall be considered to be satisfactory and acceptable, if all the test results are within acceptable limits and statistically satisfactory.

If any of the tests results do not meet the requirements, the whole tests shall be repeated on other samples selected again. If the results of the repeat tests are not within acceptable limit, the entire supplies shall be rejected. The purchaser shall have however the right to reject the supplies in full or in part.

8. SCHEDULE OF TESTING

TABLE - 2

S.No.	Tests	Test methods	Acceptance criteria	Type test	Routine Test per lot	Acceptance test per lot
A. Dimensions						
1.	Thickness (mm)	IEC 60371-2, Clause 4	0.10 +0.02 -0.03	✓	✓	✓
2.	Width (mm)	Vernier caliper	25.0 +0.5	✓	✓	✓
3.	Roll length (m)		30 +1/-0	✓	✓	✓
B. Raw material contents						
4.	Polyimide film IR spectrograph	Clause 4.2		✓	✓	✓
5.	Silicone binder IR spectrograph	Clause 4.3		✓	✓	✓
6.	Aramid fibre content(%)	Clause 4.4	3 ± 1	✓	✓	✓
7.	Total substance (g/m ²)	IEC 60371-2, Clause 7	120±15	✓	✓	✓
8.	Mica content (%)	IEC 60371-2, Clause 7	56±4	✓	✓	✓
9.	Binder content (%)	IEC 60371-2, Clause 7	10 ± 3	✓	✓	✓
C. Properties						
10.	Tensile Strength (kg/cm)	IEC60371-2 Clause 8	4 (min.)	✓	✓	✓
11.	Elongation at break	IEC60371-2 Clause 8	15% (min)	✓	✓	✓
12.	Stiffness (N/m)	IEC60371-2 Clause 10	40 (max)	✓	✓	✓
13.	Winding property	Clause 6.1.4	No cracks, delamination or wrinkles	✓	✓	✓
14.	Electrical strength (BDV), kV/layer(Min) i) at room temp. ii) after heat aging at 220C, 1 hr.	IEC60371-2 Clause 16	For each of the cases (i) and (ii) : Average ≥5.5kV Individual ≥4.5kV	✓	✓	✓

15.	Temperature Index	IEC60216	Min. 200	✓	----	--
16.	Varnish Retention Test (g/m ²)	Clause 9	15 (min)	✓	✓	✓

9. VARNISH RETENTION TEST

1.	Purpose	To determine the varnish retention capacity of electrical insulation tapes used on conductors that are subjected to VPI process.				
2.	Significance	Electrical coils after winding and application of insulating tape are put for VPI. Enhanced Varnish retention by the coil during VPI depends on the varnish retention capacity of insulation tape leading to better electrical properties and life of the coil. The following test is to be carried out at atmospheric pressure only as better varnish retention by an insulation tape under said conditions would imply a better performance of the tape under VPI.				
3.	Equipments and samples	3.1 Meyer Rod. 3.2 Oven. 3.3 Weighing balance 3.4 Polyesterimide Varnish FT 2005 of Beck India Limited				
4.	Test Procedure.	4.1 Place a 5"x13" sample on a horizontal surface and cut a 5.0 cm X 5.0 cm. square sample at three consecutive places. Weight the three pieces and determine the average weight W_0 . 4.2 Similarly, place a 5" x 13" sample on a horizontal surface and keep a Meyer Rod at one end. Pour 15 g (approx) of varnish on one of the Meyer Rod. Draw down the Meyer Rod such that the varnish is evenly coated on the sample. 4.3 Dry the coated sample at 70 deg. C and 180 deg. C for 5 minutes each and then cool down to room temperature. 4.4 Cut 5.0 cm x 5.0 cm square sample from three consecutive places and note down there weights and calculate the average weight W_2 . 4.5 Repeat the steps 4.2 to 4.4 and determine weights W_3 , W_4 and W_5 . 4.6 Calculate the average weight W_s as follows : $W_s = (W_2 + W_3 + W_4 + W_5)/4$ 4.7 Calculate the varnish deposition as follows : $(W_s - W_0) \times 400 \text{ g/m}^2$				
5.	Report	Report the Varnish retention of the insulation tape in g/m ² .				

10. SHELF LIFE AND STORAGE:

The product shall have a minimum shelf life of 12 months below 25 °C.

The storage conditions are given below for guidance of end users as well as manufacturers.

(i) The tapes should be stored in original carton without tampering polyethylene bags in cool dry cold storage.

(ii) The tape roll should be taken out from refrigerator/cold storage 24 hours in advance before application, so that the tape can be brought fully to ambient temperature (room temperature). On account of this, the condensed water on the polyethylene bag will not come in contact with the tape.

12 Marking :

12.1 Each roll of the tape shall be clearly and legibly marked with the following information :

- a) Manufacturer's name/Supplier's name.
- b) Type of tape/Designation/Trade-mark, if any.
- c) Length of roll, in metres.
- d) Thickness and width of tapes, in mm.
- e) Date (month and year) of manufacture.
- f) Date (month and year) of expiry
- g) Batch No./Lot No.

12.2 Each transit pack containing number of rolls shall have following informations clearly and indelibly marked on it :

- RDSO Specification No.
- Railway's specification no.
- Manufacturer's name/Supplier's name
- Type of tape/Designation/Trade-mark, if any.
- Batch/Lot No.
- Length of roll, in metres.
- Thickness and width of tapes, in mm.
- No. of rolls and meters suppliers
- Date (month and year) of manufacture and shelf life expiry date under specified storage condition.

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