STR No. – ELRS/STR/EWW/0013

GOVERNMENT OF INDIA

MINISTRY OF RAILWAYS

SCHEDULE OF TECHNICAL REQUIREMENTS

FOR

FIRMS SEEKING APPROVAL

FOR SUPPLY OF

ENAMELLED WINDING WIRES

FOR

ELECTRIC LOCOMOTIVES / EMUs

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ISSUED BY

ELECTRICAL DIRECTORATE

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Schedule of technical requirements for Enamelled Winding Wires used for stator winding of Auxiliary motors for Electric Locomotives & EMUs.

1. General

1.1 Indian Railways are procuring enamelled winding wires for stator winding of auxiliary motors used on Electric Locomotives and EMUs to IS-13730 – Part 13 – 1993 referred to as "Specification" hereafter. This wire is coated with enamels Polyesterimide over coated with Polyamide–imide, known as enamelled Round Copper wire, Class 200. The schedule of Technical Requirement mentioned hereunder is issued to serve as a guide to the manufacturer (called the firm hereafter) and should be read in conjunction with the above said specification. The firm should satisfy themselves about having complied the requirements of the specification and the schedule of Technical Requirements. The technical requirements are meant to serve as guidelines and are not exhaustive.

1.2 The firm should have currently valid ISO 9000 certificate including the subject item under its range of manufacture.

2. Raw Material

2.1 The enamels shall be procured by the firm only from M/s. Beck India Ltd., Pune. In case the firm proposed to procure the enamel from any other source, it must have prior specific approval of RDSO.

2.2 8 mm cc Copper shall be purchased to specific from reputed source only.

2.3 The firm should preferably have its own Metallurgical and Chemical testing laboratory other wise service of a Government approved can be availed.

2.4 A record of each sub-suppler clearly showing the quantity purchased and as well as cases of late delivery shall be kept.

3. Manufacturing

3.1 Manufacturing shall be carried out in dust free, clean and closed environment.

3.2 List of M&P required for manufacturing shall be as per Annexure –1. The list does not specify the capacity and quantity of M&P which may vary both manufacturing capacity of the individual firm.

4. Testing

4.1 List of testing facilities to be maintained in firm laboratory shall be as per Annexure 2. The accuracy and capacity of the testing and measuring equipment shall be adequate to meet the requirement of the specification. Measuring equipment should be calibrated regularly.

4.2 Meticulous record of each batch of production shall be maintained along with a sample for verification and investigation, if necessary.

5. Quality Assurance Plan

5.1 All items as mentioned in Annexure 3 should also be included in the QAP followed by the firm.

6. Handling / Storage / Delivery

6.1 The manufacturer shall have proper facilities for handling and storage of raw material and finished products so as to prevent damage or deterioration. The supplier shall control packing, preservation and marking processes so as to ensure conformity to the Railway's requirements.

7. After sales service

7.1 The firm shall have adequate service network alongwith technically qualified staff to cater to the warrant failure and other after sales service problems reported by the Railway's.

Annexure I

RECOMMENDED LIST OF MACHINERY & PLANT FOR THE MANUFACTURE OF ENAMELLED WINDING WIRES

1. Wire drawing machine
2. Annealing plant
3. Enamelling plant
4. Die maintenance equipment
5. Cranes of suitable capacity
6. Fork lifter
7. Cutter, planer
8. Cutting band saw
9. Facility for rolling of conductors on to reels.

Enamelling Plant (for copper enamelled winding wire)

i) The enamelling plant shall be automatic, provided in dust free environment. The plant shall have fully covered tanks and bath & channel should not be exposed to atmosphere.

ii) Enamelling plant should have complete recirculation system and control over the temperature and flow of fresh air.

iii) It shall ensure smooth, uniform, concentric application and cooling of enamel.

iv) The temperature of the enamelling plant shall be minutely controlled within tolerance limit of ± 1° C.

v) The coolant should be free from dust and other solid impurities.

vi) Exhaust of the air should be chemically inert to avoid pollution in the neighbourhood. In this connection manufacturer should submit "Pollution free Certificate" from State "Pollution Board".

vii) The enamelling plant should preferably be provided with catalytic converter for better energy efficiency and pollution control. This requirement is, however, not mandatory.

Annexure 2

TESTING EQUIPMENT FOR ENAMELLED WINDING WIRES

SL	Description of test	Equipment and standard needed for the tests
1.	Tensile test & Elongation	a) Automatic tensile testing machine b) Micrometer (Least count 1 micron) c) Precision dial micrometer d) Elongation tester motorized upto 5 mm.
2.	Electrical conductivity	Conductivity meter
3.	Diameter	Micrometer (least count 0.001 mm)
4.	Resistivity	Wheat stone bridge (0.5% accurate) IEC-93
*5.	Solid content in enamel (preferred)	As per IS 13730 requirement
6.	Viscosity of enamel	As per DIN 53211 Cup No. 4/IS:3944 Cup no. 4
*7.	Flash point of enamel (preferred)	As per ISO / 1523 or DIN 53213 / ISO 1523
*8.	Density of enamel (preferred)	As per DIN 51757 / ISO 1675
9.	Electrical Resistance	i) Kelvin double bridge (Accuracy 0.2%) ii) Wheat stone bridge (Accuracy 0.5%) iii) DC source of supply suitable for bridge. iv) Sensitive Galvanometer. v) Thermometer (least count 1° C)
10	Continuity of enamel covering	Test facility as per IS 13778 (Pin Hole Tester)
11.	Springness	Apparatus as shown in IS 13778 (Springness tester)
12.	Flexibility & Adherence	-do- (Mandrel winding tester)
13.	Resistance and abrasion	-do-
14.	Heat and shock	a) Air circulated oven b) Magnifying glass
15.	Cut through test	As per IS 13778 (Cut through tester)
16.	Solvent test	-do-
17.	Break down voltage test	Break down voltage tester (as per IS 13778)
*18.	Thermal endurance test (preferred)	As per IEC / IS (IEC 216-1)
19.	Tan delta tester	For measuring Dielectric loss test

* Note 1. A test certificate shall be obtained from enamels manufacturers, the enamels used by wire manufacturers for supply to Railway's.

Note 2: All the tests shall be conducted as per requirement mentioned in the specification for particular type of winding wire conforming to IS 13730 Pt 13-1993, IS 137370 (Part 3) – 1990 and method of tests shall be as per IS 13778 Pat 1 to 6. All the acceptance test value will be as laid down in IS 13730 Part 13.

Annexure 3

Points to be included in the firm's – Quality Assurance Plan (QAP)

SL	Description	Type of check	Quantum of check	Acceptance norms
1.	Raw Material			
	a) Bare Copper wire	Visual	100%	Shall be free from instruction
		Tensile strength Electrical conductivity	One in a lot of 100 kg. Two samples in lot of 1 t. Three samples in a lot of more than 1 t.	IS 191 IS 191
		Diameter	100%	
		Resistivity Torsion Chemical composition	One sample in a lot of 100 kg. Two samples in a lot of 1t. Three samples in a lot of more than 1t.	IS 8130 IS 191
	b) Polyesterimide enamel (Mt533.39A / TR543.38) as base coal	Visual Solid content Viscosity Density Flashpoint Compatibility with thinner	One sample in a lot of one drum	Should be free from embodied particles & dust and other deleterious material. DIN/53211 cup No. 4/153944 DIN – 51757 / ISO 1675 DN 53213 / ISO 1523
	c) Polyamide enamel (Allotherm 602.35A)/ AL 1013 BV as top coat		100%	As per suppliers instruction IS 5595 – 1970 (Enamel should be procured) from Beck India Ltd., Pune (which is also known as Altana Insulation)
2.	Testing of wire ROD	Visual surface finish	100%	
		Diameter	100%	
		Electrical Resistance Tensile test & Elongation	One sample in a lot of 100 kg Two samples in a lot of 1 t. Three samples in a lot of more than 1t.	IS 191

3.	Annealing	Surface finish	100%	IS 8130
		Dimension		
		Annealing temperature		
4.	Wire drawing	Profile checking of drawing Dis. Optical profile projector	100%	
5.	Testing of wire	Visual	100%	
		Dimension	100%	IS 191
		Tensile strength & elongation Electrical resistance	One sample in a lot of 100 kg Two samples in a lot of 1 t. Three samples in a lot of more than 1 t.	IS 13730
6.	Enamelling / Polymeride cooling	Oven temperature		As per manufacturer recommendations.
		Number of passes	100%	
		Processing speed		
		Surface finish	100%	
		Diameter	100%	
		Tensile strength & Elongation	One sample in a lot of 100 kg Two samples in a lot of 1 t. Three samples in a lot of more than 1 t.	
		Continuity of enamel coating		

7.	Finished Product			For the EWW
	i)	Surface finish (Visual)	100%	
		Diameter	100%	IS 13730 (Pt. 13)
		Electrical resistance		
		Elongation		All tests as per method laid down in IS: 13778 – Pt.1 to 6 of 1993
		Springers		
		Flexibility		
		Adherence		
		Resistance & Abrasion		
		Heat shock test		
		Cut through test		
		Solvent test		
		Break down voltage		
		Continuity of covering		
		Dielectric loss test		
		Solder test		
		Thermal endurance test		
		Compatibility with transformer oil		
	ii) Painting & Marking	Visual	100%	IS 13730 / Following details to be provided in the drum: - P.O. Number - Size of wire - Length of wire - Gross & net weight of wire - Drum number - Name of consignee - Firm's name - Date & year of manufacture
	iii) Sealing	Visual	100%	IS 13730 / Consignee's stamp on seal to be provided.
	iv) Packing & Despatch	Visual	100%	IS 13730 / wire in drum should get loose in transport.