STR No.ELRS/STR/ZHLS/0007

Government of India
Ministry of Railways

Schedule of Technical Requirements

Of

Zero Halogen, Low Smoke, Limited Fire Survival Flexible Elastomeric Cables with Copper Conductors

For

Metro Coaches

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Issued by

Electrical Directorate.
Research Designs & Standards Organisation
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Schedule of Technical Requirements of ZHLS Cables for Metro Coaches

1.0 GENERAL

1.1 In view of fire hazards in the Metro Coaches of Calcutta Metro Railways, RDSO studied the development of cables used in metro rails world over and formulated a Cable Specification No.E-14/04 (Sept.'96) for Zero halogen, low smoke cables for adoption in the metro coaches. Revision 1 of specification No. E-14/04 (Rev.1) – August'1998 was issued incorporating certain additions / alterations considered necessary.

1.2 The technical requirements mentioned hereunder are meant to serve as a guideline only and should be read in conjunction with the specification.

2.0 DOCUMENTATION

2.1 The firm should have current valid ISO 9000 certification including the subject item under its range of manufacture.

2.2 The firm shall maintain list of bought out items along with

- Basis of procurement i.e. specification etc. and assurance that the material is of standard quality.
- Tests carried out by sub-vendors on bought out items and test certificate for each lot of supply.
- Test carried out by the firm on the bought items before usage.
- Sources of procurement with details of Quality Assurance Plan of these sources.

2.3 The firm shall maintain:-

- Record of the polymer identification by high revolution infrared spectrophotometer in each batch of the compound formed.
- Record of the percentage cross-linking and other rheological properties of the compound checked up from the curing characteristic graph drawn with the Rheometer / Mooneymeter / Rheocord.

- Record of the brand and specification of the base material and other ingredients for sheathing and insulation with date / year of manufacture and storage life of the same.

- Details of the manufacturing process adopted with fixtures required.

- Details of Checks / routine tests at different stages of the manufacturing process.
- Record of shelf life of items such as base material and other input ingredients etc used.

2.4 Testing be done as per specification under competent technical staff of firm and documents to indicate his competence be maintained.

3.0 MANUFACTURING

3.1 The base polymers such as EPR, EPDM, EVA and EA etc. and other ingredients should be stored in a neat, clean and dust free surrounding.

3.2 Mixing of rubber compound and pressing the same to form strips of required size should be done in a dust free atmosphere.

3.3 Extrusion of insulation / sheath on the formed conductor should be carried out as far as possible in a clean environment with automatic input and take off system i.e. through continuous vulcanizing / curing (CV Line) process.

3.4 During fine wire drawing, in case of breakage of wire, the wire should be joined by brazing or soldering or cold pressing by jointing machine. Surface of the joint should be as smooth as that of drawn wire.

3.5 The minimum requirement of machinery and plants at the firm's premises shall be as per Annexure'A'.

4.0 TESTING

4.1 The minimum requirement of testing facilities at the firms works shall be as per Annexure-B.

4.2 The accuracy and capacity of the testing and measuring instruments shall be adequate to meet the requirements of the specification.

4.3 All testing equipments should have valid calibration certificate from a Government approved laboratory.

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ANNEXURE-A

List of Machinery and Plant at FIRM'S Premises

1. Pickling plant
2. Rod breaking machine (heavy duty)
3. Intermediate wire drawing machine
4. Multi single wire drawing machine
5. Fine wire drawing machine
6. Tinning plant
7. Annealing plant with temperature monitor
8. Die maintenance equipment
9. Braiding machine
10. Stranding machine
11. Bunching machine
12. Bunching rewinding machine
13. Rubber mixing mill for mixing the ingredients
14. Vulcanizer
15. LCM (PCLV) / CV line (Elastomeric / HRPVC extruder)
16. Laying machine
17. Taping machine
18. Printing machine
19. Overhead cranes
20. Fork lifter / trucks
21. Equipment for rheological properties (Rheometer / Mooney / Rheocord)

OPTIONAL – could be arranged from Trade also

22. Cutter, moulder and planner
23. Circular saw
24. Wood cutting band saw
25. Cross cut saw
26. Milling machine
27. Radial drilling machine
28. Lathe machine
29. Hydraulic press
30. Power hacksaw
31. Surface grinder

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ANNEXURE 'B'

TEST EQUIPMENTS FOR ZHLS CABLES

DESCRIPTION	EQUIPMENTS
1. Composition of Conductor Conductor	i) Ratched micrometer OR ii) Dial micrometer (with Dia 5.00mm) iii) Facility for analysing metal composition.
2. Persulphate test	i) Porcelain or Glass Beaker ii) Nessler's Tube iii) Pipette Graduated iv) Balance (accuracy 0.1mg) v) Volumetric Flask.
3. Conductor Resistance	i) Kelvin double Bridge (accuracy 0.2%) OR ii) Wheatstone Bridge (accuracy 0.5%) iii) DC Source of Supply suitable for Bridge. iv) Sensitive Galvanometer v) Thermometer, least count $1^{o}C$
4. Annealing Test	i) Automatic Tensile testing machine. ii) Plane faced micrometer (least count 0.01mm) iii) Suitable scale (least count 0.5mm)
5. Test for Thickness of Insulation & sheath	i) Micrometar (least count 0.01mm) ii) Vernier Callipers (least count 0.01mm) iii) Measuring microscope with linear magnification of not less than 7 times & possibility of reading at-least 0.01mm. iv) Graduated magnifying glass capable of reading at-least 0.01mm.

DESCRIPTION	EQUIPMENTS
6. Physical tests for Elastomeric insulation & sheath	
6.1 Tensile strength & Elongation at break of Thermoplastic & Elastomeric Insulation & sheath	i) Dumb-bell punching die. ii) Automatic tensile testing machine iii) Analytical weighing Balance (Sensitivity 0.1mg) iv) Machanical/Optical Instruments for measuring dimensions of test specimen accurately
6.2 Breaking strength & enlongation at break.	i) Automatic Tensile testing machine. ii) Micrometer(least count 0.001 mm) iii) Precision Dial Micro meter (Calibration shall be done before use)
6.3 Loss of Mass Test	i) Oven (Electrically operated & thermostatically controlled) ii) Weighing balance (least count 0.2 mg) iii) Tube of 100 mm dia & 300 mm length iv) Recording instruments (to monitor the temperature in oven.)
6.4 Thermal ageing in air	i) Oven ii) Recording instruments to monitor the temperature in oven
6.5 Shrinkage Test	i) Oven ii) Suitable scale (least count 0.5mm)
7. Ozone Resistance Test	i) Test Chamber (shall be such that its surface does not react with Ozone) ii) Equipment for generating filtered and controlled air-ozone stream. iii) Equipment for controlling temperatures of the specimens iv) Ozone generator. v) Equipments for determining the percentage of Ozone consentration. vi) Mandrel for being test specimens.

DESCRIPTION	EQUIPMENTS
	vii) Chemical reagants - a) Starch indication solution b) Sodium Thiosulphate solution. c) Potassium Iodide solution d) Standard Iodine solution e) Acetic Acid
8. High Voltage Test	i) High Voltage source (6KV,ac RMS) ii) Water Bath (Themostatically controlled)
9. Insulation Resistance Test	i) DC supply source 500V +/- 50V ii) Voltmeter (Suitable to measure above voltage) iii) Screened leads & switches iv) Galvenometer (sensitivity 10 A/mm) v) Universal shunt OR Electronic Megohm meter range 10 million Megohm. vi) Standard Resistance minimum. 1 Megohm vii) Thermostatically controlled water bath.
10. Destructive Puncture Test	i) High Voltage, 50 Hz AC supply system (more than 15KV) ii) Equipment to control voltage in steps at fixed time intervals. iii) Water tank to immerse cable sample.
11. Resistance to Cracking	i) Mandrel of Different sizes. ii) Oven suitable to maintain temperature of 150°C +/- 2°C continuously.
12. Flexibility Test	i) Mandrel of suitable sizes,. ii) High Voltage, 50 HZ AC supply system (more than 150 KV)
13. Fire Resistance Test	i) A chamber with still air. ii) Bun sen Burner with gas supply and regulator. iii) System to provide angle as shwon in RDSO Specn. E-14/01 (Part-I). iv) Stop watch.

DESCRIPTION	EQUIPMENTS
14. DC Stability Test	i) Suitable water tank to immerse test sample (with heating arrangement) ii) Sodium chloride. iii) DC supply source (Voltage not less than the maximum working voltage of cable) iv) Discharge measuring instruments)
15. Resistance to Surface Tracking	i) Annular Electrodes. ii) Water tank with temperature Control. iii) Filter paper. iv) Milli-ammeter. v) High voltage 50HZ AC Supply, (15KV) source with voltage regulator & time control.
16. Slippage Test	i) Mandrel.
17. Identification of Polymers	i) Extraction Appratus. ii) Pyrolysis Appratus. iii) Capallary pipets. iv) Oven capable of maintaining a temperature of 200°C +/- 5°C v) Water Bath. vi) Salt plates Sodium chloride or Potassium Bromide) 4 by 25 mm to serve as windows for the spectrophotometer. vii) High resolution infrared spectrophotometer, double beam capable of recording a spectrum over the 2.5 to 15- m(4000 to 667cm^{-1}) region. viii) Chemical reagents and equipments covered in ASTM-D-3677-83
18. Life Cycle Test	i) Air oven.