REVISION OF SPECIFICATION / STR

Ref: Draft Spec. No. RDSO/2014/CG-04(Rev-1), STR for Glass Fibre Reinforced Epoxy Resin (GFRE) sheets for roof paneling of Railways passenger coaches (B.G).

1. RDSO is reviewing the specification/STR to cater to the latest technological developments in the field, modify clauses not relevant in the present context and making them more enabling with focus on functional requirements.

2. It is requested that your comments / suggestions with regard to improvements / modifications in specification / STR of this item may be submitted in the following format alongwith the justification for the changes required.

Part A: Basic Information

SN	Particulars	Information
1	Name	
2	Designation	
3	Professional Qualification	
4	Organization / Firm's Name	
5	Address for Correspondence	
6	Contact No.	
7	Email ID	
8	In case of Firm / Individual: Manufacturing experience of item (or similar Item) on which comments are offered	
9	Where relevant: Whether any technical document to support suggested changes is available / enclosed for better appreciation	

Part B: Comments / suggestions on the specification

SN	Clause No. of RDSO STR / Spec	Clause, as exists in RDSO STR / Spec	Clause , as it should read after incorporation of comments / suggestions in the RDSO Spec / STR	Justification for changes

Comments may be sent to:

Director/SS/Carriage
Research Designs and Standards Organization
Manak Nagar, Lucknow – 226011

Email: edcar.rdso@gmail.com Or dirssrdso@gmail.com

INDIAN RAILWAYS

सत्यमेव जयते

SCHEDULE OF TECHNICAL REQUIREMENTS FOR GLASS FIBRE REINFORCED EPOXY RESIN (GFRE) SHEETS FOR ROOF PANELLING OF INDIAN RAILWAYS PASSENGER COACHES (B.G.) ~~(PROVISIONAL)~~

S. No.	Month/Year of issue	Revision / Amendment	Page No.	Reason for Revision / Amendment
1.	April, 2015	Nil	---	First issue
2.	July, 2020	Revision-1	3, 4, 5, 8, 9 & 10	• S.N.-8 a, b & c i.e Electrical properties of Table -1 of clause 3.2.1 of section-A have been deleted. • Clause 3.2.2 of Section A has been modified. • To include ISO Document No: QO-D-8.1-11 new sub Clause 1.2 in Scope of section- A has been added. • Clauses 2.1, 4.7, 5.1, 5.2, 5.5 & 5.6 of Section-B have been modified.

Issued By:

Carriage Directorate
Research Designs and Standards Organization
Manak Nagar, Lucknow - 226011.

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SCHEDULE OF REQUIREMENTS FOR GLASS FIBRE REINFORCED EPOXY RESIN (GFRE) SHEETS FOR ROOF PANELLING OF IR PASSENGER COACHES

SECTION-A

0. **Foreword:**

0.1 This schedule is intended to cover the technical requirements/provisions relating to materials construction and tests and does not include all the necessary provisions of the contracts.

0.2 For the purpose of deciding whether a particular requirement of the schedule is complied with the final value observed or calculated expressing the results of a test or analysis shall be rounded off in accordance with IS: 2 with latest revision. The number of significant places retained in the rounded off value should be the same as that of the specified value in this schedule.

0.3 In this schedule due consideration has been given to the developments in the field of polymerized materials, process technologies and serviceability requirements of the Indian Railways and the practices followed in advanced countries in the field.

1. Scope

1.1 This specification for Glass Fibre Reinforced Epoxy Resin sheets for roof paneling of Indian Railway Passenger Coaches consists of two sections i.e. Section-A and Section-B. Section-A covers the technical requirements, methods of sampling and tests of Glass Fibre Reinforced Epoxy Resin sheets and Section-B covers infrastructure requirements of manufacture, testing and quality control.

1.2 All the provisions contained in RDSO's ISO procedures laid down in Document No. QO-D-8.1-11 dated 01.07.2020 (titled "Vendor – Changes in approved status") and subsequent versions/amendments thereof, shall be binding and applicable on the successful vendor/vendors in the contract floated by Railways to maintain quality of products supplied to Railways.

2. Method of manufacture

The sheets shall be manufactured by compression moulding. Any other recognised method can also be used subject to prior approval of RDSO.

3. Requirements

3.1 General

3.1.1 These sheets shall be made from Glass fiber/ Fiber Glass Fabric with or without fillers. The sheets may also contain inorganic materials and colouring agents.

3.1.2 The surface of the sheets shall not show blisters, porosity or cracks. The surface shall be reasonably smooth and even.

3.1.3 The parameter and tests on raw material i.e. Glass fibre and resin should be mentioned in firm's QAP. Firm should keep records of test results to show the inspecting authority wherever asked for.

3.1.4 The sheets shall be sufficiently robust to withstand the normal handling during assembly on coaches. The sheets shall not crack or fracture when worked on by ordinary wood working tools or machinery.

3.1.5 The sheets shall be weatherproof and shall not loose shape or rot in service. They shall also withstand attack by vermin. The sheets shall not warp, split, delaminate or blister. Expansion or contraction due to thermal changes shall be negligible.

3.1.6 The sheets shall be self coloured and shall be available in different colours as per the requirement of Railway.

3.1.7 Unless otherwise specified the thickness of sheets shall be 1.5 ± 0.2 mm. The length and width of the sheets shall be as agreed to between the purchaser and the manufacturer. The tolerances shall be ± 10mm for length and width. The out of squareness of the sheets shall not exceed 10mm/1500mm length.

3.1.8 Material shall be supplied with surface/ self-protective film to avoid scratches at the time of transit and fitment.

3.2 Physical properties

3.2.1 The physical properties of sheets shall conform to the requirements indicated in table 1

TABLE-1

S.N.	Property	Required value	Method of test
1	Density (gm/cm3)	1.7±0.3	Appendix A
2	Tensile strength (MPa) Min. both along the length and width	200	Appendix B
3	Breaking strength (Kg) Min. both along the length and width	30	Appendix C
4	Drop impact test	1.5 Kg	Appendix D
5	Flexibility	To Pass	Appendix E
6	Water absorption (%) Max.	1%	Buoyancy method or Appendix F
7	Fire Worthiness Properties		
a	Resistance to spread of flame- Min.	Class A	Appendix - 11 of UIC-564-2 OR
b	Deterioration of visibility due to smoke - Min.	Class A	Appendix -15 of UIC-564-2 OR
c	Limiting Oxygen Index - Min.	35	IS: 13360 Pt.-6, Sec-19:2001
d	Toxicity	Less Than 1	NCD - 1409
e	Heat Release Rate (MARHE i.e. maximum Average Rate of Heat Emission in KW/m2) as specified in EN 45545-2:2013	R1 (HL3)	ISO 5660-1: 50 KW/m2
8	~~Electrical Properties~~		
a	~~Di Electrical Constant~~	~~< 5.4~~	~~IEC 60250:1959~~
b	~~Dissipation Factor~~	~~< 0.035~~	~~IEC 60250:1959~~
c	~~Dielectric Breakdown (Edge wise)~~	~~> 40 KV~~	~~IPC-TM-650Number 2.5.6 Dated 5 /86 Revision B~~

3.2.2 Number of Test: All the tests given in Table - 1 shall be carried out on each lot. ~~The test for Heat release rate (HRR) is type test. Heat Release Rate (HRR) test is to be done at every six months till 01.01.2016. Thereafter it will be the part of acceptance test.~~

3.2.3 RDSO may draw the samples for quality checks at its discretion and firm shall arrange the testing of these samples in a reputed outside laboratory as decided between RDSO and manufacturer. Testing charges shall be borne by the manufacturer.

4. SAMPLING AND CRITERIA FOR CONFORMITY

4.1 Test specimen

The number of samples for various tests shall be drawn as per table 2. The specimens for individual tests shall be as per the test procedure.

TABLE - 2

Lot size	For appearance and dimensions.		For properties as given in Table 1
	No. of sheets to be selected	Permissible No. of defects	
Up to 100	2	0	1
101 - 200	3	0	1
201 - 300	5	1	2
301 - 500	8	1	3
501 & above	10	2	4

4.2 For each test specified in the specification the scale of samples to be drawn and tested shall be as above. In case any sample drawn fails to satisfy the requirements, twice the number of samples shall be drawn and tested. If any of the retested samples fail to satisfy the requirements of the specification, the entire lot shall be considered rejected.

5. MARKING AND PACKING

5.1 Marking

The following shall be marked on all sheets as under;

5.1.1 Manufacturers name and recognized trademark if any.
5.1.2 Date of Manufacture.
5.1.3 Lot or batch number.

5.2 Rejection Marking:

Any lot rejected by inspecting authority during inspection shall be permanently embossed by “REJECTED” so it cannot be re-offered and used in anywhere for Railway Purpose.

5.3 Packing:

After inspection and approval, sheets shall be suitably packed to prevent damage in transit. The method of packing used shall be as agreed to between the purchaser/inspector and the supplier.

6.0 Warranty:

78 Months from the date of supply and 72 months from the date of fitment whichever is earlier, the product shall be warranted against cracking due to manufacturing defect.

APPENDIX - A

DENSITY: - The test specification of about 100 cm^2 shall be weighed correctly to 0.1 gm. and its dimensions measured. The length and width shall be measured to an accuracy of ± 0.5 mm and thickness shall be measured at 6 random places widely spaced on the test specimen and average value shall be considered for calculation of volume. The weight of the test piece in grams divided by its volume in cm^3 gives the density.

Three test specimens shall be subjected to this test and average value taken for consideration as given in table-I

APPENDIX - B

TENSILE STRENGTH: - The tensile strength test shall be carried out on test specimen of 25mm wide of 200 mm long and of the actual thickness of the sheet. These specimens shall be cut along the length and width of the sheet. Specimens with clear- cut edges only shall be used. Specimen with irregularities in the cut edges shall be rejected. The rate of traverse of the moving jaw of the tensile testing machine shall be 20 ± 5 mm /minute.

Three test specimen shall be tested and mid value taken for consideration as given, in table -1 for each directions

APPENDIX - C

BREAKING LOAD TEST: - Breaking load test shall be carried out on a universal testing machine on a specimen of 200mm Long x 75mm wide. The distance between supports shall be 100mm with a bedding shank of 25mm Dia. The loading shall be completed between 30 to 60 seconds and the load at which fracture occurs shall be recorded.

Three test specimens shall be tested and mid value taken for consideration as given in table-1 for each direction.

APPENDIX - D

DROP IMPACT TEST: - The drop impact test shall be carried out with a falling weight type of impact tester, which shall essentially consist of the following,

i) A rigid metallic base preferably with leveling screws. The base shall have a hole or a ring of 25mm inside diameter attached to it for supporting the test specimen on it. The ring/hole should be so situated that its axis coincides with the line of fall of the striker. A device for clamping the test specimen to hold it in position while under impact shall also be provided.

ii) A striker consisting of a 19 mm diameter hardened steel ball ended plummet capable of being clamped released and falling freely in the guides. The spherical striking surface of the plummet shall be free from faults or any other imperfections. The entire striker assembly shall weigh 1.5 Kg. The line of fall of the plummet shall be perpendicular to the specimen surface and shall be concentric to the axis of the ring.

iii) Superstructure shall consist of rigid frame with guides to adjust the height of the striker. The height of the frame shall be such that the maximum height of fall of the striker is not less than 300 mm and the frame shall be calibrated from 0 to the maximum of the fall.

iv) The test specimen supported on the ring shall be subjected to drop impact. The material shall not fracture in drop impact test with a drop height of 200 mm. Minor cracks on the reverse side, if any should confine to the point of indentation only and shall not propagate beyond an area with 20 mm diameter.

v) Sample Size: Five test specimens of size 70mm X 70mm shall be subjected to test and each of the test specimens shall confirm to the requirements. Four test specimens should be drawn from each corner at the distance of 100mm from the edges of the sheet and one test specimen should be drawn from the middle of the sheet.

APPENDIX — E

FLEXIBILITY: - The sheets shall be flexible enough to take the curvature of coach ceiling. For flexibility test sample 400mm Long x 75mm wide shall be cut from a sheet both along the length and width leaving 150mm from the edges of the sheet. The flexibility test shall be conducted in “as received” condition. These samples shall be capable of being bent through 180 deg around a mandrel of 250 mm diameter without showing any visible crack.

Three test specimens shall be subjected to flexibility test and each shall pass the test.

APPENDIX – F

WATER ABSORPTION: - Three-test specimens each of 100mm x 100mm shall be cut from a sheet. These specimens shall be cut leaving 150mm smoothened with sand paper but not sealed. The specimens shall be conditioned in an atmosphere maintained at a relative humidity of 65 ± 5% and at a temperature of 27 ± 2°C until the weight is substantially constant. After this each of the test specimens shall be weighed to an accuracy of ± 0.1gm. They shall then be kept fully submerged in water clear of the bottom of the container, maintained at 27 ± 2°C for 24 hrs. At the conclusion of 24 hours immersion period, the test specimens shall be withdrawn from water and all excess water shall be wiped with a damp cloth and finally with dry tissue paper. Each of the specimens shall be weighed to an accuracy of ± 0.1gm. For each of the specimens the increase in weight, expressed as percentage of the weight before immersion shall be calculated.

Three-test specimen shall be subjected to this test and average value shall be taken for consideration as given in table-I. The test specimen should also not show sign of warping, deformation and delamination.

SECTION-B

1. SCOPE

1.1 This section covers the infrastructural requirements for manufacture of Glass Fibre Reinforced Epoxy Resin (GFRE) sheets for roof paneling of Railway passenger coaches.

2. REQUIREMENTS

2.1 All vendor seeking registration with ~~RDSO~~ Vendor Approval/Registration authority shall comply all the requirements mentioned below.

3. PLANT, MACHINERY AND INFRASTUCTURE REQUIREMENTS

3.1 The manufacturers shaft have adequate space and a covered area with cemented floor to accommodate the following.

a) Damp free place for storage of raw materials i.e. Glass Fibre, resin, chemicals etc.

b) Independent manufacturing area for GFRE sheet.

c) Inspection area.

3.2 The firm should have resin coating arrangement on Glass Fibre.

3.3 The firm should have at least one number heavy-duty hydraulic press with die arrangement to manufacture GFRE sheet of adequate size for roof ceiling with adequate margin of trimming.

3.4 The firm should have at least one No. of trimming machine.

4. TESTING FACILITIES:

4.1 The testing lab should have facility for temperature and humidity control.

4.2 The firm should have an electronic balance.

4.3 The firm should have one universal testing machine of adequate capacity.

4.4 The firm should have density-measuring arrangement.

4.5 The firms should have facility for impact testing as per Appendix 'D' of Section — A of this specification.

4.6 The firm should have in-house testing facilities for conducting test for Resistance to spread of flame, Limiting Oxygen index, Deterioration of visibility due to smoke and toxicity.

4.7 The firm should have in-house testing facilities as per ISO 5660-1 for conducting test for Heat release rate (HRR)~~w.e.f.01.01.2016. Till such time, firm should arrange testing at reputed laboratory as decided between IR/Inspecting Authority and manufacturer. The cost of testing will be borne by the manufacturer.~~

4.8 The firm should have facility for conducting test for flexibility as per Appendix 'E' of Section — A of this specification.

4.9 The firm should have facility for conducting test for water absorption as per Appendix 'F' of Section — A of this specification.

4.10 The firm should have the following instruments.

a) Vernier calipers with Digital display
b) Micro meters with Digital display/Dial Thickness Gauge
c) Moisture meter with Digital display
d) Hydrometer
e) Measuring scale
f) Measuring tape

4.11 The firm should have arrangement for periodical calibration of all the gauges & instruments.

5 QUALITY CONTROL REQUIREMENTS

5.1 The firm should have acquired ISO: 9001- ~~2000~~ 2015 (Latest) certification and the product for which the approval is sought should be broadly covered in the scope of the certification for manufacture and supply.

5.2 The Quality manual of the firm for ISO: 9001- ~~2000~~ 2015 (latest) should clearly indicate at any stage the control over manufacturing and testing of the said railway product.

5.3 There should be a system to ensure the traceability of the product from raw material stage to finished product stage. The system should also facilitate to identify the raw material composition from the finish product stage.

5.4 It should be ensured that there is a Quality Assurance Plan for the product detailing the following various aspects:

- Organisation chart
- Process flow chart
- Stage inspection details from raw materials stage to finish product stage
- Various parameters to be checked and level of acceptance of such parameters indicated and method to ensure control over them.
- Disposal system of rejected raw material and components.

5.5 There should be at least one full time technologist qualified ~~having a minimum bachelor's degree~~ in relevant field with experience of at least ~~5~~ 2 years ~~or a person with diploma in relevant field with 12 years' experience~~. He should be free from day to-day production, testing and quality control responsibilities. He should be mainly responsible for development of a product, analysis of products, control over raw material, and corrective action in case of difficulties in achieving the parameters.

5.6 Ensure that the Incharge of the Quality Control Section is having a qualification ~~of minimum bachelor's degree~~ in the relevant field and has a minimum of ~~5~~ 2 years experience. ~~Alternatively, he should be a diploma holder with minimum of 12 years' experience.~~ He should be actively involved in day-to-day activities of quality control/stage inspection / compliance of QAP etc.

5.7 The firm must ensure that proper analysis is being done on monthly basis to study the rejections at various internal stages and it is documented.

5.8 The firm should ensure that latest version all the relevant specifications, IS standards are available with the firm.

6. DOCUMENTATION

Firm shall maintain the following documents/records:

6.1 A well-documented Quality Plan.

6.2 Incoming raw material register with Test Certificates references of suppliers and internal test results.

6.3 Stage inspection results including finished products results.

6.4 Records of internal rejection and its analysis vis-a.-vis action plan.

6.5 Records of final products inspection by external agencies (like RDSO), Nonconformity reports and case analysis as well as action taken thereof.

6.6 Records for maintenance of dies/moulds.

6.7 Ensure that proper systems are available for dealing with customer complaint.

7 TRAINING

7.1 Training needs should be identified for all concerned officials and regular training shall be organised and imparted on maintenance of machines, quality assurance, safety parameters etc.

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