FINAL DRAFT OF REVISION OF SPECIFICATION / STR

Ref: Final Draft of Specification No. RDSO/2007/CG-01 (Rev.1)

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:

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

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

INDIAN RAILWAYS

SCHEDULE OF TECHNICAL REQUIREMENTS FOR SHEET MOULDING COMPOUND(SMC) TO BE USED FOR MANUFACTURING OF F.R.P. PRODUCTS

S. No.	Month/Year of issue	Revision / Amendment	Page No.	Reason for Amendment
1.	**April-2007**	-	-	**First issue**
3.	**August-2020**	Rev. 1	4 &10	• **Amendment 1 to 3 has been incorporated.** • **In section –A, clause 1.3 has been replaced with clause 7.1 and has been modified.** • **Clause 7.2 added in Section –A.** • **Clause 4.1 of Section –B has been modified.**

Issued By:
Carriage Directorate
Research Designs and Standards Organization
Manak Nagar , Lucknow-226011

Signature			
Name & Designation	Prepared By:- Sonu Kr. Gupta JE/Design	Checked By:- Abhay Sinha SSE/Mech.	Approved By:-Gaurav Kr. Singh Director/SS

INDEX

Cl. No.	Contents	Page
	Foreword	3
Section-A		
1	Scope	3
2	Materials	4
3	Sampling	4
4	Properties	4
5	Tests	5
6	Storage and self-life	6
Annexure - I	Proforma	7
Appendix - 1	Fibre content and Fibre length	8
Appendix - 2	Resistance to boiling water	9
Section-B		
1	The System	10
2	Plant, machinery and infrastructure requirements	10
3	Records	10
4	Approved manufacturers	10

SCHEDULE OF TECHNICAL REQUIREMENTS FOR SHEET MOULDING COMPOUND (SMC) TO BE USED FOR MANUFACTURE OF FRP PRODUCTS

FORWARD

i. This Schedule is intended to cover the technical requirements/provisions relating to materials, constructions and tests and does not include all the necessary provisions of the contracts.

ii. This schedule draws references to some of the relevant Naval, ASTM, UIC and other Indian Standard specifications. Unless otherwise specified, the latest version of the relevant specifications shall be taken as reference.

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

iv. In this schedule, due consideration has been given to the development in the field of polymeric materials process technologies, serviceability requirements of the Indian Railways as the practice followed in advanced countries in this field.

v. This schedule consists of two sections i.e.- Section-A and Section-B. Section-A covers the technical requirements, methods of sampling and tests for the Sheet Moulding Compound proposed to be used for manufacture of FRP products for use on Indian Railways and Section- B covers infrastructure requirements for manufacture, testing and quality control at the works of the manufacturers.

SECTION - A

1. SCOPE:

1.1 This section covers the technical requirements, methods of sampling and tests for the Sheet Moulding Compound to be used for manufacture of FRP products for use on Indian Railways.

1.2 This Schedule shall be read along with the Schedule of Technical Requirements for relevant products.

2. MATERIAL

2.1 Sheet Moulding Compound shall consist of resin, glass fibre reinforcements, fillers and additives etc. processed in a continuous sheet form.

2.2 Resin, glass fibre & other additives used in the manufacture of SMC shall be selected such that the product conforms to the requirements as laid down in this Schedule and the relevant product specifications.

3. SAMPLING:

3.1 Samples shall be selected at random from each lot of SMC stock from which the products will be manufactured.

3.2 Five test laminates of 320 x 320mm size and 3 to 4mm mm thick shall be compression moulded from samples drawn from each batch with the facilities available with the manufactures/moulders. These test laminates shall be post cured in an oven at 80 ± 5ºC for at least six hours or at 100 ± 5ºC for 4 hours and conditioned for 16 hrs. before test are undertaken.

3.3 If schedule of requirements for the product stipulates that the same shall be fire retardant, the test laminates as specified in product specification shall also be prepared by compression moulding for testing of fire properties.

4. PROPERTIES

4.1 **Workmanship and finish** - The test laminates shall be free from crack, crazing, blister, porosity, air-bubble, dry spot and other surface defects.

4.2 **Physical properties -** The test specimen prepared from the laminates when tested as per the method of test indicated against each test shall conform to the requirements as laid down in Table1.

TABLE-1

S. No.	Property	Specified Value	Method of test
1	Specific gravity	1.75 - 2.0	ASTM D-792
2	Hardness, minimum a) Barcol Hardness OR b) Rockwell R	 48 115	 ASTM 2583-67 ASTM D 785

3	Tensile strength (in any direction) (MPa) minimum.	70	ASTM D-3039
4	Cross breaking strength (in both directions at a testing speed of 25 mm per minute with supports and loading nose of 1.5 mm radius) Mpa. minimum.	150	ASTM D-790
5	Compressive strength (Proof test) (Mpa) minimum.	150	ASTM D-695
6	Izod Impact strength (J/m) minimum.	450	ASTM D-256
7	Water absorption at 27±2°C for 24±0 hrs., Maximum	0.5%	ASTM D-570
8	Fibre content (%) minimum	35	Appendix 1
9	Fibre length	50% of the fibres shall not be less than 50 mm in length	Appendix 1
10	Resistance to boiling water	Shall pass the test	Appendix-2

4.3 **Fire worthiness Properties** – Fire worthiness properties specified in table – 2 shall be carried out as specified in relevant product specifications.

TABLE-2

S. No.	Property	Specified Value	Method of test
1	Resistance to spread of flame	Minimum Class 'A'	Appendix-11 of UIC-564-2 OR
2	Deterioration of visibility due to smoke	Minimum Class 'A'	Appendix-15 of UIC-564-2 OR
3	Limiting Oxygen Index	Minimum 35	IS: 13360 Part-6, Section-19
4	Toxicity Index	<1	NCD-1409
5	Heat Release Rate (MARHE i.e. Maximum Average Rate of Heat Emission in kW/m^2) as specified in EN 45545-2:2013	R1 (HL3)	ISO 5660-1: 50 kW/m^2

5. TESTS AND SAMPLING

5.1 The manufacturers shall furnish the Purchasing/Inspecting authorities the details of tests and inspection records and other relevant records as required under the quality control systems in force. These records & reports shall be maintained by the Competent Technical Authority of the manufacturers and shall be open to examination by the Purchasing/Inspecting Authorities at all reasonable a time.

5.2 The Purchasing/Inspecting Authorities at their discretion may draw samples of materials at any stage of production for conformity tests either at the works of the manufacturers or in an approved laboratory and the testing charges will borne by the manufacturers.

5.3 In case the samples do not conform to the requirements of the respective specifications, double the number of samples from the same lot/batch shall be drawn for re-tests. Should any of the re-test samples do not conform to the requirements, the entire lot/batch shall be rejected.

6. STORAGE AND SHELF-LIFE:

6.1 The SMC stock shall be stored in a cool, dark and dry place, preferably at temperature not beyond 30ºC. The stock shall be consumed within 45 days from the date of manufacture.

6.2 In case the stock is not consumed within 45 days, tests as per clause 4 shall be conducted again. If the SMC stock passes all the tests in re-testing, the same shall be consumed immediately.

6.3 Stock of SMC shall be stored batch wise and in such a manner that it shall be possible to easily identify the batch of each lot.

6.4 Details of stock of SMC stored by manufacturer shall be kept in a register maintained in the format given in Annexure-I and shall be available for examination by the purchaser or inspecting authority.

7. General

7.1 Following Shall be applicable when this item appears in RDSO`s vendor directory.

'All the provisions contained in RDSO's ISO procedures laid down in Document No. QO-D- 7.1-11 dated 19.07.2016 (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.'

7.2 The Govt. of India policy on `Make in India` shall apply.

ANNEXURE - I

Batch No.	Quantity	Fibre Glass Content	Name of SMC manufacturer	Date of manufacture of batch	Date of Receipt	Date Consumed	Initial

APPENDIX - 1

FIBRE CONTENT AND FIBRE LENGTH

1. This test is to distinguish SMC with longer fibre from DMC and to ensure that SMC has the stipulated fibre content. This method is not suitable for determining fibre content if the filler is not removable by washing with hydrochloric acid in such a situation FRP manufacturer shall indicate the test method.

2. At least two specimens cut out from two different laminates as per Clause 3.2 shall be selected for checking of fibre content. All weighing shall be to the nearest 0.01 gm.

3. Specimen of size 75 x 75 mm shall be cut from the corners of the square laminates.

4. A silica dish of appropriate dimensions shall be heated in a muffle furnace at 575 ±25ºC for 15 min., cooled in a desicator and weighed (W1). The test specimen shall then be placed in the dish and the whole unit heated at 105ºC for 2 hours, cooled in a desicator and weighed (W2).

5. The sample with dish shall then be heated in a ventilated muffle furnace at a temperature of 575 ±25ºC for 30 minutes, cooled in a desicator and weighed (W3). This process is repeated until the difference in weight in successive weighing is less than 0.01 gm.

6. The contents in the dish shall be treated with concentrated hydrochloric acid and the acid shall be removed by washing. The contents remaining in the dish shall then be dried at 105ºC for 2 hours and weighed (W4). This process shall be repeated until the difference in weight is less than 0.01 gm. The length of the fibre selected from the Centre of the sample on the dish away from cut edges shall be measured and recorded. The contents shall be examined to find whether filler particles still remain within the contents. If filler particles are not present, the fibre content shall be calculated as follows: -

$$\text{Fibre content (\%)} = 100 \times \frac{(W4 - W1)}{(W2 - W1)}$$

The approximate filler content shall be as follows:

$$\text{Filler content (\%)} \; 100 \times \frac{(W3 - W4)}{(W2 - W1)}$$

7. REQUIREMENTS

7.1 **Fibre length**: - 50% of the fibres shall not be less than 50 mm in length and rest shall be between 25 and 50 mm.

7.2 The fibre content shall be not less than the values specified in the relevant product specifications.

APPENDIX - 2

RESISTANCE TO BOILING WATER

1. This test is to assess the amount of water absorbed in boiling water and soluble matter and to serve as an accelerated weathering test.

2. Three test specimens used for measuring cross-breaking strength as per ASTM -D - 790 shall be prepared. The specimens shall be dried in an oven at 50±3ºC for 24 hrs., cooled in a desicator and weighed (W1). These shall then be immersed in boiling distilled water for 4 hours. The specimens shall then be cooled for 15 minutes in water at room temperature and dried with a clean cloth or filler paper and weighed (W2)

3. The specimen shall then be redried in an oven at 50±3ºC for 24 hours, cooled in a desicator and weighed (W3). The percentage of water absorption.

$$= 100 \times \frac{(W2 - W3)}{W1}$$

$$\text{The percentage water soluble matter} = 100 \times \frac{(W1 - W3)}{W1}$$

4. The specimens shall then be tested for cross-breaking strength as per ASTM D-790(say CBS-2) and percentage reduction computed against the value obtained with the original sample (cross breaking strength, CBS-1)

$$\text{Percentage reduction} = \frac{(CBS\text{-}1 - CBS\text{-}2)}{CBS\text{-}1}$$

5. Requirements

5.1 The test specimens shall not show any warping, cracking or change in appearance.

5.2 The percentage of water absorbed (average of three measurements) shall be less than 2%.

5.3 Percentage of water soluble matter shall not exceed 0.1%.

5.4 The percentage reduction in CBS (Cross-breaking strength) after boiling in water for 4 hours shall not be more than 20%.

SECTION – B

CODE OF PRACTICE FOR QUALITY CONTROL AND INSPECTION

1 THE SYSTEM

1.1 The manufacturers shall furnish to the purchasing/Inspecting Authorities information in respect of quality control systems in force at their works on various materials used in the manufacture of components.

2 PLANT, MACHINERY AND INFRASTRUCTURE REQUIREMENTS

2.1 The manufacturers shall have adequate space and covered area with cemented floor to accommodate the following:

a) Damp free place for storage of powder chemicals and other raw materials including bought out items.
b) Independent manufacturing areas for various FRP components and SMC separately.
c) Storing of SMC rolls & components and dispatch of finished products.
d) Finishing and inspection area.

2.2 SMC manufacturing plant owned by any manufacturer should be capable of producing 500mm width (Min.) SMC sheet and shall be equipped with speed controller. The firm shall also have stainless steel container with high-speed motorised stirrer for resin mixing.

3 RECORDS

3.1 The manufacturers shall furnish the Purchasing/Inspecting authorities the details of tests and inspection records and other relevant records as required under the quality control systems in force. These records & reports shall be maintained by the Competent Technical Authority of the manufacturers and shall be open to examination by the Purchasing/Inspecting Authorities at all reasonable a time.

4 APPROVED MANUFACTURERS

4.1 For reasonable quality assurance, it is desirable that the components are procured form ~~Manufacturers approved by Research , Design & Standards Organisation (RDSO), Lucknow~~ approved vendor by Vendor approving authority, or by any other agency as assigned by the Purchasing Authority, based on evaluation of the components as per the specification, manufacturing & quality control facilities and quality/assurance programme. However, such approval does not guarantee the supply of consistent quality of material/components; & therefore, every lot/batch offered shall be subjected to inspection and testing as per the specification.

4.2 The approved manufacturers shall be subjected to periodical re-apprisal (periodicity for each components shall be assigned by the approving authority). In case of withdrawal of any manufacturing & quality control facilities provided at the time of approval or the components produced at the time of reapprisal are not conforming to the specification, the manufacturers are liable to be withdrawn from the approved list. The approving authority reserves the right to withdraw the manufacturers from the approved list without assigning any reason.

4.3 The consignee may also periodically arrange testing if so desired, in an approved laboratory for conformatory tests within six months from the date of receipt of the supplies, in their original packings. In case of samples do not conform to the specification, the consignees may at their discretion suspend the manufacturer for further supply and the fact brought to the notice of approving/inspecting authorities for appropriate action.