INDIAN RAILWAYS

SCHEDULE OF TECHNICAL REQUIREMENTS

MODULAR TOILETS FOR INDIAN RAILWAY COACHES (BG)

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COMPOSITE MODULAR TOILET UNIT FOR RAILWAY COACHES

Section A- Schedule of Technical Requirements

1.0 FOREWORD

1.1 This schedule is intended to cover in two parts i.e. A & B. Section -A intends to cover the technical requirements/provisions relating to materials, constructions and tests and does not include all the necessary provisions of the contracts. The Section B covers the infrastructural, testing and quality control facilities required to manufacture the modular toilet.

This schedule draws reference to some of the relevant specifications. Latest version of these specifications shall be taken as reference.

1.2 IR mainline passenger coaches have 4 toilets each, of both western commode and Indian squat-pan types. Some coaches may have 2/3 toilets. The number of toilets and their type (Indian or western) depends upon the coach type. The modular toilet system is required for both designs, to meet the following objectives:

- Toilets should be ready to assemble resulting in lower manpower input
- Reduction in weight of coaches
- To reduce the extent of corrosion in the bottom portion of the toilets
- To provide for a clean odourless, hygienic and aesthetically pleasing toilet.
- To have a toilet which is easy to clean and refurnish
- To enable use of materials in toilets which provide for
    - Good impact resistance
    - High specific stiffness
    - Excellent resistance to ignition
    - Low smoke evolution
    - Extremely low Toxic fumes emission
- Toilets should have long life with easy maintainability

The modular toilet is required to suit the space constraints of the different coaches, and should not infringe with the Schedule of Dimensions, 1929. All parts of the system should be at least 225 mm above rail level (preferably 400 mm). The equipment should not impede the inspection & maintenance of various bogie/coach sub-assemblies.

The tenderer is permitted to make minor changes in the original design of the system to meet IR's requirements. However, this shall be done at the tenderer's sole responsibility

2.0 SCOPE

2.1 This specification indicate the requirements regarding the material of construction and it's properties, the quality of workmanship etc for the manufacture of the composite shell for the modular toilet unit to be used for A/C Railway Coaches.

3.0 GENERAL ARRANGEMENT

3.1 Composite Modular toilet with Indian style pan and outside wash basin to RDSO drawing No.SK-K2024

3.2 Composite Modular Toilet Unit with Indian Style pan to RDSO drawing No.SK-K2025.

3.3 Composite Modular Toilet Unit with commode to RDSO drawing No.SK-K2026.

4.0 MATERIAL

4.1 The material shall consist of fire retardant thermosetting polyester resin with suitable gel coat and E-glass continuous filament mat (CFM) or stitched chopped strand mat and Woven Roving (WR) combination suitable for polyester resin system.

4.2 RESIN SYSTEM

The resin for FRP back up shall be Isopthalic acid based fire retardant unsaturated Polyester Resin. No filler shall be used except those required for obtaining fire retardant property in the resin system (Resin manufacturer certificate to this effect required). A fire retardant vinyl or epoxy resin system with equivalent mechanical properties may also be used with approval of RDSO.

The resin shall be procured from a reputed manufacturer in sealed containers along with the test certificates. The heat distortion temperature of the resin shall not be less than 100°C and the percentage elongation of the resin shall not be less than 3 %.

4.2.1 Neutral colour NPG Isopthalic acid based Polyester Resin system shall be used for the Solid Surface (Gel coat), which does not impart colour or tinge up on curing and would have fire retardant characteristics when mixed with ready mix granite finish filler. This resin system shall provide suitable UV resistance surface characteristics when used with the ready mix granite finish filler. Minimum Solid Surface (Gel coat) thickness shall be 1 mm.

Ready mix granite finish filler system of a reputed brand, resulting in a Solid surface of a shade mutually agreed between Railways and Vendor shall be procured from a reputed supplier. This filler system when used with neutral colour resin for Solid Surface (Gel coating) shall impart necessary fire retardant characteristics to the FRP laminate as defined in the Table-1. Alternatively manufacturers may provide PU paint over the gel coat (gel coat should be minimum 0.4mm thick) in place of solid surface. The anti graffiti PU painting should be done in a paint booth. Subsequently, baking should be done in an oven. Only those manufacturers fulfill the requirement as laid down in Para 3.4 of Section-B should opt for doing PU painting on modular toilets.

4.3 GLASS REINFORCEMENT

The glass shall be made of E-glass fibres which should be suitable for RTM / Vacuum Assisted RTM process and the properties of the continuous filament mat or stitched chopped strand mat and WR used for fabrication shall be in conformity with the properties given for it in the table 5 at page 10 of BS 4994: 1987. Glass reinforcement material shall be of reputed brand with a test certificate.

4.4 PROPERTIES OF FINAL LAMINATE

The properties of the laminate shall be as per the values specified in Table-1.

TABLE-1

Minimum value required of the FRP laminates of modular toilet units

S.No.	PROPERTY	SPECIFIED VALUE	METHOD OF TEST
1	Specific Gravity	1.5 - 1.75	ASTM: D-792
2	Tensile Strength – Min (N/mm^2)	80	IS:1998
3	Tensile Modulus – Min (N/mm^2)	8000	IS:1998
4	% Elongation at break - Min	1.0 %	IS:1998
5	Inter laminar shear strength – Min (N/mm^2)	7.5	BS: 4994
6	Hardness - Min. Barcol	40	ASTM: D-2583
7	Cross Breaking Strength-Min	120 M Pa	IS: 1998
8	Resistance to impact test	Should not show crack, Crazing or pores on the tested surface	ICF/MD/Spec-107 Annexure-A
9	Fibre Glass Content		IS: 13411 Annexure-A Use formula given in Annexure – I of this STR
	By weight (w/w) – Min (%)	30%	
	By Volume - Min. (%) When density of cured resin is not less than 1.2	16.8%	
10	Water Absorption in 24 hrs.	0.5 % (max)	ASTM: D-570
11	Resistance to spread of flame	Class A or B	UIC 564-2 OR Appendix 4
12	Resistance to stains for (a) Acetone (for solid surface) (b) Black tea	Should not show any visible change on surface	IS: 2046
13	Critical oxygen index	28 % min.	ASTM:D-2863
14	Surface finish (by 60° Specular gloss meter	Gloss value more than 50	ASTM:D-523
15	Crack and Blister Test (Ink Test)	Shall not show any crack in the surface coat	ICF/MD Spec–107 Annexure-B
16	Smoke Density	Class A or B	UIC 564-2 OR Appendix 15
17	Toxicity	1.0 max.	NCD-1409
18	Colour fastness and Aging	No effect	ASTM: D-2565 & ASTM: D-2244

5.0 FABRICATION

The modular toilet unit shall be made by RTM / Vacuum Assisted RTM process.

5.1 WORKMANSHIP

The inner & outer surface of modular toilet shall be smooth and free from visual defects or any other surface defect such as delaminations, cavities, and discontinuities etc. The panel surface finish shall be glossy. The finished surface shall be superior abrasion resistance property. The supplier shall submit the FRP panel sample of size 600mm x 600mm x 3mm for approval of colour shade, pattern and surface finish & also for testing in accordance with table-I by purchaser before commencing the manufacturing.

5.2 GEOMETRY

5.2.1 The dimensions of the modular toilet shall be as per relevant drawings.

5.2.2 The thickness given in the drawings are minimum nominal thickness. However, the reinforcement content specified for each thickness must be provided in terms of number of layers of WR and CFM or stitched chopped strand mat each with specified surface density of the layers. The minimum reinforcement layers of each type for given thickness are given below:

10 mm thickness - One finished Solid Surface (Gel coat) of 1mm thickness + 4 alternate layers of 600 gm/m^2 WR + 6 layers of 450 gm/m^2 E-glass continuous filament mat (CFM) or stitched chopped strand mat.

6 mm thickness - One finished Solid Surface (Gel coat) of 1mm thickness + 2 alternate layer of 600 gm/m^2 WR + 4 layers of 450 gm/m^2 E-glass continuous filament mat (CFM) or stitched chopped strand mat.

4 mm thickness - One finished Solid Surface (Gel coat) of 1mm thickness + 1 layer of 600 gm/m^2 WR + 3 layers of 450 gm/m^2 E-glass continuous filament mat (CFM) or stitched chopped strand mat.

Note: For those modular toilets which are painted with PU paint, the gel coat shall be of 0.4mm thickness instead of 1mm thickness.

5.3 ASSEMBLY

5.3.1 FASTENERS

The components of the module shall be assembled using stainless steel cross-recessed head screws with adhesives at locations shown in the assembly drawing. Galvanized steel inserts to IS:277 with sufficient number of perforated holes shall be bonded to the panels at locations shown in the drawing for fixing the panels/fittings as the bearing and shear strength of FRP is poor. Flat head Nutserts (Blind rivet Nuts) of low carbon steel (galvanized) with round body & knurls in the grip should be provided in the bottom tray & side panels at location shown in the drawings. It should be ensured that all fasteners in FRP have a back up of steel inserts.

5.3.2 Assembled module must meet the internal dimension tolerances as specified in the drawing. There should no damage to the surface in terms of cracks or deep scratches on the surface in course of assembly.

6.0 DIMENSION AND TOLERANCES

The dimensions and tolerances shall be as per relevant drawings.

7.0 SCOPE OF SUPPLY

The scope of supply shall include all the items shown in the respective general arrangement drawings including the FRP panels with CFL light for gangway.

7.1 TRANSPORT PIPE SYSTEM

All pipes and pipe connections should be provided with KiTEC (PE-AL-PE) Composite Pressure Pipe i.e. flexible pipes with aluminium core encased within two HDPE layers with strong adhesive tie layer on both side of the aluminium core. These pipes are easy to install with compression type fittings, have very long life with virtually no maintenance and easily take the required bend & curve by hand with bending springs during fixing. The material used for this piping system has to conform to IS: 15450. The connection fittings of this system are completely leak-proof and made of non-corroding materials. Line valves should be located for easy accessibility for maintenance, and should be completely leak-proof while in use. It should be possible to isolate different circuits for repairs without complete dismantling. The pipelines will be clamped with the help of brackets so as to prevent whipping of pipes during run. Bracket for clamps should be bonded with structural adhesive. The repair of concealed pipelines can be done by means of removal of Inspection cover given in out side panel on the gangway side.

7.2 WATER TAPS

All the water taps shall be of self-closing type. The tap shall be of high quality with aesthetic appearance and shall provide trouble free service. Anti-pilferage arrangement should be provided.

7.3 FLUSHING SYSTEM

Flushing valve provided shall be as per ICF drg. No. ICF/SK3-6-3-423 (latest alteration). it shall be concealed and easy to operate. Flushing system is such that water jet is provided all around the squatting pan/commode so that perfect flushing is ensured.

7.4 WASH BASIN

Wash basin shall be as per RDSO drg. No. SK-K2034 (latest alteration). It shall be made of high quality stainless steel to spec. No. AISI – 304 with mirror finish on the working surface. The wash basin outlet pipe diameter should be increased to 40mm dia and sharp bends should be avoided to eliminate the problem of choking of outlet pipe.

7.5 LAVATORY PAN & WALL PROTECTOR

The lavatory Pan with wall protector shall be as per RDSO drg. No. SK-K2032 (latest alteration). It shall be made of high quality stainless steel to spec. No. AISI – 304 with mirror finish on the working surface.

7.6 COMMODE

A ceramic commode shall be provided as used on Indian Railway to RCF drg. No. CC63884 (latest alteration).

7.7 TOILET PAPER HOLDER

The commode lavatory shall be provided with integral sunk-in type toilet paper holder as per RDSO drg. SK-K2029 (latest alteration).

7.8 MIRROR

Mirror shall be pasted with VHB tape of 3M make in sunken space provided in the side panels (RDSO drg No. SK-K2029 & 30 with latest alteration). Aesthetically pleasing cap type screws shall also be provided on each corner as per RCF drg. No. AE 63139 (latest alteration).

7.9 LIQUID SOAP CONTAINER

Lavatories of AC coaches shall be provided with push type liquid soap container.

7.10 HANDLES

Two Nos. of Stainless steel handles as per RDSO drg. No.SK-K2035 (latest alteration) shall be provided at location shown in the drawing.

7.11 COAT HOOKS

Three pronged swiveling type stainless steel coat hooks to ICF Drg. No.ICF/STD-6-4-010 (latest alteration) shall be provided at locations shown in the drawing.

7.12 SUNK IN TYPE SHELF

Sunk-in-type shelf shall be provided in each lavatory as shown in the RDSO drawing No. SK-K2029 (latest alteration).

7.13 LITTER BIN

Litter bin has been modified so as to take care of the problems being faced by Railways. The bins shall be as per RDSO drawing No. SK-K2036(latest alteration).

7.14 TOILET DOOR ASSEMBLY

Toilet door assembly shall be as per RDSO drg. No.SK-K2031(latest alteration) with integral FRP louvers or It can be made with externally SS louver with proper frame.

7.15 EXHAUST FAN

110V AC exhaust fan for AC coach lavatories shall be provided as per location shown in RDSO drawing No. SK-K2029 (latest alteration). The fan shall conform to IS: 6680.

7.16 LIGHT FITTINGS

7.16.1 Two CFL light fittings as per RDSO drawing No.SK-K2033(latest alteration) shall be provided., one above wash basin inside the toilet unit and one above the window on side wall. The cover of the CFL fitting shall be with hinge on one side and two guard locks to drawing CC-76213 (latest alteration)

7.16.2 One CFL light fittings as per RDSO drawing No. SK-K2033(latest alteration) shall be provided above outside wash basin.

7.16.3 The Electronic Lamp ballast 110 V DC/11 W suitable for CFL fitting as per RCF spec. No.EDTS-064 shall be procured from approved sources only. The sources shall be ascertained from ICF before commencing the supplies.

7.16.4 Good engineering practices shall be adopted for fitment of light fittings to meet the rolling stock service and maintenance conditions.

7.16.5 The modular toilet shall be supplied in pre-wired condition for lights, fans and switches. The cables and wiring fittings shall be procured as per spec.RDSO/PE/Spec/TL/0027 from ICF/RDSO approved sources. The electrical wiring looping between the light fittings and fans (toilet fan and exhaust fan) shall be restricted as minimum as possible. This shall be finalized in consultation with ICF.

8.0 DISPOSAL OF WASTE

The supplier at his own cost shall collect all off-cuts and grinding dust (to be done in a closed enclosure) generated during installation of modular toilet from ICF and dispose off observing the Pollution Control Board norms in this regard.

9.0 VENDOR APPROVAL

9.1 Modular toilets shall be procured from vendors approved by RDSO.

9.2 The vendors shall have all the facilities mentioned in section B of this STR.

9.3 A request for the registration for the item shall be made in the prescribed form to RDSO. The request for registration shall be accompanied with test results of the product.

9.4 The vendor will be assessed by RDSO for compliance of STR and QAP in accordance with extent procedure. All tests mentioned in the specification will be conducted by type test.

9.5 Any vendor who desires to supply modular toilets to Railways must manufacture 4 prototype toilets as per laid down drawings. The type tests on samples as per the requirements of specification will be carried out.

10.0 QUALITY CHECK BY THE MANUFACTURER

10.1 Rigorous internal inspection of the modular toilets shall be carried out by the manufacturer. Records of all internal inspection shall be maintained and put up to the inspecting authority. Records should be preserved for the complete duration of the warranty.

10.2 100 % of the modular toilet unit shall be visually examined for conformity as per clause 5.1.

10.3 Dimensional checks as per clause 5.2.1 shall be carried out on 100 % of the lot.

10.4 25% of the bottom trough should be subjected to a load of 1000 N over an area of 250 X 250 mm at any location with support as provided in the drawing and the deflection must not exceed 1 % of the maximum span of the trough. The same trough should be subjected to the same load as given above at two different locations (total 2000 N). There must be no sign of permanent deformity under such loads.

10.5 Test specimens of size 300 mm long and 300 mm wide should be cut out from FRP components at the location of toilet seat / side panel / top cover for each nominal thickness from every fabricated modules for carrying out all test (except test given at para 10.2.6) as mentioned in Table 1. Extended flanges should be incorporated in the mould in absence of cutouts. The test results should meet the laid down requirements in table-1.

10.6 The test concerning fire retardant property such as, critical oxygen index, smoke density, toxicity and resistance to flame should be carried out for every 50% of modular toilets supplied by the vendor.

11.0 INSPECTION

11.1 External inspection of the modular toilets shall be done by M/s RITES.

11.2 Minimum lot size offered for inspection shall be 2 coach sets (8 nos toilets).

11.3 100 % of the lot offered for inspection shall be visually examined for conformity as per clause 5.1.

11.4 Dimensional checks as per clause 5.2.1 shall be carried out on 25% of the lot offered for inspection.

11.5 The bottom trough of 10% of the lot size (subject to minimum 1 number) should be subjected to a load of 1000 N over an area of 250 X 250 mm at any location with support as provided in the drawing and the deflection must not exceed 1 % of the maximum span of the trough. The same trough should be subjected to the same load as given above at two different locations (total 2000 N). There must be no sign of permanent deformity under such loads.

11.6 Test specimens of size 300 mm long and 300 mm wide should be cut out from FRP components at the location of toilet seat / side panel / top cover for each nominal thickness from 10% of the lot size of (minimum 1) fabricated modules for carrying out all test (except test given at para 10.2.6) as mentioned in Table 1. Extended flanges

should be incorporated in the mould in absence of cutouts. The test results should meet the laid down requirements in table-1.

11.7 The test concerning fire retardant property such as, critical oxygen index, smoke density, toxicity and resistance to flame should be carried out for every 20% of the lot size (minimum 2) of the modular toilets supplied by the vendor or when ever desired by RITES / IR officials.

11.8 In the event of failure of any one tested sample, the lot may be withdrawn and re-offered by the manufacturer after satisfaction is possible. In this re-inspection, double the number of sample drawn earlier will be checked for the parameter in which earlier failure was encountered. In the event of failure of any one of these redrawn samples, the earlier lot shall be rejected. The failed lot shall be destroyed in the presence of the inspector.

12. MARKING

Each lavatory module shall be embedded with resin the name of manufacturer and month & year of manufacturing on the backside of vertical panel at location given in the drawing.

13. WARRANTY

13.1 The warranty period shall be 6 years for the following items from the date of installation of the composite modular toilet unit for functioning of the following items:

1. FRP structure of FRP Modular toilet such as bottom tray top & side wall panels and outside wash basin panels & door.
2. SS Squatting Pan
3. SS Wash basin
4. SS Handles
5. SS Wall protector
6. Coat Hook
7. Light cover (Except Electronic Ballast and CFL tube lights).

13.2 The warranty period shall be 24 months from the date of installation of the Composite Modular toilet unit for functioning of the following items:

1. Flush Valve
2. Gravity type spring loaded water tap
3. Spring aided door closer
4. Door handle and lock
5. Mirror – limited to the silver coating at the back.
6. Liquid soap container

In case composite modular toilet unit or its any part crack/fails within the warranty period, it shall be replaced by new one without any cost.

14. SPARES

The following spares shall be supplied with each coach set of modular toilets.

1. Flush Valve - 1 No.
2. Spring aided door closer - 1 No.
3. CFL fitting - 2 Nos.

15. TRAINING

The firm shall conduct training of Zonal Railway staff for installation, operation, trouble-shooting, repairs and preventive maintenance of the toilet system at their own cost. The firm shall supply comprehensive maintenance manual to all user railways.

SECTION-B
REQUIREMENTS OF INFRASTRUCTURE FACILITIES TO MANUFACTURE MODULAR TOILET FOR INDIAN RAILWAY COACHES (BG)

1. SCOPE

1.1 This Section covers the infrastructural requirements for manufacture of composite Modular Toilet for Indian Railway Coaches (BG).

2. REQUIREMENTS

2.1 All vendors seeking registration with RDSO must fulfill the requirements of this schedule.

3. PLANT, MACHINERY AND INFRASTRUCTURE REQUIREMENTS

3.1 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 reinforcement and other raw materials including bought out items.
b) Independent manufacturing areas for various FRP components.
c) Finishing, Assembly and inspection area.

3.2 The manufacturer shall have at least one Resin Transfer Moulding Machine and dispensing system material pump capable to develop upto 7.5 bar fluid pressure and 50 Ltr. Capacity.

3.3. Manufacturer shall have one No. Gel coating system with AAC (Air Assist containment) Spray gun with pump.

3.4. One paint booth, paint shop and flash off zone with oven for PU painting and baking of the modular toilet and its components.

3.5. The manufacturer shall have sufficient vacuum generating equipment.

3.5. Manufacturer shall have at least one drilling machine with provision for drilling, different dia holes and at least two portable hand grinders for finish grinding of components.

3.6. Manufacturer shall have one number air compressor of minimum capacity 126 Cfm, 25 to 30HP with Air dryer attachment.

3.7 Manufacturer shall have one number oven (0-200^0 C) with digital temperature indicators fitted with control panel for post or pre heating of moulds and spraying of moulds.

3.8 The firm must ensure availability of a separate close space for spraying of Gel Coat Resin with required ventilation keeping in view the use of chemicals, which are toxic.

3.9 The firm shall have suitable tools, cutters, fine polishing files, Buffing Machine for de-flusing the moulded products.

3.10 The manufacturer should have a system to ensure that moulds are checked at regular intervals. They shall have adequate mould handling facilities like chain pulleys or electric hoist or any other suitable method for movement of heavy moulds.

3.11 Prior to release of dies / moulds for production, it should be ensured that these are checked dimensionally in all respects. Proper records of die/moulds inspection checking showing the date of checking should be available.

3.12 The manufacturer seeking approval shall have at least one number die/moulds for each item. The moulds shall be made using high quality tooling resin without filler, polished to high glossy finish (or) mould shall be made out of metal, chromium plated, buffed and polished to mirror finish.

3.13 Proper weighing facilities for measuring various raw material constituents should be available. One electronic weighing balance of minimum 10 mg. accuracy and one mechanical weighing balance of 100kg. capacity and 0.2% accuracy shall be available.

3.14 It must be ensured that the weighing machines are calibrated regularly and frequency of calibration should be specified.

4. TESTING FACILITIES

4.1 The manufacturer shall have one tensile testing machine of 2.5MT capacity having a least-count of 2.0 Kg with adequate speed of testing required for FRP components.

4.2 The firm shall have one Barcol impressor (Model No.934-1) for conducting hardness test.

4.3 The firm shall have electronic balance (least count - 0.001 gm) with density determination kit.

4.4 The firm should ensure that arrangements are available for resistance to impact test.

4.5 The firm should ensure that the arrangements are available for measuring water absorption percentage.

4.6 One muffle furnace (800^0C) with digital temperature controller and indicator required for glass content determination should be available.

4.7 Bunsen burner and necessary stand/holder required for flame test should be available. A hot plate for boiling water test of FRP shall also be available.

4.8 The manufacture shall have at least 3 Nos. of silica crucible of 4" size for glass content test and two Nos. of glass desiccators. Other glassware like beakers, watch plate, funnel etc. should also be available.

4.9 The firm must ensure that the measuring instruments like steel scales (300, 600 & 1000mm), and vernier calipers (0-200mm) are available.

4.10 The manufacturer shall have test sample preparation arrangements like vice, cutter, polishing files etc. for preparation of various samples for tests for tensile strength, hardness, specification gravity etc.

4.11 All measuring and checking gauges for different components of the modular toilet to ensure the dimensions as per drawings should be available.

4.12 The firm should have in house test facilities for Critical oxygen index, smoke density and toxicity as per table-1 w.e.f. 1.1.2006.

4.13 Digital Gloss meter with 60 deg. gloss head as per IS:101 (Part-4/Section-4)-1998 to measure gloss value of the surface, of the FRP products shall be available.

4.14 Manufacturer shall have at least one number flow cup B-4 (Ford) for measuring the viscosity of Resin.

4.15 Manufacturer shall have necessary arrangement for measuring the gel time for resin like beakers, pipette, conical flask etc.

4.16 Manufacture shall have one number stopwatch.

4.17 Manufacturer shall have one number Lab stirrer for mixing the different chemicals & filters.

4.18 Jigs & fixtures for conducting load test, tensile test etc. should be available.

4.19 The firm must ensure that one number full-scale fixture for fitment of bottom tray with the Rail Coach Body is available.

5 QUALITY CONTROL REQUIREMENTS

5.1 The manufacturer shall have their own valid ISO:9000 series certification for the product for which the approval is sought.

5.2 There should be the system to ensure 'first-in first-out' for all raw materials and intermediate stages to finish products.

5.3 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.

5.4 The quality manual of the firm for ISO:9000 should clearly indicate the control over manufacturing at every stage and testing of the said Railway product.

5.5 It should be ensured that proper analysis is being done on monthly basis to study the rejection at various stages of production and is documented.

5.6 There shall be at least one graduate degree holder person in relevant technology with field experience of at least five years or diploma holder with field experience of ten years on polymers for regular production and quality control.

5.7 Latest version of all the relevant specification IS, BS, ISO, ASTM, UIC, NCD, RDSO, ICF standards/ specifications and drawings with latest alterations should be available with the firm.

5.8 The firm shall have a system for traceability of the raw materials used, especially the liquid resins. Each drum of the resin shall be traced to a finished product. Similarly each finished product shall be traced back to the drum of resin from which it was manufactured.

6. DOCUMENTATION

Firm shall maintain following documents/records:

6.1 A well documented Quality Plan.

6.2 Incoming raw material register with TC reference of supplier and for 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), NCR 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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Annexure-I

CALCULATION OF GLASS FIBER CONTENT IN FRP LAMINATE

$$\text{Volume of glass fiber (\%)} = \frac{\delta_{resin} \times W_g / 100}{\delta_{glass} - W_g / 100 \, (\delta_{glass} - \delta_{resin})} \times 100$$

W_g = Fraction weight of glass fiber

δ_{resin} = Density of cured resin

δ_{glass} = Density of glass fiber