INDIAN RAILWAYS

SCHEDULE OF TECHNICAL REQUIREMENTS

FOR

SELF LUBRICATING POLYESTER RESIN BASED COMPOSITE BRAKE GEAR BUSHES TO BE USED IN MAINLINE COACHES (BG)

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SECTION-A

SCHEDULE OF TECHNICAL REQUIRMENTS FOR SELF LUBRICATING POLYESTER RESIN BASED COMPOSITE BRAKE GEAR BUSHES TO BE USED IN MAIN LINE COACHES (BG)

0. FOREWORD

0.1 This schedule consists of two parts viz. Section A section B. Section A covers the technical requirements/provision relating to material, manufacture and tests and does not include all the necessary provisions of the contracts. Section B covers the infrastructural, testing and quality control facilities required for manufacture of Self-lubricating polyester resin based composite brake gear bushes.

0.2 These, self-lubricating polyester resin based composite brake gear bushes are to be used in ICF/RCF/BEML Coaches.

0.3 This schedule draws reference to some of the relevant ASTM/ISO specifications. The latest version of the specifications shall be taken as reference unless mentioned otherwise.

0.4 For the purpose of deciding whether a particular requirement of the schedule is complied with, the final value observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS:2-1960. The number of significant places retained in the rounded off value shall be the same as that of the specified values in this schedule.

0.5 While preparing this specification, due consideration has been given to the latest developments in the field of polymeric materials and process technologies, service requirements of the Indian Railways and practices followed in advanced countries.

1. SCOPE

This schedule covers the requirements, sampling and methods of tests for compression moulded Self-lubricating polyester resin based composite brake gear bushes to be used in ICF/RCF/BEML Coaches.

2. REQUIRMENTS

2.1 Material

2.1.1 The raw material used in the manufacture of brake gear bushes shall be graphite filled, self lubricating, unsaturated polyester resin based composites which should be procured from source whose material is being used extensively in brake gear bushes in rail road application in India or abroad. The material should be reinforced with fibers which are not in the form of yarns or cloth and it shall not cause the brake rigging pins to wear fast. The vendor seeking registration with RDSO should have a suitable MOU for supply of raw material and technical support from the such source of raw material.

2.1.2 Use of regenerated/reconstituted material is not permitted. A guarantee shall be given by the manufacturer that no reconstituted and recovered material has been used for the manufacture of Brake Gear Bushes.

2.1.3 The raw material shall be resistant to oil contamination. A certificate from primary manufacturer of raw material will be required for compliance of this requirement.

2.1.4 The color of the Brake Gear Bushes shall be black/dark grey.

2.2 **Construction, Workmanship and Finish**

2.2.1 Self-lubricating polyester resin based composite brake gear bushes shall be made by in house compression molding of raw materials into tubes and subsequent machining of the same into bushes. Up to 31.12.09, the vendors shall be permitted to machine the bushes from tubes supplied by the source of raw material as defined in clause 2.1.1 above.

2.2.2 The surface of the composites Brake Gear Bushes shall be smooth, sound and free from moulding defects such as bubbles, voids, surface sinking, grazing and blistering of the surface, cracks etc. All edges shall be neatly finished and free from flash.

2.3 **Dimensions & Tolerances**

The dimensions and tolerances of the polyester resin based composites Brake Gear Bushes shall be same as given in RDSO drawing No. SK-81039.

3. **PERFORMANCE REQUIREMENTS**

3.1 Unless otherwise specified, all tests shall be carried out under the following atmospheric conditions;

a) Temperature $27 \pm 2°C$
b) Relative humidity $50 \pm 10\%$

The temperature and humidity shall be substantially constant during a series of measurements carried out as part of one test on one lot.

3.2 The raw material used for the manufacture of Brake Gear Bushes shall conform to the requirements prescribed in table-1.

Table-1

Sl. No.	Properties	Values	Specimen size	Test Direction	Number of samples	Test Method
1	Compressive Strength, MPa	160 (min)	12mmX12mm X12mm right prism	Into moulded face	5	ISO 604
2	Impact Strength Izod Un notched, KJ/ sq.mt	Average Values ≥ 75 Minimum values ≥68	12.7mm X 12.7mm X 64mm	Across moulded face	10	ISO 180

3	Rockewell hardness; M	75 (min)	Min 6 mm thick sheet	Into moulded face	3	ISO 2039-2
4	Residual ash at 950 degree C	22 to 27%	Nominal 3 gram	NA	3	ISO 3451-1
5	Density (gram/cc)	1.60-1.68	10 g to nearest 1mg	NA	3	ISO 1183

4. TESTS AND SAMPLING CRITERIA FOR CONFORMITY

4.1 Tests

4.1.1 The tests in table-1 shall constitute Type Test performed on the raw material specimen.

4.1.2 The Type Test, for all the requirements laid down in this schedule is mandatory for product approval. However Approving Authority reserves the right to repeat the test at their discretion.

4.1.3 In any consignment, all the bushes of the same type manufactured by the same factory during the same period shall be grouped together to constitute a lot.

4.1.4 From each lot a certain number of bushes shall be selected at random and subjected to Acceptance Test as given in Clause 4.2.

4.2 Acceptance Test

4.2.1. The Acceptance Test shall consist of the following:

i. Visual Inspection
ii. Dimensional Check
iii. Specific Gravity (as per ISO 1183)
iv. Ash Content (as per ISO 3451-1)
v. Ring Crushing Test (As per Appendix 1)
vi. Hardness (As per Appendix 2 & ISO 2039-2)

4.2.2. The inspection lot shall consist of ***2500*** Nos. of Brake Gear Bushes or part thereof.

4.2.3. The number of Brake Gear Bushes to be selected from the lot for Acceptance Test shall be as under:

i.	Visual Inspection	5% of the lot shall be checked as per clause No. 2.2.2.
ii.	Dimensional Check	10 samples selected at random from each lot shall be checked as per clause No. 2.3.
iii	Specific Gravity	10 samples shall be drawn at random from each lot. Out of these, 5 nos shall be tested for hardness as per ISO 2039-2 and Appendix 2. Balance shall be tested for ring
iv	Ash Content	
v	Ring Crushing Test	

vi	Hardness	crushing test as per Appendix1. Specific gravity and ash content test shall be done as per Table 1 on bushes passing the ring crushing test.

4.2.4. Each sample selected for Acceptance Test shall conform to the requirements as laid down in clause no. 4.2. Should any one of the test samples fail to meet the requirements of Acceptance Test, double the number of samples from the same lot shall be drawn for re-testing. Should any of these samples fail, the entire lot shall be rejected.

4.2.5. In case of non-compliance in regard to dimensional check, the manufacturer may be given one chance to segregate the lot for dimensional conformity.

4.2.6. In the event of rejection of the lot, all Self lubricating polyester resin based composite brake gear bushes constituting the lot shall be made unusable in the presence of the Inspecting Authority.

4.2.7. During inspection, Purchasing/Inspecting Authority, at their discretion may conduct Type Test and the samples shall conform to the values specified in Table 1 of this schedule.

4.2.8. RDSO may draw the sample for quality checks at its discretion and conduct tests at manufacturer's premises or at RDSO. If need arises, sample shall be sent a reputed outside laboratory as decided between RDSO and manufacturer and the testing charges shall be borne by the manufacturer.

5. APPROVAL OF FIRMS

5.1 Self-lubricating polyester resin based composite brake gear bushes shall be procured from firms approved by RDSO.

5.2 During Bulk Production, the Supplier shall not alter any material or process after having successfully undergone the approval process.

5.3 The firm shall have all the facilities mentioned in Section-B of this STR.

5.4 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 in-house test results of the product and a valid copy of MOU as specified under clause 2.1.1 of this schedule.

5.5 The firm will be assessed by RDSO for compliance of STR and QAP in accordance with extent procedure. All tests mentioned in this schedule are mandatory for product approval.

5.6 Based on satisfactory assessment, verification of infrastructure facilities and type test, firm shall supply a minimum of 50 coach sets of Polyester Resin based Composites Brake Gear Bushes for extensive field trial for a period of 18 months. Final approval of the firm will be granted in Part-II after satisfactory performance of

the field trials. For the purpose of field trial, RDSO will nominate 2 to 3 Railways where trial will be carried out. In case, manufacturer is procuring and using the same raw material and technology support from the primary raw material supplier with whose material and technical support the other manufacturer has already manufactured brake gear bushes and which have been cleared for regular use after successful field trials, the field trials will not be necessary before approval in Part-II. The manufacturer shall submit the Certificate/MOU/Contract from primary raw material supplier confirming that the raw material and technology support are same as provided to the firm whose brake gear bushes have already been cleared for regular use after successful field trials.

6. MARKING

6.1 Each polyester resin based composite brake gear bushes shall be suitably marked on the upper face with the following legend as per size and location indicated in the drawing.

i. Manufacturer's name/initial/trade mark.
ii. The month and year of manufacture.
iii. Drawing Number/ Part number

7. PACKING

7.1 The brake gear bushes shall be securely packed in plastic bags indicating by a sticker the above-mentioned markings on each bag. These plastic bags shall be packed in a wooden/cardboard carton strong enough to resist damage in transit/storage.

8. STORAGE

8.1 The brake gear bushes shall be stored in a cool and dry place.

8.2 The brake gear bushes shall be kept covered and free from exposure to bright light, particularly sunlight.

8.3 The brake gear bushes shall be stocked and arranged in such order as the ensure use of old stock first.

SECTION – B

INFRASTRUCTURE & TESTING FACILITIES REQURIED FOR MANUFACTURE OF SELF LUBRICATING POLYESTER RESIN BASED COMPOSITE BRAKE GEAR BUSHES TO BE USED IN MAIN LINE COACHES (BG)

1. **SCOPE**

1.1 This Section covers the infrastructure requirements for manufacture of Self lubricating polyester resin based composite brake gear bushes for main line coaches (BG).

2. **REQUIREMENTS**

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

3. **PLANT, MACHINERY & INFRASTRUCTURE REQUIRMENTS.**

3.1 The Manufacturer shall have adequate space and covered area with cemented floor to accommodate the following & for smooth logistics:

a) Damp-free place for storage of raw materials.
b) Adequate manufacturing area.
c) Finishing, Assembly and Inspection area.
d) Storing and dispatch of finished products.

3.2 In cases where the firm is manufacturing its own raw material, it must have all items of plant and machinery required for the manufacture of the same.

3.3 In case where the firm is molding the tubes made out of raw material manufactured by itself or purchased from approved source, it must be in possession of the following additional items of plants and machinery:

b) The manufacturer shall have at least one 100MT Hydraulic Press with digital temperature controller and Hydraulic ejector.
c) Mold for different sizes of tubes.
d) Manufacturer shall have an Air Compressor of suitable capacity.
e) Lathe machine for machining of the tubes.

3.4 The Manufacturer shall have suitable tools, cutters, polishing files, and Buffing Machine for de-flashing of moulded products.

3.5 The Manufacturer shall have a system to ensure that moulds are checked at regular intervals and adequate mould handling facilities like Chain Pulleys or Electric Hoists or other suitable equipment for moving heavy moulds.

3.6 Prior to release of dies/moulds for production, these are to be checked dimensionally and records containing details of such inspection and date maintained.

3.7 Two Electronic Weighing Machines of reputed make, one of maximum 3 Kg. capacity and the other of 100 Kg. capacity with an accuracy of 1 g and 100g shall be provided. Weighing machines shall be calibrated regularly and the frequency of calibration shall be as per directives issued by the Government.

3.8 In-house availability of minimum infrastructure for maintenance and polishing of dies and moulds shall be ensured.

4. TESTING FACILITIES

4.1 The Manufacturer must have the following testing and other equipment installed in a laboratory set up with controlled temperature and humidity.

a. Digital Vernier caliper (0-150 mm range)
b. Bore dial gauge (0-50mm range OR 0-25 mm and 25-50 mm range)
c. Compression Testing Machine / Tensile Testing Machine / Universal Testing Machine equipped with computerized load Vs deflection recording facilities
d. Weighing Balance with specific gravity determination kit.
e. Izod Impact Tester.
f. Muffle furnace for temperature upto 1000 ^{0}C with temperature control and indication.
g. Rockwell hardness tester.
h. Hydraulic press for compression molding of test specimens.

4.2 The manufacturer shall have dies/moulds for preparation of various test specimens for the relevant tests.

4.3 All gauges required to ensure that the dimensions of Self lubricating polyester resin based composite brake gear bushes are as per drawings shall be available.

4.4 Jigs & fixtures for conducting load test, compression, flexural test etc. shall be available.

4.5 The Manufacturer shall have arrangements like vice, cutter, polishing files etc. for preparation of various samples for tests such as tensile strength, hardness, specific gravity etc.

5. QUALITY CONTROL REQUIRMENTS

5.1 The manufacturer shall have their own valid ISO: 9001-2000 certificate from certifying agency accredited to NABCB 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 There should be the system to ensure the trace ability of the product beginning with raw material stage to finish product stage. The firm shall have a system for traceability of the raw materials used, especially the liquid resins.

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

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 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.

5.6 There shall be at least one graduate degree holder person in relevant technology with field experience of at least 5 years or a diploma holder with experience of 10 years on thermo setting polymers for regular production and quality control.

5.7 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.

5.8 Latest version of all the relevant specification IS, ASTM and RDSO standards and drawings with latest alterations should be available with the firm.

6. DOCUMENTATION

Firm shall maintain 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), Non-Conformity 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.

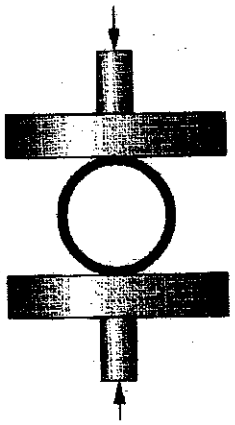
7. TRAINING

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.

Appendix-I

Ring Crushing Test

The geometry of ring crushing test is as shown in the figure below:



Schematic showing arrangement used for a ring crushing test.

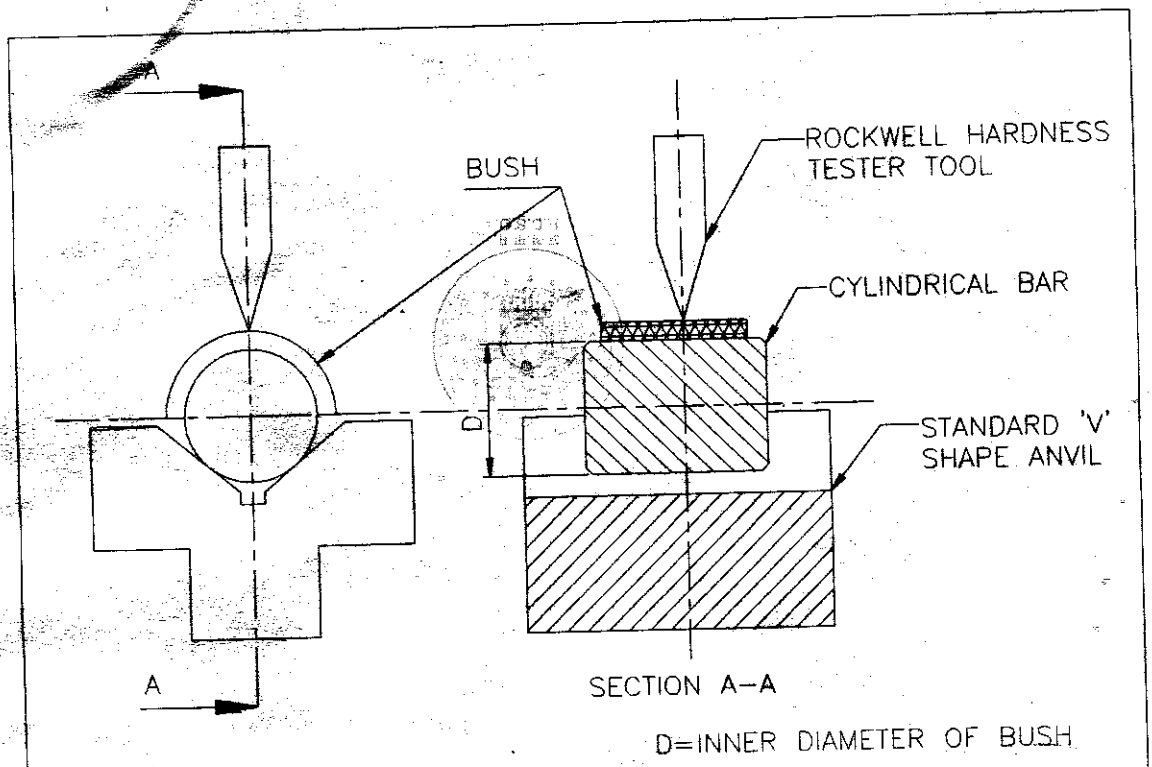
Test procedure:

a) The bushes are placed between platens of a Compression Testing Machine / Tensile Testing Machine / Universal Testing Machine and compressed at the rate of 10 mm per minute. Load and corresponding deflection shall be recorded.
b) For Self Lubricating Polyester resin based composite brake gear bushes the yield point will be taken where there is a significant change in the slope of the load Vs compression curve.
c) The test criterion is to see that when the bush is compressed to half of its original outer diameter, the load supported by it should be 75% or more of the load supported by the bush at its yield point as above.
d) In case of flanged bushes, the test is to be performed after removing the flange from the bush by machining.

Appendix-II

HARDNESS TEST FOR FINISHED BUSH

Test Specimen : Longitudinally half cut pieces from finished bush.
Apparatus : Standard 'V' shape anvil and cylindrical bar with diameter equivalent to inner diameter of bush as per arrangement shown below.
Testing Procedure : As per ISO 2039-2



SCHEMATIC DIAGRAM SHOWING TESTING ARRANGEMENT TO CHECK HARDNESS OF FINISHED BUSH