INDIAN RAILWAYS

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DOCUMENT CONTENT	TECHNICAL STANDARDS/ SPECIFICATION	YES
	SCHEDULE OF TECHNICAL REQUIREMENTS	YES
DESCRIPTION OF ITEM	CONTROL ARM TOP AND CONTROL ARM LOWER LH & RH FOR FIAT TYPE BOGIE OF LHB COACHES (INDIAN RAILWAYS)	
REMARKS	----	

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TECHNICAL STANDARDS /SPECIFICATION / /SCHEDULE OF TECHNICAL REQUIREMENTS FOR CONTROL ARM TOP AND CONTROL ARM LOWER LH & RH FOR FIAT TYPE BOGIE OF LHB COACHES (INDIAN RAILWAYS)

0 FORWARD:

0.1 This specification for Control Arm Top and Control Arm Lower LH & RH for Fiat Type Bogie of LHB Coaches of Indian Railways consists of two sections i.e. Section: A and Section: B. Section: A covers the technical requirements, methods of sampling and tests of Control Arm Top and Control Arm Lower LH & RH and Section: B covers infrastructure requirements of manufacture testing and quality control.

0.2 The Control Arm shall conform to this specification and relevant drawings with latest alteration number and latest relevant specifications/standards.

0.3 All the provisions contained in RDSO's ISO procedures laid down in Document No. QO-D-8.1-11 Version 3.5 or latest (titled "Vendor-Changes in approved status") and subsequent versions/amendments thereof, shall be binding and applicable on the successful vendor/vendors in the contracts floated by Railways to maintain quality of products supplied to Railways.

0.4 The Government of India policy on "Make in India" shall be apply.

0.5 **WORKING CONDITION**

Train Type-	Medium High Speed
Operational Speed-	160 km/h
Maximum Speed-	180 km/h
Max. Weight (one coach)-	65 t
Max. Axle Load-	16.25 t
Wheel Diameter-	New: Ø 915 mm, Worn: Ø 845 mm
Shock and vibration -	Higher than specified in IEC 61373

Coach body displacement under dynamic condition:-

i)	Vertically-	±30 mm
ii)	Laterally -	±80 mm
iii)	Longitudinally-	±10 mm
iv)	Bogie rotation about center pivot -	$\pm 4^0$

0.6 ENVIRONMENT CONDITIONS

The Control Arm are likely to be exposed to the following operating conditions:

- Change in temperature from -40^0C to $+70^0$C
- Relative humidity from 30% to 100%
- Altitude upto 3000 m.
- Average annual rainfall 1750 to 6250 mm.
- Maximum wind pressure 200 kg/m^2.
- Both acidic and basic cleaning product
- Urine, feces, and kitchen waste (restaurant cars)
- Sand, brake and ferric oxide dust (abrasion of wheel and tracks)
- Damage from flying stones raised from the ballast track bed.
- Salty air (coastal area)

SECTION –A

1.0 **SCOPE**

1.1 This section covers the technical requirements, methods of sampling and tests of Spheroidal Graphite Cast Iron Control Arm Top and Control Arm Lower LH & RH for Fiat Type Bogie of LHB Coaches of Indian Railways. It conform the technical requirement of RCF Drawing No. - 1277122 Alt 01 R3, 1267716 Alt 00 R2 and 1267717 Alt 00 R2 or latest.

1.2 Requirement Material: Spheroidal Graphite Cast Iron (SG 400/18L) - Chemical composition - Carbon-3.2-3.7%, Silicon-1.70-2.20%, Mn-0.4%Max, P-0.05Max, S-0.02 Max, Cu - 0.4Max, Magnesium-0.03-0.06%.

2.0 **Manufacturing Requirements**

2.1 Casting: Spheroidal Graphite Cast Iron shall be manufactured as per the following requirements:

2.1.1 Raw Material

All basic foundry processes e.g. moulding, core making, heat treatment, fettling shall be done in house for all castings.

The foundry shall lay down the specification of all raw materials used in the manufacture of castings and follow the same. The foundry shall use appropriate quality of raw materials i.e. silica-sand, scrap, foundry returns & Ferro - alloys, whose quality shall be ensured through relevant tests. Quality of all additives to sand, molten metal and mould/core wash shall be standardized, checked and only acceptable quality raw material and additives shall be used. Record of all raw materials and additives, their quality characteristics shall be maintained which shall be made available to inspecting officer to facilitate scrutiny and establish traceability.

2.1.2 **Sand Preparation and testing:**

The foundry shall lay down the characteristics of all sand mixes i.e. moulding sand, core sand, facing sand and shall have proper arrangement for sand drying and preparation of sand mix of consistent quality and the characteristics of each batch shall be checked to ensure conformance to standard arrived at by the foundry. Sand mix of unacceptable quality shall not be processed.

2.1.3 Resin sand Mould preparation:

Moulds shall be prepared from sand mix of predetermined composition and characteristics to ensure consistency. Mould shall be prepared by green sand or Alpha set moulding system by machine moulding. Mould hardness shall be checked for each mould to ensure proper compaction. Damaged moulds shall not be used for producing castings. Repair of the moulds can be carried out if the same does not affect the casting quality. Suitable arrangement shall be made in the mould to obtain manufacturer's identity. All moulds shall be given a 'wash' of appropriate quality on the entire surface coming in contact with the molten metal to ensure proper surface finish and undesirable metal mould reaction.

2.1.4 Core- Making.

All cores shall be made in house, the sand, the binder and the additives shall be of appropriate quality. Damaged core shall not be used for producing casting. Process of core making should be specifically defined and the core also shall be prepared from sand mix of predetermined composition.

2.1.5 Running, gating and risering:

Based on sound foundry practices and adequate experimental castings, the foundry shall standardize the running, gating and risering system of Control Arm castings to produce sound casting. The methoding system shall be standardized, proper records maintained and any alteration in the system shall be intimated immediately for obtaining approval.

Knock-off riser shall be used wherever possible, to eliminate damage to the casting during finishing operation. All surface of the core coming in contact with the molten metal and where surface finish is important to ensure proper seating of the mating components shall be provided with core wash

2.1.6 Melting and Pouring:

The foundry facility shall have the category' A' Type foundries specified and updated by Bureau of Indian standards/RDSO from time to time. However, no certificate for the same is essential. The foundry shall have at least one number tilting type electric arc furnace or Induction furnace having ladle refining facility of adequate capacity and facility for oxygen lancing and argon purging for removal of entrapped gases. To ensure the chemistry of the castings, suitable direct reading spectrometer shall be available. The molten metal meeting the specified chemistry shall only be used for producing castings.

The tapping and pouring temperature of the molten metal shall be standardized by the foundry and the same shall be determined for each heat. Pouring time for control arm casting shall also be arrived at.

Use and availability of digital pyrometer should be introduced at the time of pouring.

There should be a positive method to trace the last two castings poured.

Knock-out time and Knock-out temperature should also be specified.

2.1.7 Finishing Operation:

The castings shall be dressed and cleaned using mechanical arrangements. Runners and risers shall be removed without damaging the surface finish and dimensions of the castings. Generally, no grinding shall be necessary except for removal of the parting line. Adequate precaution shall be taken to ensure that deep grinding marks, notches are not left on the surface. After dressing and ensuring its freedom from sand, runner, risers etc., the castings shall be shot blasted to achieve desired degree of cleanliness.

2.2 Heat Treatment:

2.2.1 All heat treatment furnaces shall be equipped with adequate number of pyrometers and recorders. Facility for output chart indicating time verses temperature shall be available for each furnace.

2.2.2 Plans for placement of castings and their orientation in the furnace shall be standardized to ensure uniformity of heat treatment for each casting of particular batch and the same shall be followed without any deviation.

2.2.3 Castings shall be heat treated by adequate method to met the specified mechanical properties. The heat treatment cycle shall be recorded for each batch and made available to the inspecting authority.

2.3 **Machining**

2.3.1 The casting used for finish machining shall conform to this specification/ drawings.

2.3.2 Finish machined Control arm shall be free from blowholes, porosities, sand inclusions and other casting defects.

2.3.3 For finish machining of final assembly both upper and lower control arm to be fixed in a fixture with secured locating for finish machining of critical dimensions of holes for bolts, and internal dimensions of assembled control arm coming in contact with bearing cup (outer ring). After machining proper marking of both parts to maintain its pairs to be ensured by suitable marking.

2.3.4 The holes shall be jig drilled in one setting so that there is no mismatch.

3.0 Testing & inspection

3.1. **Visual inspection**: 100% of control arm should be visually inspected.

3.1.1 Control arm should be free from sharp Edges/burrs/rust/dust etc

3.1.2 Production welding on job not allowed.

3.2. **Dimensions and Tolerances**: 100% dimension should be carried out by suitable measuring equipment. 10% dimensions to be checked preferably with CMM or machining centre using inspection probe.

3.2.1 All dimension/tolerances shall be as per details given in the RCF Drawings. No. - 1277122 Alt 01 R3, 1267716 Alt 00 R2 and 1267717 Alt 00 R2 or latest.

3.2.2 Detailed dimension control charts/sheets shall be prepared for each control arm, in which measurements of critical dimensions shall be recorded and kept for evaluation and verification by the inspecting agency.

3.2.3 All the un- toleranced dimensions shall be in accordance with IS: 2102 (Medium), Gauges, *Fixtures* and templates and accurate measuring Instruments shall be used to ensure the correctness of the dimensions.

3.2.4 Dimensional control charts shall be supplied along with the control arms to the purchaser.

3.3 **Surface finish**: Finish as specified in relevant drawings.

3.4 The properties of control arm conform to the requirements indicated in Table: 1.

TABLE: 1

S. N.	Properties	Required Value	Method of Test
1	0.2 % Proof stress (Minimum)	250 Mpa	IS:1865
2	Tensile strength (Minimum)	400Mpa	
3	Elongation (Minimum)	18%	
4	Impact (Minimum)	Mean value of 3-12J at (-20+/-2)^{o}C Individual Value-9J at (-20+/-2)^{o}C.	IS:1865
5	Microstructure (Cl 9 of IS:1865)	Nodularity of graphite 80% minimum in form of V or VI as specified in IS: 7754 Predominant constituent of matrix-ferrite as specified in table 1 of IS: 1865	IS: 7754
6	Hardness	130-180 BHN	IS:1865
7	Magnetic particle as per DIN1690 part 2 table 1/Liquid penetration inspection as per DIN 1690 part 2 table 2 (Application one of two	Level I	DIN 1690 part -2 Or IS 3703

	procedure , according to testing possibilities and qualifications)		
8	Ultrasonic as per DIN 1690 part 2 table 3 / Radiographic as per DIN 1690 part 2 table 4 (Application one of two procedure , according to testing possibilities and qualifications)	Level II	ASTM E446

4.0 SAMPLING AND CRITERIA FOR CONFORMITY

4.1 Test Specimen

100% of control arm should be visually inspected.

100% Dimension of control arm should be carried out by suitable measuring equipment. 10% dimensions to be checked preferably with CMM or machining centre using inspection probe.

Sample size for Separately cast Test samples : for S.No. 1 to 6 sampling 1 Separately cast Test samples per Heat. Separately cast test samples.should have same Heat number as same on product's heat number.

Sample size for Cast on test samples : for S.No. 1 to 6 sampling 1 product (i.e Cast on test samples) each of Control Arm Top, lower (LH & RH) per lot, S.No.7 -100% per lot and S.No.8 -10% per lot.

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 rejected.

5.0 Pilot sample approval:

Manufacturer should get pilot samples approved from Vendor Approval/Registration authority before start of series manufacture and bulk supply.

6. Code of Practice for Quality Control and Inspection:

6.1 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 castings.

6.2 The manufacturers shall furnish to the Purchasing/ Inspecting authorities the details of tests and inspection records and other relevant records as required under the quality control systems in force.

6.3 These records and reports shall be maintained by the Competent Technical Authority of the manufacturer and shall be open to examination by the Purchasing/ Inspecting Authorities at all reasonable time.

6.4 Vendor Approval/Registration authority / Purchasing/ Inspecting Authorities at their discretion may draw samples of products *at* any stage of production for conformity tests at the works of the manufacturer or in an approved laboratory. Testing charges shall be borne by the manufacturer. In case the samples do not conform to the requirements of the specification, double the number of samples from the same lot/batch shall be drawn for re-tests. If any of the re-test samples do not conform to the requirements, the entire lot/batch shall be rejected.

6.5 Vendor Approval/Registration authority may carry out in process inspection of casting and machining of control arms at the manufacturer premises.

6.6 The purchasing/ inspection authority shall inspect the rough casting as per specification and drawing for Mechanical properties, Dimensions and non destructive testing as per approved Quality Assurance Plan.

7. Identification Marking: Each control arm shall be stamped with an easily visible identification indicating the control arm serial number, Heat number, month & year of manufacture and manufacturer‘s name to facilitate identification/correlation with the inspection/ test results. Same identification mark should be on a pair (i.e. for Top (Serial number) and for Lower LH (Serial number of Top with L)) and another same identification mark should be on a pair (i.e. for Top (Another Serial number) and for Lower RH (Another Serial number of Top with R)).

8. Painting:

Procedure for surface protection for Bought out / shop-made finished items:

Proper masking should be done on machined areas/areas where no primer/paint is required and then follow the following procedure:

8.1 Pre- treatment:

Steel: Shot/Grit/Sand blasting according to ISO:8501 Sa 2/1/2

8.2 Primer

8.2.1 The first paint coat is needs to be applied within four hours after pre-treatment.
8.2.2 High performance Anti corrosion Epoxy coating (Two pack) to RDSO. specification No. M&C/PCN/123/2006 having colour green with DFT of 75-0/+30 microns is to be done.

8.3 Final coat:

Two Component epoxy top coat Elastified paint to MDTS-094 with shade to RAL-7012 having DFT of 200-0/+60 microns is to be done.

8.4 Machined areas/machined components, which don't require primer/paint, should be protected against corrosion with suitable corrosion preventive coating, which is removable easily and suitable packing should be done so as to avoid any possibility of damage during transit.

8.5 Deviations: Supplier should ask for deviations in their offer if required.

9. Packing:

9.1. All machined surfaces shall be applied with suitable rust preventive which shall prevent it from corrosion & oxidation for a minimum period of one year of storage.

9.2. The packing shall be such that all the machined surfaces shall be properly protected against rubbing/ impact/ scratches with other control arms or with mode of transportation i.e. wagon/truck/trailers etc.

10. Warranty: The manufacturer shall warrant the control arm for conformance to quality for a period of 30 months from date of supply or 24 months from date of Installation whichever shall be sooner, as per IRS conditions.

SECTION: B

1. SCOPE

1.1 This section covers the infrastructural requirements for manufacture of Spheroidal Graphite Cast Iron Control Arm Top and Control Arm Lower LH & RH for Fiat Type Bogie of LHB Coaches of Indian Railways and their testing and quality control.

2. REQUIREMENTS

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

2.2 The Control Arm Top and Control Arm Lower LH & RH are to be supplied conforming to the relevant drawings & specifications/standards.

2.3 The manufacturer is required to coordinate and liaise with the purchaser during manufacture of the prototype components.

3. PLANT, MACHINERY AND INFRASTUCTURE REQUIREMENTS:

3.1. Requirement of Infrastructure and Manufacturing Facilities: The vendor preferably should have following in house infrastructure for casting and machining of Control Arm Top and Control Arm Lower LH & RH. In case firm possesses complete Infrastructure for only casting or machining it should submit tie-up for remaining infrastructure (machining or casting).

3.1.1 **General Requirement for casting**:

3.1.1.1 The manufacturer should be an ISO-9001-2015 certified company.
3.1.1.2 The Manufacturer should have sufficient Covered area for manufacturing, raw material storage i.e. Sand and Scrap etc.
3.1.1.3 At least one number tilting type electric arc or electric Induction furnace having Ladle-treatment facility.
3.1.1.4 Weighing machine of 500 kg capacity for Ferro alloys charge and finished casting weighment.
3.1.1.5 The firm should have a compressor.

3.1.2 **Sand Preparation and testing:**

Moulds and cores can be prepared using resin Alpha set moulding or green **sand**.

3.1.2.1 Green sand mould or Alpha set moulding and core preparation:

3.1.2.1.1 Automatic sand mixer machine for making 'Mould' and 'Core' should be available, the mixer should be Intensive type or sand mixing Muller with

arrangement of ensuring correct mixing of ingredients.

3.1.2.1.2 For testing incoming virgin sand, moulding sand, core sand following equipment at least one number each should be available:

i. Permeability tester
ii. Sand Rammer
iii. Quick Moisture teller
iv. Chemical balance
v. Sand sieve shaker
vi. Sand Muller for preparing test samples
vii. Shatter Index tester
viii. Dry compression strength tester
ix. Sand mouldability / Compatibility tester
x. Sand flowability tester
xi. Mould/Core hardness tester
xii. Portable hardness tester

3.1.2.1.3 Resin sand Mould and core preparation:

3.1.2.1.4 Continuous sand mixer with calibration facility should be available to manufacture resin sand moulds and cores.

3.1.2.1.5 Facilities to check:

i. Sieve shaker
ii. Clay content stirrer
iii. Scratch hardness tester
iv. Tensile strength Permeability meter
v. Gas evolution tester

3.1.2.2 Heat Treatment:

3.1.2.2.1 Heat treatment furnace should be oil fired, LPG fired or electric type.

3.1.2.2.2 Heat treatment furnace should be provided with digital Indicators & cut offs for each point (one point at every five feet length).

3.1.2.3 Shot blasting Machine:

3.1.2.3.1 Shot blasting machine conveyor monorail or Hanger type or Twin table type.

3.2 General Requirement for Machining of control arms:

3.2.1 Minimum 4 axis (X,Y,Z & B axis) CNC Horizontal Machining Centers with probing facility (for reference and inspection), axis movements/traverse of X=800mm, Y=700mm & Z=800mm and with rotary index table (B axis) having 1°x360 indexing positions (indexing accuracy ±3 sec) for the required machining of control arm top, lower LH & RH bores and facing etc. from every angle.

3.2.2 Fixtures for machining of control arms of different types.

3.2.3 Level surface table of minimum size 2MX1M.

4 TESTING FACILITIES:

4.1 Chemical Laboratory:

4.1.1 Computerized emission spectrometer with automatic printer should be available for analysis and recording of chemical composition at different stages of manufacturing.

4.1.2 Metallographic polishing equipment, Belt polisher etc. should be available.

4.2 Physical Laboratory:

4.2.1 Universal testing machine of minimum 20t capacity with graphical recording facilities for conducting tensile test.

4.2.2 Brinell Hardness testing machine.

4.2.3 Impact testing machine for conducting Impact test at room temperature and sub zero temperature should be available. Liquid Nitrogen container and stainless steel bath or Acetone container with temperature indicator for sub zero test arrangement must be available.

4.2.4 Liquid penetrate test facilities for checking surface welding cracks.

4.2.5 Magnetic particle Inspection facilities for cracks detection should be available.

4.2.6 Metallurgical microscope with magnification up to 400x should be available.

4.2.7 Hot air oven, Hot plate, Electrical oven and other accessories and chemical agents necessary for wet analysis should be available Including platinum crucibles.

4.2.8 The firm should have in house or sub-contract radiographic testing facility as per requirement of ASTM-E-446-81.

4.2.9 The firm shall have adequate facilities for preparation of test sample. Facilities like machining, grinding, polishing etc. should be available in house.

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

5 .0 QUALITY CONTROL REQUIREMENTS

5.1 The firm should have acquired ISO: 9001- 2015 (or latest) certification and the same/similar 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- 2015 (or latest) should clearly indicate at any stage the control over manufacturing and testing of the said same/similar 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 Firm has to get Quality Assurance Plan (QAP) approved by Vendor Approval/Registration authority for the product covering incoming material, in process, stage inspection and final testing.

It should be ensured that in QAP 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, having a minimum bachelor's degree which having a qualification in relevant field and has experience of at least 5 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 in-charge of the Quality Control Section is having a qualification of minimum bachelor's degree in the relevant field and has a minimum of 5 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 contrail / stage inspection / compliance of QAP etc.

5.7 For internal crack detection, Control arm to be subjected to Ultrasonic Test (UT) / Radio graphy test (RT) method as per relevant standard. The Qualification of testing personnel shall be UT/RT level-II.

5.8 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 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 test 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 ROSO), 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.

6.8 Calibration records.

6.9 Casting records Sr. no. wise, components wise, month wise.

6.10 Register for heat treatment indicating charge wise, loading serial no wise Temperature graph must be pasted on the H.T register.

6.11 Weighment records of casting once in a month.

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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