

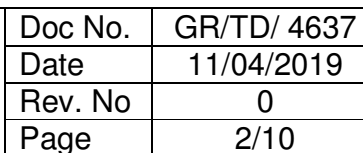


**BEML LIMITED
BANGALORE**

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**Procurement Technical Specification
of Castings for Metro Cars**

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1. Introduction

1.1. General

This document specifies the requirements for manufacture, inspection during manufacture, testing and supply of steel castings for any Metro Rail Project.

The Vendor shall be responsible for all works required in this document with regard to Castings and shall be responsible for supporting BEML activities as contractor for Metro car Projects.

1.2. Climatic Conditions

The Metro Car has to operate reliably and safely under various climatic conditions specified in the relevant ERTS & ERGS of that project.

1.3. Defining of unclear aspects

If any term or clause is not described or not clear in the specification, Supplier shall discuss those with Design Team in BEML, prior to making a contract, to confirm their definitions.

After making a contract, Supplier shall follow the definition and opinions of Design Team in BEML

1.4. Responsibility of Supplier

Supplier shall have the responsibility for manufacture and defined performance testing with regard to the supply of castings.

2. Standards

Test and inspection standard applicable for the castings shall conform to the standards as per the applicable drawing.

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3. Scope of Supply

3.1. General

The supplier shall supply Castings in conformance to the PTS, purchase order requirements and the Applicable drawing.

3.2. Submission of Documents

The supplier shall submit the following documents conforming to the applicable drawing/standards/specifications/PTS along with every batch of supplies.

- Dimensional check sheets for all castings.
- Material test certificates for each cast & heat treatment batch.
 - ✓ Chemical composition
 - ✓ Mechanical Properties
 - ✓ Micro Structure
 - ✓ Inclusion Rating
 - ✓ Grain size
- NDT test reports along with X-ray films
- Heat treatment record along with time temperature graph
- Any other document as applicable.

3.3. Submission of Test Bars

Test bars shall be *cast integral with the castings & heat treated along with the castings*. The Supplier shall submit at least *two nos. casting with integral test bar for each heat batch of casting supplies*. Final acceptance shall be based on test bar results carried out by BEML.

3.4. Submission of one no. sample casting for First Article Inspection

The supplier shall supply one no. free sample finished casting as per relevant drawing for First Article Inspection. BEML may decide to conduct destructive tests on the

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casting. After obtaining approval from BEML only, mass production has to be taken up. The sample shall be subjected to 100% NDT tests covering full area of the castings. If sample fails the test, then 100% NDT tests shall be continued till desired results are obtained.

3.5. Packing

The supplier shall apply rust preventive coating on machined surfaces and any tapped holes etc. The tapped holes shall be plugged with dummy plugs after application of rust preventive coating.

The supplier shall provide proper packing to avoid transit damages during shipment of the Castings.

4. Quality Assurance Program

4.1. General

The supplier shall hold ISO 9001:2015 certification and shall manufacture the product accordingly. The supplier shall submit a copy of ISO 9001:2015 certification along with the offer. The supplier shall monitor and control the Quality systems as per ISO 9001:2015 guidelines. BEML and/or customer/their representative may periodically conduct compliance audits of the supplier's Quality management system.

4.2. Quality assurance plan

The supplier shall develop and submit a Quality assurance plan (QAP) to BEML for review and approval based on ISO 9001:2015 guidelines.

5. Technical Requirements

5.1. General

The material grade in respect of chemical composition, heat treatment, microstructure and mechanical properties shall be as stipulated in the drawing and applicable national/ international standards. The Supplier shall submit the reports for the above along with the casting supplies.

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5.2. Workmanship and finish

All Castings shall be made to conform to the dimensions on drawings supplied along with the purchase order. The Castings shall be free from injurious defects that will adversely affect machining or utility of the Castings.

In the event of any casting proving defective from foundry causes in the course of preparation, machining or installation, such a casting shall be rejected in Toto not withstanding any previous certification of satisfactory testing and/or inspection.

5.3. Fettling and Dressing

All castings shall be properly fettled and dressed, and all surfaces shall be thoroughly cleaned.

5.4. Heat Treatment

The Castings shall be heat treated in a properly constructed furnace, having adequate means of temperature control, which shall permit the whole of the casting being uniformly heated to the necessary temperature. All Castings shall be suitably heat treated as per the requirements of the applicable drawings and corresponding material standards. The Supplier shall maintain time-temperature records for the heat treatment carried out and submit the same.

Test pieces shall be heat treated along with the castings they represent.

5.5. Painting

The castings shall be shot blasted to SA 2 ½ and primer painted with grey color epoxy primer to Gr. EP1119 & Thinner 024 of M/s. KCC Paints, with DFT 40-80 microns.

Note:

The primer painted casting after finish machining shall be finish painted with colour NCS 8500N to Gr. UT 5119 & Thinner 037U of M/s. KCC Paints, with DFT 40-80 microns. The total DFT (primer + finish) of paint shall be 80-160 microns.

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5.6. Machining

Machining as per the drawing requirement shall be carried out. Care shall be taken to ensure that the tolerances as specified in the drawing are achieved. Dimensional inspection report shall be submitted along with the Castings.

Machined casting shall be measured for dimensions on a 3-axis Co-ordinate Measuring Machine (CMM) and the report shall be submitted.

5.7. First Article Inspection (FAI)

The sample machined casting submitted by the Supplier before mass production shall be subjected to First Article Inspection by BEML and/or customer/their representative. BEML may decide to conduct destructive tests on the casting. Only, after clearance from BEML, mass production shall be taken up. Castings shall be offered to BEML representative(s) for inspection before dispatch for pilot / proto lot.

6. Inspection & Testing

6.1. General

The Supplier shall perform all tests in accordance with the Standards specified in the drawing, related material standard and purchase order. BEML and/or customer/their representative have the right to witness any of these tests at any stage of test progress.

6.2. Visual inspection

Every casting, irrespective of lot size shall be examined visually for surface defects and irregularities. The Castings shall be free from cracks, shrinkage cavities, blow holes, pin hole porosity, sand inclusions and any other defect that would impair the utility of the Castings.

6.3. Chemical Composition Analysis

The supplier shall carry out ladle analysis on a sample of each melt and product analysis on a test piece or a casting representing each melt as per the material standards mentioned in the drawings and shall submit test reports.

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6.4. Mechanical tests

The hardness test, tensile test, impact test, bend test and any other test as per the requirements of the applicable drawings and corresponding material standards shall be carried out by the Supplier on the test bars cast either separately from or attached to the castings to which they refer and heat treated along with the castings. Reports shall be submitted along with the casting supplies.

6.5. Micro Structure:

One number sample from each heat shall be subjected to micro structural analysis & shall show grain size min:5 (or) more. Micro structural analysis shall conform to normalized structure with pearlite & Ferrite. No martensite (or) retained austenite is permitted.

6.6. Non-Destructive tests

If any Non-destructive testing is specified in the drawing/ corresponding material standards, the Supplier shall ensure that the same is carried out by a reputed third party NDT agency having ISO 9001:2015 certification, preferably having NABL accreditation and all the reports shall be certified by ASNT/ ISNT Level II qualified personnel.

The details of the agency with whom the vendor has tied up for NDT and the certificates of the qualified personnel shall be submitted along with the offer. For radiography inspection the site in charge & X-ray / Gamma rays cameras shall be approved by AERB/BARC. Agency employed for NDT testing shall be approved by BEML before executing order. The extent of testing shall be as per the drawing requirement. Test reports along with the X-ray films shall be submitted with the casting supplies. The serial number and heat number of the casting shall be clearly visible on the X-ray film to have traceability.

6.7. Performance tests

If any performance test is specified in the drawing and the related material standard, the same shall be carried out and test report submitted. The details of the testing shall also be submitted.

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7. Repair of castings

Generally repair of castings is not permitted. However, minor repairs may be carried out with the prior permission of BEML, in accordance with the requirements of the individual material standards adopting qualified procedures and personnel.

8. Marking

Each casting shall be legibly marked as shown in the respective drawing with the following details for traceability:

- a) The number or identification mark by which it is possible to trace the melt and heat-treatment batch from which it was made.
- b) The serial no. of the casting.
- c) The month & year of manufacture and
- d) The manufacturer's name or trade-mark

9. Submittals with Technical offer

The following requisites should be fulfilled by the Suppliers:

1. Complete Technical offer for manufacturing of casting.
2. Clause by Clause comments of PTS.
3. Supplier shall submit complete details of their earlier experience in the manufacturing, machining, inspection & painting of similar castings.
4. BEML representative have the right to witness the facilities before placing the order.
5. Supplier shall provide presentation on the process to be adopted in the manufacturing of casings.