

TERMS OF REFERENCE FOR THE R&D PROJECT

Title: Study of grades, chemical and mechanical properties of ‘Austenitic- Manganese steel castings’.

1. Background:

1.1 India is the world’s third-largest casting producer after China and the U.S. India produces castings of about 11 and 12 million tonnes per year. Generally, the casting are manufactured of Cast Iron, however wherever along with strength properties such as toughness, smoother surface finish, weldability, dimensional accuracy is desired, steel casting are preferred. Steel casting process involves pouring molten steel into a cast to form a desired shape.

1.2 The original austenitic manganese steel, containing about 1.2% C and 12% Mn, was invented by Sir Robert Hadfield in 1882. Hadfield’s steel was unique in that it combined high toughness and ductility with high work-hardening capacity and, usually, good resistance to wear. Consequently, it rapidly gained acceptance as a very useful engineering material. Hadfield’s austenitic manganese steel is still used extensively, with minor modifications in composition and heat treatment, primarily in the fields of earthmoving, mining, quarrying, oil well drilling, steelmaking, railroading, dredging, lumbering, and in the manufacture of cement and clay products. Austenitic manganese steel is used in equipment for handling and processing earthen materials (such as rock crushers, grinding mills, dredge buckets, power shovel buckets and teeth, and pumps for handling gravel and rocks). Other applications include fragmentizer hammers and grates for automobile recycling and military applications such as tank track pads.

1.3 There is an Indian standard IS 276: 2000 “Austenitic-Manganese steel castings” which mentions seven grades. However, this standard is very old and in last 20 years several new grades are being manufactured. ISO has also recently upgraded its specification and an ISO Standard ISO 13521:2023 “Austenitic manganese steel casting”, has been published.

A need was felt to identify and verify the grades of Austenitic-Manganese steel castings in India and this study will be basis for upgradation and revision of IS 276: 2000.

Indian standard can be accessed from <https://standardsbis.bsbedge.com/>

2. Objective:

To collect relevant data and information, from primary and secondary sources, for grades of Austenitic- Manganese steel castings and verify quality requirements (chemical and mechanical properties) of these grades.

3. Scope:

- 3.1 Study the available literature like national and international standard such as ASTM, JIS, EN, ISO etc available on the subject, research papers, any study conducted by other organisations, companies' brochure. Identify the grades, their chemical and mechanical properties and any other requirements which can be included in the standard.
- 3.2 Collect data of the manufacturing base of the product.
- 3.3 Visit the manufacturers of the product and get the information on the following:
 - 3.3.1 Types of Raw material used
 - 3.3.2 Types of castings manufactured
 - 3.3.3 Grades manufactured
 - 3.3.4 Quality parameters (chemical, and mechanical properties) of different grades
 - 3.3.5 Manufacturing process,
 - 3.3.6 In process quality checks
 - 3.3.7 Test facilities and test methods used
 - 3.3.8 Tests being undertaken
 - 3.3.9 Requirement of heat treatment
 - 3.3.10 Marking and labelling being done
 - 3.3.11 Packaging requirement
 - 3.3.12 Steps taken to address sustainability and 3 R, reduce, reuse and recycle.
 - 3.3.13 Waste recycling
- 3.4 Identify and visit the laboratories
- 3.5 Check the quantity of the product imported and exported and countries with which the trade for this product is occurring. Also check if any technical regulations exist for this product in these countries. Take data of the foreign specification as per which the product is being imported or exported.
- 3.6 Identify the users of the product and take data of the quantity being used by them, specification used, check for the test certificates received by them and study the chemical and physical properties mentioned in the TC. Also understand from the user the main properties required by them in the product.
- 3.7 Prepare a comprehensive project report incorporating the points mentioned above.

4. Methodology:

- 4.1 Study the literature and analyse the findings.
- 4.2 Visit the manufacturing unit and
 - a. observe the manufacturing process,
 - b. examine in-process control measures,
 - c. conduct focussed group discussion with production and quality personnel.
 - d. collect the data as mentioned in the scope through a questionnaire.

- e. Test various grades manufactured and draw sample of the grades.

4.3 Visit laboratories and make report on

- a. test equipment required
- b. test method being used
- c. testing charges
- d. testing time required.

4.4 Test the samples drawn in In-house laboratory/ NABL accredited laboratory/ BIS recognized laboratory and verify the chemical and mechanical properties.

4.5 Visit the identified importers and exporters and collect data as mentioned in the scope through a questionnaire

4.6 Visit the users of the product and collect data as mentioned in the scope through a questionnaire

4.7 Analyse the data and test reports from diverse sources and include the same in the project report.

5. Sampling plan:

5.1 Two manufacturers from each large/medium and small/micro scale shall be visited.

5.2 Three samples for each grade shall be tested.

5.3 Samples may be drawn from manufacturer, user, importer or market.

5.4 Two users of the product shall be visited.

5.5 Two laboratories, preferably one in government sector and one in private sector shall be visited.

6. Deliverables:

6.1 Final project report, in hard copy format as well as in editable soft copy, covering all aspects mentioned in the scope.

6.2 Questionnaire, discussion, visit reports, test reports to be appended with the final project report

7. Timeline:

The duration of the project is 4 months from the date of award of the project. The proposed indicative timeline stage-wise is given below:

Sr No	Stage	Time from date of award of project (cumulative)
1	Literature review and identification of manufacturing base, testing laboratories, user/user industry, and discussion with BIS for the finalization of sampling plan	1 month

2	Visit to manufacturers, testing laboratories, users and importers and exporters and data collection	3 month
3	Preparation and submission of first draft report to BIS	3.5 month
4	Submission of final project report	4 month

Note: The proposer may submit the draft report to BIS without waiting for test report from independent laboratories if the test is of long duration test.

8. Support BIS will Provide:

BIS will provide access to latest available editions of Indian standards and/ or international standards relevant to the project, on request.

9. Relevant sectional committee and Nodal officer from BIS

Sectional committee:

MTD 14 (Foundry and Steel Castings Sectional Committee)

Nodal officer:

Mr Kunal Kumar, Scientist D/ Joint Director – Member Secretary MTD 14,

Email: mtd14@bis.gov.in