भारतीय मानक

सामान्य इंजीनियरी और संरचना कार्यों के लिए उच्च सामर्थ्य इस्पात ढलाइयाँ — विशिष्टि

(चौथा पुनरीक्षण)

Indian Standard

HIGH STRENGTH STEEL CASTINGS FOR GENERAL ENGINEERING AND STRUCTURAL PURPOSES — SPECIFICATION

(Fourth Revision)

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BUREAU OF INDIAN STANDARDS
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Price Group 3

Steel Castings Sectional Committee, MTD 17

FOREWORD

This Indian Standard (Fourth Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Steel Castings Sectional Committee had been approved by the Metallurgical Engineering Division Council.

This standard was first published in 1964 and was revised in 1969, 1979 and 1986. While reviewing the standard in the light of the experience gained during these years the committee has decided that the standard may be further revised. In this revision various clauses have been aligned with the recent standards on steel castings.

High strength steel castings have, in addition to high strength, good toughness and often good weldability. These castings find extensive use in transportation equipment, agricultural machinery parts and general engineering, as structural parts.

In the preparation of this standard, assistance has been derived from ISO/DIS 9477 'High strength cast steels for general engineering and structural purposes', issued by International Organization for Standardization (ISO).

For the purpose of deciding whether a particular requirement of this standard 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 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

HIGH STRENGTH STEEL CASTINGS FOR GENERAL ENGINEERING AND STRUCTURAL PURPOSES — SPECIFICATION

(Fourth Revision)

1 SCOPE

This standard covers the requirements for high strength steel castings for general engineering and structural purposes.

2 REFERENCES

The Indian Standards listed in Annex A are necessary adjuncts to this standard.

3 TERMINOLOGY

3.0 For the purpose of this standard, the following definitions shall apply.

3.1 Cast (Melt)

The product of any of the following:

a) One furnace heat,

b) One crucible heat, or

c) A number of furnace or crucible heats of similar composition mixed in a ladle or tapped in separate ladles and poured simultaneously for making a casting.

3.2 Batch

A group of castings of one grade of material, cast from the same melt and heat-treated together under identical conditions.

4 GRADES

This standard covers a total of five grades of high strength steel castings.

5 SUPPLY OF MATERIAL

General requirements relating to supply of steel castings shall be as laid down in IS 8800 : 1986.

6 MANUFACTURE

The steel for the castings shall be made by electric arc or electric induction or such other processes as may be agreed to between the purchaser and the manufacturer.

7 PARTICULARS TO BE SPECIFIED WHILE ORDERING

For the benefit of the purchaser, particulars to be specified while ordering for steel castings to this specification are given in Annex B.

8 CHEMICAL COMPOSITION

8.1 The ladle analysis of steel when carried out either by the method specified in IS 228 and its relevant parts or any other established instrumental/chemical methods shall be as given in Table 1. In case of dispute, the procedure given in IS 228 shall be the referee method. However, where the method is not given in IS 228, the referee method shall be as agreed to between the purchaser and the manufacturer.

Table 1 Chemical Composition of High Strength Steel Castings

Constituent	Requirement, Percent *Max*
Silicon	0·60
Sulphur	0·035
Phosphorus	0·035

8.2 The manufacturer shall carry out analysis from a sample of each melt of steel and, if so specified by the purchaser at the time of enquiry and order, shall supply a test certificate of chemical analysis of the sample of steel for each melt.

8.3 Product Analysis

If specified at the time of enquiry and order, the product analysis may be carried out from a test piece or from a casting representing each melt. Drillings for analysis shall be taken from not less than 6 mm beneath the cast surface, and in such a manner as not to impair the usefulness of any casting selected. The permissible variation in product analysis from the limits specified in Table 1 shall be as given in IS 6601 : 1987.

8.4 Residual Elements

Analysis and reporting of the analysis in the test certificate for the residual elements shall be done only when so specified by the purchaser in the enquiry and order. However, the manufacturer shall ensure that the residual elements are within the limits, when such limits are specified by the purchaser in the enquiry and order.

9 WORKMANSHIP AND FINISH

9.1 The castings shall be accurately moulded in accordance with the pattern or the working drawings supplied by the purchaser with the addition of such letters, figures and marks as may be specified.

9.2 The purchaser shall specify the tolerances on all important dimensions. On other dimensions, tolerances specified in IS 4897 : 1994 shall apply.

10 FREEDOM FROM DEFECTS

10.1 All castings shall be free from defects that will adversely affect machining or utility of castings.

10.2 When necessary to remove risers or gates by flame or arc or a combination thereof, or by any other process involving intense heat, care shall be taken to make the cut at a sufficient distance from the body of the casting so as to prevent any defect being introduced into the casting due to local heating. Any such operation is to be done before final heat treatment.

10.3 In the event of any casting proving defective from foundry causes in the course of preparation, machining or erection, such casting may be rejected notwithstanding any previous certification of satisfactory testing and/or inspection.

11 FETTLING AND DRESSING

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

12 HEAT TREATMENT

12.1 The castings shall be heat-treated in a properly constructed furnace, having adequate means of temperature control, which shall permit the whole of the castings being uniformly heated to the necessary temperature. All castings shall be suitably heat treated so as to attain the specified mechanical properties.

12.2 The test pieces shall be heat treated along with the casting they represent.

13 MECHANICAL TESTS

13.1 The mechanical properties specified are those which are to be obtained from test bars cast either separately from or attached to the castings to which they refer and heat treated as given in **12.** The test values so exhibited; therefore, represent the quality of steel from which the castings have been poured, they do not necessarily represent the properties of the castings themselves.

13.2 The tensile test shall be carried out in accordance with IS 1608 : 1972. The relevant mechanical properties shall be as given in Table 2.

13.3 The Brinell Hardness when tested in accordance with IS 1500 : 1983 shall be as specified in Table 2.

13.3.1 The hardness test shall be carried out on the ends of tensile test specimens or when so stated in the enquiry and order, on castings preferably on a rectangular pad 20 mm × 40 mm so located on the casting as to permit proper mounting on the Brinell tester. The location where hardness reading is taken shall be properly prepared to eliminate the effect of

Table 2 Mechanical Properties of High Strength Steel Castings for General Engineering and Structural Purpose

(*Clauses* 13.2 *and* 13.3)

Property	Grade→ / Designation→	Requirement				
		Gr 1 CS 640	Gr 2 CS 700	Gr 3 CS 840	Gr 4 CS 1030	Gr 5 CS 1230
Tensile strength, MPa, *Min*		640	700	840	1 030	1 230
Yield stress, (0·5 percent proof stress), MPa, *Min*		390	580	700	850	1 000
Elongation, percent, *Min*		15	14	12	8	5
Reduction in area, percent, *Min*		35	30	28	20	12
Charpy, V-notch impact[1] value, J, *Min*		25	25	20	15	—
Brinell Hardness, HB, *Min*		190	207	248	305	355

[1]NOTE — Impact test is optional.

surface variables. The frequency of Brinell Hardness inspection on castings shall be as per agreement between the purchaser and the manufacturer and shall be indicated in enquiry and order.

NOTE — Due to variation of section thickness in actual castings, the hardness as measured on the casting may deviate from the specified values for the test bar by up to ± 20 percent.

13.4 If specified in the enquiry and order, the impact test shall be carried out in accordance with IS 1757 : 1988 and the values obtained shall conform to the requirements given in Table 2.

14 NON-DESTRUCTIVE TESTS

14.1 Non-destructive testing shall be applied if so specified in the euquiry and the order. Under this heading are grouped the tests, which aim at revealing defects which cannot be revealed by a simple visual examination, such as penetrant, magnetic particle, ultrasonic, X-radiographic, or gamma-radiographic inspection; also included under this heading are tests on the surface condition by visual or visual-tactile examination. The purchaser shall specify in the enquiry and order:

a) The type of non-destructive testing which he intends to carry out or to have carried out;

b) The area or areas of the casting to which these tests apply, and the types of discontinuity, where relevant;

c) Whether all, or what proportion, of the castings are to be tested;

d) The severity level defining the acceptability or non-acceptability of defects which may be revealed; and

e) Whether the manufacturer is or is not contractually responsible for carrying out the tests.

14.2 Unless otherwise agreed upon, when non-destructive testing is to be done, the castings shall be examined as follows:

a) Ultrasonic examination as per IS 7666 : 1988,

b) Magnetic particle examination as per IS 3703 : 1980,

c) Liquid penetrant examination as per IS 3658 : 1981, and

d) Radiographic examination as per IS 2595 : 1978.

14.3 Unless otherwise agreed upon the following shall be the acceptance standards:

a) IS 9585 : 1986 for ultrasonic inspection;

b) IS 10724 : 1988 for magnetic particle inspection;

c) IS 11732 : 1986 for dye penetrant inspection; and

d) IS 12938 : 1990 for radiographic inspection.

15 REPAIR OF CASTINGS

15.1 Unless otherwise specified by the purchaser in the enquiry and order, castings may be rectified by welding. All repairs by welding shall be carried out in accordance with the procedure laid down in IS 5530 : 1987. If castings have been subjected to non-destructive or hydraluic testing by agreement between the purchaser and the manufacturer, the castings shall be re-examined in the area of repair following any rectifying operation performed on the castings.

15.2 To form the basis of an agreement between the purchaser and the supplier in this respect, the following classification shall apply concerning the extent of repair:

a) Weld repair involving a depth not exceeding 20 percent of wall thickness or 25 mm, whichever is lower, shall be termed as a minor repair;

b) Any weld repair exceeding the above shall be termed as a major repair. Further any single repair having an area exceeding 250 mm square for every millimetre of wall thickness shall also be deemed to be a major repair, regardless of the considerations mentioned in (a) above.

15.3 Carbon Equivalent

Unless otherwise specified in the enquiry and order, or otherwise agreed to, the Carbon Equivalent (C.E.) for the purpose of guidance in determination of the pre- and post-weld treatment applicable to carbon and low alloy steels shall be computed as follows:

$$\text{C.E.} = \text{C} + \frac{\text{Mn}}{6} + \frac{\text{Cr} + \text{Mo} + \text{V}}{5} + \frac{\text{Ni} + \text{Cu}}{15}$$

15.4 The welding procedure to be followed for any welding that may be required on the surface hardened area, if any, shall be as agreed to.

16 METHOD OF SAMPLING

The method of sampling the steel castings for the purpose of chemical analysis and mechanical tests including re-test shall be in accordance with IS 6907 : 1992.

17 MARKING

17.1 Each casting shall be legibly and indelibly marked with the following:

a) The number or identification mark by which it is possible to trace the melt and the heat-treatment batch from which it was made;

b) The manufacturer's initials or trade-mark; and

c) Other identification marks in accordance with any agreement between the purchaser and the manufacturer.

NOTE — It is recommended that a minimum of markings be used.

17.2 By agreement between the purchaser and the manufacturer, castings complying with the requirements of this standard may, after inspection, be legibly marked with an acceptance mark.

17.2.1 The castings may also be marked with the Standard Mark. The use of Standard Mark is governed by the provisions of Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*	*IS No.*	*Title*
228	Methods for chemical analysis of steels (*second revision*)	6601 : 1987	Permissible deviations in chemical composition for products analysis of steel castings (*first revision*)
1500 : 1983	Methods for Brinell Hardness test for metallic materials (*second revision*)	6907 : 1992	Methods of sampling of steel castings (*first revision*)
1608 : 1972	Methods for tensile testing of steel products (*first revision*)	7666 : 1988	Recommended procedure for ultrasonic examination of ferritic castings of carbon and low alloy steel (*first revision*)
1757 : 1988	Methods for charpy impact test (V-notch) for metallic material (*second revision*)	8800 : 1986	Technical delivery conditions for steel castings (*second revision*)
2595 : 1978	Code of practice for radiographic testing (*first revision*)	9565 : 1986	Acceptance standards for ultrasonic inspection of steel castings (*first revision*)
3658 : 1981	Code of practice for liquid penetrant flaw detection (*first revision*)	10724 : 1988	Acceptance standards for magnetic particle inspection of steel castings (*first revision*)
3703 : 1980	Code of practice for magnetic particle flaw detection (*first revision*)	11732 : 1986	Acceptance standards for dye penetrant inspection of steel castings
4897 : 1994	Deviations for untoleranced dimensions and mass of steel castings (*third revision*)	12938 : 1990	Acceptance standards for radiographic inspection of steel castings
5530 : 1987	Code of procedure for repair and rectification of steel castings by metal arc welding process (*first revision*)		

ANNEX B

(*Clause* 7)

INFORMATION TO BE SUPPLIED BY THE PURCHASER

B-1 BASIS FOR ORDER

While placing an order for the purchase of steel castings covered by this standard, the purchaser should specify the following:

a) Material specification;

b) Drawing or reference number of the pattern (if supplied by the purchaser), along with a copy of the drawing;

c) Optional/Additional tests required, if any;

d) Whether the castings are to be inspected and tested in the presence of the purchaser's representative;

e) Condition of delivery;

f) Any special requirement; and

g) Test report, if required.

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Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Handbook' and 'Standards Monthly Additions'.

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