BUREAU OF INDIAN STANDARDS

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भारतीय मानक **मसौदा**

आयघर्षण प्रतिरोध के लिए 1 प्रतिशत क्रोमियम इस्पात ढलाइयाँ – विशिष्टि

(आई एस 4896 का तीसरा पुनरीक्षण)

***Draft** Indian Standard*

ONE-PERCENT CHROMIUM STEEL CASTINGS FOR RESISTANCE TO ABRASION – SPECIFICATION

(*Third Revision of* IS 4896)

ICS 77.140.180

Foundry and Steel Castings Sectional Committee, MTD14	Last date of comments 18-06-2024

FOREWORD

(Formal clause to be added later)

This standard was first published in 1968. This revision has been brought out to bring the standard in the latest style and format of Indian Standard.

In addition, the following changes have been made:

a) Cross referred standards has been updated

b) Clause 17.3 on Marking has been modified and Clause 8.2 on BIS certification marking has been added.

Chromium forms either a chromium carbide, or a complex carbide of chromium and iron. These carbides are very hard, and since the casting hardness is dependent in a large measure upon the carbides formed, the amount of carbon as well as the chromium content are important factors in determining the abrasion resistance of the steel.

Addition of molybdenum to chromium cast steels increases the resistance to impact. These cast steels show excellent properties in the normalised and tempered condition. The increased hardenability imparted by chromium and molybdenum permits the advantageous use of these steels for large intricate castings which require deep hardening, but which may not be regarded as suitable for liquid quenching. The presence of molybdenum reduces the tendency towards temper brittleness exhibited by certain chromium containing alloy steels.

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: 2022 ‘Rules for rounding off numerical values (Second Revision)’. A number of

significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Draft Indian Standard

ONE-PERCENT CHROMIUM STEEL CASTINGS FOR RESISTANCE TO ABRASION -SPECIFICATION

(*Third Revision of* IS 4896)

1 SCOPE

This standard covers the requirements for one-percent chromium steel castings for resistance to abrasion.

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 three grades of one-percent chromium steel castings for resistance to abrasion.

5 SUPPLY OF MATERIAL

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

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 reference method shall be as agreed to between the purchaser and the manufacturer.

Table 1 Chemical Composition of One-Percent Chromium Steel Castings for Resistance to Abrasion

Constituent	Requirement, percent*		
	Grade 1	Grade 2	Grade 3
Carbon	0.45-0.55	0.55-0.70	0.90-1.20
Silicon	0.75	0.75	0.75
Manganese	0.50-1.00	0.50-1.00	0.50-1.00
Sulphur	0.040	0.040	0.040
Phosphorus	0.040	0.040	0.040
Chromium	0.80-1.20	0.80-1.50	0.80-1.50
Molybdenum	—	0.20-0.40	—
*Maximum, unless range is specified			

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 lest 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.

8.4 Residual Elements

8.4.1 Elements not specified in Table 1 shall not ordinarily be added to the steel and all reasonable precautions shall be taken to prevent con animation from scrap etc, to keep them as low as practicable.

8.4.2 The following limits shall apply for the elements not specified in Table 1:

Constituent	Max, Percent
Nickel	0.40
Molybdenum	0.15
Copper	0.30
Vanadium	0.05
Tungsten	0.10
Total content of these unspecified elements, *Max*	1.0

8.4.3 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 specified.

9 WORKMANSHIP AND FINISH

9.1 The castings shall be accurately moulded in accordance with 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 4897shall 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 preferably done before 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 and which shall permit the whole of the castings being uniformly heated to the necessary temperature.

12.2 Unless otherwise specified castings shall be supplied in the annealed followed by normalizing and tempering or normalized and tempered, or hardened and tempered, or annealed followed by hardening and tempering, either at the discretion of the manufacturer or as specified at the time of enquiry and order.

12.3 Heat Treatment of Test Bars The test pieces shall be heat treated along with the castings 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. The relevant mechanical properties shall be as given in Table 2.

Table 2 Mechanical Properties of One-Percent Chromium Steel Castings for Resistance to Abrasion

Property	Requirement		
	Grade 1	Grade 2	Grade 3
Tensile Strength MPa, *Min*	690	-	-
Elongation, Percent,Min	10		
Hardness, HB	200-250	330-380	340*Min*

13.3Brinell Hardness Test

When supplied in the heat treated condition and tested in accordance with IS 1500, the Brinell hardness shall be as given in Table 2.

The hardness specified is normally applicable to the test bars selected for other tests.

NOTE — if the purchaser so requires, he may stipulate at the time of enquiry and other that the hard-ness specified in the standard is to be attained on the castings and not on the test bars, or he may specify a dc6nite hardness requirement at a particular location of the castings.

14 NON-DESTRUCTIVE TESTS

14.1 Non-destructive testing shall he applied if specified in the enquiry 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,

b) Magnetic particle examination as per IS 3703,

c) Liquid penetrant examination as per IS 3658, and

d) Radiographic examination as per IS 2595.

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

a) IS 9565 for ultrasonic inspection.

b) IS 10724 for magnetic particle inspection.

c) IS 11732 for dye penetrant inspection.

d) IS 12938 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 he carried out in accordance with the procedure laid down in IS 5530. If castings have been subjected to non- destructive or hydraulic 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 where (relevant, 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:

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

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

16 METHODS 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.

17 MARKING

17.1 Each casting shall be legibly 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 marking may 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.

17.3 The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the Bureau of Indian Standards Act, 2016 and the Rules and Regulations framed there under, and the products may be marked with the Standard Mark.

ANNEX A

(*Item* 2)

IS No.	Title
IS 228	Methods for Chemical Analysis of Steels (second revision)
IS 1500 (Part 1) : 2019 ISO 6506-3 : 2014	Metallic materials - Brinell hardness test: Part 1 test method (Fifth Revision)
IS 1608 (Part 1) : 2022 ISO 6892-1 : 2019	Metallic materials - Tensile testing - Part 1 : Method of test at room temperature
IS 2595 : 2008	Industrial radiographic testing - Code of practice (Second Revision)
IS 3658 : 1999	Code of practice for liquid penetrant flaw detection (Second Revision)
IS 3703 : 2023	Recommended practice for magnetic particle flaw detection Third Revision
IS 4897 : 1994	Deviations on untoleranced dimensions and mass of steel castings (Third Revision)
IS 5530 : 2005	Recommendations for production, rectification and repair of steel castings by metal arc welding process (Second Revision)
IS 6907 : 1992	Steel castings - Methods of sampling (First Revision)
IS 7666 : 1988	Ultrasonic examination of ferritic castings of carbon and low alloy steel - Recommended procedure (First Revision)
IS 8800 : 2023	Technical Delivery Conditions For Steel Castings Excluding Investment Castings
IS 9565 : 2023	Acceptance Standards For Ultrasonic Inspection Of Steel Castings-Specification
IS 10724 : 1990	Acceptance standards for magnetic particle inspection of steel castings - Specification (First Revision)
IS 11732 : 1995	Acceptance standards for liquid penetrant inspection of steel casting (First Revision)
IS 12938 : 1990	Acceptance standards for radiographic inspection of steel castings

ANNEX B

(*Item* 7)

INFORMATION TO BE SUPPLIED BY THE PURCHASE

A-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.