भारतीय मानक **IS 8800 : 2023**

Indian Standard

इस्पात ढलाई की तकनीकी वितरण शर्तें (इंवेस्टमेंट ढलाईयों के अतिरिक्त)

(चौथा पुनरीक्षण)

Technical Delivery Conditions for Steel Casting (Excluding Investment Castings)

(Fourth Revision)

ICS 77.140.80

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुर शाह ज़फर मार्ग, नई दिल्ली - 110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI - 110002
www.bis.gov.in www.standardsbis.in

August 2023 **Price Group 8**

Foundry and Steel Castings Sectional Committee, MTD 14

FOREWORD

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

This standard was first published in 1978 and subsequently revise on 1985, 1986 and 1997. This revision has been brought out to bring the standard in the latest style and format of the Indian Standards. It also incorporates 1 amendment issued to the last version of the standard.

In addition, the following changes have been made:

a) Reference clause is modified;
b) Editorial mistakes were corrected in **4.1.17.3**;
c) IS 1586 (Part 1) method to determine hardness is included in **6.2.6**; and
d) Hot isostatic pressing (HIP) is included in **7.2.2**.

In the formulation of this standard, considerable assistance has been derived from the following publication:

ISO 4990 : 2015 Steel castings, general technical requirements steel castings — General technical delivery requirements

The composition of the Committee responsible for formulation of this standard is given in Annex B.

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*)’. The number of significant places retained in the rounded off value should be same as that of the specified value in this standard.

Indian Standard

TECHNICAL DELIVERY CONDITIONS FOR STEEL CASTINGS (EXCLUDING INVESTMENT CASTINGS)

(*Fourth Revision*)

1 SCOPE

1.1 This standard outlines technical conditions for supply of steel castings and conditions for selection and preparation of samples and test pieces.

1.2 Where a material of product specification lays down different conditions, those conditions shall apply. In special cases, variations on these conditions may be agreed upon at the time of enquiry and order.

2 REFERENCES

The standards listed in Annex A contain provisions, which through references in this text constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of these standards.

3 TERMINOLOGY

3.1 Cast (Melt) — The product of any of the following:

a) One furnace heat;
b) One crucible heat; and
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 WORKING OF ENQUIRIES AND ORDERS

4.1 Each enquiry and order shall provide the information given in **4.1.1** to **4.1.17**.

4.1.1 Designation and, where necessary, identification number of the casting.

4.1.2 The quantity, rate of delivery and plus or minus tolerance on the quantity of castings.

4.1.3 The numbers of the drawings provided.

4.1.4 If the pattern is supplied by the purchaser, its design, its condition, its number and the inspection to be carried out.

NOTE — Where a pattern is supplied by the purchaser, the manufacturer would not ordinarily be held responsible for the dimensional accuracy or the castings unless otherwise agreed.

4.1.5 The reference numbers of all standards or specifications concerned.

4.1.6 The method of inspection, especially in the case of non-destructive tests in accordance with **7.2.1.4**.

4.1.7 Indication of the special requirements, in accordance with **7.2**.

4.1.8 Grade and quality of the steel and, if appropriate, the method of melting and additional properties.

4.1.9 Important dimensions with indication of their detum points for marking out of machining.

4.1.10 Class of deviations on dimensions and mass chosen in accordance with IS 4897 (*see* **7.2.1.1**).

4.1.11 Submission, where appropriate, of sample castings for approval before bulk manufacture.

4.1.12 Place of purchaser’s inspection when the tests cannot be carried out in the manufacturer’s works.

4.1.13 Method of batching.

4.1.14 Methods of statistical control to be used (if used).

4.1.15 Restrictive clauses on repairs by welding (if any).

4.1.16 Procedures for marking, in accordance with **8**, machining, loading, despatching and the destination.

4.1.17 *Type of Inspection*

4.1.17.1 With no certificate of compliance, no statement of routine control test results and no works certificate.

4.1.17.2 *Non-specific inspection*

Non-specific inspection is carried out by the manufacturer on a cast resulting from the same production process but not necessarily on the products supplied.

a) *Documents*

1) *Statements of compliance with the order* — A document by which the founder states that the castings supplied comply with the requirements of the order without giving any test results; and

2) *Statement of routine control test results* — A document by which the founder states that the casting supplied comply with the requirements of the order and in which he supplies the results of routine control tests of the foundry carried out on products obtained by the same method of manufacturer as those supplied, but not necessarily on the castings delivered.

4.1.17.3 *Specific inspection*

Specific inspection means the acceptance procedure carried out on the products to be delivered in order to check whether these products comply with the requirements of the order.

a) *Documents*

1) *Certificate of acceptance* — The certificate of acceptance contains the result of all prescribed tests carried out on samples taken from products (*see* Note 1) which are themselves delivered in the conditions specified for the forming of batches.

The acceptance procedures may be carried out by one of the following methods as agreed at the time of enquiry and order.

i) By the competent department (*see* Note 2) at the works; and

ii) In the presence of the purchaser or of an organization appointed by him.

In case (i), the acceptance certificate is signed by the representative of the competent department, and in case (ii) by the purchaser or the representative of the organizations appointed. In some special cases the acceptance procedure may also be carried out by an organization which is independent of the purchaser and the manufacturer, the test being carried out outside the manufacturing works. In this case, representative of this organization has to sign the acceptance certificate. If there is no specific stipulation from the purchaser or an agreement to the contrary, the supplier can presume that the acceptance procedures may be carried out by the competent department (*see* Note 2) at the works (*see* Table 1).

2) *Acceptance report* — When it has been agreed that the certificate of acceptance specified in **4.1.17.3** (a) (1) shall also be signed by the purchaser or his representative, it is called the acceptance report.

NOTES

1 Both the castings and the test blocks used for inspection are known as the product.

2 The competent department at the works means the inspection department, which is different from the production department. In certain cases, this department may be the subject of approval by the purchaser.

Table 1 Type of Document Required for Various Types of Inspection and Testing

(*Clause* 4.1.17.3)

Sl No.	Type of Inspection and Testing	Type of Document	Symbol
(1)	(2)	(3)	(4)
i)	Non-specific inspection and testing	No document or Statement of compliance or Test report	— SC TR
ii)	Specific inspection and testing carried out by the qualified department (*see* Note 2) of the manufacturer's factory	Inspections certificate signed by the representative of the qualified department of the works	IC
iii)	Specific inspection and testing carried out in the presence of the purchaser or of a body named by him	Inspection certificate signed by the purchaser or the representative of the body named by him or Inspection report signed by the manufacturer and the purchaser or his representative	ICP IR
iv)	Specific inspection and testing carried out by an independent body, the test being carried out outside the production works	Inspection certificate signed by the independent body	ICP
v)	Continuous inspection	By agreement between the interested parties	—

5 MANUFACTURE

5.1 Steel Making

Except where stipulated to the contrary, the steel making process is left to the discretion of the foundry, it shall, however, be indicated to the purchaser if the latter so specifics in the enquiry and order.

5.2 Unless otherwise specified in the enquiry and order or mutually agreed upon, the choice of the methods of moulding, running, heat treatment, etc, is left to the discretion of the foundry.

5.3 Cleaning and Dressing

All the castings shall be cleaned, have the sand removed, and be dressed sufficiently to allow them to respond to heat treatment and to be adequately examined.

5.4 Repair and Fabrication Welding

The repair and fabrication welds required by the nature of the steel casting shall be carried out in accordance to IS 5530. Unless any restrictive clauses specify to the contrary at the time of the enquiry and order, the castings may be finished by means of welding without the previous approval of the purchaser.

6 SELECTION OF SAMPLES AND PREPARATION OF TEST PIECES

6.1 Test Blocks

Except for routine control tests or where otherwise agreed upon, the test blocks whether cast separately or attached to the castings, are produced from the same cast and are heat treated along with the castings they represent. In case of classification by batch, same test blocks shall be put with each batch for heat treatment.

6.1.1 Unless otherwise specified, the test blocks may be cast separately from the castings.

6.1.2 The test pieces used for the mechanical tests are selected from the test blocks with their axes at least 12 mm from the surface.

6.1.3 In the absence of a specific agreement when ordering, the thickness of the test block shall be 30 mm ± 23 mm.

6.1.4 Test bars with different thicknesses and corresponding mechanical properties as well as the conditions under which they are to be used (location in the case of attached blocks, method of removal, etc) may form the subject of agreement when ordering. In such a case the thickness of the test bar may be maintained nearly equal to the ruling section thickness of the casting concerned. However, when the ruling section thickness is 50 mm or more the height and length of the test bar shall be each kept at least 3 times its thickness. The ruling section thickness shall be indicated by the purchaser in the enquiry and the order. The test pieces should be taken as shown in the Fig. 1. Attached test pieces should preferably have independent risers so that solidity of mother casting is not jeopardized in any manner.

NOTE — In the case of large casting where the ruling section thickness is more than the thickness of the test block to be provided it may be advisable to heat treat such test blocks separately, giving a similar heat treatment cycle as recommended for the parent castings, subject to agreement between the purchaser and the supplier. By similar heat treatment cycle it is generally meant that the temperature range, rate of heating and cooling, etc, will be the same as those of the parent castings but the soaking time and method of cooling may be different depending on the ruling section thickness.

6.2 Mechanical Tests

6.2.1 Unless otherwise specified the mechanical properties specified are those which are to be obtained when tested at 30 °C + 10 °C from test bars cast either separately from or attached to the casting to which they refer. The test values so exhibited represent, therefore, the quality of steel from which the castings have been poured; they do not necessarily represent the properties of the castings themselves.

6.2.2 *Tensile Test at Ambient Temperature*

The shape and the dimensions, as well as the test method, shall comply with IS 1608 (Part 1). Unless otherwise specified, the dimeter of machined test bars shall be 14 mm.

6.2.3 *Tensile Test at Elevated Temperature*

A test piece of the same dimeter as for the test at ambient temperature shall be used.

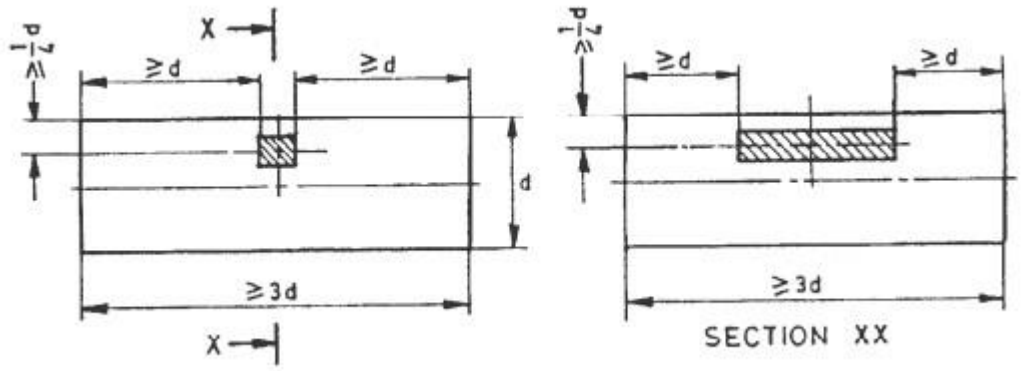
6.2.3.1 The proof stress at elevated temperature shall be determined in conformity with IS 1608 (Part 2). The temperature specified in the product standard is used.

6.2.4 *Creep Testing and Stress Rupture Testing at Elevated Temperature*

The dimension of the test pieces and the test methods shall comply with the requirements in IS 3407 (Parts 1 and 2). The choice of method and the testing conditions shall be the subject of agreement between the purchaser and the manufacturer.

6.2.5 *Impact Test*

This shall be carried out on V-notch Charpy test pieces in accordance with IS 1757 (Part 1).



d is the thickness of the ruling section.

FIG. 1 POSITION OF THE TEST PIECE AND SIZE OF THE SAMPLE

6.2.6 *Hardness Test*

Hardness test on steel castings shall be conducted in accordance to IS 1586 (Part 1). This test shall be carried out after removal of surface layer in order to eliminate de-carburized zones.

6.2.7 *Bend Test*

This test shall be carried in accordance with the procedure given in IS 1599.

6.3 Chemical Test

Samples for chemical analysis are obtained either from the test block or more generally from the ladle. The sample shall be sufficient to allow three determinations.

6.3.1 The quantitative analysis of the elements is determined by spectrography or any other method specified in the standards in force, on samples, the shape and dimensions of which are suitable for the method used. When the analysis is carried out by spectrography, measurement is effected on a point of the sample which represents its means chemical composition. In the case of dis-agreement about the results, only those obtained by chemical analysis in accordance with the relevant parts of IS 228 shall be taken as being reliable. When the determination is made chemically, the analysis shall be made on chips taken at least 6 mm beneath the surface.

6.3.1.1 The permissible variation in product analysis from the limits specified for the ladle analysis shall be as given in IS 6601.

6.3.2 *Residual Elements*

Elements not specified in the required chemical composition of the respective standard shall not ordinarily be added to the steel and all reasonable precautions shall be taken to prevent contamination from the scarp, etc, to keep them as low as practicable. Analysis and reporting of the analysis in the test certificate for 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.

6.3.3 *Inter-Granular Corrosion Test*

This test is normally reserved for stainless steels. The test shall be carried out in conformity with IS 10641 (Part 1) or IS 10461 (Part 2) or otherwise by agreement between the parties.

6.4 Magnetic Test

6.4.1 The specified characteristic is normally magnetic induction. The choice of other properties shall be subject to agreement between the parties.

6.4.2 In order to determine the magnetic induction, unless there are special indications, the measuring procedure to be used, and the shape of the test piece shall comply with IS 10181.

7 INSPECTION

7.1 General Requirement

The general requirements give the normal general Supply conditions for steel castings. The condition of inspection is specified on the order in accordance with **4.1.17**, **4.1.17.2**, or **4.1.17.3**.

7.1.1 *Visual Examination of the Casting*

7.1.1.1 *Shape and dimensions*

The shape and dimensions of the castings shall comply with the requirements of the order whether in the form of drawing, pattern of template. All modifications to be made to the drawings, or patterns for the technical requirements of the manufacturer, shall form the subject of an agreement between the purchaser and the manufacturer. The founder shall then verify by suitable means that the shape and dimensions correspond to those specified on the order, if he is responsible for producing the pattern or, unless otherwise specified, to those of the pattern, after adjusting for contraction allowance, if it is supplied by the purchaser.

7.1.1.2 *Surface condition*

The surface of the castings shall be free from defects that will adversely affect the utility and mechanic of the castings. Surface affects which are not prejudicial to the proper use of the castings cannot be a reason for rejection. Unless specified otherwise at the time of enquiry and order, the castings are delivered in the unmachined condition but duly dressed and cleaned of all moulding: material and heat treatment scale.

7.1.1.3 The castings shall not be painted unless so indicated at the time of enquiry and order.

7.1.2 *Examination of the Material*

The material is characterized by its mechanical properties and/or when required by the product standards, by its chemical composition. For special steels the properties below may be supplemented by their own particular basic properties.

7.1.2.1 *Mechanical properties*

a) Tensile test at ambient temperature:
   1) Tensile strength;
   2) Yield stress; and
   3) Elongation.

NOTE — In the event of non-availability of a test bar for any reason, the purchaser may at his discretion agree to have the tensile test conducted on the test piece taken from a casting. In that case, it may be stated for information that the properties so obtained may go down to as low as 80 percent of those obtainable from test bars.

b) *Hardness test* (*specific to certain products*) — Following agreement between the parties, the tensile test may be replaced by a hardness test, however, this test may also be used concurrently with the tensile test to check the homogeneity of a supply;

NOTE — Due to variation of sectional thickness in actual castings, the hardness is measured on the castings, may deviate from that specified for the test bars by ± 20 percent.

c) *Reduction of area or impact test* (*Charpy V*) *at ambient temperature* — One of the properties shall be applicable. However, the purchaser, if he so desires, may ask for both the properties at the time of enquiry and order; and

d) *Bend test* — The test piece shall be capable of being bent to the stipulated angle. In order to meet the requirements of this test, the guided bend specimens shall have no cracks or other open defects each exceeding 3 mm measured in any direction on the convex surface or at the corner of the specimen after bending.

7.1.2.2 *Chemical analysis* (*specific to certain products*)

The chemical purity and composition limits are given in the product standards. The specified ranges of chemical composition are based on the results of the cast analysis and if so specified at the time of enquiry and order the manufacturer shall provide a certificate indicating the content for each element specified in the standard for the product. Any deviation from the specification in **6.3** shall be notified in writing.

7.2 Special Requirements

The purchaser shall specify the special requirements, if any, like microstructure, intergranular corrosion test, etc, to supplement the general requirements on the enquiry and order. The condition of inspection are specified on the order in accordance with **4.1.17.1**, **4.1.17.2** or **4.1.17.3**.

7.2.1 *Inspection of the Castings*

The purchaser shall in all cases specify on the enquiry and order or through a subsequently issued mutually accepted/approved quality plan the inspection which he has decided to carry out in relation to the service conditions of the castings and specifically the non-destructive tests together with their severity levels as defined in **7.2.1.4**. In addition, if he proposes to make the founder responsible for these inspection procedures, he shall clearly state this on the order. In the absence of such a statement, or otherwise, in the absence of the contractual agreement subsequent to the founder's quotation for the inspection methods, the founder need only check for dimensions, shape and surface appearance, in accordance with **7.1.1.1** and **7.1.1.2**.

7.2.1.1 *Machining allowances and tolerances on dimensions and mass*

a) Machining allowances and tolerances on dimensions and mass shall be as specified on the drawing supplied; otherwise they shall conform to IS 4897. Verification of the dimensions is carried out on castings in the state of delivery, at the reference temperature of 30 °C ± 10 °C. The dimensions of machined and unmachined parts are measured by mean of instruments which allow a precision compatible with the required tolerances. The purchaser shall indicate the detum points for machining and marking out. It is desirable for him to supply the drawings of the finished component;

b) *Proof machining* — Proof machining is an operation sometimes carried out on castings in order to ensure, before supply, that a castings is free of surface and near-surface defects that may otherwise appear in the course of final machining, causing downtime and delays during such a final machining operation, which often involves expensive machine tools. When proof machining is done, it is carried out as preliminary coarse machining operation on a few important surfaces that will, thereafter, undergo the final finish machining. The permissible deviations on untoleranced proof machined dimensions, unless otherwise agreed shall be as per the class 'Extra Coarse' specified in IS 2102 (Part 1); and

NOTES

1 Where such proof machining is done not merely on a few important surfaces but on all the surfaces that are ultimately finish machine, then such an operation is called 'Rough Machining'.

2 Proof machining and rough machining is sometimes also carried out to improve the 'as cast' dimensional accuracy of castings so as to make them fit to be loaded, with appropriate fixtures, on to the machine tools used for finish machining.

c) *Mass* — The mass of the castings shall be taken to mean the mass after all normal

fettling operations are carried out but prior to doing any machining or drilling that is the mass shall include any stock kept for any machining operation, unless otherwise agreed to.

7.2.1.2 *Surface inspection*

The examination of the surface is ordinarily carried out visually in adequate lighting in the state of delivery, without optical aids. The surface conditions and the method of examination thereof may be the subject of a special agreement between the purchaser and the manufacturer. Method of sampling, if sampling technique is agreed to, shall be as per IS 6907.

7.2.1.3 *Repair of castings*

a) Unless otherwise specified by the purchaser on 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. If castings have been subjected to non-destructive 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;

b) Major repair welds shall be documented on drawing or photographs showing location and extent of weld and welding procedure followed. Documentation shall be submitted to the purchaser at the time of despatch of particular casting if so specified and the time of enquiry and order;

c) To form the basis of an agreement between the purchaser and the supplier in this respect, the following classification shall apply concerning to the extent of repair; and

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

   2) Any weld repair exceeding the above shall be term as a major repair. Also any single repair having an area exceeding 250 mm^2 for every millimetre of wall thickness shall also be deemed to be a major repair, regardless of the considerations mentioned in (1) above.

d) *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:

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

In case of high alloy steels, the definition of C. E. shall be subject to agreement between the parties.

7.2.1.4 *Non-destructive test*

a) Under this heading are grouped the test which aim at revealing defects which cannot be revealed by a simple visual examination, such a 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. In application of the principle started in **7.2.1**, the purchaser shall specify in the enquiry and order;

   1) The type of non-destructive testing which he intends to carry out or to have carried out;
   2) The area or areas of the castings to which these tests apply and types of discontinuity; where relevant;
   3) Whether all, or what proportion, of the castings are to be tested;
   4) The severity levels defining the acceptability or non-acceptability of defects which may be revealed; and
   5) Whether the manufacturer is or not contractually responsible for carrying out the tests.

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

   1) Ultrasonic examination as per IS 7666;
   2) Magnetic particle examination as per IS 3707;
   3) Liquid penetrant examination as per IS 3658; and
   4) Radiographic examination as per IS 2595.

c) Unless otherwise agreed upon the following shall be the acceptance standards:
   1) IS 9565 for ultrasonic inspection;
   2) IS 10724 for magnetic particle inspection;
   3) IS 11732 for liquid penetrant inspection; and
   4) IS 12938 for radiographic inspection;

NOTE — In case of austenitic grades, ultrasonic inspection and magnetic particle inspection may not ordinarily be feasible.

7.2.1.5 *Pressure tightness*

Pressure tightness tests are carried out on machined or unmachined castings.

a) The pressure tightness test conditions (test pressure, fluid, temperature and time), as well as the interpretation of the results, are as defined in existing standards, otherwise by agreement or as stipulated in the enquiry and order. The castings which are required to be leak proof to a fluid (air, water, oil petroleum, vapour, etc), under pressure indicated on the enquiry or order are tested with that fluid at the specified pressure for the test time indicated;

b) If these castings are only intended to contain a liquid at atmospheric pressure, they are filled with the liquid stated on the order for the time necessary to verify freedom from leakage. The castings submitted to the test shall not be oxidized and shall not receive any protective casting or covering before the test. In the castings for pressure vessels, reference shall be made to the test standard relating to these vessels; and

c) The castings shall not be peened, plugged or impregnated, to stop leakages. However, unless otherwise specified at the time of enquiry and order, rectification and upgradation of a castings by welding may be carried out in accordance with the approved procedures as laid down in the relevant clause of the standard.

7.2.2 *Hot Isostatic Pressing* (*HIP*)

The castings shall be processed by hot isostatic pressing (HIP) when specified in the order. Unless specified by the purchaser in the purchase order or contract, the HIP time, temperature, pressure, and other parameters shall be at the discretion of the manufacturer.

8 PURCHASER'S INSPECTION

8.1 General

If the supply is subject to the purchaser's inspection, this shall be stated on the enquiry and order, and the correspondingly increased cost of manufacturer, tests, etc, if any, may be implicitly included in the quotation. The purchaser's inspection may be carried out by the representative of the foundry, or by the representative of the purchaser; the inspection by the representative of the purchaser shall, however, be specified in the enquiry and order. In the case of inspection by a representative of the foundry, the later supplies a certificate of acceptance in conformity with **4.1.17.3 (a) (1) (i)**. In the case of inspection by a representative of the purchaser in the presence 01 a representative of the foundry, an acceptance report is drawn up, in conformity with **4.1.17.3 (a) (1) (ii)**. The final acceptance is carried out in the foundry by the handing over of the certificate of the acceptance, or the acceptance report, except for inspections which can only take place later at the purchaser's works within limits specified by agreement between the parties. selections of samples, preparation of test piece and the tests defined in the order shall normally be carried out at the foundry.

8.2 Procedure for Purchaser's Inspection

8.2.1 *Formation of Lots*

The method of forming lots shall be stated in the order. For example, it may be done as follows:

a) By cast — The products are of the same type. They come from the same cast and where necessary have undergone the same heat treatment procedure;

b) By lot — The products may come from cast of the same grade and/or heat treatment having the same cycles, which may or may not be identified; in this case, the lot is limited to a number of castings or a tonnage which is fixed by the parties and which constitutes the unit of acceptance; the homogeneity of the lot is verified by hardness tests carried out on 5 percent of the castings (or at least 5 castings) per lot or by agreement between the parties; the hardness is measured at the same place on each castings. Each hardness value obtained shall not deviate by more than 10 percent from the average of the hardness value of all the castings representing the lot, measured at comparable section thicknesses. If this is not the case, the manufacturer may either: and

   1) Subject all the castings in the lot of testing, to eliminate those which do not correspond to the condition of homogeneity, in order to subject them to a new heat treatment; and

   2) Or subject the whole lot to a new heat treatment, before presenting it again for purchaser's inspection; and

c) In certain cases, when agreed to between the parties, other methods for the making up of lots by means of statistical control may be used.

8.2.2 *Submission for Purchaser's Inspection*

The manufacturer shall inform the purchaser, at an appropriate time the date for submission for inspection. The means of communication to be used for giving of such an intimation by the manufacturer to the purchaser, and the notice period that shall be allowed to the purchaser for this purpose shall be as may be agreed to between the parties. He shall indicate the number of castings to be submitted against each melt and the reference of the order of which they are the subject; this constitutes a certificate stating that the manufacturing conditions specified have been complied with and that any individual examinations which may have been specified, have been carried out. The purchaser's representative who is permitted access to the places where the castings are stored, will present himself on the day specified by the written notice, or within the next five days; otherwise, in order to avoid disturbance in the manufacturing cycle, the manufacturer may carry out the inspection operation himself and deliver to the purchaser the certificate of acceptance.

8.2.2.1 *Rights and duties of the accepting agent*

The accepting agent shall have free access at any suitable time to the places in which the products to be inspected by the purchaser are manufactured and stored: He may indicate the parts of the acceptance unit or the products from which the samples shall be selected in accordance with the specification. He shall have the option of attending the selection of samples, the preparation (machining and treatment) of test pieces and the carrying out of the tests. An accepting agent who visits the workshops shall respect all the safety regulation in force in the works, if possible. The acceptance procedures shall be carried out in accordance with normal production requirements.

8.2.3 *Validity of Tests*

No account is taken of tests where unsatisfactory results are not attributable to the quality of steel, but are the results of:

a) Either incorrect mounting of the test piece, or the abnormal operation of the test machine;

b) Or defective preparation of the test piece;

c) Or fracture of the tensile test piece, outside the gauge length; and

d) Casting defects observed in the test piece.

In the above casts, a new test piece may be selected from the test block, or from another test block belonging to the same lot and the results obtained may be substituted for those corresponding to the defective test piece.

8.2.4 *Retest*

In casts other than those mentioned in **8.2.3**, where the results of the mechanical tests carried out on the test pieces do not comply with the requirement of the products standard, the manufacturer may, unless otherwise agreed upon, one of the following procedures:

a) He may repeat the mechanical test (including the inter-granular corrosion test where applicable) which failed, on two additional test pieces. If the results obtained from both these test pieces are satisfactory, then the material represented shall be considered to be satisfying the requirements of the products standard. Should any of the two new test pieces fail to give satisfactory results, the manufacturer may follow the procedure indicated in c);

b) In case of the impact tests, if the average value obtained from three tests dots not reach the specified value, or one of the individual values dots not reach two-thirds of the specified minimum, three additional test pieces selected from a test bar coming from the same batch shall be tested and the average shall be recalculated. If the new average satisfies the specified average value, the materials shall be considered to be satisfying the requirements of the products standard. Should the new mean value not satisfy the specified requirements or if one of the individual values does not reach two-thirds of specified minimum, the manufacturer may follow the procedure indicated in c); and

c) He may submit the castings and test bars to a new heat treatment, and then carry out all the mechanical tests required in the product standard on the test bars, including the inter-granular corrosion test, if required.

8.2.4.1 Should they fail again, the castings and test bars may be submitted once more to a final heat treatment and undergo all the mechanical tests required by the product standard once more. In no case shall the castings and test bars be submitted to more than two additional heat treatments (excluding tempering).

8.2.5 *Grading or Reprocessing*

Unless otherwise specified, the manufacturer may reserve the right to grade of subject the products to heat treatment, either before or after the retest, and present these products as a new acceptance unit in accordance with the procedures in **8.2.1** and **8.2.2**, without prejudice to the purchaser. The manufacturer shall indicate to the accepting agent

the method of grading used or the type of heat treatment applied.

8.2.6 *Condition of Acceptance*

If all the conditions required in the order are fulfilled in accordance with this standard the lot is considered to conform and is accepted by the purchaser without prejudice to the inspection which can only take place later at the purchaser's works within the time specified by agreement between the parties.

8.3 Rounding off Test Results

8.3.1 *Mechanical and Chemical Properties*

The mechanical and chemical tests shall be rounded off, using the rules specified in IS 2.

8.3.2 *Dimension*

Rounding off the results of measured dimensions and shape is not required.

9 AGREED MANUFACTURING PROCEDURE

Under normal circumstances, the manufacturing procedure is to be at the discretion of the manufacturer. However, certain supplies, where castings are produced in large numbers, the purchaser or the manufacturer may request at the time of enquiry and order the benefit of a manufacturing approval. In this cast, a programme of manufacture and inspection is drawn up by common agreement. The parties shall agree to a certain number of satisfactory preliminary test and the manufacturer of pilot series of castings. All these conditions taken together constitute approved tests of the manufacturer by the purchaser. Where the results are satisfactory, the purchaser may place subsequent orders with the manufacturer in accordance with these programmes of manufacturer and inspection.

10 RECORDS AND COMPLAINTS

10.1 Unless otherwise specified in the enquiry and the order, the manufacturer shall maintain the record of results of all the chemical, mechanical and other specified tests performed by him for a minimum period of two years from the date of supply.

10.2 If a complaint is made by the purchaser concerning a supply, the manufacturer shall be given reasonable time to examine merits of the complaint and castings in question shall remain available for his examination.

11 PROTECTION

If the order so specifies, the machined or unmachined castings may be submitted to a protective treatment otherwise the unmachined castings shall ordinarily be supplied unpainted and the machined castings be greased in the areas machined.

12 MARKING

12.1 Each casting shall be legibly marked with the following as may be relevant. However, where linkage and traceability are required, the relevant marking shall be indelible.

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 manufacturers 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 be used.

12.2 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.

12.3 BIS Certification Marking

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

ANNEX A

(*Clause* 2)

LIST OF REFERED STANDARDS

IS No.	*Title*
IS 228 (all parts)	Methods for chemical analysis of steels
IS 1030 : 1998	Carbon steel castings for general engineering purposes — Specification (*fifth revision*)
IS 1586 (Part 1) : 2018/ISO 6508-1 : 2016	Metallic materials — Rockwell hardness test: Part 1 Test method (*fifth revision*)
IS 1599 : 2019	Metallic materials — Bend test (*fourth revision*)
IS 1608 (Part 2) : 2020/ISO 6892-2 : 2018	Metallic materials — Tensile testing: Part 2 Method of test at elevated temperature (*fourth revision*)
IS 1757 (Part 1) : 2020/ISO 148-1 : 2016	Metallic materials — Charpy pendulum impact test: Part 1 Test method (*fourth revision*)
IS 2595 : 2008	Industrial radiographic testing — Code of practice (*second revision*)
IS 2644 : 1994/ ISO 9477 : 2015	High strength steel castings for general engineering and structural purposes — Specification (*fourth revision*)
IS 2708 : 1993	1.5 percent manganese steel castings for general engineering purposes — Specification (*third revision*)
IS 2762 : 2009	Wire rope slings and sling legs — Specification (*second revision*)
IS 2787 : 2006	Oil pressure heaters — Specification (*third revision*)
IS 2985 : 1990	Steel Castings for Ship's Structure — Specification (*third revision*)
IS 2986 : 1990	Steel castings for marine engines and boilers — Specification (*second revision*)
IS 3038 : 2006	Martensitic stainless steel and alloy steel castings for pressure containing parts suitable for high temperature service — Specification (*fourth revision*)
IS 3407	Method for creep testing of steel at elevated temperatures:
(Part 1) : 1983	Tensile creep testing (*first revision*)
(Part 2) : 1983	Tensile creep stress rupture testing (*first revision*)
IS 3444 : 1999	Corrosion resistant high alloy steel and nickel base castings for general applications — Specification (*third 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 4098 : 1983	Specification for lime-pozzolana mixture (*first revision*)
IS 4491 : 1994	Steel castings of high magnetic permeability — Specification (*third revision*)
IS 4522 : 1986	Specification for heat resistant alloy steel and nickel base castings (*second revision*)
IS 4896 : 1992	One-percent chromium steel castings for resistance to abrasion — Specification (*second revision*)
IS 4897 : 1994	Deviations on untoleranced dimensions and mass of steel castings (*third revision*)
IS 4899 : 2006	Ferritic and martensitic steel castings for use at low temperature — Specification (*third revision*)
IS 5530 : 2005	Recommendations for production, rectification and repair of steel castings by metal arc welding process (*second revision*)

IS No.	*Title*
IS 6079 : 1989	Low alloy cast steel grinding media — Specification (*second revision*)
IS 6601 : 1987	Permissible deviations in chemical composition for product analysis of steel castings (*first 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 7806 : 1993	Martensitic steel and austenitic high alloy steel castings for high temperature corrosion services — Specification (*second revision*)
IS 7899 : 2006	Alloy steel castings suitable for pressure service — Specification (*third revision*)
IS 8092 : 1992	Code for inspection of surface quality of steel castings for valves, fittings and other
IS 9541 : 1987	Specification for cast CTC segments (*first revision*)
IS 9565 : 1995	Acceptance standards for ultrasonic inspection of steel castings — Specification (*second revision*)
IS 10181 : 1982	Method for determination of magnetic permeability of iron and steel
IS 10461	Resistance to inter-granular corrosion of austenitic stainless steels — Method for determination:
(Part 1) : 1994	Corrosion test in nitric acid medium by measurement of loss in mass (huey test) (*first revision*)
(Part 2) : 1994	Corrosion test in a sulphuric acid/copper sulphate medium in the presence of copper turnings (monypenny strauss test) (*first revision*)
IS 10724 : 1990	Acceptance standards for magnetic particle inspection of steel castings — Specification (*first revision*)
IS 11166 : 1993	Permissible deviation on dimensions, surface roughness and mass of steel castings made with investment casting process (*first revision*)
IS 11732 : 1995	Acceptance standards for liquid penetrant inspection of steel casting (*first revision*)
IS 11758 : 1994	Precipitation hardening stainless steel castings — Specification (*first revision*)
IS 12938 : 1990	Acceptance standards for radiographic inspection of steel castings
IS 12968 : 1991	Steel castings for crankshafts for marine engines — Specification
IS 13505 : 1992	Centrifugally cast high alloy steel and nickel base tubing for pressure application at high temperature — Specification

ANNEX B

(*Foreword*)

COMMITTEE COMPOSITION

Foundry and Steel Castings Sectional Committee, MTD 14

Organization	*Representative(s)*
BHEL (CFFP), Haridwar	SHRI V. K. RAIZADA **(*Chairperson*)**
Bakul Castings Private Limited, Chennai	SHRI RAKESH NAGER
BEML Limited, Bengaluru	SHRI MAHENS KULKARNI SHRI A. S. PHANEEDRA (*Alternate*)
Bharat Heavy Electrical Limited, New Delhi/Haridwar	SHRI A. N. SUDHAKAR SHRI RANJITH LAKRA (*Alternate* I) SHRI ABHINAV AGRAWAL (*Alternate* II)
Bhilai Engineering Corporation Limited, Bhilai	SHRI AKHIL DUBEY SHRI SHIV DUTT MISHRA (*Alternate*)
CSIR - Central Mechanical Engineering Research Institute, Durgapur	DR SUDIP SAMANTHA
CSIR - National Institute for Interdisciplinary Science and Technology (NIIST), Thiruvananthapuram	DR TPD RAJAN DR M. RAVI (*Alternate*)
CSIR - National Metallurgical Laboratory, Jamshedpur	DR D. N. PASWAN MS MINAL SAHA (*Alternate*)
Directorate General of Quality Assurance, Ichhapur	SHRI ASHOK KUMAR SHRI RUPESH BANAIT (*Alternate*)
Disa India Ltd, Bangalore	SHRI SUNIL KUMAR GHOSH SHRI SURESH KUMAR A. (*Alternate*)
Forace Polymers Private Limited, Haridwar	SHRI D. K. GHOSH
Hindustan Aeronautics, Foundry and Forge Division, Bengaluru	SHRI K. SATYENDRA KUMAR
Indian Institute of Technology, Kharagpur	PROF SHIV BRAT SINGH PROF DEBALAY CHAKRABARTI (*Alternate*)
Indian Ordnance Factory, Grey Iron Foundry, Jabalpur	SHRI M. P. YADAV SHRI ARUNANSHU PRAMANIK (*Alternate*)
Indian Register of Shipping, New Delhi	DR K. K. DHAWAN SHRI S. VELMURUGAN (*Alternate*)
Institute of Technology (BHU), Varanasi	DR INDRAJIT CHAKRABARTY DR JAYANT KUMAR SINGH (*Alternate*)
Ministry of Railway, RDSO, Lucknow	SHRI C. SENGUPTA SHRI RAJ KISHORE PRASAD (*Alternate*)
Ministry of Science & Technology, New Delhi	MS TAMANNA ARORA SHRI K. S. P. RAO (*Alternate*)

Organization	*Representative(s)*
National Institute of Foundry & Forging Technology, Ranchi	DR KAMLESH KUMAR SINGH DR AMITESH KUMAR (*Alternate*)
NIT Manipur, Langol, Imphal	PROF (DR) GOUTAM SUTRADHAR DR ANIL KUMAR BIRRU (*Alternate* I) DR SABINDRA KACHHAP (*Alternate* II)
Sponge Iron Manufacturers Association, New Delhi	SHRI D. KASHIVA SHRI VIVEK AGARWAL (*Alternate*)
Steel Cast Ltd, Bhavnagar	SHRI B. C. ROUTRAY
The Institute of Indian Foundry Men, New Delhi	SHRI DINESH GUPTA SHRI SANJEEV KUMAR (*Alternate* I) SHRI PRADEEP MITTAL (*Alternate* II)
The Wesman Engineering Co Pvt Ltd, Kolkata	SHRI RANJAN GUHA SHRI ASHUTOSH MONDAL (*Alternate* I) SHRI PARTHA CHATTERJEE (*Alternate* II)
Versatile Equipments Pvt Ltd, Kolhapur	SHRI PUSHKRAJ JANWADKAR SHRI PRADEEP PARIT (*Alternate*)
BIS Directorate General	SHRI SANJIV MAINI, SCIENTIST 'F'/SENIOR DIRECTOR AND HEAD (METALLURGICAL ENGINEERING) [REPRESENTING DIRECTOR GENERAL (*Ex-officio*)]

Member Secretary
SHRI KUNAL KUMAR
SCIENTIST 'D'/JOINT DIRECTOR
(METALLURGICAL ENGINEERING), BIS

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act*, 2016 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

Review of Indian Standards

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 website-www.bis.gov.in or www.standardsbis.in

This Indian Standard has been developed from Doc No.: MTD 14 (21906).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones: 2323 0131, 2323 3375, 2323 9402 *Website*: www.bis.gov.in

Regional Offices:		*Telephones*
Central	: 601/A, Konnectus Tower -1, 6th Floor, DMRC Building, Bhavbhuti Marg, New Delhi 110002	2323 7617
Eastern	: 8th Floor, Plot No 7/7 & 7/8, CP Block, Sector V, Salt Lake, Kolkata, West Bengal 700091	2367 0012 2320 9474
Northern	: Plot No. 4-A, Sector 27-B, Madhya Marg, Chandigarh 160019	265 9930
Southern	: C.I.T. Campus, IV Cross Road, Taramani, Chennai 600113	2254 1442 2254 1216
Western	: Plot No. E-9, Road No.-8, MIDC, Andheri (East), Mumbai 400093	2821 8093

Branches : AHMEDABAD. BENGALURU. BHOPAL. BHUBANESHWAR. CHANDIGARH. CHENNAI. COIMBATORE. DEHRADUN. DELHI. FARIDABAD. GHAZIABAD. GUWAHATI. HIMACHAL PRADESH. HUBLI. HYDERABAD. JAIPUR. JAMMU & KASHMIR. JAMSHEDPUR. KOCHI. KOLKATA. LUCKNOW. MADURAI. MUMBAI. NAGPUR. NOIDA. PANIPAT. PATNA. PUNE. RAIPUR. RAJKOT. SURAT. VISAKHAPATNAM.

Published by BIS, New Delhi