BS ISO 4990:2015

BSI Standards Publication

Steel castings — General technical delivery requirements

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National foreword

This British Standard is the UK implementation of ISO 4990:2015.

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Third edition
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Steel castings — General technical delivery requirements

Pièces moulées en acier — Conditions techniques générales de fourniture

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information.

The committee responsible for this document is ISO/TC 17, *Steel*, Subcommittee SC 11, *Steel castings*.

This third edition cancels and replaces the second edition (ISO 4990:2003), which has been technically revised with the following changes:

— Clause 2: new and replacement normative references have been added;

— 3.1 has been revised;

— 4.2 has been developed;

— 6.2.2.1 has been moved to 6.2.3, and the subclauses have been renumbered;

— in 6.2.2.4, editorial changes have been carried out to eliminate confusion over paragraph identification and the last paragraph and the reference to ISO/TR 9769 have been deleted;

— 6.2.3.2.2 has been deleted and the contents moved to 6.2.3.2;

— 6.2.3.3 has been revised;

— Clause 7 has been revised;

— A.1.3 has been revised;

— A.3 has been deleted;

— B.2.2, B.4.2, and B.4.4 have been revised;

— Table 1 has been revised;

— Table 2 has been deleted;

— editorially revised.

INTERNATIONAL STANDARD **ISO 4990:2015(E)**

Steel castings — General technical delivery requirements

1 Scope

This International Standard specifies the general technical delivery requirements for the supply of steel, nickel, and cobalt alloy castings, including the requirements for the selection and preparation of samples and test pieces.

When a material or product standard differ from this delivery specification, the material or product standard shall apply. In the case of investment castings, ISO 16468 will apply.

This International Standard also specifies a group of supplementary requirements which may be applied to steel, nickel, and cobalt alloy castings. These requirements are provided for use when additional testing or inspection is desired and apply only when individually specified by the purchaser.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 148-1, *Metallic materials — Charpy pendulum impact test — Part 1: Test method*

ISO 404:2013, *Steel and steel products — General technical delivery requirements*

ISO 3651-2, *Determination of resistance to intergranular corrosion of stainless steels — Part 2: Ferritic, austenitic and ferritic-austenitic (duplex) stainless steels — Corrosion test in media containing sulfuric acid*

ISO 4948-1, *Steels — Classification — Part 1: Classification of steels into unalloyed and alloy steels based on chemical composition*

ISO 4986, *Steel castings — Magnetic particle inspection*

ISO 4987, *Steel castings — Liquid penetrant inspection*

ISO 4992-1, *Steel castings — Ultrasonic examination — Part 1: Steel castings for general purposes*

ISO 4992-2, *Steel castings — Ultrasonic examination — Part 2: Steel castings for highly stressed components*

ISO 4993, *Steel and iron castings — Radiographic inspection*

ISO 6506-1, *Metallic materials — Brinell hardness test — Part 1: Test method*

ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

ISO 6892-2, *Metallic materials — Tensile testing — Part 2: Method of test at elevated temperature*

ISO 6929:2013, *Steel products — Vocabulary*

ISO 10474, *Steel and steel products — Inspection documents*

ISO 11970, *Specification and approval of welding procedures for production welding of steel castings*

ISO 11971, *Steel and iron castings — Visual examination of surface quality*

ISO 14284, *Steel and iron — Sampling and preparation of samples for the determination of chemical composition*

ISO 18265, *Metallic materials — Conversion of hardness values*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 404, ISO 4948-1, ISO 6929:2013, Clause 9, ISO 11970, and the following apply. In case of dispute, the terms and definitions in ISO 4990 apply.

3.1
cast (heat)
all the molten metal poured from a single furnace or all the molten metal from two or more furnaces poured into a single ladle or casting

Note 1 to entry: The following are some examples [the words in **boldface** are the criteria for determining the cast (heat) definition]:

a) all the molten metal from one or more furnaces poured into a **single ladle or casting**;

b) all the molten metal in one melt in a **single furnace**.

4 Information to be supplied by the purchaser

4.1 The enquiry and order should include the information as specified in 4.1.1 and 4.1.2.

4.1.1 A description of the casting(s) by pattern number and/or drawing. When a pattern is supplied, a complete list of the pattern equipment should be included. When a drawing is not supplied, the casting is purchased on the basis of the pattern. In that case, the foundry shall not be responsible for the dimensions of the part.

NOTE Machining allowances, dimensional tolerances, and geometrical tolerances can be selected from ISO 8062-3.

All modifications to be made to the drawing, for the technical requirements of the manufacturer, shall form the subject of an agreement between the manufacturer and the purchaser.

4.1.2 The material standard, delivery condition, and grade of steel, nickel, or cobalt alloy.

4.2 Where appropriate, the enquiry and order should include additional information, e.g.:

a) any supplementary requirements in accordance with Annex B;

b) non-destructive testing procedures to be used, extent of the non-destructive testing, and acceptance criteria;

c) type of inspection document to be provided at the time of supply;

d) size of a test lot, see 6.2.3.1;

e) procedures for marking (in accordance with Clause 7), machining, protection, packaging, loading, dispatching, and the destination;

f) submission of sample castings for approval before production quantities are produced, see A.1.3;

g) methods of statistical control to be used.

Inspection and testing procedures shall conform to Annex A, including the place of inspection and testing for the purchaser, if the inspection or testing cannot be performed at the manufacturer's works.

5 Conditions of manufacture

5.1 Foundry practice

Unless otherwise agreed upon at the time of enquiry and order or specified in the material standard, the selection of the method of melting, moulding, heat treatment, etc., is left to the discretion of the manufacturer.

5.2 Cleaning and dressing

All the castings shall be cleaned and dressed sufficiently to determine compliance with the requirements of 6.2.3. Additional dressing may be agreed to at the time of the enquiry and order.

5.3 Production welding

Unless specified at the time of the enquiry and order, the casting(s) may be subjected to production welding without the prior approval of the purchaser. Weld procedures for production welding shall be in accordance with ISO 11970.

For a supplement specifying major finishing welds, see B.8.1 and B.8.2.

6 Inspection and testing

6.1 Non-specific inspection

This inspection shall be arranged by the manufacturer and drawn up to ensure that the specified requirements are complied with.

At the request of the purchaser at the time of the enquiry and ordering, the manufacturer shall supply a statement of compliance or test report on the basis of these non-specific inspections or tests.

6.2 Specific inspection

6.2.1 Documents

Inspection documents shall be agreed upon at the time of the enquiry and order and shall be in accordance with ISO 10474.

If one of the documents for specific inspection and testing from ISO 10474 is ordered, the inspections and tests are to be carried out in accordance with 6.2.2, 6.2.3, and Annex A.

The inspection document shall contain the results of the chemical analysis and mechanical tests, including the results of any other tests required by the specification and by the purchaser. It shall include a statement that castings were manufactured in accordance with the requirements of the specification.

The inspection document shall be signed by an authorised agent of the manufacturer.

Electronic data interchange (EDI): the manufacturer's certification printed from or used in electronic form shall be regarded as having the same validity as a counterpart printed in the certifier's facility provided that it conforms to any existing agreement between the purchaser and the supplier.

The inspection document shall provide the required traceability to the castings.

6.2.2 Sampling, preparation of test pieces, and mechanical and chemical test methods and requirements

6.2.2.1 Test blocks

The test blocks may be cast separately, attached to the castings or cast integrally on the castings. When more than one ladle is used, the test block shall be cast integrally. They shall be produced from the same cast (heat) of steel and shall be heat treated in the production furnaces to the same procedure as the casting(s) they represent.

Unless otherwise specified, the test block shall be 28 mm minimum and the test pieces used for the mechanical tests shall be taken from test blocks with their axes at least 7 mm from the surface. See B.6.1.2 and B.6.1.3.

The test results represent the material from which the castings have been poured. They do not necessarily represent the properties of the castings. These can be affected by solidification conditions and the rate of cooling during heat treatment, which are in turn influenced by casting thickness, size, and shape.

6.2.2.2 Mechanical tests

6.2.2.2.1 Tensile tests at room temperature

One tensile test shall be carried out per test lot (see 6.2.3.1). The shape, dimensions, and method shall comply with ISO 6892-1. The test results shall comply with the specification for the grade of material ordered.

6.2.2.2.2 Impact test

When the test is specified, it shall be carried out in accordance with ISO 148-1. Three Charpy test pieces with V-notches shall be prepared. The test temperature shall be as shown in the material specification. The average value of absorbed energy from the three test pieces shall not be less than the value indicated in the material specification for the grade specified. Only one of the three values may be below but not less than 70 % of the minimum specified value.

6.2.2.3 Retests

6.2.2.3.1 Test results not in compliance with the specification are not valid when due to any one of the following conditions:

— defective assembly of the test piece or abnormal functioning of the test machine;

— defective manufacture of the test pieces;

— break in the tensile-test piece outside the reference marks;

— anomalies shown in the test piece.

In all cases, a new test piece shall be taken from the same test block or from another test block belonging to the same test lot and the results obtained can be substituted for those corresponding to the defective piece.

6.2.2.3.2 Except as provided, when the results of the test do not comply with the requirements of the material standard, the manufacturer shall, unless otherwise agreed upon at the time of enquiry and order, adopt one of the procedures specified below.

a) Repeat the test which failed on two additional test pieces. If any of the two new test pieces do not give the specification requirements, the manufacturer may follow the procedure specified in c).

b) In the case of impact tests, if the average value obtained from the three tests does not reach the minimum specified value or if one of the individual values does not reach the specified minimum (i.e. 70 % of the minimum specified value), the manufacturer may test three additional test pieces. The additional test pieces shall be selected from the same test block or from another block from the same heat and heat treated test lot to represent the castings in question. The results from these additional tests shall be added to the results previously obtained and the average recalculated. If this new average satisfies the average value specified, the material represented may be considered to satisfy the requirements of the material standard. Where the new average value does not satisfy the specified requirements, or any one of the new values is less than 70 % of the minimum specified value, the manufacturer may then follow the procedure specified in c).

c) Submit the castings and test blocks to a new heat treatment within the limits of the material standard and then carry out all the tests required in the material standard on the test blocks. In any case, the castings and test bars shall not be submitted to more than two additional heat treatments (excluding tempering) without the approval of the purchaser.

6.2.2.4 Chemical composition

The chemical composition determined from the cast (heat) sample shall meet the requirements of the specification of the grade selected. When more than one ladle is used to pour a single casting, an analysis of each ladle is required and the analysis of each ladle shall meet the requirements of the specification of the selected grade.

Samples for chemical analysis shall be obtained and prepared in accordance with ISO 14284. When chips are taken, they shall be removed at least 6 mm below the cast surface when the cast wall section is greater than 15 mm.

In case of a dispute, an analysis may be carried out, subject to the agreement of the purchaser and manufacturer. This analysis is made on samples used for cast (heat) analysis or on test blocks or test pieces from the cast (heat): in these cases the permissible deviations in Table 1 apply.

Table 1 — Permissible deviations above the maximum or below the minimum limits of the chemical requirements of the applicable product specification for the results of product analysis

Element	**Specified composition range** mass fraction %	**Permissible deviation** mass fraction %	**Element**	**Specified composition range** mass fraction %	**Permissible deviation** mass fraction m/m
Carbon	≤0,03	+0,005	Nickel	≤1,00	±0,07
	>0,03 ≤ 0,08	±0,01		>1,00 ≤ 2,00	±0,10
	>0,08 ≤ 0,30	±0,02		>2,00 ≤ 5,00	±0,15
	>0,30 ≤ 0,60	±0,03		>5,00 ≤ 10,00	±0,20
	>0,60 ≤ 1,20	±0,05		>10,00 ≤ 20,00	±0,25
	>1,20 ≤ 2,00	±0,06		>20,00 ≤ 30,00	±0,30
	>2,00	±0,08		>30,00	±0,50
Silicon	≤2,00	±0,10	Niobium	≤1,00	±0,05
	>2,00	±0,20		>1,00	±0,10
Manganese	≤0,70	±0,06	Vanadium	≤0,30	±0,03
	>0,70 ≤ 2,00	±0,10		>0,30 ≤ 1,00	±0,07
	>2,00 ≤ 10,00	±0,25	Copper	≤2,00	±0,10
	>10,00	±0,40		>2,00 ≤ 5,00	±0,20
Sulfur and Phosphorous	≤0,045	±0,005	Nitrogen	≤0,30	±0,02
	>0,045 ≤ 0,060	±0,010	Tungsten	≤1,00	±0,05
				>1,00 ≤ 3,00	±0,10
				>3,00 ≤ 6,00	±0,15
Chromium	≤2,00	±0,10			
	>2,00 ≤ 10,00	±0,20			
	>10,00 ≤ 15,00	±0,30			
	>15,00 ≤ 20,00	±0,40			
	>20,00	±0,50			
			Cobalt	≤1,00	±0,07
				>1,00 ≤ 2,00	±0,10
				>2,00 ≤ 5,00	±0,15
Molybdenum	≤1,00	±0,07		>5,00 ≤ 10,00	±0,20
	>1,00 ≤ 2,00	±0,10		>10,00 ≤ 20,00	±0,25
	>2,00 ≤ 5,00	±0,15		>20,00 ≤ 30,00	±0,30
	>5,00 ≤ 10,00	±0,20		>30,00	±0,50
	>10,00 ≤ 20,00	±0,25	Titanium	≤1,00	±0,05
	>20,00 ≤ 30,00	±0,30		>1,00 ≤ 3,00	±0,07
	>30,00	±0,50		>3,00	±0,10

6.2.3 Inspection and testing of castings and requirements for surface appearance and dimensions

6.2.3.1 Formation of test lots

The method of forming test lots shall be stated in the order. The size of the test lot may be defined in terms of mass or number of castings; e.g. it may be carried out as follows:

a) by batch: the products may come from different heats of the same grade and/or from different heat treatments having the same cycles, which may or may not be identified. In this case, the batch is limited to a number of castings or to a tonnage fixed between the parties concerned and constituting the unit of acceptance;

b) by heat: the products are of the same type. They come from the same heat and have undergone the same heat treatment in the same furnace;

c) by piece: for certain products where made necessary by technical requirements;

d) by supplementary agreement.

6.2.3.2 Non-destructive tests

Examination of the accessible surfaces of the casting shall be carried out visually (see B.9.5).

Unless otherwise specified at the time of the enquiry and order, the castings shall be delivered in the unmachined condition, trimmed, with heads and gates removed. Accessible surfaces shall be free from adhering sand and heat treatment scale.

The castings may be subjected to certain non-destructive testing (liquid penetrant, magnetic particle, radiography, ultrasonic testing; see B.9.1 to B.9.4).

6.2.3.3 Shapes, dimensions, and dimensional tolerances

The shapes and dimensions of the casting shall comply with the requirements of the order, whether in the form of drawing, pattern, or template. Unless specified by the purchaser, the location of the datum points for dimensional inspection and machining shall be at the discretion of the manufacturer.

In case of dispute, verification of the dimensions shall be carried out on castings in the as-delivered state.

7 Marking

By agreement between the purchaser and manufacturer, each casting shall be marked. Unless specified by the purchaser, the locations of the markings shall be at the discretion of the manufacturer. The marks may include the following:

a) symbol of the manufacturer;

b) test lot identification;

c) grade designation (name or number) of the cast;

d) other marks requested by the purchaser.

These marks shall be located at a place agreed upon by the purchaser and manufacturer.

By agreement between the purchaser and manufacturer, small castings may be batched and the identifying marks applied to a label attached to each batch.

8 Complaints

If a complaint is made, the manufacturer shall be given time to examine the merits of the complaint. The castings in question shall remain available for examination.

Annex A
(normative)

General conditions for specific inspections and tests

A.1 Inspection conditions

A.1.1 General

Inspection documents and conditions should be agreed upon at the time of the order. Inspection documents are described in ISO 10474.

A.1.2 Place of inspection

Inspections and tests shall be carried out at a place agreed upon between the manufacturer and purchaser.

Samples may be selected in the manufacturer's works. Depending on the type of test, samples may be blocks or castings representative of the product.

A.1.3 Submission for inspection

The manufacturer shall arrange with the purchaser, by mutual agreement, the date of submission for inspection.

The purchaser's inspection representative shall have free access at any suitable time to the places in which the products to be inspected are manufactured and stored. The purchaser's inspection representative may indicate the samples to be selected in accordance with the specification. The purchaser's inspection representative shall have the option of attending the selection of samples, the preparation (machining and treatment) of the test pieces, and carrying out the tests. However, a purchaser's inspection representative who visits the workshops shall respect all of the safety regulations in force in the works and shall be accompanied, as far as possible, by a representative of this works.

A.1.4 Conditions of acceptance

If all the requirements of the order and this International Standard are fulfilled, the test lot is considered to conform and is accepted by the purchaser without prejudice to the inspection which may take place later at the purchaser's works within the time limits specified by agreement between the manufacturer and purchaser.

A.2 Rounding of test results

The results of the mechanical and chemical tests shall be rounded using the rules specified in ISO 404:2013, 8.5.

Annex B
(normative)

Supplementary requirements

B.1 General

One or more of the following supplementary requirements may be applied when specified in the order. Details of these supplementary requirements shall be as agreed upon by the manufacturer and purchaser at the time of enquiry and order. The specified tests shall be carried out before delivery of the castings.

B.2 Manufacturing considerations

B.2.1 Steelmaking process

The steelmaking process shall be reported to the purchaser.

B.2.2 Mass of test lots

The mass of the test lot may be specified from one of the following:

a) up to 500 kg;

b) up to 1 000 kg;

c) up to 5 000 kg.

Other methods for making up the test lots for testing by statistical means may be used. Such alternative methods shall be specified in the enquiry and order.

B.2.3 Mass and tolerance on mass

If applicable, mass and tolerance on mass shall be agreed upon at the time of the enquiry and order.

B.3 Chemical analysis for residual elements

Chemical analysis for residual elements not listed in the specification shall be agreed upon between the manufacturer and purchaser.

B.4 Mechanical tests

B.4.1 Proof stress at elevated temperature

The dimensions of the test pieces and method of tests shall meet the conditions of ISO 6892-2. The proof stress at elevated temperature shall be determined in accordance with the requirements of ISO 6892-2. The test temperature and proof stress shall be as specified in the material standard or shall be agreed upon between the manufacturer and purchaser.

B.4.2 Brinell hardness test

Measurement of the hardness at certain points on the castings shall be carried out in accordance with ISO 6506-1. The location on the casting or test block where hardness tests are to be taken shall be specified in the enquiry and order. Unless specified by the purchaser, the locations of the hardness tests shall be at the discretion of the manufacturer.

B.4.3 Alternative hardness tests

Hardness tests other than Brinell hardness tests may be used. Conversion of values shall be in accordance with ISO 18265.

B.4.4 Impact test at low temperatures

Impact energy at low temperatures shall be determined. Test temperatures and energy values shall be as specified in the individual product standards. Where the product standard does not specify the test temperature and energy value, they shall be agreed upon between the manufacturer and purchaser. Other properties which may be specified include the following:

a) lateral expansion;

b) percentage of shear area.

B.5 Homogeneity of the test lot

Under conditions agreed upon between the manufacturer and purchaser, the homogeneity of the test lot shall be verified by hardness test carried out on 5 % of the castings (at least five castings) per test lot.

B.6 Test blocks

B.6.1 Test blocks representative of the castings

B.6.1.1 General

The size, shape, and location of the test blocks, corresponding mechanical properties, conditions under which the test blocks are cast (see 6.2.2.1), and position of the test pieces shall be agreed upon between the manufacturer and the purchaser at the time of the enquiry and order. The test block can be selected as described in B.6.1.2 and B.6.1.3.

B.6.1.2 Test block *t x t*

The dimensions of the test block may be *t x t* instead of 28 mm × 28 mm, where *t* is the ruling section thickness, ($28 < t \leq 56$) mm. The ruling section shall be indicated by the purchaser in the enquiry and the order.

The test pieces shall be taken from the test blocks as follows:

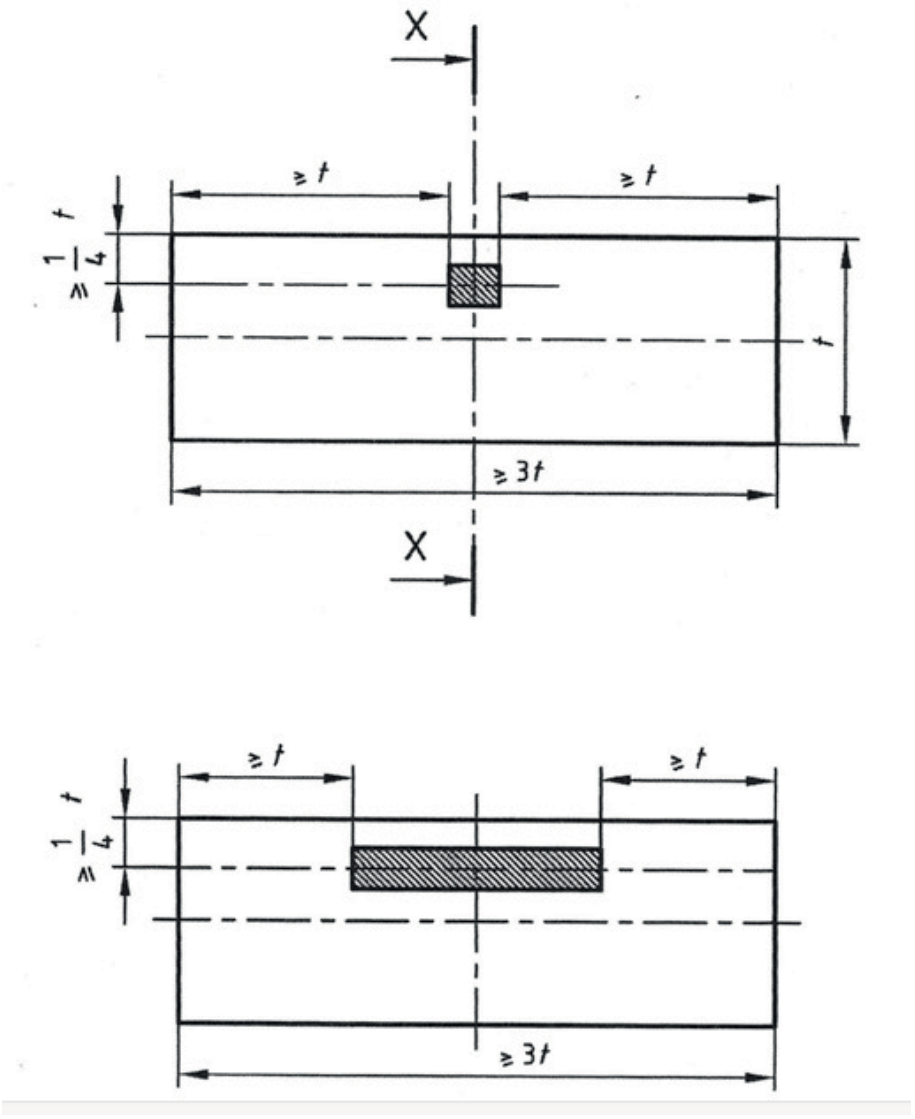
— if the section thickness is ≤ 56 mm, the axis of the test piece shall be ≥ 14 mm from the cast surface;

— if the section thickness is > 56 mm, the axis of the test piece shall be $t/4$ to not more than $t/3$ from the cast surface.

B.6.1.3 Test block $t \times 3t \times 3t$

When the ruling section thickness is > 56 mm, the dimensions of the test block can be taken as $t \times 3t \times 3t$ where *t* is the ruling section thickness. The ruling section thickness shall be indicated by the purchaser

at the time of the enquiry and order. The maximum dimension of the test block is limited to 500 mm. The test piece shall be taken as shown in Figure B.1.



Key

t relevant thickness

Figure B.1 — Position of the test piece and size of the sample

B.6.2 Heat treatment of separately cast test blocks

Test blocks shall be heat treated in the same furnace as the castings which they represent.

B.6.3 Test blocks attached to casting

When the test blocks are attached to the castings, the attachment method shall be agreed upon between the manufacturer and purchaser.

The test blocks shall not be detached before the manufacturer has carried out the final heat treatment of the castings.

B.7 Heat treatment

B.7.1 Type of heat treatment

The type of heat treatment applied to the castings shall be reported to the purchaser.

B.7.2 Details of the treatment

When agreed upon between the purchaser and manufacturer in the enquiry and the order, the time/temperature cycle of the applied heat treatment shall be reported to the purchaser.

B.8 Production welds

B.8.1 Prior agreement relating to major production welds

Unless otherwise agreed upon, production welds shall be considered major when the depth of the cavity prepared for welding exceeds 40 % of the wall thickness or 25 mm, whichever is smaller.

When specified in the product standard, major production welds are subject to prior approval of the purchaser, by agreement in the enquiry or the order.

B.8.2 Weld maps (sketches)

Major production welds shall be documented on drawings or photographs showing the location and extent of the weld. Documentation shall be submitted to the purchaser at the completion of the order.

B.9 Non-destructive tests

B.9.1 Liquid penetrant testing

The castings shall be examined by liquid penetrant testing in order to detect any surface discontinuities. The examination shall be carried out in accordance with ISO 4987. The area(s) to be examined and the levels of acceptance shall be agreed upon between the manufacturer and purchaser.

B.9.2 Magnetic particle testing

The castings shall be examined by magnetic particle testing in order to detect discontinuities on or near to the surface. The examination shall be carried out in accordance with ISO 4986. The area(s) to be examined and the levels of acceptance shall be agreed upon between the manufacturer and purchaser.

B.9.3 Radiographic testing

The castings shall be examined by radiography in order to detect internal discontinuities. The examination shall be carried out in accordance with ISO 4993. The extent of the examination and the levels of acceptance shall be agreed upon between the manufacturer and purchaser.

B.9.4 Ultrasonic testing

The castings shall be examined by ultrasonic testing in order to detect internal discontinuities. The examination shall be in accordance with ISO 4992-1 or ISO 4992-2. The extent of the examination and the levels of acceptance shall be agreed upon between the manufacturer and purchaser.

B.9.5 Visual inspection

The castings shall be examined visually. ISO 11971 may be used to establish typical and acceptable surface requirements. The extent of the examination and the levels of acceptance shall be agreed upon between the manufacturer and the purchaser.

B.9.6 Inspection of weld preparation for production welds

Production welds shall be examined by the non-destructive test method specified in the enquiry and in the order.

Magnetic particle or liquid penetrant testing of surfaces prepared for welding shall be performed to verify removal of discontinuities found unacceptable by the inspection method specified for the casting.

Testing shall be carried out in accordance with the requirements described in B.9.1, B.9.2, B.9.3, and B.9.4, depending upon the testing technique employed. The acceptance criteria shall be agreed upon between the manufacturer and purchaser. Unless otherwise specified, the same acceptance criteria as for the base material in the same area are required.

B.10 Miscellaneous tests

B.10.1 Intergranular corrosion tests

The criteria for acceptance shall be agreed upon between the manufacturer and purchaser at the time of the enquiry and the order.

The test shall be carried out in accordance with the test methods described in ISO 3651-2 or by any other method agreed upon between the manufacturer and purchaser.

B.10.2 Magnetic tests

The specified characteristic is normally magnetic permeability. The choice of test methods and acceptance criteria shall be agreed upon between the manufacturer and purchaser.

B.10.3 Pressure tightness

Castings shall be tested with the specified fluid at the specified pressure and for the time indicated.

The castings submitted to the test shall not be oxidized and shall not receive any coating, covering, or impregnation before the tests.

In the case of pressure vessel castings, reference shall be made to the test conditions indicated in the test standards for these vessels.

The manufacturer is responsible for the satisfactory performance of the castings under the pressure tightness test. It is realised that the foundry might be unable to perform the test prior to shipment or that the purchaser might wish to defer testing until additional work or machining has been performed on the casting.

B.11 Surface treatment

The unmachined or machined castings shall be subjected to a protective treatment.

B.12 Hot isostatic pressing (HIP)

The castings shall be processed by hot isostatic pressing (HIP). 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.

Bibliography

[1] ISO 4948-2, *Steels — Classification — Part 2: Classification of unalloyed and alloy steels according to main quality classes and main property or application characteristics*

[2] ISO 8062-3, *Geometrical product specifications (GPS) — Dimensional and geometrical tolerances for moulded parts — Part 3: General dimensional and geometrical tolerances and machining allowances for castings*

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