
Heat-resistant steels

Aciers réfractaires

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 4955 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 4, *Heat treatable and alloy steels*.

This third edition cancels and replaces the second edition (ISO 4955:1994), which has been technically revised.

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Heat-resistant steels

1 Scope

1.1 This International Standard specifies requirements for the grades of wrought steels, listed in Table 1, which are usually employed for products for which the resistance to the effects of hot gases and the products of combustion at temperatures in the region above 550 °C is the main requirement.

1.2 This International Standard is applicable to

- flat products;
- bars;
- sections;
- wire and rod;
- forgings.

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NOTE 1 Heat-resisting steels for valves are covered by ISO 683-15.

NOTE 2 Corrosion-resistant stainless steels for which resistance to corrosion is of primary importance are covered by ISO 16143-1, ISO 16143-2 and ISO 16143-3.

NOTE 3 Not all of the steels included in this International Standard are necessarily available in all product forms.

NOTE 4 Wire in the cold-worked condition is covered by ISO 16143-3.

1.3 In addition to this International Standard, the general technical delivery requirements of ISO 404 are applicable.

2 Normative references

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

ISO 377:1997 + Cor.1:1997, *Steel and steel products — Location and preparation of samples and test pieces for mechanical testing (including Technical Corrigendum 1:1997)*

ISO 404:1992, *Steel and steel products — General technical delivery requirements*

ISO 4885:1996, *Ferrous products — Heat treatments — Vocabulary*

ISO/TS 4949:2003, *Steel names based on letter symbols*

ISO 6506-1:1999, *Metallic materials — Brinell hardness test — Part 1: Test method*

ISO 6892:1998, *Metallic materials — Tensile testing at ambient temperature*

ISO 4955:2005(E)

ISO 6929:1987, *Steel products — Definitions and classification*

ISO/TR 9769:1991, *Steel and iron — Review of available methods of analysis*

ISO 10474:1991, *Steel and steel products — Inspection documents*

ISO 14284:1996, *Steel and iron — Sampling and preparation of samples for the determination of chemical composition*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 377, ISO 404, ISO 4885, ISO 6929, ISO 14284 and the following apply.

3.1 heat-resisting steels
steels used at above 550 °C (wustite point) due to their excellent resistance to the effects of hot gases and products of combustion, as well as their resistance to the influence of molten salts and molten metals, but also showing good mechanical properties during short- and long-term stressing.

4 Designation

The steel names given in the relevant tables were allocated in accordance with ISO/TS 4949.

5 Information to be supplied by the purchaser

It shall be the responsibility of the purchaser to specify all requirements that are necessary for products under this specification. Such requirements to be considered include, in the order listed, but not limited to, the following:

- the desired quantity;
- the product form;
- the number of the appropriate dimensional standard (see Annex A), the nominal dimensions, plus any choice of requirements;
- the type of material (steel);
- the number of this International Standard (ISO 4955);
- the steel name;
- the desired process route, including surface finish (see 7.2, 7.5 and footnote d to Table 3);
- if an inspection document is required, its designation according to ISO 10474.

EXAMPLE 1 ton of plates according to ISO 9444 with a specified thickness of 5,0 mm, a specified width of 1 200 mm, with trimmed edges (T) and a specified length of 2 500 mm, made of a steel grade with the name X8NiCrAlTi32-21 as specified in ISO 4955, in process route 1U and inspection certificate 3.1B as specified in ISO 10474:

1 t plate ISO 9444 — 5,0 x 1200T x 2500
Steel ISO 4955 — X8NiCrAlTi32-21 + 1U
ISO 10474 - 3.1.B

6 Classification of grades

Heat-resisting steels covered in this International Standard are classified according to their structure into:

- ferritic steels;
- austenitic steels.

7 Requirements

7.1 Manufacturing process

Unless a special steelmaking process is agreed when ordering, the steelmaking process shall be at the discretion of the manufacturer. When he so requests, the purchaser shall be informed what steelmaking process is being used.

7.2 Delivery condition

The products shall be supplied in the delivery condition agreed in the order, by reference to the process route given in Tables 3 and 4 (see also Annex B).

7.3 Chemical composition

7.3.1 The chemical composition requirements given in Table 1 apply with respect to the chemical composition of the cast analysis. (standards.iteh.ai)

7.3.2 The product analysis may deviate from the limiting values for the cast analysis given in Table 1 by the values listed in Table 2.

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7.4 Mechanical properties

The mechanical properties at room temperature, as specified in Tables 5 and 6, apply for the relevant heat-treatment condition. This does not apply to the process route 1U and 3U (hot rolled, not heat treated, not descaled). If, by agreement at the time of ordering, the products are to be supplied in a non-heat-treated condition, the mechanical properties specified in Tables 5 and 6 shall be obtainable from reference test pieces which have received the appropriate heat treatment (simulated heat treatment).

7.5 Surface quality

Availability, and the determination of the types of process route and surface finish most suited to a particular case, should be discussed with the manufacturer.

The general surface appearance, with respect to soundness and surface finish, shall be consistent with good production practice, for the grade and quality ordered, as determined by visual inspection. When products are delivered in coil form, the degree and extent of imperfections may be expected to be higher, due to the impracticability of removing short lengths of coil.

Except for symbols 1G, 3G, 4G, 3P and 4P, minor surface imperfections caused by the manufacturing process are no cause for rejection.

If more exact requirements for the surface quality are necessary, this shall be agreed at the time of enquiry and order.

7.6 Internal soundness

For the internal soundness, where appropriate, requirements together with the conditions for their verification may be agreed at the time of enquiry and order.

7.7 Dimensions and tolerances on dimensions and shape

7.7.1 The dimensions and tolerances on dimensions and shape are to be agreed at the time of enquiry and order, as far as possible with reference to the International Standards for dimensions listed in Annex A. The ordered dimensions shall, where applicable, include the minimum machining allowances.

7.7.2 If none of the International Standards listed in Annex A is applicable, then the dimensions and tolerances should be agreed at the time of enquiry and order on the basis of regional or national standards.

8 Inspection, testing and conformance of products

8.1 General

The manufacturer shall carry out appropriate process control, inspection and testing to assure himself that the delivery complies with the requirements of the order.

This includes the following:

- a suitable frequency of verification of the dimensions of the products;
- an adequate intensity of visual examination of the surface quality of the products;
- an appropriate frequency and type of test to ensure that the correct grade of steel is delivered.

The nature and frequency of these verifications, examinations and tests are determined by the manufacturer, based on the degree of consistency that has been determined by the evidence of his quality system. In view of this, verifications by specific tests for these requirements are not necessary, unless otherwise agreed.

8.2 Inspection procedures and types of inspection documents

8.2.1 For each delivery, the issue of any inspection document according to ISO 10474 may be agreed upon at the time of enquiry and order.

8.2.2 If, in accordance with the agreements made at the time of enquiry and order, a test report is to be provided, this shall cover:

- a) the statement that the material complies with the requirements of the order;
- b) the results of the cast analysis for all elements specified for the type of steel supplied.

8.2.3 If, in accordance with the agreements in the order, an inspection certificate 3.1.A, 3.1.B or 3.1.C or an inspection report 3.2 (see ISO 10474) is to be provided, the specific inspections and tests described in 8.3 shall be carried out and their results shall be certified in the document.

In addition to 8.2.2, the document shall cover

- a) the results of the mandatory tests marked in the second column of Tables 7 and 8 by an "m";
- b) the results of any optional test or inspection agreed when ordering.

8.3 Specific inspection and testing

8.3.1 Extent of testing

The tests to be mandatorily (m) carried out, the composition and size of the test units, and the number of sample products, samples and test pieces to be taken are given in Tables 7 and 8.

8.3.2 Selection and preparation of samples and test pieces

8.3.2.1 The general conditions for selection and preparation of samples and test pieces shall be in accordance with ISO 377 and ISO 14284.

8.3.2.2 The samples for the tensile test shall be taken in accordance with Figures 1 to 3. Samples from flat products shall be taken in such a way that they are located halfway between the centre and a longitudinal edge.

The samples shall be taken from products in the delivery condition. If agreed, the samples may be taken from flat products before flattening, or from bars before straightening.

For samples to be given a simulated heat treatment, the conditions for annealing shall be agreed.

8.3.2.3 Samples for the hardness test, where requested, shall be taken from the same locations as those for the tensile test.

8.4 Test methods iTeh STANDARD PREVIEW

8.4.1 Unless otherwise agreed when ordering, the choice of a suitable physical or chemical method of analysis to determine the product analysis is at the discretion of the manufacturer. In cases of dispute, the analysis shall be carried out by a laboratory approved by the two parties. In these cases, the reference method of analysis shall be agreed, where possible, with reference to ISO/TR 9769.

8.4.2 The tensile test at room temperature shall be carried out in accordance with ISO 6892, taking into account, for flat products, the additional or deviating conditions specified in footnote a of Figure 3.

Unless otherwise agreed, $R_{p0,2}$, R_m and A shall be determined. For austenitic steels, $R_{p1,0}$ may be reported instead of $R_{p0,2}$, if agreed between purchaser and manufacturer.

8.4.3 The Brinell hardness test shall be carried out in accordance with ISO 6506-1.

8.4.4 Dimensions and dimensional tolerances of the products shall be tested in accordance with the requirements of the relevant International Standards for dimensions given in Annex A.

8.5 Retest

See ISO 404.

9 Marking

The products shall be marked with the manufacturer's symbol, the steel grade, and, if so agreed when ordering, with the cast number. When specific inspection is carried out, the products shall be provided additionally with an identification number, which enables the test pieces to be related to the cast and product from which they stem.

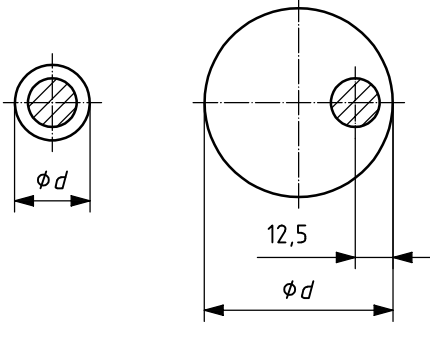
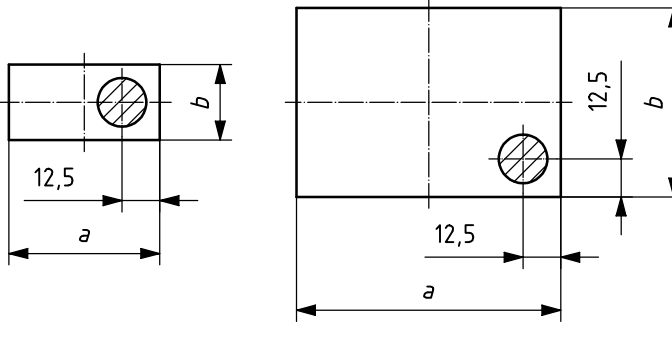
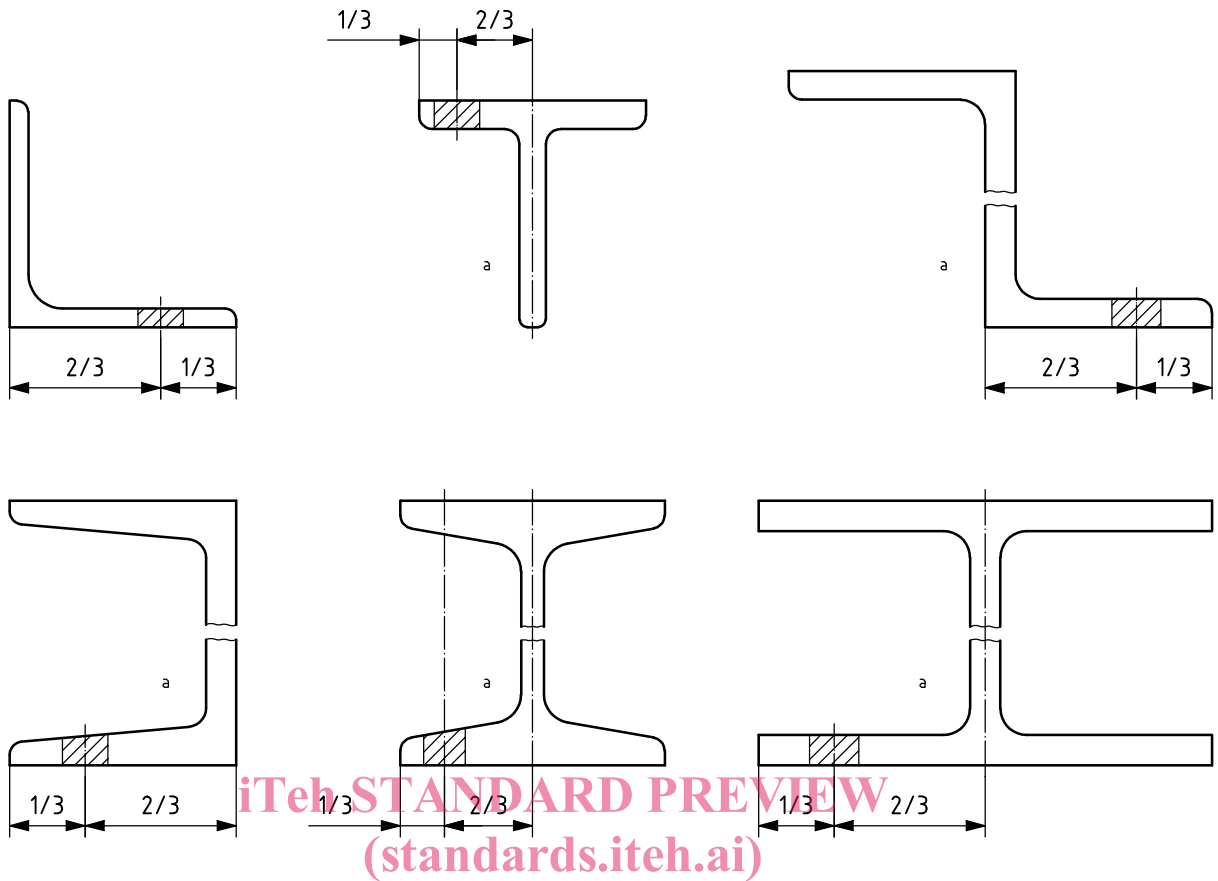
Type of test	Round cross-section products mm	Rectangular cross-section products mm
Tensile	 <p>$d \leq 25^a$ $25 < d \leq 160$</p>	 <p>$b \leq 25$ $25 < b \leq 160$ $a \geq b$ $a \geq b$</p>
	<p>^a Samples of product may alternatively be tested unmachined.</p>	

Figure 1 — Location of test pieces for steel bars, rods and wire of diameter or thickness ≤ 160 mm (longitudinal test pieces)

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a By agreement, the sample can be taken from the web, at a quarter of the total height.

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Figure 2 — Location of test pieces for beams, channels, angles, T-sections and Z-sections