INTERNATIONAL STANDARD

**ISO 16143-2**

Second edition
2014-05-15

# Stainless steels for general purposes —

## Part 2: Corrosion-resistant semi-finished products, bars, rods and sections

*Aciers inoxydables pour usage général —*

*Partie 2: Demi-produits, barres, fils machine et profils en acier résistant à la corrosion*

Reference number
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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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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 4, *Heat treatable and alloy steels*.

This second edition cancels and replaces the first edition (ISO 16143-2:2004), which has been technically revised.

ISO 16143 consists of the following parts, under the general title *Stainless steels for general purposes*:

— *Part 1: Corrosion-resistant flat products*

— *Part 2: Corrosion-resistant semi-finished products, bars, rods and sections*

— *Part 3: Wire*

# Stainless steels for general purposes —

# Part 2:
# Corrosion-resistant semi-finished products, bars, rods and sections

## 1 Scope

This part of ISO 16143 specifies the technical delivery conditions for semi-finished products, hot formed bars, rods, and sections for general purposes made of the most important corrosion-resistant stainless steel grades.

NOTE 1 Throughout this part of ISO 16143, the term "general purposes" means purposes other than the special purposes mentioned in the Bibliography.

NOTE 2 Heat-resistant steel grades can be found in ISO 4955 and they can be used for corrosion-resistant purposes.

In addition to this part of ISO 16143, the general technical delivery requirements of ISO 404 are applicable.

This part of ISO 16143 does not apply to components manufactured by further processing the product forms listed in the first paragraph above with quality characteristics altered as a result of such further processing.

## 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 377, *Steel and steel products — Location and preparation of samples and test pieces for mechanical testing*

ISO 404, *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 6506-1, *Metallic materials — Brinell hardness test — Part 1: Test method*

ISO 6892-1:2009, *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, *Steel products — Vocabulary*

ISO 9443, *Heat-treatable and alloy steels — Surface quality classes for hot-rolled round bars and wire rods — Technical delivery conditions*

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

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

ISO 15510, *Stainless steels — Chemical composition*

ISO 20723, *Structural steels — Surface condition of hot-rolled sections — Delivery requirements*

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

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

## 3 Terms and definitions

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

**3.1**
**corrosion-resistant stainless steel**
steel with at least 10,5 % (mass fraction) Cr and a maximum of 1,2 % (mass fraction) C for which resistance to corrosion is of primary importance

**3.2**
**product form**
shape of a product

Note 1 to entry: See ISO 6929 for different forms of products.

## 4 Designation

For the steel grades covered by this part of ISO 16143, the steel names as given in the tables are allocated in accordance with ISO/TS 4949.

For the steel grades covered by this part of ISO 16143, the steel numbers as given in the tables are allocated in accordance with ISO 15510.

## 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 part of ISO 16143. Such requirements to be considered include, in the order listed but not limited to, the following:

a) the desired quantity;

b) the product form (e.g. square bar or round rod);

c) the number of the appropriate dimensional standard (see Annex C), the nominal dimensions, plus any choice of requirements;

d) the type of material (steel);

e) the number of this part of ISO 16143 (i.e. ISO 16143-2);

f) the steel name or steel number;

g) if, for the relevant steel in Tables 5 to 9 for the mechanical properties, more than one treatment condition is covered, the symbol for the desired heat treatment;

h) the desired process route (see symbols in Table 4);

i) if a verification of internal soundness is required, the requirements have to be agreed at the time of enquiry and order;

j) any further optional test agreed between the manufacturer and purchaser at the time of enquiry and order [see 8.2.3 b)];

k) the type of inspection document and its designation in accordance with ISO 10474 (see 8.2.1).

EXAMPLE 10 t round bar in accordance with ISO 1035-1 and ISO 1035-4 of 50 mm diameter made of a steel grade with name X5CrNi18-10 and number 4301-304-00-I as specified in ISO 16143-2 in process route 1D, inspection certificate 3.1 as specified in ISO 10474, is designated as follows:

**10 t round bar ISO 1035-1 and -4 – 50**
**Steel ISO 16143-2 – X5CrNi18-10 + 1D**
**ISO 10474 – 3.1**

or

**10 t round bar ISO 1035-1 and -4 – 50**
**Steel ISO 16143-2 – 4301-304-00-I + 1D**
**ISO 10474 – 3.1**

## 6 Classification of grades

Corrosion-resistant stainless steels covered by this part of ISO 16143 are classified according to their structure into

— austenitic steels,

— austenitic-ferritic steels,

— ferritic steels,

— martensitic steels, or

— precipitation-hardening steels.

## 7 Requirements

### 7.1 Manufacturing process

Unless a special steelmaking process is agreed upon 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 Table 4 and, where different alternatives exist, to the treatment conditions given in Tables 5 to 9 (see also Annex A).

### 7.3 Chemical composition

**7.3.1** The chemical composition requirements given in Table 2 apply with respect to the chemical composition of the cast analysis.

**7.3.2** The product analysis can deviate from the limiting values for the cast analysis given in Table 2 by the values listed in Table 3.

## 7.4 Susceptibility to intergranular corrosion

Referring to resistance to intergranular corrosion as defined in ISO 3651-2, for austenitic, austenitic-ferritic, and ferritic steels, the specifications in Tables 5, 6, and 7 apply.

The susceptibility of stainless steels to intergranular corrosion is dependent on the type of environment and therefore cannot always be clearly ascertained through standard laboratory tests. The selection of the test or tests to be agreed upon should be based on experience with the use of the selected grade of steel in the intended environment.

## 7.5 Mechanical properties

The mechanical properties at room temperature as specified in Tables 5 to 9 apply for the relevant specified heat-treatment condition. This does not apply to process route 1U (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 to 9 shall be obtainable from reference test pieces that have received the appropriate heat treatment (simulated heat treatment).

The values in Tables 10 to 14 apply for the 0,2 %- and 1 %-proof strength at elevated temperatures.

NOTE Austenitic steels are insensitive to brittle fracture in the solution-annealed condition. Because they do not have a pronounced transition temperature, which is characteristic of other steels, they are also useful for application at cryogenic temperatures.

## 7.6 Surface quality

The available surface finishes are given in Table 4. Slight surface imperfections, inherent to the production process, are permitted. Exact requirements concerning the maximum depth of acceptable discontinuities for bars, rods, and sections in the relevant conditions are given in Table 1.

**Table 1 — Maximum depth of acceptable discontinuities for bars, rods, and sections**

| Conditions | Product forms | Permissible depth of discontinuities[a] | Max. % of delivered weight in excess of permissible depth of discontinuities |
|---|---|---|---|
| 1U, 1C, 1E, 1D | Sections | To be agreed upon at the time of enquiry and order on the basis of ISO 20723. | |
| 1U, 1C, 1E, 1D | Rounds and rod | Unless not specified otherwise at the time of enquiry and order, ISO 9443 class 1 za2. | |
| 1X[b] | Rounds | — max. 0,2 mm for $d \leq 20$ mm<br>— max. 0,01 $d$ for 20 mm < $d \leq 75$ mm<br>— max. 0,75 mm for $d > 75$ mm | 1 % |
| | Hexagons | — max. 0,3 mm for $d \leq 15$ mm<br>— max. 0,02 $d$ for 15 mm < $d \leq 63$ mm | 2 % |
| | Other bars | — max. 0,3 mm for $d \leq 15$ mm<br>— max. 0,02 $d$ for 15 mm < $d \leq 63$ mm | 4 % |
| 1G | Rounds | Technically defect free by manufacture. | 0,2 % |

[a] Depth of discontinuities is understood as being the distance, measured normally to the surface, between the bottom of the discontinuities and that surface.

[b] At the time of enquiry and order, it can be agreed that the product shall be delivered with a surface that is technically defect free by manufacture. In this case, also the maximum % of delivered weight in excess of permissible depth of discontinuities shall be agreed.

For further information, see Table 4.

### 7.7 Internal soundness

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

### 7.8 Dimensions, tolerances on dimensions, and shape

The dimensions and the tolerances on dimensions and shape are to be agreed upon at the time of enquiry and order, as far as possible with reference to the dimensional standards listed in Annex C.

## 8 Inspection, testing, and conformance of products

### 8.1 General

The manufacturer shall carry out appropriate process control, inspection, and testing to ensure 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 upon.

### 8.2 Inspection and testing procedures and types of inspection documents

**8.2.1** Products complying with this part of ISO 16143 shall be ordered and delivered with one of the inspection documents as specified in ISO 10474. The type of document shall be agreed upon at the time of enquiry and order. If the order does not contain any specification of this type, a test report 2.2 shall be issued.

**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) a statement that the material complies with the requirements of the order and

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 or 3.2 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 Table 15 by an "m" and

b) the results of any optional test or inspections agreed upon when ordering marked in the second column of Table 15 by an "o".

## 8.3 Specific inspection and testing

### 8.3.1 Extent of testing

The tests to be carried out, either mandatorily (m) or by agreement (o), and the composition and size of the test units, and the number of sample products, samples, and test pieces to be taken are given in Table 15.

### 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.

The samples shall be taken from products in the as-delivered condition. If agreed, samples from bars can be taken before straightening. For martensitic and precipitation-hardened grades being delivered in the annealed condition, a test to demonstrate the capability of further treatment to one of the specified conditions shall be conducted by the manufacturer on a sample taken from the product in the as-delivered condition and further treated in accordance with a listed production route. Unless specified in the order, that final condition and details of conditions of further treatment shall be at the option of the manufacturer.

**8.3.2.3** Samples for the hardness test and for the resistance to intergranular corrosion test, where requested, shall be taken from the same locations as those for the mechanical tests.

## 8.4 Test methods

**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 upon, where possible, with reference to ISO/TR 9769.

**8.4.2** The tensile test shall be carried out in accordance with ISO 6892-1 and it shall be performed under controlled conditions in accordance with Clause 5 of ISO 6892-1:2009.

Unless otherwise agreed, the tensile strength and elongation after fracture shall be determined and, in addition, for ferritic, martensitic, precipitation-hardening, austenitic free-cutting, and austenitic-ferritic steels, the 0,2 %-proof strength, and for austenitic steels, the 0,2 %- and 1 %-proof strength.

For bars made of resulfurized grades, it can be agreed upon to determine the hardness instead.

If a tensile test at elevated temperature has been ordered, this shall be carried out in accordance with ISO 6892-2. If the proof strength is to be verified, the 0,2 %-proof strength shall be determined, for ferritic, martensitic, precipitation-hardening, and austenitic-ferritic steels. In the case of austenitic steels, the 0,2 %- and the 1 %-proof strength shall be determined.

**8.4.3** If an impact test has been ordered, it shall be carried out in accordance with ISO 148-1 on test pieces with a V-notch and a 2 mm hammer. The average obtained from three test pieces is considered to be the test result (see also ISO 404).

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

**8.4.5** The resistance to intergranular corrosion shall be tested in accordance with ISO 3651-2, unless otherwise agreed.

**8.4.6** Dimensions and dimensional tolerances of the products shall be tested in accordance with the requirements of the relevant dimensional standards given in Annex C.

### 8.5 Retests

See ISO 404.

## 9 Marking

**9.1** The products shall be marked with the manufacturer's trademark or symbol and the steel name or number. The product shall also be marked with the cast number, thickness, or dimension, as well as an identification number related to an appropriate inspection certificate.

**9.2** Unless otherwise agreed, the method of marking and the material of marking shall be at the option of the manufacturer. Its quality shall be such that it shall be durable for at least one year, can withstand normal handling, and can be stored in unheated storage under cover. The corrosion resistance of the product shall not be impaired by the marking.

**9.3** Each unit shall be marked:

— for semi-finished products, bars, and sections, by means of labels attached to the bundle or, by agreement at the time of enquiry and order, by inking, adhesive labels, electrolytic etching, or stamping;

— for rods, by means of a label attached to the coil.

## Table 2 — Chemical composition (cast analysis)

| Steel designation | | % (mass fraction)[a] | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | ISO number | C | Si | Mn | P | S | Cr | Mo | Ni | N | Others |
| **Austenitic steels** | | | | | | | | | | | |
| X10CrNi18-8 | 4310-301-00-I | 0,05 to 0,15 | 2,00 | 2,00 | 0,045 | 0,030 | 16,0 to 19,0 | 0,80 | 6,0 to 9,5 | 0,10 | — |
| X2CrNi18-9 | 4307-304-03-I | 0,030 | 1,00 | 2,00 | 0,045 | 0,030 | 17,5 to 19,5 | — | 8,0 to 10,0[b] | 0,10 | — |
| X10CrNiS18-9 | 4305-303-00-I | 0,12 | 1,00 | 2,00 | 0,060 | ≥0,15 | 17,0 to 19,0 | — | 8,0 to 10,0 | 0,10 | Cu:[c] |
| X2CrNiN18-9 | 4311-304-53-I | 0,030 | 1,00 | 2,00 | 0,045 | 0,030 | 17,5 to 19,5 | — | 8,0 to 10,0 | 0,12 to 0,22 | — |
| X3CrNiCu18-9-4 | 4567-304-30-I | 0,04 | 1,00 | 2,00 | 0,045 | 0,030 | 17,0 to 19,0 | — | 8,0 to 10,5 | 0,10 | Cu: 3,0 to 4,0 |
| X6CrNiCuS18-9-2 | 4570-303-31-I | 0,08 | 1,00 | 2,00 | 0,045 | ≥0,15 | 17,0 to 19,0 | 0,60 | 8,0 to 10,0 | 0,10 | Cu: 1,40 to 1,80 |
| X5CrNiN19-9 | 4315-304-51-I | 0,08 | 1,00 | 2,50 | 0,045 | 0,030 | 18,0 to 20,0 | — | 7,0 to 10,5 | 0,10 to 0,30 | —[d] |
| X5CrNi18-10 | 4301-304-00-I | 0,07 | 1,00 | 2,00 | 0,045 | 0,030 | 17,5 to 19,5 | — | 8,0 to 10,5[b] | 0,10 | — |
| X6CrNiTi18-10 | 4541-321-00-I | 0,08 | 1,00 | 2,00 | 0,045 | 0,030 | 17,0 to 19,0 | — | 9,0 to 12,0[b] | — | Ti: 5 × C to 0,70 |
| X6CrNiNb18-10 | 4550-347-00-I | 0,08 | 1,00 | 2,00 | 0,045 | 0,030 | 17,0 to 19,0 | — | 9,0 to 12,0[b] | — | Nb: 10 × C to 1,00 |
| X2CrNi19-11 | 4306-304-03-I | 0,030 | 1,00 | 2,00 | 0,045 | 0,030 | 18,0 to 20,0 | — | 10,0 to 12,0[b] | 0,10 | — |
| X6CrNi18-12 | 4303-305-00-I | 0,08 | 1,00 | 2,00 | 0,045 | 0,030 | 17,0 to 19,0 | — | 10,5 to 13,0 | 0,10 | — |

Table 2 — *(continued)*

| Steel designation | | % (mass fraction)[a] | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | ISO number | C | Si | Mn | P | S | Cr | Mo | Ni | N | Others |
| X8CrMnCuN17-8-3 | 4597-204-76-I | 0,10 | 2,00 | 6,5 to 9,0 | 0,040 | 0,030 | 15,0 to 18,0 | 1,00 | 3,00 | 0,10 to 0,30 | Cu: 2,00 to 3,5 |
| X3CrMnNiCu15-8-5-3[g] | 4615-201-75-E[g] | 0,030 | 1,00 | 7,0 to 9,0 | 0,040 | 0,010 | 14,0 to 16,0 | 0,80 | 4,5 to 6,0 | 0,02 to 0,06 | Cu: 2,0 to 4,0 |
| X12CrMnNiN18-9-5 | 4373-202-00-I | 0,15 | 1,00 | 7,5 to 10,0 | 0,060 | 0,030 | 17,5 to 19,0 | — | 4,0 to 6,0 | 0,15 to 0,30 | — |
| X11CrNiMnN19-8-6 | 4369-202-91-I | 0,07 to 0,15 | 0,50 to 1,00 | 5,0 to 7,5 | 0,030 | 0,015 | 17,5 to 19,5 | — | 6,5 to 8,5 | 0,20 to 0,30 | — |
| X1CrNi25-21 | 4335-310-02-I | 0,020 | 0,25 | 2,00 | 0,025 | 0,010 | 24,0 to 26,0 | 0,20 | 20,0 to 22,0 | 0,10 | — |
| **Austenitic steels with Mo** | | | | | | | | | | | |
| X2CrNiMo17-12-2 | 4404-316-03-I | 0,030 | 1,00 | 2,00 | 0,045 | 0,030 | 16,5 to 18,5 | 2,00 to 3,00 | 10,0 to 13,0[b] | 0,10 | — |
| X5CrNiMo17-12-2 | 4401-316-00-I | 0,07 | 1,00 | 2,00 | 0,045 | 0,030 | 16,5 to 18,5 | 2,00 to 3,00 | 10,0 to 13,0[b] | 0,10 | — |
| X6CrNiMoTi17-12-2 | 4571-316-35-I | 0,08 | 1,00 | 2,00 | 0,045 | 0,030 | 16,5 to 18,5 | 2,00 to 2,50 | 10,5 to 13,5[b] | — | Ti: 5 × C to 0,70 |
| X2CrNiMo17-12-3 | 4432-316-03-I | 0,030 | 1,00 | 2,00 | 0,045 | 0,030 | 16,5 to 18,5 | 2,50 to 3,00 | 10,5 to 13,0[b] | 0,10 | — |
| X3CrNiMo17-12-3 | 4436-316-00-I | 0,05 | 1,00 | 2,00 | 0,045 | 0,030 | 16,5 to 18,5 | 2,50 to 3,00 | 10,5 to 13,0[b] | 0,10 | — |
| X2CrNiMoN17-12-3 | 4429-316-53-I | 0,030 | 1,00 | 2,00 | 0,045 | 0,030 | 16,5 to 18,5 | 2,50 to 3,00 | 10,5 to 13,0[b] | 0,12 to 0,22 | — |
| X2CrNiMo18-14-3 | 4435-316-91-I | 0,030 | 1,00 | 2,00 | 0,045 | 0,015 | 17,0 to 19,0 | 2,50 to 3,00 | 12,5 to 15,0 | 0,10 | — |
| X2CrNiMoN18-12-4 | 4434-317-53-I | 0,030 | 1,00 | 2,00 | 0,045 | 0,030 | 16,5 to 19,5 | 3,0 to 4,0 | 10,5 to 14,0[b] | 0,10 to 0,20 | — |
| X2CrNiMoN17-13-5 | 4439-317-26-E | 0,030 | 1,00 | 2,00 | 0,045 | 0,015 | 16,5 to 18,5 | 4,0 to 5,0 | 12,5 to 14,5 | 0,12 to 0,22 | — |
| X1CrNiMoCuN20-18-7 | 4547-312-54-I | 0,020 | 0,70 | 1,00 | 0,035 | 0,015 | 19,5 to 20,5 | 6,0 to 7,0 | 17,5 to 18,5 | 0,18 to 0,25 | Cu: 0,50 to 1,00 |

Table 2 — (*continued*)

| Steel designation | | % (mass fraction)[a] | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | ISO number | C | Si | Mn | P | S | Cr | Mo | Ni | N | Others |
| X1CrNiMoN25-22-2 | 4466-310-50-E | 0,020 | 0,70 | 2,00 | 0,025 | 0,010 | 24,0 to 26,0 | 2,00 to 2,50 | 21,0 to 23,0 | 0,10 to 0,16 | — |
| X1CrNiMoCuNW24-22-6 | 4659-312-66-I | 0,020 | 0,70 | 2,0 to 4,0 | 0,030 | 0,010 | 23,0 to 25,0 | 5,5 to 6,5 | 21,0 to 23,0 | 0,35 to 0,50 | Cu: 1,00 to 2,00<br>W: 1,50 to 2,50 |
| X1CrNiMoCuN24-22-8 | 4652-326-54-I | 0,020 | 0,50 | 2,0 to 4,0 | 0,030 | 0,005 | 23,0 to 25,0 | 7,0 to 8,0 | 21,0 to 23,0 | 0,45 to 0,55 | Cu: 0,30 to 0,60 |
| X2CrNiMnMoN25-18-6-5 | 4565-345-65-I | 0,030 | 1,00 | 5,0 to 7,0 | 0,030 | 0,015 | 24,0 to 26,0 | 4,0 to 5,0 | 16,0 to 19,0 | 0,30 to 0,60 | Nb: 0,15 |
| **Austenitic steels with Ni/Co as main alloying elements** | | | | | | | | | | | |
| X1NiCrMoCu25-20-5 | 4539-089-04-I | 0,020 | 0,75 | 2,00 | 0,035 | 0,015 | 19,0 to 22,0 | 4,0 to 5,0 | 23,5 to 26,0 | 0,15 | Cu: 1,20 to 2,00 |
| X1NiCrMoCuN25-20-7 | 4529-089-26-I | 0,020 | 0,75 | 2,00 | 0,035 | 0,015 | 19,0 to 21,0 | 6,0 to 7,0 | 24,0 to 26,0 | 0,15 to 0,25 | Cu: 0,50 to 1,50 |
| X1NiCrMoCu31-27-4 | 4563-080-28-I | 0,020 | 0,70 | 2,00 | 0,030 | 0,010 | 26,0 to 28,0 | 3,0 to 4,0 | 30,0 to 32,0 | 0,10 | Cu: 0,70 to 1,50 |
| **Austenic-ferritic steels** | | | | | | | | | | | |
| X2CrNiN22-2ᵴ | 4062-322-02-Uᵴ | 0,030 | 1,00 | 2,00 | 0,040 | 0,010 | 21,5 to 24,0 | 0,45 | 1,00 to 2,90 | 0,16 to 0,28 | — |
| X2CrMnNiN21-5-1ᵴ | 4162-321-01-Eᵴ | 0,040 | 1,00 | 4,0 to 6,0 | 0,040 | 0,015 | 21,0 to 22,0 | 0,10 to 0,80 | 1,35 to 1,90 | 0,20 to 0,25 | Cu: 0,10 to 0,80 |
| X2CrNiN23-4 | 4362-323-04-I | 0,030 | 1,00 | 2,00 | 0,035 | 0,015 | 22,0 to 24,5 | 0,10 to 0,60 | 3,5 to 5,5 | 0,05 to 0,20 | Cu: 0,10 to 0,60 |
| X2CrNiMoN22-5-3ᵴ | 4462-318-03-Iᵴ | 0,030 | 1,00 | 2,00 | 0,035 | 0,015 | 21,0 to 23,0 | 2,5 to 3,5 | 4,5 to 6,5 | 0,10 to 0,22 | — |
| X2CrNiMnMoCuN24-4-3-2ᵴ | 4662-824-41-Xᵴ | 0,030 | 0,70 | 2,50 to 4,0 | 0,035 | 0,005 | 23,0 to 25,0 | 1,00 to 2,00 | 3,0 to 4,5 | 0,20 to 0,30 | Cu: 0,10 to 0,80 |
| X3CrNiMoN27-5-2 | 4460-312-00-I | 0,050 | 1,00 | 2,00 | 0,035 | 0,015 | 25,0 to 28,0 | 1,30 to 2,00 | 4,5 to 6,5 | 0,05 to 0,20 | — |
| X2CrNiMoCuN25-6-3 | 4507-325-20-I | 0,030 | 0,70 | 2,00 | 0,035 | 0,015 | 24,0 to 26,0 | 2,5 to 4,0 | 5,0 to 7,5 | 0,15 to 0,30 | Cu: 1,00 to 2,50 |
| X2CrNiMoN25-7-4 | 4410-327-50-E | 0,030 | 1,00 | 2,00 | 0,035 | 0,015 | 24,0 to 26,0 | 3,0 to 4,5 | 6,0 to 8,0 | 0,24 to 0,35 | — |
| X2CrNiMoCuWN25-7-4 | 4501-327-60-I | 0,030 | 1,00 | 1,00 | 0,035 | 0,015 | 24,0 to 26,0 | 3,0 to 4,0 | 6,0 to 8,0 | 0,20 to 0,30 | Cu: 0,50 to 1,00<br>W: 0,50 to 1,00 |
| X2CrNiMoCoN28-8-5-1ᵴ | 4658-327-07-Uᵴ | 0,030 | 0,50 | 1,50 | 0,035 | 0,010 | 26,0 to 29,0 | 4,0 to 5,0 | 5,5 to 9,5 | 0,30 to 0,50 | Cu: 1,00<br>Co: 0,50 to 2,00 |

**Table 2 — (*continued*)**

| Steel designation | | % (mass fraction)[a] | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Name** | **ISO number** | **C** | **Si** | **Mn** | **P** | **S** | **Cr** | **Mo** | **Ni** | **N** | **Others** |
| **Ferritic steels** | | | | | | | | | | | |
| X6Cr13 | 4000-410-08-I | 0,08[e] | 1,00 | 1,00 | 0,040 | 0,030[b] | 11,5 to 14,0 | — | 0,75 | — | — |
| X6Cr17 | 4016-430-00-I | 0,08[e] | 1,00 | 1,00 | 0,040 | 0,030 | 16,0 to 18,0 | — | — | — | — |
| X7CrS17 | 4004-430-20-I | 0,09 | 1,50 | 1,50 | 0,040 | ≥0,15 | 16,0 to 18,0 | 0,60 | — | — | — |
| X3CrNb17 | 4511-430-71-I | 0,05 | 1,00 | 1,00 | 0,040 | 0,015 | 16,0 to 18,0 | — | — | — | Nb: 12 × C to 1,00 |
| X2CrTiNb18 | 4509-439-40-X | 0,030 | 1,00 | 1,00 | 0,040 | 0,015 | 17,5 to 18,5 | — | — | — | Ti: 0,10 to 0,60<br>Nb: 0,30 + 3 × C to 1,00 |
| X6CrMo17-1 | 4113-434-00-I | 0,08 | 1,00 | 1,00 | 0,040 | 0,030 | 16,0 to 18,0 | 0,90 to 1,40 | — | — | — |
| X2CrMoTiS18-2 | 4523-182-35-I | 0,030 | 1,00 | 0,50 | 0,040 | ≥0,15 | 17,5 to 19,0 | 2,00 to 2,50 | — | — | Ti: 0,30 to 0,80<br>(C + N): 0,040 |
| **Martensitic steels** | | | | | | | | | | | |
| X12Cr13 | 4006-410-00-I | 0,08 to 0,15 | 1,00 | 1,50 | 0,040 | 0,030 | 11,5 to 13,5 | — | 0,75 | — | — |
| X12CrS13 | 4005-416-00-I | 0,08 to 0,15 | 1,00 | 1,50 | 0,040 | ≥0,15 | 12,0 to 14,0 | 0,60 | — | — | — |
| X20Cr13 | 4021-420-00-I | 0,16 to 0,25 | 1,00 | 1,50 | 0,040 | 0,030 | 12,0 to 14,0 | — | — | — | — |
| X30Cr13 | 4028-420-00-I | 0,26 to 0,35 | 1,00 | 1,50 | 0,040 | 0,030 | 12,0 to 14,0 | — | — | — | — |
| X17CrNi16-2 | 4057-431-00-X | 0,12 to 0,22 | 1,00 | 1,50 | 0,040 | 0,030 | 15,0 to 17,0 | — | 1,50 to 2,50 | — | — |
| X14CrS17 | 4019-430-20-I | 0,10 to 0,17 | 1,00 | 1,50 | 0,040 | ≥0,15 | 16,0 to 18,0 | 0,60 | — | — | — |
| X110Cr17 | 4023-440-04-I | 0,95 to 1,20 | 1,00 | 1,00 | 0,040 | 0,030 | 16,0 to 18,0 | 0,75 | 0,60 | — | — |
| X50CrMoV15 | 4116-420-77-E | 0,45 to 0,55 | 1,00 | 1,00 | 0,040 | 0,015 | 14,0 to 15,0 | 0,50 to 0,80 | — | — | V: 0,10 to 0,20 |
| X3CrNiMo13-4 | 4313-415-00-I | 0,05 | 0,70 | 0,50 to 1,00 | 0,040 | 0,015 | 12,0 to 14,0 | 0,30 to 1,00 | 3,5 to 4,5 | — | — |
| X4CrNiMo16-5-1 | 4418-431-77-E | 0,06 | 0,70 | 1,50 | 0,040 | 0,015 | 15,0 to 17,0 | 0,80 to 1,50 | 4,0 to 6,0 | ≥0,020 | — |
| X39CrMo17-1 | 4122-434-09-I | 0,33 to 0,45 | 1,00 | 1,50 | 0,040 | 0,015 | 15,5 to 17,5 | 0,80 to 1,30 | 1,00 | — | — |

Table 2 — (*continued*)

| Steel designation | | % (mass fraction)[a] | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | ISO number | C | Si | Mn | P | S | Cr | Mo | Ni | N | Others |
| **Precipitation-hardening steels** | | | | | | | | | | | |
| X5CrNiCuNb16-4 | 4542-174-00-I | 0,07 | 0,70 | 1,50 | 0,040 | 0,030 | 15,0 to 17,0 | 0,60 | 3,0 to 5,0 | — | Cu: 3,0 to 5,0<br>Nb: 5 × C to 0,45 |
| X7CrNiAl17-7 | 4568-177-00-I | 0,09 | 0,70 | 1,00 | 0,040 | 0,015 | 16,0 to 18,0 | — | 6,5 to 7,8[f] | — | Al: 0,70 to 1,50 |

NOTE Elements not listed in this table cannot be intentionally added to the steel without the agreement of the purchaser, except for finishing the cast. All appropriate precautions shall be taken to avoid the addition of such elements from scrap and other materials used in production, which would impair mechanical properties and the suitability of the steel.

a Maximum values unless indicated otherwise.

b Where, for special reasons (e.g. hot workability or low magnetic permeability), it is necessary to minimize the ferrite content, the maximum nickel mass fraction can be increased by the following amounts:

— by 0,50 % for steels X2CrNi18-9, X5CrNi18-10, and X6CrNiMoTi17-12-2;

— by 1,00 % for steels X6CrNiTi18-10, X6CrNiNb18-10, X2CrNi19-11, X5CrNiMo17-12-2, X3CrNiMo17-12-3, X2CrNiMoN17-12-3, and X2CrNiMoN18-12-4;

— by 1,50 % for steels X2CrNiMo17-12-2 and X2CrNiMo17-12-3.

c Copper can be added up to 1 %. If added, it shall be reported in the inspection document, provided such a document has been ordered.

d Nb can be added up to 0,15 %.

e For certain applications, e.g. weldability or high strength wire, a maximum of 0,12 % C can be agreed upon.

f By special agreement, the steel, when intended for cold deformation, can also be ordered with 7,0 % to 8,3 % Ni.

g Patented steel grade.

**Table 3 — Permissible deviations between the product analysis and the limiting values given in Table 2 for the cast analysis**

| Element | Specified limits, cast analysis % (mass fraction) | | Permissible deviation[a] % (mass fraction) |
|---|---|---|---|
| Carbon | | ≤0,030 | +0,005 |
| | >0,030 | ≤0,20 | ±0,01 |
| | >0,20 | ≤0,60 | ±0,02 |
| | >0,60 | ≤1,20 | ±0,03 |
| Silicon | | ≤1,00 | +0,05 |
| | >1,00 | ≤3,00 | ±0,10 |
| | >3,00 | ≤6,00 | ±0,15 |
| Manganese | | ≤1,00 | +0,03 |
| | >1,00 | ≤2,00 | ±0,04 |
| | >2,00 | ≤15,0 | ±0,10 |
| Phosphorus | | ≤0,045 | +0,005 |
| | >0,045 | 0,070 | ±0,010 |
| Sulfur | | ≤0,015 | +0,003 |
| | >0,015 | ≤0,030 | ±0,005 |
| | ≥0,10 | ≤0,50 | ±0,02 |
| Chromium | ≥10,5 | ≤15,0 | ±0,15 |
| | >15,0 | ≤20,0 | ±0,20 |
| | >20,0 | ≤35,0 | ±0,25 |
| Molybdenum | | ≤0,60 | +0,03 |
| | >0,60 | ≤1,75 | ±0,05 |
| | >1,75 | ≤8,0 | ±0,10 |
| Nickel | | ≤1,00 | +0,03 |
| | >1,00 | ≤5,0 | ±0,07 |
| | >5,0 | ≤10,0 | ±0,10 |
| | >10,0 | ≤20,0 | ±0,15 |
| | >20,0 | ≤38,0 | ±0,20 |
| Nitrogen | | ≤0,10 | +0,01 |
| | ≥0,10 | ≤0,60 | ±0,02 |
| Aluminium | ≥0,05 | ≤0,30 | ±0,05 |
| | >0,30 | ≤1,50 | ±0,10 |
| Boron | | ≤0,010 | +0,000 5 |
| Copper | | ≤1,00 | +0,04 |
| | >1,00 | ≤5,0 | ±0,10 |
| Niobium | | ≤1,00 | +0,05 |
| Titanium | | ≤1,00 | +0,05 |
| | >1,00 | ≤3,0 | ±0,07 |
| Tungsten | | ≤3,00 | +0,05 |
| Vanadium | | ≤0,50 | +0,03 |

[a] ± means that in one cast, the deviation can occur over the upper value or under the lower value of the specified range in Table 2, but not both at the same time.

## Table 4 — Types of process routes and surface finish of long products[a]

| Condition | Abbreviation[b] | Type of process route | Surface finish | Product form | | | Notes |
|---|---|---|---|---|---|---|---|
| | | | | Rods | Bars, sections | Semi finished | |
| Hot formed | 1U | Hot formed, not heat treated, not descaled | Covered with scale (spot ground if necessary) | X | X | X | Suitable for products to be further hot formed. For semi-finished products, ground on all sides can be specified. |
| | 1C | Hot formed, heat treated[c], not descaled | Covered with scale (spot ground if necessary) | X | X | X | Suitable for products to be further processed. For semi-finished products, ground on all sides can be specified. |
| | 1E | Hot formed, heat treated[c], mechanically descaled | Largely free of scale (but some black spots might remain) | X | X | X | The type of mechanical descaling, e.g. grinding, peeling, or shot blasting, is left to the manufacturer's discretion unless otherwise agreed. Suitable for products to be further processed. |
| | 1D | Hot formed, heat treated[c], pickled | Free of scale | X | X | — | Tolerance ≥ IT 14[de] |
| | 1X | Hot formed, heat treated[c], rough machined (rough turned) | Metallically clean | — | X | — | Tolerance ≥ IT 12[de] |
| Special finishing process | 1G | Centreless ground | Uniform finish; type and degree of grinding to be agreed | — | X | — | Surface roughness can be specified. Finish for close ISO tolerances. Normally obtained from material in finishes 1E, 1D, 2H, or 2B.<br>Tolerance ≤ IT 8[de] |
| | 1P | Polished | Smoother and brighter than finish 1G or 2G; type and degree of polishing to be agreed | — | X | — | Surface roughness can be specified. Finish for close ISO tolerances. Normally obtained from material in finishes 1E, 1D, 2B, 1G, or 2H.<br>Tolerance ≤ IT 11[de] |

[a] Not all process routes and surface finishes are available for all steels.

[b] First digit: 1 = hot formed, 2 = cold processed.

[c] On ferritic, austenitic, and austenitic-ferritic grades, the heat treatment can be omitted if the conditions for hot forming and subsequent cooling are such that the requirements for the mechanical properties of the product and the resistance to intergranular corrosion are obtained.

[d] For information: IT = international tolerance, as defined in ISO 286-1, and in other dimensional tolerance standards.

[e] Specific tolerance within the ranges shall be agreed upon at the time of enquiry and order.

## Table 5 — Mechanical properties at room temperature for austenitic steels in the solution-annealed condition (+AT) (see Table B.1)

| Steel designation | | Thickness $t$ or diameter $d$ | Proof strength[a] | | Tensile strength | Elongation after fracture[a] | | Impact energy (ISO-V) | | Resistance to intergranular corrosion[b] | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | ISO number | mm | $R_{p0,2}$ MPa min. | $R_{p1,0}$ MPa min. | $R_m$ MPa | $A$ % min. | | $KV_2$ J min. | | in the delivery condition | in the sensitized condition[c] |
| | | | | | | long. | tr. | long. | tr. | | |
| **Austenitic steels** | | | | | | | | | | | |
| X10CrNi18-8 | 4310-301-00-I | g | — | — | 500 to 700 | — | — | — | — | no | no |

**Table 5** *(continued)*

| Steel designation | | Thickness $t$ or diameter $d$ | Proof strength[a] | | Tensile strength | Elongation after fracture[a] | | Impact energy (ISO-V) | | Resistance to intergranular corrosion[b] | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | ISO number | mm | $R_{p0,2}$ MPa min. | $R_{p1,0}$ MPa min. | $R_m$ MPa | $A$ % min. | | $KV_2$ J min. | | in the delivery condition | in the sensitized condition[c] |
| | | | | | | long. | tr. | long. | tr. | | |
| X2CrNi18-9 | 4307-304-03-I | ≤160 | 180 | 220 | 480 to 680 | 40[e] | — | 100 | — | yes | yes |
| | | 160 < $t$ ≤ 250 | | | | — | 35 | — | 60 | | |
| X10CrNiS18-9 | 4305-303-00-I | ≤160[d] | 190 | h | 500 to 700 | 35[e] | — | — | — | no | no |
| X2CrNiN18-9 | 4311-304-53-I | 160 | 270 | 310 | 550 to 750 | 40[e] | — | 100 | — | yes | yes |
| | | 160 < $t$ ≤ 250 | | | | — | 30 | — | 60 | | |
| X3CrNiCu18-9-4 | 4567-304-30-I | g | — | — | 450 to 650 | — | — | — | — | yes | yes |
| X6CrNiCuS18-9-2 | 4570-303-31-I | ≤160[d] | 185 | 220 | 500 to 710 | 35[e] | — | — | — | no | no |
| X5CrNiN19-9 | 4315-304-51-I | ≤40 | 270 | 310 | 550 to 750 | 40 | — | 100 | — | yes | no[f] |
| X5CrNi18-10 | 4301-304-00-I | ≤160 | 200 | 240 | 510 to 710 | 40[e] | — | 100 | — | yes | no[f] |
| | | 160 < $t$ ≤ 250 | | | | — | 35 | — | 60 | | |
| X6CrNiTi18-10 | 4541-321-00-I | ≤160 | 200 | 240 | 510 to 710 | 40[e] | — | 100 | — | yes | yes |
| | | 160 < $t$ ≤ 250 | | | | — | 30 | — | 60 | | |
| X6CrNiNb18-10 | 4550-347-00-I | ≤160 | 205 | 240 | 510 to 740 | 40[e] | — | 100 | — | yes | yes |
| | | 160 < $t$ ≤ 250 | | | | — | 30 | — | 60 | | |
| X2CrNi19-11 | 4306-304-03-I | ≤160 | 180 | 220 | 480 to 680 | 40[e] | — | 100 | — | yes | yes |
| | | 160 < $t$ ≤ 250 | — | — | | — | 35 | — | 60 | | |
| X6CrNi18-12 | 4303-305-00-I | ≤160 | 190 | 225 | 480 to 680 | 45 | — | 100 | — | yes | no[f] |
| | | 160 < $t$ ≤ 250 | | | | — | 35 | — | 60 | | |
| X8CrMnCuN17-8-3 | 4597-204-76-I | ≤160[d] | 270 | 305 | 560 to 760 | 40[e] | — | 100 | — | yes | no |
| X3CrMn-NiCu15-8-5-3 | 4615-201-75-E | ≤160 | 175 | 210 | 400 to 600 | 45 | — | — | — | yes | yes |
| X12CrMnNiN18-9-5 | 4373-202-00-I | ≤10[d] | 350 | 380 | 700 to 900 | 35[e] | — | — | — | yes | no |
| X11CrNiMnN19-8-6 | 4369-202-91-I | ≤15[d] | 340 | 370 | 750 to 950 | 35[e] | — | — | — | yes | no |
| X1CrNi25-21 | 4335-310-02-I | g | — | — | 470 to 670 | — | — | — | — | yes | yes |
| **Austenitic steels with Mo** | | | | | | | | | | | |
| X2CrNiMo17-12-2 | 4404-316-03-I | ≤160 | 205 | 245 | 520 to 720 | 40 | — | 100 | — | yes | yes |
| | | 160 < $t$ ≤ 250 | | | | — | 30 | — | 60 | | |
| X5CrNiMo17-12-2 | 4401-316-00-I | ≤160 | 205 | 245 | 520 to 720 | 40[e] | — | 100 | — | yes | no[f] |
| | | 160 < $t$ ≤ 250 | | | | — | 30 | — | 60 | | |
| X6CrNiMoTi17-12-2 | 4571-316-35-I | ≤160 | 205 | 245 | 520 to 720 | 40[e] | — | 100 | — | yes | yes |
| | | 160 < $t$ ≤ 250 | | | | — | 30 | — | 60 | | |
| X2CrNiMo17-12-3 | 4432-316-03-I | ≤160 | 205 | 245 | 520 to 720 | 40[e] | — | 100 | — | yes | yes |
| | | 160 < $t$ ≤ 250 | | | | — | 30 | — | 60 | | |
| X3CrNiMo17-12-3 | 4436-316-00-I | ≤160 | 205 | 245 | 520 to 720 | 40[e] | — | 100 | — | yes | no[f] |
| | | 160 < $t$ ≤ 250 | | | | — | 30 | — | 60 | | |
| X2CrNiMoN17-12-3 | 4429-316-53-I | ≤ 60 | 280 | 315 | 580 to 800 | 40[e] | — | 100 | — | yes | yes |
| | | 160 < $t$ ≤ 250 | | | | — | 30 | — | 60 | | |
| X2CrNiMo18-14-3 | 4435-316-91-I | ≤160 | 200 | 235 | 500 to 700 | 40[e] | — | 100 | — | yes | yes |
| | | 160 < $t$ ≤ 250 | | | | — | 30 | — | 60 | | |
| X2CrNiMoN18-12-4 | 4434-317-53-I | g | — | — | 540 to 740 | — | — | — | — | yes | yes |

**Table 5** *(continued)*

| Steel designation | | Thickness $t$ or diameter $d$ | Proof strength[a] | | Tensile strength | Elongation after fracture[a] | | Impact energy (ISO-V) | | Resistance to intergranular corrosion[b] | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | ISO number | mm | $R_{p0,2}$ MPa min. | $R_{p1,0}$ MPa min. | $R_m$ MPa | $A$ % min. | | $KV_2$ J min. | | in the delivery condition | in the sensitized condition[c] |
| | | | | | | long. | tr. | long. | tr. | | |
| X2CrNiMoN17-13-5 | 4439-317-26-E | ≤160 | 280 | 315 | 580 to 800 | 35 | — | 100 | — | yes | yes |
| | | 160 < $t$ ≤ 250 | | | | — | 30 | — | 60 | | |
| X1CrNiMo-CuN20-18-7 | 4547-312-54-I | ≤160 | 300 | 340 | 650 to 850 | 35 | — | 100 | — | yes | yes |
| | | 160 < $t$ ≤ 250 | | | | — | 30 | — | 60 | | |
| X1CrNiMoN25-22-2 | 4466-310-50-E | ≤160 | 250 | 290 | 540 to 740 | 35[e] | — | 100 | — | yes | yes |
| | | 160 < $t$ ≤ 250 | | | | — | 30 | — | 60 | | |
| X1CrNiMo-CuNW24-22-6 | 4659-312-66-I | ≤160[d] | 420 | 460 | 800 to 1 000 | 50[e] | — | 90 | — | yes | yes |
| X1CrNiMo-CuN24-22-8 | 4652-326-54-I | ≤50[d] | 430 | 470 | 750 to 1 050 | 40[e] | — | 100 | — | yes | yes |
| X2CrNiMn-MoN25-18-6-5 | 4565-345-65-I | ≤160[d] | 420 | 460 | 800 to 1 000 | 35[e] | — | 100 | — | yes | yes |
| **Austenitic steels with Ni/Co as main alloying elements** | | | | | | | | | | | |
| X1NiCrMoCu25-20-5 | 4539-089-04-I | ≤160 | 220 | 260 | 530 to 730 | 35[e] | — | 100 | — | yes | yes |
| | | 160 < $t$ ≤ 250 | | | | — | 30 | — | 60 | | |
| X1NiCrMo-CuN25-20-7 | 4529-089-26-I | ≤160 | 300 | 340 | 650 to 850 | 40[e] | — | 100 | — | yes | yes |
| | | 160 < $t$ ≤ 250 | | | | — | 35 | — | 60 | | |
| X1NiCrMoCu31-27-4 | 4563-080-28-I | ≤160 | 220 | 259 | 500 to 750 | 35 | — | 100 | — | yes | yes |
| | | 160 < $t$ ≤ 250 | | | | — | 30 | — | 60 | | |

NOTE 1 MPa = 1 N/mm².

a Elongation and proof strength are not valid for rod.

b When tested in accordance with ISO 3651-2.

c See note to 7.4.

d For larger thicknesses, the values shall be agreed upon.

e The minimum elongation value can be lowered to 20 % for sections and bars ≤ 35 mm thickness having a final cold deformation.

f Sensitization treatment of 15 min at 700 °C followed by cooling in air.

g For rod only.

h Maximum HB = 262. This value can be raised by 60 units or the maximum tensile strength value can be raised by 150 MPa and the minimum elongation be lowered to 10 % for sections and bars ≤ 35 mm thickness having undergone final cold deformation.

**Table 6 — Mechanical properties at room temperature for austenitic-ferritic steels in the solution-annealed condition (+AT) (see Table B.1)**

| Steel designation | | Thickness $t$ or diameter $d$ | Hardness[a] HB | 0,2 %-proof strength $R_{p0,2}$[b] | Tensile strength $R_m$[b] | Elongation after fracture $A$[bc] | Impact energy (ISO-V) | Resistance to intergranular corrosion[d] | |
|---|---|---|---|---|---|---|---|---|---|
| Name | ISO number | mm | | MPa min. | MPa min. | % min. | $KV_2$ J min. | in the delivery condition | in the sensitized condition[e] |
| X2CrNiN22-2 | 4062-322-02-U | ≤160[f] | 290 | 380 | 650 | 30 | 40 | yes | yes |
| X2CrMnNiN21-5-1 | 4162-321-01-E | ≤160[f] | 290 | 400 | 650 | 25 | 60 | yes | yes |
| X2CrNiN23-4 | 4362-323-04-I | ≤160[f] | 260 | 400 | 600 | 25 | 100 | yes | yes |
| X2CrNiMoN22-5-3 | 4462-318-03-I | ≤160[f] | 290 | 450 | 650 | 25 | 100 | yes | yes |
| X2CrNiMnMo-CuN24-4-3-2 | 4662-824-41-X | ≤160[f] | 290 | 450 | 650 | 25 | 60 | yes | yes |
| X3CrNiMoN27-5-2 | 4460-312-00-I | ≤160[f] | 260 | 450 | 620 | 20 | 85 | yes | yes |
| X2CrNiMo-CuN25-6-3 | 4507-325-20-I | ≤160[f] | 270 | 500 | 700 | 25 | 100 | yes | yes |
| X2CrNiMoN25-7-4 | 4410-327-50-E | ≤160[f] | 290 | 530 | 730 | 25 | 100 | yes | yes |
| X2CrNi-MoCuWN25-7-4 | 4501-327-60-I | ≤160[f] | 290 | 530 | 730 | 25 | 100 | yes | yes |
| X2CrNiMo-CoN28-8-5-1 | 4658-327-07-U | ≤5[f] | 300 | 650 | 800 | 25 | 100 | yes | yes |

NOTE 1 MPa = 1 N/mm$^2$.

[a] Only for guidance.

[b] For rods, only the tensile strength values apply.

[c] At the option of the manufacturer, it is permitted to use transverse test specimens provided that the same requirement be met.

[d] When tested in accordance with ISO 3651-2.

[e] See note to 7.4.

[f] For larger thicknesses, the values shall be agreed upon.

**Table 7 — Mechanical properties at room temperature for ferritic steels in the annealed condition (+A) (see Table B.1)**

| Steel designation | | Thickness $t$ or diameter $d$ | Hardness[a] HB | 0,2 %-proof strength $R_{p0,2}$ | Tensile strength[a] $R_m$ | Elongation after fracture[ab] $A$ | Resistance to intergranular corrosion[c] | |
|---|---|---|---|---|---|---|---|---|
| Name | ISO number | mm | | MPa min. | MPa min. | % min. | in the delivery condition | in the welded condition |
| X6Cr13 | 4000-410-08-I | 25 | 200 | 230 | 400 | 20 | no | no |
| X6Cr17 | 4016-430-00-I | 75[e] | 200 | 240 | 400 | 20 | yes | no |
| X7CrS17 | 4004-430-20-I | 75[d] | 262 | 250 | 430 | 20 | no | no |
| X3CrNb17 | 4511-430-71-I | 100[d] | — | 230 | 420 | 20 | yes | yes |
| X2CrTiNb18 | 4509-439-40-X | 50 | 200 | 200 | 420 | 28 | yes | yes |
| X6CrMo17-1 | 4113-434-00-I | e | — | — | 440 | — | yes | no |
| X2CrMoTiS18-2 | 4523-182-35-I | 100[d] | 200 | 280 | 430 | 15 | yes | no |

NOTE 1 MPa = 1 N/mm$^2$.

a The maximum HB values can be raised by 60 units or the maximum tensile strength value can be raised by 150 MPa and the minimum elongation value be lowered to 10 % for sections and bars ≤ 35 mm thickness having undergone final cold deformation.

b Longitudinal test pieces.

c When tested in accordance with ISO 3651-2.

d For larger thicknesses, the values have to be agreed.

e For rod only.

**Table 8 — Mechanical properties at room temperature for martensitic steels in the heat-treated condition (see Table B.1)**

| Steel designation | | Thickness $t$ or diameter $d$ mm | Heat treatment[a] | Hardness[b] HB | 0,2 %-proof strength $R_{p0,2}$ | Tensile strength $R_m$ | | Elongation after fracture $A$ | | Impact energy (ISO-V) $KV_2$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | ISO number | | | | MPa min. | MPa min. | MPa max. | % min. (long.) | % min. (tr.) | J min. (long.) | J min. (tr.) |
| | | — | +A | 223 | — | — | 730 | — | — | — | — |
| | | ≤75[c] | +QT | — | 345 | 540 | — | 15 | — | 25 | — |
| X12CrS13 | 4005-416-00-I | — | +A | 262 | — | — | 880 | — | — | — | — |
| | | ≤160[c] | +QT | — | 450 | 650 | — | 12 | — | — | — |
| X20Cr13 | 4021-420-00-I | — | +A | 230 | — | — | 900 | — | — | — | — |
| | | ≤160[c] | +QT1 | — | 500 | 700 | 850 | 13 | — | 25 | — |
| | | ≤160[c] | +QT2 | — | 600 | 800 | 950 | 12 | — | 20 | — |
| X30Cr13 | 4028-420-00-I | — | +A | 245 | — | — | 800 | — | — | — | — |
| | | ≤75[c] | +QT | — | 540 | 740 | — | 12 | — | 12 | — |
| X17CrNi16-2 | 4057-431-00-X | — | +A | 295 | — | — | 950 | — | — | — | — |
| | | ≤160[c] | +QT1 | — | 600 | 800 | 950 | 14[e] | — | 20 | — |
| | | ≤160[c] | +QT2 | — | 700 | 900 | 1 050 | 12[d] | — | 15 | — |
| X14CrS17 | 4019-430-20-I | — | +A | 262 | — | — | 880 | — | — | — | — |
| | | ≤160[c] | +QT | — | 500 | 650 | 850 | 12[d] | — | — | — |
| X110Cr17 | 4023-440-04-I | ≤100[c] | +A | 285 | — | — | — | — | — | — | — |
| X50CrMoV15 | 4116-420-77-E | — | +A | 280 | — | — | 900 | — | — | — | — |
| X3CrNiMo13-4 | 4313-415-00-I | — | +A | 320 | — | — | 1 100 | — | — | — | — |
| | | ≤160[c] | +QT1 | — | 520 | 700 | 800 | 15 | — | 70 | — |
| | | 160 < t ≤ 250 | | | | | | — | 12 | — | 50 |
| | | ≤160[c] | +QT2 | — | 620 | 780 | 980 | 15 | — | 70 | — |
| | | 160 < t ≤ 250 | | | | | | — | 12 | — | 50 |
| | | ≤160[c] | +QT3 | — | 800 | 900 | 1 100 | 12 | — | 50 | — |
| | | 160 < t ≤ 250 | | | | | | — | 10 | — | 40 |
| X4CrNiMo16-5-1 | 4418-431-77-E | — | +A | 320 | — | — | 1100 | — | — | — | — |
| | | ≤160[c] | +QT1 | — | 550 | 760 | 960 | 16 | — | 90 | — |
| | | 160 < t ≤ 250 | | | | | | — | 14 | — | 70 |
| | | ≤160[c] | +QT2 | — | 700 | 900 | 1100 | 16 | — | 80 | — |
| | | 160 < t ≤ 250 | | | | | | — | 14 | — | 60 |
| X39CrMo17-1 | 4122-434-09-I | — | +A | 280 | — | — | 900 | — | — | — | — |
| | | ≤160[c] | +QT | — | 550 | 750 | 950 | 12 | — | 10 | — |

NOTE 1 MPa = 1 N/mm².

a +A: soft annealed; +QT: quenched and tempered.

b The maximum HB values can be raised by 60 units or the maximum tensile strength value can be raised by 150 MPa and the minimum elongation value be lowered to 10 % for sections and bars ≤ 35 mm thickness having undergone final cold deformation.

c For larger thicknesses, the values shall be agreed upon.

d $A$ = 10 % for thicknesses > 60 mm.

e $A$ = 12 % for thicknesses > 60 mm.

**Table 9 — Mechanical properties at room temperature for the precipitation-hardening steel in the heat-treated condition (see Table B.1)**

| Steel designation | | Hardness | Heat treatment[a] | 0,2 %-proof strength | Tensile strength | Elongation after fracture | Impact energy (ISO-V) |
|---|---|---|---|---|---|---|---|
| Name | ISO number | HB | | $R_{p0,2}$ MPa min. | $R_m$ MPa | $A$ % min. | $KV_2$ J min. |
| X5CrNiCuNb16-4 | 4542-174-00-I | 363 | +AT | — | ≤1 200 | — | — |
| | | — | +P1 | 725 | ≥930 | 16 | 40 |
| | | — | +P2 | 860 | ≥1 000 | 13 | — |
| | | — | +P3 | 1 000 | ≥1 070 | 12 | — |
| | | — | +P4 | 1 175 | ≥1 310 | 10 | — |
| X7CrNiAl17-7 | 4568-177-00-I | — | +AT | — | ≤50[b] | — | — |

NOTE 1 MPa = 1 N/mm$^2$.

[a] +AT = solution annealed; +P = precipitation hardened.

[b] For rod only.

## Table 10 — Minimum values for the 0,2 %- and 1 %-proof strength of austenitic steels at elevated temperatures

| Steel designation | | Heat treatment condition[a] | Minimum 0,2 %-proof strength MPa[c] | | | | | | | | | | Minimum 1 %-proof strength MPa[c] | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | ISO number | | at a temperature (in °C) of | | | | | | | | | | | | | | | | | | | |
| | | | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 | 550 | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 | 550 |
| X10CrNi18-8 | 4310-301-00-I | +AT | 210 | 200 | 190 | 185 | 180 | 180 | — | — | — | — | 230 | 215 | 205 | 200 | 195 | 195 | — | — | — | — |
| X2CrNi18-9 | 4307-304-03-I | +AT | 145 | 130 | 118 | 108 | 100 | 94 | 89 | 85 | 81 | 80 | 180 | 160 | 145 | 135 | 127 | 121 | 116 | 112 | 109 | 108 |
| X2CrNiN18-9 | 4311-304-53-I | +AT | 205 | 175 | 157 | 145 | 136 | 130 | 125 | 121 | 119 | 118 | 240 | 210 | 187 | 175 | 167 | 160 | 156 | 152 | 149 | 147 |
| X5CrNi18-10 | 4301-304-00-I | +AT | 155 | 140 | 127 | 118 | 110 | 104 | 98 | 95 | 92 | 90 | 190 | 170 | 155 | 145 | 135 | 129 | 125 | 122 | 120 | 120 |
| X6CrNiTi18-10 | 4541-321-00-I | +AT | 175 | 165 | 155 | 145 | 136 | 130 | 125 | 121 | 119 | 118 | 205 | 195 | 185 | 175 | 167 | 161 | 156 | 152 | 149 | 147 |
| X6CrNiNb18-10 | 4550-347-00-I | +AT | 175 | 165 | 155 | 145 | 136 | 130 | 125 | 121 | 119 | 118 | 210 | 195 | 185 | 175 | 167 | 161 | 156 | 152 | 149 | 147 |
| X2CrNi19-11 | 4306-304-03-I | +AT | 145 | 130 | 118 | 108 | 100 | 94 | 89 | 85 | 81 | 80 | 180 | 160 | 145 | 135 | 127 | 121 | 116 | 112 | 109 | 108 |
| X6CrNi18-12 | 4303-305-00-I | +AT | 155 | 140 | 127 | 118 | 110 | 104 | 98 | 95 | 92 | 90 | 190 | 170 | 155 | 145 | 135 | 129 | 125 | 122 | 120 | 120 |
| X8CrMnCuN17-8-3 | 4597-204-76-I | +AT | 225 | 205 | 190 | 177 | 165 | 152 | 145 | 140 | 137 | 135 | 260 | 235 | 218 | 204 | 190 | 180 | 175 | 168 | 165 | 165 |
| X11CrNiMnN19-8-6 | 4369-202-91-I | +AT | 225 | 200 | 185 | 175 | 165 | 155 | — | — | — | — | 255 | 230 | 210 | 200 | 190 | 180 | — | — | — | — |
| X2CrNiMo17-12-2 | 4404-316-03-I | +AT | 165 | 150 | 137 | 127 | 119 | 113 | 108 | 103 | 100 | 98 | 200 | 180 | 165 | 153 | 145 | 139 | 135 | 130 | 128 | 127 |
| X5CrNiMo17-12-2 | 4401-316-00-I | +AT | 175 | 158 | 145 | 135 | 127 | 120 | 115 | 112 | 110 | 108 | 210 | 190 | 175 | 165 | 155 | 150 | 145 | 141 | 139 | 137 |
| X6CrNiMoTi17-12-2 | 4571-316-35-I | +AT | 185 | 175 | 165 | 155 | 145 | 140 | 135 | 131 | 129 | 127 | 215 | 205 | 192 | 183 | 175 | 169 | 164 | 160 | 158 | 157 |
| X2CrNiMo17-12-3 | 4571-316-35-I | +AT | 165 | 150 | 137 | 127 | 119 | 113 | 108 | 103 | 100 | 98 | 200 | 180 | 165 | 153 | 145 | 139 | 135 | 130 | 128 | 127 |
| X3CrNiMo17-12-3 | 4436-316-00-I | +AT | 175 | 158 | 145 | 135 | 127 | 120 | 115 | 112 | 110 | 108 | 210 | 190 | 175 | 165 | 155 | 150 | 145 | 141 | 139 | 137 |
| X2CrNiMoN17-12-3 | 4429-316-53-I | +AT | 215 | 195 | 175 | 165 | 155 | 150 | 145 | 140 | 138 | 136 | 245 | 225 | 205 | 195 | 185 | 180 | 175 | 170 | 168 | 166 |
| X2CrNiMo18-14-3 | 4435-316-91-I | +AT | 165 | 150 | 137 | 127 | 119 | 113 | 108 | 103 | 100 | 98 | 200 | 180 | 165 | 153 | 145 | 139 | 135 | 130 | 128 | 127 |
| X2CrNiMoN17-13-5 | 4439-317-26-E | +AT | 225 | 200 | 185 | 175 | 165 | 155 | 150 | — | — | — | 255 | 230 | 210 | 200 | 190 | 180 | 175 | — | — | — |
| X1CrNiMoCuN20-18-7 | 4547-312-54-I | +AT | 230 | 205 | 190 | 180 | 170 | 165 | 160 | 153 | 148 | — | 270 | 245 | 225 | 212 | 200 | 195 | 190 | 184 | 180 | — |
| X1CrNiMoN25-22-2 | 4466-310-50-E | +AT | 195 | 170 | 160 | 150 | 140 | 135 | — | — | — | — | 225 | 205 | 190 | 180 | 170 | 165 | — | — | — | — |
| X1CrNiMo-CuNW24-22-6 | 4659-312-66-I | +AT | 350 | 330 | 315 | 307 | 300 | 298 | 295 | 288 | 280 | 270 | 390 | 365 | 350 | 342 | 335 | 328 | 325 | 318 | 310 | 300 |
| X1CrNiMoCuN24-22-8 | 4652-326-54-I | +AT | 350 | 320 | 315 | 310 | 300 | 295 | 295 | 285 | 280 | 275 | 390 | 370 | 355 | 345 | 335 | 330 | 330 | 320 | 310 | 305 |
| X2CrNiMn-MoN25-18-6-5 | 4565-345-65-I | +AT | 350 | 310 | 270 | 255 | 240 | 225 | 210 | 210 | 210 | 200 | 400 | 355 | 310 | 290 | 270 | 255 | 240 | 240 | 240 | 230 |
| X1NiCrMoCu25-20-5 | 4539-089-04-I | +AT | 205 | 190 | 175 | 160 | 145 | 135 | 125 | 115 | 110 | 105 | 235 | 220 | 205 | 190 | 175 | 165 | 155 | 145 | 140 | 135 |
| X1NiCrMoCuN25-20-7 | 4529-089-26-I | +AT | 230 | 210 | 190 | 180 | 170 | 165 | 160 | — | — | — | 270 | 245 | 225 | 215 | 205 | 195 | 190 | — | — | — |
| X1NiCrMoCu31-27-4 | 4563-080-28-I | +AT | 190 | 175 | 160 | 155 | 150 | 145 | 135 | 125 | 120 | 115 | 220 | 205 | 190 | 185 | 180 | 175 | 165 | 155 | 150 | 145 |

**Table 10** *(continued)*

| Steel designation | | Heat treatment condition[a] | Minimum 0,2 %-proof strength MPa[c] | | | | | | | | | | Minimum 1 %-proof strength MPa[c] | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | ISO number | | at a temperature (in °C) of | | | | | | | | | | at a temperature (in °C) of | | | | | | | | | |
| | | | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 | 550 | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 | 550 |

a +AT = solution annealed.

b This grade is intended to be used at room temperature in the cold work hardened condition. Therefore, values for proof strength at elevated temperatures are not available. In cases where this grade is used in the solution-annealed condition, the values of grade X5CrNi18-10 (1.4301) can be adopted.

c 1 MPa = 1 N/mm$^2$.

**Table 11 — Minimum values for the 0,2 %-proof strength of austenitic-ferritic steels at elevated temperatures**

| Steel designation | | Heat treatment condition[a] | Minimum 0,2 %-proof strength MPa[b] at a temperature (in °C) of | | | |
|---|---|---|---|---|---|---|
| Name | ISO number | | 100 | 150 | 200 | 250 |
| X2CrMnNiN21-5-1 | 4162-321-01-E | +AT | 365 | 325 | 295 | 275 |
| X2CrNiN23-4 | 4362-323-04-I | +AT | 330 | 300 | 280 | 265 |
| X2CrNiMoN22-5-3 | 4462-318-03-I | +AT | 360 | 335 | 315 | 300 |
| X2CrNiMnMoCuN24-4-3-2 | 4662-824-41-X | +AT | 385 | 345 | 325 | 315 |
| X3CrNiMoN27-5-2 | 4460-312-00-I | +AT | 360 | 335 | 310 | 295 |
| X2CrNiMoCuN25-6-3 | 4507-325-20-I | +AT | 450 | 420 | 400 | 380 |
| X2CrNiMoN25-7-4 | 4410-327-50-E | +AT | 450 | 420 | 400 | 380 |
| X2CrNiMoCuWN25-7-4 | 4501-327-60-I | +AT | 450 | 420 | 400 | 380 |

a +AT = solution annealed.

b 1 MPa = 1 N/mm$^2$.

**Table 12 — Minimum values for the 0,2 %-proof strength of ferritic steels at elevated temperatures**

| Steel designation | | Heat treatment condition[a] | Minimum 0,2 %-proof strength MPa[b] at a temperature (in °C) of | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Name | ISO number | | 100 | 150 | 200 | 250 | 300 | 350 | 400 |
| X6Cr13 | 4000-410-08-I | +A | 220 | 215 | 210 | 205 | 200 | 195 | 190 |
| X6Cr17 | 4016-430-00-I | +A | 220 | 215 | 210 | 205 | 200 | 195 | 190 |
| X3CrNb17 | 4511-430-71-I | +A | 190 | 180 | 170 | 160 | 155 | — | — |
| X2CrTiNb18 | 4509-439-40-X | +A | 190 | 180 | 170 | 160 | 155 | — | — |
| X6CrMo17-1 | 4113-434-00-I | +A | 250 | 240 | 230 | 220 | 210 | 205 | 200 |
| X2CrMoTiS18-2 | 4523-182-35-I | +A | 250 | 240 | 230 | 220 | 210 | 205 | 200 |

a +A = annealed.

b 1 MPa = 1 N/mm$^2$.

## Table 13 — Minimum values for the 0,2 %-proof strength of martensitic steels at elevated temperatures

| Steel designation | | Heat treatment condition[a] | Minimum 0,2 %-proof strength MPa[b] at a temperature (in °C) of | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Name | ISO number | | 100 | 150 | 200 | 250 | 300 | 350 | 400 |
| X12Cr13 | 4006-410-00-I | +QT | 420 | 410 | 400 | 385 | 365 | 355 | 305 |
| X20Cr13 | 4021-420-00-I | +QT1 | 460 | 445 | 430 | 415 | 395 | 365 | 330 |
| | | +QT2 | 515 | 495 | 475 | 460 | 440 | 405 | 355 |
| X17CrNi16-2 | 4057-431-00-X | +QT1 | 515 | 495 | 475 | 460 | 440 | 405 | 355 |
| | | +QT2 | 565 | 525 | 505 | 490 | 470 | 430 | 375 |
| X3CrNiMo13-4 | 4313-415-00-I | +QT1 | 500 | 490 | 480 | 470 | 460 | 450 | — |
| | | +QT2 | 590 | 575 | 560 | 545 | 530 | 515 | — |
| | | +QT3 | 720 | 690 | 665 | 640 | 620 | — | — |
| X4CrNiMo16-5-1 | 4418-431-77-E | +QT1 | 520 | 510 | 500 | 490 | 480 | — | — |
| | | +QT2 | 660 | 640 | 620 | 600 | 580 | — | — |
| X39CrMo17-1 | 4122-434-09-I | +QT | 540 | 535 | 530 | 520 | 510 | 490 | 470 |

[a] +QT = quenched and tempered.

[b] 1 MPa = 1 N/mm².

## Table 14 — Minimum values for the 0,2 %-proof strength of precipitation-hardening steels at elevated temperatures

| Steel designation | | Heat treatment condition[a] | Minimum 0,2 %-proof strength MPa[b] at a temperature (in °C) of | | | | |
|---|---|---|---|---|---|---|---|
| Name | ISO number | | 100 | 150 | 200 | 250 | 300 |
| X5CrNiCuNb16-4 | 4542-174-00-I | +P1 | 680 | 660 | 640 | 620 | 600 |
| | | +P2 | 730 | 710 | 690 | 670 | 650 |
| | | +P3 | 880 | 830 | 800 | 770 | 750 |

[a] +P = precipitation hardened.

[b] 1 MPa = 1 N/mm².

**Table 15 — Tests to be carried out, test units, and extent of testing in specific testing**

| Test | [a] | Test unit | Product form: rods, bars, and sections | Number of test pieces per sample |
|---|---|---|---|---|
| Chemical analysis | m | Cast | The cast analysis is given by the manufacturer[b] | |
| Tensile test at room temperature or hardness test at room temperature | m | Batch[c] | One sample per 25 t; maximum of two per test unit | 1 |
| Tensile test at elevated temperature | o | | To be agreed at the time or ordering (see Table 10 to 14) | 1 |
| Impact test at room temperature | o | | To be agreed at the time of ordering | 3 |
| Resistance to intergranular corrosion | o[d] | | To be agreed at the time of ordering if intergranular corrosion is a hazard | 1 |

[a] Tests marked with an "m" (mandatory) shall be carried out as specific tests. In all cases, those marked with an "o" (optional) shall be carried out as specific tests only if agreed at the time of ordering.

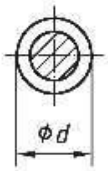
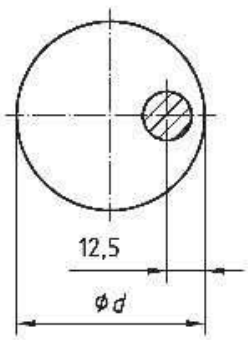
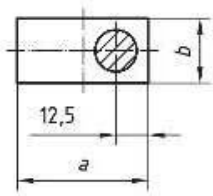
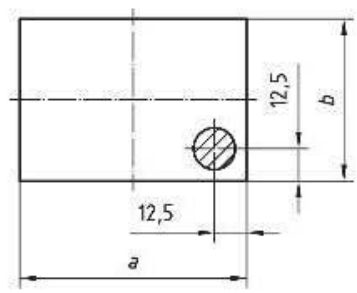
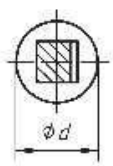
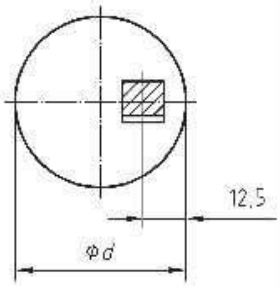
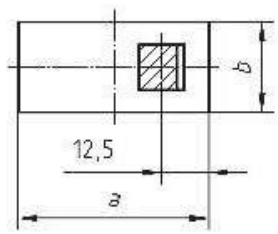
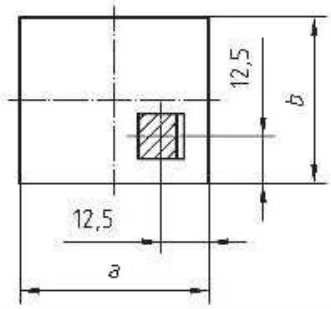
[b] A product analysis can be agreed at the time of ordering; the extent of testing shall be specified at the same time.

[c] Each batch consists of products coming from the same cast. The products shall have been subjected to the same heat-treatment cycle in the same furnace. In the case of a continuous furnace or in process annealing, a batch is the lot heat treated without interruption with the same process parameters.

The shape and size of cross sections of products in a single batch can be different providing that the ratio of the largest to the smallest cross-sectional areas be equal to or less than three.

[d] The test for resistance to intergranular corrosion is normally not carried out.

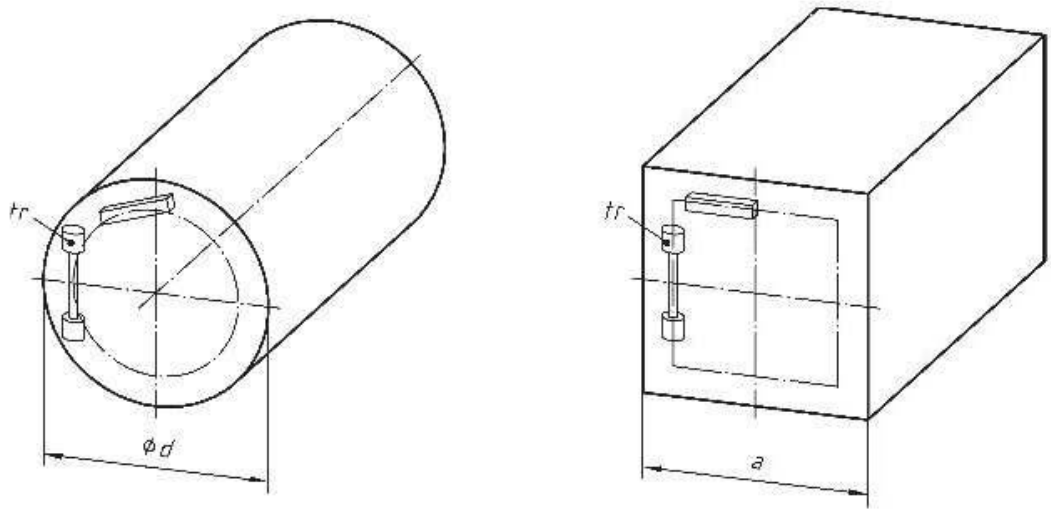
Dimensions in millimetres

| Type of test | Round cross-section products | | Rectangular cross-section products | |
|---|---|---|---|---|
| | $d \leq 25$[a] | $25 < d \leq 160$ | $b \leq 25$<br>$a \geq b$ | $25 < b \leq 160$<br>$a \geq b$ |
| Tensile |  |  |  |  |
| Impact[b] |  |  |  |  |

a Samples of product can alternatively be tested unmachined.

b For products of a round cross section, the axis of the notch is parallel to a diameter; for products with a rectangular cross section, the axis of the notch is perpendicular to the greatest rolled surface.

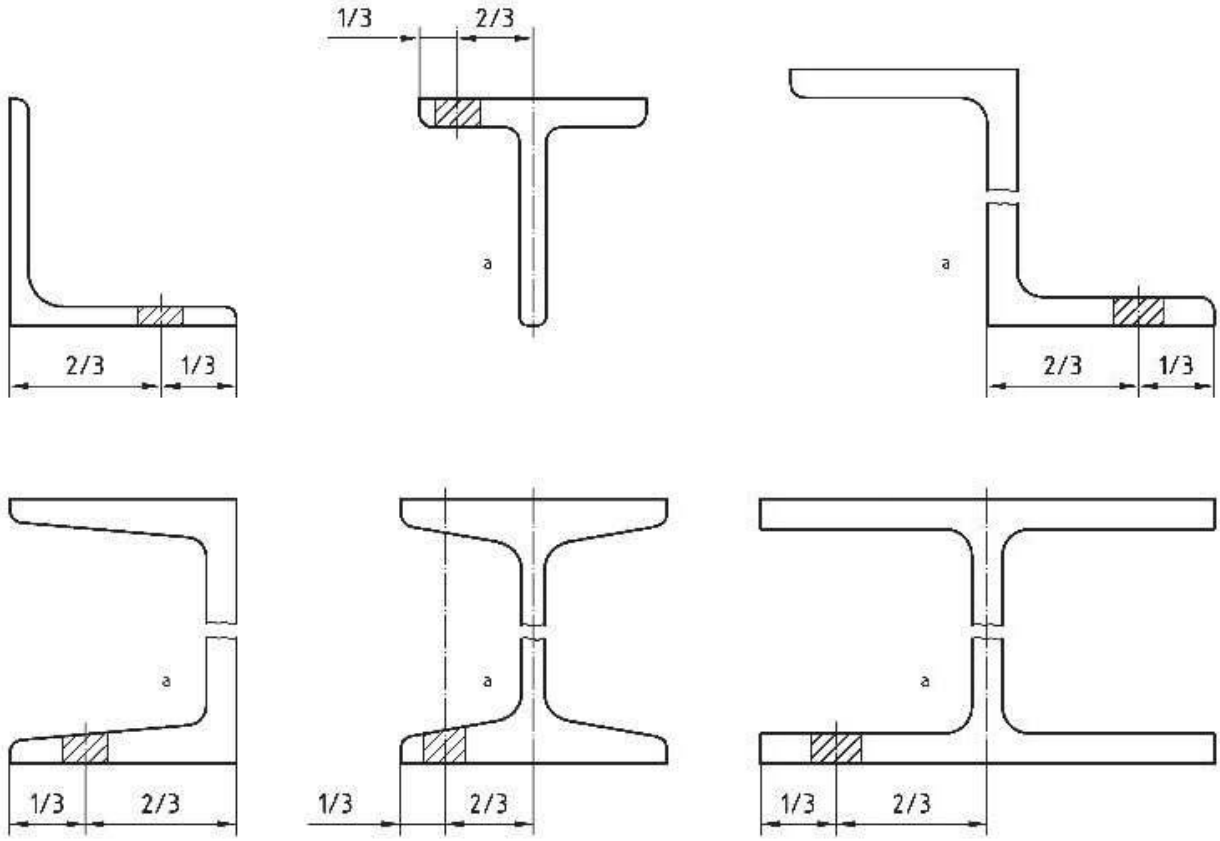
**Figure 1 — Position of test pieces for steel bars and rods ≤ 160 mm diameter or thickness (longitudinal test pieces)**




**Key**

| | |
|---|---|
| tr | transverse |
| NOTE 1 | The axis of the notch on the impact test pieces should be radial in the case of round steel bars, and perpendicular to the nearest rolled surface for rectangular bars. |
| NOTE 2 | The location of the impact test piece is $d/6$ or $a/6$ with max. 50 mm from the surface. |

**Figure 2 — Position of test pieces for steel bars > 160 mm diameter or thickness (transverse test pieces)**




**Key**

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

**Figure 3 — Position of test pieces (hatched) for beams, channels, angles, T sections, and Z sections**

# Annex A
(informative)

# Guidelines for further treatment (including heat treatment) in fabrication

**A.1** The guidelines given in Tables A.1 to A.5 are intended for hot forming and heat treatment.

**A.2** Because the corrosion resistance of stainless steels is only ensured when the surface is metallically clean, layers of scale and annealing colours produced during hot forming, heat treatment, or welding should be removed as far as possible before use. Resistance to corrosion by finished parts made of steels with approximately 13 % Cr is increased by the presence of a smooth, clean surface.

## Table A.1 — Guidelines on the temperatures for hot forming and heat treatment[a] of austenitic corrosion-resistant stainless steels

| Steel designation | | Hot forming | | Heat treatment symbol | Solution annealing[b] | |
|---|---|---|---|---|---|---|
| Name | ISO number | Temperature °C | Type of cooling | | Temperature[c] °C | Type of cooling |
| X10CrNi18-8 | 4310-301-00-I | 1 200 to 900 | Air | +AT | 1 000 to 1 100 | Water, air[d] |
| X2CrNi18-9 | 4307-304-03-I | 1 200 to 900 | | | 1 000 to 1 100 | |
| X10CrNiS18-9 | 4305-303-00-I | 1 200 to 900 | | | 1 000 to 1 100 | |
| X2CrNiN18-9 | 4311-304-53-I | 1 200 to 900 | | | 1 000 to 1 100 | |
| X3CrNiCu18-9-4 | 4567-304-30-I | 1 200 to 900 | | | 1 000 to 1 100 | |
| X6CrNiCuS18-9-2 | 4570-303-31-I | 1 150 to 900 | | | 1 000 to 1 100 | |
| X5CrNiN19-9 | 4315-304-51-I | 1 150 to 850 | | | 1 000 to 1 100 | |
| X5CrNi18-10 | 4301-304-00-I | 1 200 to 900 | | | 1 000 to 1 100 | |
| X6CrNiTi18-10 | 4541-321-00-I | 1 200 to 900 | | | 1 020 to 1 120 | |
| X6CrNiNb18-10 | 4550-347-00-I | 1 150 to 850 | | | 1 020 to 1 120 | |
| X2CrNi19-11 | 4306-304-03-I | 1 200 to 900 | | | 1 000 to 1 100 | |
| X6CrNi18-12 | 4303-305-00-I | 1 200 to 900 | | | 1 010 to 1 150 | |
| X8CrMnCuN17-8-3 | 4597-204-76-I | 1 150 to 850 | | | 1 000 to 1 100 | |
| X3CrMnNiCu15-8-5-3 | 4615-201-75-E | 1 200 to 900 | | | 1 000 to 1 100 | |
| X12CrMnNiN18-9-5 | 4373-202-00-I | 1 150 to 850 | | | 1 000 to 1 100 | |
| X11CrNiMnN19-8-6 | 4369-202-91-I | 1 150 to 850 | | | 1 000 to 1 100 | |
| X1CrNi25-21 | 4335-310-02-I | 1 150 to 850 | | | 1 030 to 1 110 | |
| X2CrNiMo17-12–2 | 4404-316-03-I | 1 200 to 900 | | | 1 020 to 1 120 | |
| X5CrNiMo17-12-2 | 4401-316-00-I | 1 200 to 900 | | | 1 020 to 1 120 | |
| X6CrNiMoTi17-12-2 | 4571-316-35-I | 1 200 to 900 | | | 1 020 to 1 120 | |
| X2CrNiMo17-12-3 | 4432-316-03-I | 1 200 to 900 | | | 1 020 to 1 120 | |
| X3CrNiMo17-12-3 | 4436-316-00-I | 1 200 to 900 | | | 1 020 to 1 120 | |
| X2CrNiMoN17-12-3 | 4429-316-53-I | 1 200 to 900 | | | 1 020 to 1 120 | |
| X2CrNiMo18-14-3 | 4435-316-91-I | 1 200 to 900 | | | 1 020 to 1 120 | |
| X2CrNiMoN18-12-4 | 4434-317-53-I | 1 150 to 850 | | | 1 070 to 1 150 | |
| X2CrNiMoN17-13-5 | 4439-317-26-E | 1 200 to 900 | | | 1 020 to 1 120 | |
| X1CrNiMoCuN20-18-7 | 4547-312-54-I | 1 200 to 1 000 | | | 1 140 to 1 200 | |
| X1CrNiMoN25-22-2 | 4466-310-50-E | 1 150 to 850 | | | 1 070 to1 150 | |
| X1CrNiMoCuNW24-22-6 | 4659-312-66-I | 1 150 to 850 | | | 1 140 to 1 200 | |
| X1CrNiMoCuN24-22-8 | 4652-326-54-I | 1 200 to 1 000 | | | 1 150 to 1 200 | |
| X2CrNiMnMoN25-18-6-5 | 4565-345-65-I | 1 200 to 950 | | | 1 120 to 1 170 | |
| X1NiCrMoCu25-20-5 | 4539-089-04-I | 1 200 to 900 | | | 1 050 to 1 150 | |
| X1NiCrMoCuN25-20-7 | 4529-089-26-I | 1 200 to 950 | | | 1 120 to 1 180 | |
| X1NiCrMoCu31-27-4 | 4563-080-28-I | 1 150 to 850 | | | 1 050 to 1 150 | |

[a] The temperatures of solution annealing shall be agreed upon for simulated heat-treated test pieces.

[b] If heat treatment is carried out in a continuous furnace, the upper part of the range specified is usually preferred, or even exceeded.

[c] The lower end of the range specified for solution annealing should be aimed at for heat treatment as part of further processing, because otherwise the mechanical properties might be affected. If the temperature of hot forming does not drop below the lower temperature for solution annealing, a temperature of 980 °C is adequate as a lower limit for Mo-free steels; a temperature of 1 000 °C for steels with Mo contents up to 3 %; a temperature of 1 020 °C for steels with Mo contents exceeding 3 %.

[d] Rapid cooling.

## Table A.2 — Guidelines on the temperatures for hot forming and heat treatment[a] of austenitic-ferritic corrosion-resistant stainless steels

| Steel designation | | Hot forming | | Heat treatment symbol | Solution annealing[b] | |
|---|---|---|---|---|---|---|
| Name | ISO number | Temperature °C | Type of cooling | | Temperature °C | Type of cooling |
| X2CrNiN22-2 | 4062-322-02-U | 1 100 to 950 | Air | +AT | 980 to 1 100 | Water, air[c] |
| X2CrMnNiN21-5-1 | 4162-321-01-E | 1 100 to 900 | | | 1 020 to 1 080 | Water, air |
| X2CrNiN23-4 | 4362-323-04-I | 1 200 to 1 000 | | | 950 to 1 050 | Water, air[c] |
| X2CrNiMoN22-5-3 | 4462-318-03-I | 1 200 to 950 | | | 1 020 to 1 100 | Water, air[c] |
| X2CrNiMnMoCuN24-4-3-2 | 4662-824-41-X | 1 150 to 900 | | | 1 000 to 1 150 | Water, air |
| X3CrNiMoN27-5-2 | 4460-312-00-I | 1 200 to 950 | | | 1 020 to 1 100 | Water, air[c] |
| X2CrNiMoCuN25-6-3 | 4507-325-20-I | 1 200 to 1 000 | | | 1 040 to 1 120 | Water |
| X2CrNiMoN25-7-4 | 4410-327-50-E | 1 200 to 1 000 | | | 1 040 to 1 120 | Water |
| X2CrNiMoCuWN25-7-4 | 4501-327-60-I | 1 200 to 1 000 | | | 1 040 to 1 120 | Water |
| X2CrNiMoCoN28-8-5-1 | 4658-327-07-U | 1 200 to 1 000 | | | 1 050 to 1 150 | Water |

[a] The temperatures of solution annealing shall be agreed upon for simulated heat-treated test pieces.

[b] If heat treatment is carried out in a continuous furnace, the upper part of the range specified is usually preferred, or even exceeded.

[c] Rapid cooling.

## Table A.3 — Guidelines on the temperatures for hot forming and heat treatment[a] of ferritic corrosion-resistant stainless steels

| Steel designation | | Hot forming | | Heat treatment symbol | Annealing | |
|---|---|---|---|---|---|---|
| Name | ISO number | Temperature °C | Type of cooling | | Temperature[b] °C | Type of cooling |
| X6Cr13 | 4000-410-08-I | 1 100 to 800 | Air | +A | 750 to 800 | Air |
| X6Cr17 | 4016-430-00-I | | | | 750 to 850 | |
| X7CrS17 | 4004-430-20-I | | | | | |
| X3CrNb17 | 4511-430-71-I | | | | | |
| X2CrTiNb18 | 4509-439-40-X | | | | | |
| X6CrMo17-1 | 4113-434-00-I | | | | | |
| X2CrMoTiS18-2 | 4523-182-35-I | | | | 1 000 to 1 050 | |

[a] The temperatures of annealing shall be agreed upon for simulated heat-treated test pieces.

[b] If heat treatment is carried out in a continuous furnace, the upper part of the range specified is usually preferred, or even exceeded.

## Table A.4 — Guidelines on the temperatures for hot forming and heat treatment[a] of martensitic corrosion-resistant stainless steels

| Steel designation | | Hot forming | | Heat treatment symbol | Annealing | | Quenching | | Tempering |
|---|---|---|---|---|---|---|---|---|---|
| Name | ISO number | Temperature °C | Type of cooling | | Temperature[b] °C | Type of cooling | Temperature[b] °C | Type of cooling | Temperature °C |
| X12Cr13 | 4006-410-00-I | 1 100 to 800 | Air | +A | 800 to 900 | Slow cooling | — | — | — |
| | | | | | Approx. 750 | Rapid cooling | | | |
| | | | | +QT | — | — | 950 to 1 000 | Oil, water | 700 to 750 |
| X12CrS13 | 4005-416-00-I | 1 100 to 800 | Air | +A | 745 to 825 | Air | — | — | — |
| | | | | +QT | — | — | 950 to 1 000 | Oil, air, water | 680 to 780 |
| X20Cr13 | 4021-420-00-I | 1 100 to 800 | Slow cooling | +A | 745 to 825 | Air | — | — | — |
| | | | | +QT1 | — | — | 950 to 1 050 | Oil, air, water | 650 to 750 |
| | | | | +QT2 | — | — | 950 to 1 050 | Oil, air, water | 600 to 700 |
| X30Cr13 | 4028-420-00-I | 1 100 to 800 | Slow cooling | +A | 800 to 900 | Slow cooling | — | — | — |
| | | | | | Approx. 750 | Air cooling | | | |
| | | | | +QT | — | — | 920 to 980 | Oil | 600 to 750 |
| X17CrNi16-2 | 4057-431-00-X | 1 100 to 800 | Slow cooling | +A | 680 to 800 | Furnace, air | — | — | — |
| | | | | +QT1 | — | — | 950 to 1 050 | Oil, air | 750 to 800 + 650 to 700[c] |
| | | | | +QT2 | — | — | 950 to 1 050 | Oil, air | 600 to 650 |
| X14CrS17 | 4019-430-20-I | 1 100 to 800 | Air | +A | 750 to 850 | Furnace, air | — | — | — |
| | | | | +QT | — | — | 950 to 1 070 | Oil, air | 550 to 650 |
| X110Cr17 | 4023-440-04-I | 1 100 to 900 | Slow cooling | +A | 780 to 840 | Furnace, air | — | — | — |
| X50CrMoV15 | 4116-420-77-E | 1 100 to 800 | Slow cooling | +A | 750 to 850 | Furnace, air | — | — | — |
| X3CrNiMo13-4 | 4313-415-00-I | 1 150 to 900 | Air | +A | 600 to 650 | Furnace, air | — | — | — |
| | | | | +QT1 | — | — | 950 to 1 050 | Oil, air | 650 to 700 + 600 to 620 |
| | | | | +QT2 | — | — | 950 to 1 050 | Oil, air | 550 to 600 |
| | | | | +QT3 | — | — | 950 to 1 050 | Oil, air | 520 to 580 |
| X4CrNiMo16-5-1 | 4418-431-77-E | 1150 to 900 | air | +A | 600 to 650 | Furnace, air | — | — | — |
| | | | | +QT1 | — | — | 950 to 1 050 | Oil, air | 590 to 620[d] |
| | | | | +QT2 | — | — | 950 to 1 050 | Oil, air | 550 to 620 |

**Table A.4** *(continued)*

| Steel designation | | Hot forming | | Heat treatment symbol | Annealing | | Quenching | | Tempering |
|---|---|---|---|---|---|---|---|---|---|
| Name | ISO number | Temperature °C | Type of cooling | | Temperature[b] °C | Type of cooling | Temperature[b] °C | Type of cooling | Temperature °C |
| X39CrMo17-1 | 4122-434-09-I | 1 100 to 800 | Slow cooling | +A | 750 to 850 | Furnace, air | — | — | — |
| | | | | +QT | — | — | 980 to 1 060 | Oil | 650 to 750 |

[a] The temperatures of annealing, quenching, and tempering shall be agreed upon for simulated heat-treated test pieces.

[b] If heat treatment is carried out in a continuous furnace, the upper part of the range specified is usually preferred, or even exceeded.

[c] In cases where the nickel content is on the lower side of the range specified in Table 2, a single tempering at 620 °C to 720 °C can be sufficient.

[d] Either 2 × 4 h or 1 × 8 h as a minimum time.

## Table A.5 — Guidelines on the temperatures for hot forming and heat treatment[a] of precipitation-hardening corrosion-resistant stainless steel

| Steel designation | | Hot forming | | Heat treatment symbol | Solution annealing | | Precipitation hardening |
|---|---|---|---|---|---|---|---|
| Name | ISO number | Temperature °C | Type of cooling | | Temperature[b] °C | Type of cooling | Temperature °C |
| X5CrNiCuNb16-4 | 4542-174-00-I | 1 150 to 900 | Furnace, air | +AT[c] | 1 020 to 1 060 | Rapid cooling | — |
| | | | | +P1 | 1 020 to 1 060 | Rapid cooling | 610 to 630/air |
| | | | | +P2 | 1 020 to 1 060 | | 570 to 590/air |
| | | | | +P3 | 1 020 to 1 060 | | 540 to 560/air |
| | | | | +P4 | 1 020 to 1 060 | | 470 to 490/air |
| X7CrNiAl17-7 | 4568-177-00-I | 1 150 to 900 | Air | +AT | 1 060 to 1 080 | Water, air | — |

[a] The temperatures of solution annealing shall be agreed upon for simulated heat-treated test pieces.

[b] If heat treatment is carried out in a continuous furnace, the upper part of the range specified is usually preferred, or even exceeded.

[c] Not suitable for direct application; prompt precipitation hardening after solution annealing is recommended to avoid cracking.

# Annex B
(informative)

# Designations of the steels given in Table 2 and of comparable grades covered in ASTM, EN, JIS, and GB Standards

**Table B.1 — Designations of the steels given in Table 2 and of comparable grades covered in ASTM, EN, JIS, and GB Standards**

| Steel designations according to[a] | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| ISO number | ISO name | Line | ASTM A959/ UNS[b] | | EN 10088-1:2005 Number[c] | | JIS[d] | | GB/T20878/ ISC[e] | |
| | | | | I/N/W[f] | | I/N/W[f] | | I/N/W[f] | | I/N/W[f] |
| **a) Austenitic steels** | | | | | | | | | | |
| 4310-301-00-I | X10CrNi18-8 | AP26L | S30100 | W | 1.4310 | N | — | — | S30110 | W |
| 4307-304-03-I | X2CrNi18-9 | AP27B | S30403 | W | 1.4307 | N | SUS304L | W | S30403 | W |
| 4305-303-00-I | X10CrNiS18-9 | AP27M | S30300 | W | 1.4305 | W | SUS303 | W | S30317 | W |
| 4311-304-53-I | X2CrNiN18-9 | AP27A | S30453 | W | 1.4311 | N | SUS304LN | W | S30453 | W |
| 4567-304-30-I | X3CrNiCu18-9-4 | AP27F | S30430 | W | (1.4567) | N | SUSXM7 | W | S30488 | W |
| 4570-303-31-I | X6CrNiCuS18-9-2 | AP27I | S30331 | I | 1.4570 | N | — | — | — | — |
| 4315-304-51-I | X5CrNiN19-9 | AP28F | S30451 | N | 1.4315 | W | SUS304N1<br>SUS304N2 | I<br>N | S30458 | W |
| 4301-304-00-I | X5CrNi18-10 | AP28E | S30400 | W | 1.4301 | I | SUS304 | W | S30408 | W |
| 4541-321-00-I | X6CrNiTi18-10 | AP28G | S32100 | W | 1.4541 | I | SUS321 | W | S32168 | W |
| 4550-347-00-I | X6CrNiNb18-10 | AP28H | S34700 | I | 1.4550 | N | SUS347 | W | S34778 | N |
| 4306-304-03-I | X2CrNi19-11 | AP30A | S30403 | W | 1.4306 | N | SUS304L | W | S30403 | N |
| 4303-305-00-I | X6CrNi18-12 | AP30I | S30500 | W | 1.4303 | N | SUS305 | W | S30510 | W |
| 4597-204-76-I | X8CrMnCuN17-8-3 | AP25L | — | — | 1.4597 | N | — | — | — | — |
| 4615-201-75-E | X3CrMn-NiCu15-8-5-3 | AP28C | — | — | (1.4615) | I | — | — | — | — |
| 4373-202-00-I | X12CrMnNiN18-9-5 | AP32O | S20200 | W | 1.4373 | N | SUS202 | W | S35450 | N |
| 4369-202-91-I | X11CrNiMnN19-8-6 | AP33L | — | — | 1.4369 | I | — | — | — | — |
| 4335-310-02-I | X1CrNi25-21 | AP46A | S31002 | W | 1.4335 | I | — | — | — | — |
| **b) Austenitic steels with Mo** | | | | | | | | | | |
| 4404-316-03-I | X2CrNiMo17-12-2 | AM31A | S31603 | W | 1.4404 | N | SUS316L | W | S31603 | N |
| 4401-316-00-I | X5CrNiMo17-12-2 | AM31I | S31600 | W | 1.4401 | N | SUS316 | W | S31608 | N |

**Table B.1** *(continued)*

| Steel designations according to[a] | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| ISO number | ISO name | Line | ASTM A959/ UNS[b] | | EN 10088-1:2005 Number[c] | | JIS[d] | | GB/T20878/ ISC[e] | |
| | | | | I/N/W[f] | | I/N/W[f] | | I/N/W[f] | | I/N/W[f] |
| 4571-316-35-I | X6CrNiMoTi17-12-2 | AM31F | S31635 | W | 1.4571 | N | SUS316Ti | W | S31668 | W |
| 4432-316-03-I | X2CrNiMo17-12-3 | AM32A | S31603 | W | 1.4432 | I | SUS316L | W | S31603 | W |
| 4436-316-00-I | X3CrNiMo17-12-3 | AM32F | S31600 | W | 1.4436 | I | SUS316 | W | S31608 | W |
| 4429-316-53-I | X2CrNiMoN17-12-3 | AM32B | S31653 | W | 1.4429 | N | SUS316LN | W | S31653 | N |
| 4435-316-91-I | X2CrNiMo18-14-3 | AM35A | — | — | 1.4435 | N | SUS316L | W | S31603 | W |
| 4434-317-53-I | X2CrNiMoN18-12-4 | AM34B | S31753 | W | 1.4434 | N | SUS317LN | W | S31753 | W |
| 4439-317-26-E | X2CrNiMoN17-13-5 | AM35B | S31726 | N | 1.4439 | I | — | — | S31723 | W |
| 4547-312-54-I | X1CrNiMo-CuN20-18-7 | AM45A | S31254 | W | 1.4547 | N | SUS312L | W | S31252 | N |
| 4466-310-50-E | X1CrNiMoN25-22-2 | AM49A | S31050 | W | 1.4466 | I | — | — | S31053 | W |
| 4659-312-66-I | X1CrNiMo-CuNW24-22-6 | AM52B | S31266 | W | 1.4659 | I | — | — | — | — |
| 4652-326-54-I | X1CrNiMo-CuN24-22-8 | AM54A | S32654 | N | 1.4652 | I | — | — | S32652 | N |
| 4565-345-65-I | X2CrNiMn-MoN25-18-6-5 | AM54B | S34565 | W | 1.4565 | I | — | — | S34553 | N |
| **c) Austenitic steels with Ni/Co as main alloying elements** | | | | | | | | | | |
| 4539-089-04-I | X1NiCrMoCu25-20-5 | AN50A | N08904 | W | 1.4539 | N | SUS890L | W | S39042 | N |
| 4529-089-26-I | X1NiCrMo-CuN25-20-7 | AN52A | N08926 | W | 1.4529 | N | — | — | — | — |
| 4563-080-28-I | X1NiCrMoCu31-27-4 | AN62A | N08028 | W | 1.4563 | I | — | — | — | — |
| **d) Austenitic-ferritic (duplex) steels** | | | | | | | | | | |
| 4062-322-02-U | X2CrNiN22-2 | DP24A | S32202 | N | 1.4062 | I | — | — | — | — |
| 4162-321-01-E | X2CrMnNiN21-5-1 | DP27F | S32101 | N | 1.4162 | I | — | — | — | — |
| 4362-323-04-I | X2CrNiN23-4 | DP27B | S32304 | W | 1.4362 | I | — | — | S23043 | W |
| 4462-318-03-I | X2CrNiMoN22-5-3 | DM30A | S32205 | N | 1.4462 | I | SUS329J3L | W | S22053 | N |
| 4462-824-41-X | X2CrNiMnMo-CuN24-4-3-2 | DM33A | — | — | 1.4462 | I | — | — | — | — |
| 4460-312-00-I | X3CrNiMoN27-5-2 | DM34F | S31200 | W | 1.4460 | I | — | — | S22553 | W |
| 4507-325-20-I | X2CrNiMo-CuN25-6-3 | DM34A | S32520 | W | 1.4507 | I | — | — | S25554 | — |
| 4410-327-50-E | X2CrNiMoN25-7-4 | DM36A | S32750 | W | 1.4410 | I | — | — | S25073 | W |
| 4501-327-60-I | X2CrNi-MoCuWN25-7-4 | DM36B | S32760 | I | 1.4501 | N | — | — | S27603 | N |
| 4658-327-07-U | X2CrNiMo-CoN28-8-5-1 | DM42A | S32707 | I | 1.4658 | I | — | — | — | — |
| **e) Ferritic steels** | | | | | | | | | | |

**Table B.1** *(continued)*

| Steel designations according to[a] | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| ISO number | ISO name | Line | ASTM A959/ UNS[b] | | EN 10088-1:2005 Number[c] | | JIS[d] | | GB/T20878/ ISC[e] | |
| | | | | I/N/W[f] | | I/N/W[f] | | I/N/W[f] | | I/N/W[f] |
| 4000-410-08-I | X6Cr13 | FP13G | S41008 | W | 1.4000 | N | SUS410S | N | S41008 | N |
| 4016-430-00-I | X6Cr17 | FP17I | S43000 | W | 1.4016 | I | SUS430 | W | S11710 | W |
| 4004-430-20-I | X7CrS17 | FP17L | S43020 | W | (1.4004) | I | SUS430F | W | S11717 | W |
| 4511-430-71-I | X3CrNb17 | FP17G | — | — | 1.4511 | N | SUS430LX | W | — | — |
| 4509-439-40-X | X2CrTiNb18 | FP18B | S43940 | I | 1.4509 | N | SUS430LX | W | S11873 | I |
| 4113-434-00-I | X6CrMo17-1 | FM18I | S43400 | W | 1.4113 | N | SUS434 | W | S11790 | W |
| 4523-182-35-I | X2CrMoTiS18-2 | FM20C | S18235 | W | 1.4523 | I | — | — | — | — |
| **f) Martensitic steels** | | | | | | | | | | |
| 4006-410-00-I | X12Cr13 | MP13B | S41000 | W | 1.4006 | I | SUS410 | W | S41010 | W |
| 4005-416-00-I | X12CrS13 | MP13C | S41600 | W | 1.4005 | N | SUS416 | W | S41617 | N |
| 4021-420-00-I | X20Cr13 | MP13I | S42000 | W | 1.4021 | I | SUS420J1 | N | S42020 | N |
| 4028-420-00-I | X30Cr13 | MP13M | S42000 | W | 1.4028 | I | SUS420J2 | W | S42030 | N |
| 4057-431-00-X | X17CrNi16-2 | MP16G | S43100 | W | 1.4057 | I | SUS431 | W | S43120 | I |
| 4019-430-20-I | X14CrS17 | MP17F | S43020 | W | (1.4019) | I | — | — | S11717 | W |
| 4023-440-04-I | X110Cr17 | MP17W | S44004 | W | (1.4023) | I | SUS440C | N | S44096 | N |
| 4313-415-00-I | X3CrNiMo13-4 | MM14A | S41500 | W | 1.4313 | N | SUSF6NM | W | S41595 | W |
| 4116-420-77-E | X50CrMoV15 | MM15U | — | — | 1.4116 | I | — | — | — | — |
| 4122-434-09-I | X39CrMo17-1 | MM18R | — | — | 1.4122 | I | — | — | — | — |
| **g) Precipitation-hardening steels** | | | | | | | | | | |
| 4542-174-00-I | X5CrNiCuNb16-4 | PP20I | S17400 | W | 1.4542 | N | SUS630 | W | S51740 | W |
| 4568-177-00-I | X7CrNiAl17-7 | PP24L | S17700 | N | 1.4568 | N | SUS631 | W | S51770 | N |

NOTE The grades given in this table are comparable to those given in Table 2. However, to compare similar grades, it is necessary to check each element before making a substitution.

a See the sources in the Bibliography.

b US steel listed in ASTM A959 and in UNS; if the steel number is given in brackets, then the steel has only a UNS number.

c European steel listed in EN 10088-1:2005 and in the "Stahl-Eisen-Liste"; if the steel number is given in brackets, then the steel is only listed in the "Stahl-Eisen-Liste".

d Japanese Industrial Standard.

e Chinese steel of ISC number listed in GB/T20878.

f I = identical steel to ISO steel grade; N = steel grade with closer match of composition, but not identical; W = wider match.

# Annex C
(informative)

# Applicable dimensional standards

ISO 286-1, title/subject: Geometrical product specifications (GPS) — ISO code system for tolerances on linear sizes — Part 1: Basis of tolerances, deviations and fits

NOTE The notes in Table 4 contain information concerning tolerances for bright bars; special agreements are necessary if such information should become obligatory.

ISO 1035-1, title/subject: Hot-rolled steel bars — Part 1: Dimensions of round bars

ISO 1035-2, title/subject: Hot-rolled steel bars — Part 2: Dimensions of square bars

ISO 1035-3, title/subject: Hot-rolled steel bars — Part 3: Dimensions of flat bars

ISO 1035-4, title/subject: Hot-rolled steel bars — Part 4: Tolerances

ISO 16124, title/subject: Steel wire rod — Dimensions and tolerances

ASTM A 484M-03, title/subject: Standard Specification for General Requirements for Stainless Steel Bars, Billets, and Forgings

ASTM A 555M-97:2002, title/subject: Standard Specification for General Requirements for Stainless Steel Wire and Wire Rods

EN 10017, title/subject: Steel rod for drawing and/or cold rolling — Dimensions and tolerances

EN 10024[1)], title/subject: Hot rolled taper flange I sections — Tolerances on shape and dimensions

EN 10034[1)], title/subject: Structural steel I and H sections — Tolerances on shape and dimensions

EN 10055[1)], title/subject: Hot rolled steel equal flange tees with radiused root and toes — Dimensions and tolerances on shape and dimensions

EN 10056-2[1)], title/subject: Structural steel equal and unequal leg angles — Part 2: Tolerances on shape and dimensions

EN 10058, title/subject: Hot rolled flat steel bars for general purposes — Dimensions and tolerances on shape and dimensions

EN 10059, title/subject: Hot rolled square steel bars for general purposes — Dimensions and tolerances on shape and dimensions

EN 10060, title/subject: Hot rolled round steel bars — Dimensions and tolerances on shape and dimensions

EN 10061, title/subject: Hot rolled hexagon steel bars — Dimensions and tolerances on shape and dimensions

EN 10279[1)], title/subject: Hot rolled steel channels — Tolerances on shape, dimensions and mass

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1) In the scopes of these dimensional standards, stainless steels are expressly excluded. On the other hand, these standards are used in practice for stainless steels, too. Therefore, they are listed here.

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[18] EN 10059, *Hot rolled square steel bars for general purposes — Dimensions and tolerances on shape and dimensions*

[19] EN 10060, *Hot rolled round steel bars — Dimensions and tolerances on shape and dimensions*

[20] EN 10061, *Hot rolled hexagon steel bars — Dimensions and tolerances on shape and dimensions*

[21] EN 10279[2)], *Hot rolled steel channels — Tolerances on shape, dimensions and mass*


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