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Stainless steels for general purposes

Part 1: Corrosion-resistant flat products

National foreword

This British Standard is the UK implementation of ISO 16143-1:2014.

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A list of organizations represented on this committee can be obtained on request to its secretary.

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INTERNATIONAL STANDARD

ISO 16143-1

Second edition
2014-05-15

Corrected version
2014-09-01

Stainless steels for general purposes —

Part 1: Corrosion-resistant flat products

Aciers inoxydables pour usage général —

Partie 1: Produits plats en acier résistant à la corrosion

Reference number
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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, *Steels*, Subcommittee SC 4, *Heat treatable and alloy steels*.

This second edition cancels and replaces the first edition (ISO 16143-1:2004), which has been technically revised.

This corrected version of ISO 16143-1:2014 incorporates the following corrections: in Tables 1, 6, A.3 and B.1, the steel designation name "X2CrNbCu22" has been corrected to "X2CrTiCu22"; normative reference ISO 15510 has been updated to the latest edition (2014); some cross-references and footnotes have been corrected or deleted.

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 1:
Corrosion-resistant flat products

1 Scope

This part of ISO 16143 specifies the technical delivery conditions for hot- or cold-rolled sheet/plate and strip for general purposes made of the most important corrosion-resistant stainless steel grades.

NOTE 1 In the text, under the term "general purposes", purposes other than the special purposes mentioned in References [1] to [4] are understood.

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 of the product forms listed in the first paragraph where quality characteristics are altered as a result of such 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 6507-1, *Metallic materials — Vickers hardness test — Part 1: Test method*

ISO 6508-1, *Metallic materials — Rockwell hardness test — Part 1: Test method (scales A, B, C, D, E, F, G, H, K, N, T)*

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 10474, *Steel and steel products — Inspection documents*

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

ISO 15510:2014, *Stainless steels — Chemical composition*

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: Different forms of products are given in ISO 6929.

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 covered by this part of ISO 16143. Such requirements to be considered include, but are not limited to, the following:

a) the desired quantity;

b) the product form (strip or sheet/plate);

c) the number of the appropriate dimensional standard, e.g. ISO 9444-1, ISO 9444-2, ISO 9445-1, ISO 9445-2, and ISO 18286 (see Annex D), 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 16143-1);

f) the steel name or steel number;

g) if, for the relevant steel in Tables 4 to 8, more than one treatment condition is covered, the symbol for the desired heat treatment or cold-worked condition;

h) the desired process route/surface finish (see Table 3);

i) if a verification of internal soundness is required for flat products with thickness ≥6 mm, requirements can be agreed at the time of enquiry and order (see 7.7);

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 5 t of cold-rolled narrow strip in accordance with ISO 9445-1 with a specified thickness of 0,25 mm, precision thickness tolerance (P), with a specified width of 250 mm, precision tolerance on width (P) and with restricted tolerances on edge camber (R) made of a steel grade with name X5CrNi18-10 and number 4301-304-00-I as specified in ISO 16143-1, in process route 2D and inspection certificate 3.1 as specified in ISO 10474, is designated as follows:

5 t cold-rolled narrow strip ISO 9445-1 - 0,25P × 250P - R
Steel ISO 16143-1 - X5CrNi18-10 + 2D
ISO 10474 – 3.1

or

5 t cold-rolled narrow strip ISO 9445-1 - 0,25P × 250P - R
Steel ISO 16143-1 - 4301-304-00-I + 2D
ISO 10474 – 3.1

6 Classification of grades

Corrosion-resistant stainless steels covered in 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 at the time of 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 upon in the order, by reference to the process route given in Table 3 and, where different alternatives exist, to the treatment conditions given in Tables 4 to 8, 14, and 16 (see also Annex A).

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.

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

7.4 Susceptibility to intergranular corrosion

Referring to resistance to intergranular corrosion as defined in ISO 3651-2, for ferritic, austenitic, and austenitic-ferritic steels, the specifications in Tables 4, 5, and 6 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 4 to 8 apply for the relevant specified heat-treatment condition. This does not apply to the 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 4 to 8 shall be obtainable from reference test pieces which have received the appropriate heat treatment (simulated heat treatment).

The values in Tables 9 to 13 apply for the 0,2 %- and 1 %-proof strength at elevated temperatures.

For cold-worked products, the 0,2 %-proof strength levels at ambient temperature as specified in Table 14 apply. The available 0,2 %-proof strength levels in the cold-worked condition are indicated in Table 15.

Alternatively, cold-worked products can be ordered according to their tensile strength levels as given in Tables 16 and 17.

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 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 can be expected to be greater, due to the impracticability of removing short lengths of coil.

Products delivered with hot-rolled or cold-rolled finishes (see Table 3) shall, unless otherwise agreed, be supplied with only one surface inspected to the required finish (the prime surface). In such instances, the manufacturer should indicate the prime surface, by marking the material or the packaging, or by some other agreed method. The default method is to mark the prime surface, and to make this surface the top surface of plates, sheets, and cut lengths, or the outside surface of coiled products.

Where necessary, precise requirements on surface quality can be agreed upon at the time of enquiry and order.

7.7 Internal soundness

For internal soundness, where appropriate, 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 ISO 9444-1, ISO 9444-2, ISO 9445-1, ISO 9445-2, and ISO 18286 (see Annex D).

7.9 Calculation of mass and tolerance of mass

7.9.1 The density values of the relevant grades for calculating the nominal mass of the products shall be taken from Annex D of ISO 15510:2014.

7.9.2 If the tolerances on mass are not specified in the dimensional standards mentioned in 7.8, they can be agreed upon at the time of enquiry and order.

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.

8.2 Inspection and testing procedures and types of inspection document

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 2.2 is to be provided, this shall cover

a) the 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 document 3.1 or 3.2 of 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 a) and b), the document shall cover

a) the results of the mandatory tests marked in the second column of Table 18 by an “m” and

b) the results of any optional test or inspection agreed when ordering, marked in the second column of Table 18 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), 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 18.

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 test samples for the tensile test shall be taken in accordance with Table 19 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 can be taken before flattening. 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 and for the resistance to intergranular corrosion test, where requested, shall be taken from the same locations as those for the mechanical tests. For the direction of bending the test piece in the resistance to intergranular corrosion test, see Figure 1.

8.4 Test methods

8.4.1 Unless otherwise agreed upon 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 6892-1:2009, taking into account the additional or deviating conditions specified in footnote [a] of Table 1. It shall be performed under controlled conditions in accordance with Clause 5 of ISO 6892-1:2009.

Unless otherwise agreed upon, the tensile strength and elongation after fracture shall be determined and, additionally, for ferritic and austenitic-ferritic steels, the 0,2 %-proof strength, and for austenitic steels, the 0,2 %- and 1 %-proof strengths shall be determined.

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 (specified in ISO 404).

8.4.4 The Brinell hardness test shall be carried out in accordance with ISO 6506-1. The Vickers hardness test shall be carried out in accordance with ISO 6507-1. The Rockwell hardness test shall be carried out in accordance with ISO 6508-1.

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

8.4.6 Dimensions and dimensional tolerances of the products shall be verified in accordance with the requirements of the relevant dimensional standards (see 7.8).

8.5 Retests

Use 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. As an alternative, for items that are wrapped, bundled, or boxed, or where the surface is ground or polished, the marking can be applied to the packaging, or to a tag securely attached to it.

Table 1 — Chemical composition (cast analysis)

Steel designation		% (mass fraction)[a]									
Name	ISO number	C	Si	Mn	P	S	Cr	Mo	Ni	N	Others
Austenitic steels											
X5CrNi17-7	4319-301-00-I	0,07	1,00	2,00	0,045	0,030[b]	16,0 to 18,0	—	6,0 to 8,0	0,10	—
X12CrNi17-7	4310-301-09-X	0,15	1,00	2,00	0,045	0,030	16,0 to 18,0	—	6,0 to 8,0	—	—
X2CrNiN18-7	4318-301-53-I	0,030	1,00	2,00	0,045	0,015	16,0 to 18,5	—	6,0 to 8,0	0,10 to 0,20	—
X6CrNiCu17-8-2	4567-304-76-I	0,08	1,70	3,00	0,045	0,030	15,0 to 18,0	—	6,0 to 9,0	—	Cu: 1,00 to 3,00
X10CrNi18-8	4310-301-00-I	0,05 to 0,15	2,00	2,00	0,045	0,030[b]	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[b]	17,5 to 19,5	—	8,0 to 10,0	0,10	—
X12CrNiSi18-9-3	4326-302-15-I	0,15	2,00 to 3,00	2,00	0,045	0,030	17,0 to 19,0	—	8,0 to 10,0	—	—
X2CrNiN18-9	4311-304-53-I	0,030	1,00	2,00	0,045	0,030[b]	17,5 to 19,5	—	8,0 to 10,0	0,12 to 0,22	—
X5CrNi18-10	4301-304-00-I	0,07	1,00	2,00	0,045	0,030[b]	17,5 to 19,5	—	8,0 to 10,5	0,10	—
X6CrNiTi18-10	4541-321-00-I	0,08	1,00	2,00	0,045	0,030[b]	17,0 to 19,0	—	9,0 to 12,0	—	Ti: 5 × C to 0,70
X6CrNiNb18-10	4550-347-00-I	0,08	1,00	2,00	0,045	0,030[b]	17,0 to 19,0	—	9,0 to 12,0	—	Nb: 10 × C to 1,00
X2CrNi19-11	4306-304-03-I	0,030	1,00	2,00	0,045	0,030[b]	18,0 to 20,0	—	10,0 to 12,0	0,10	—
X6CrNi18-12	4303-305-00-I	0,08	1,00	2,00	0,045	0,030[b]	17,0 to 19,0	—	10,5 to 13,0	0,10	—
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
X12CrMnNiN17-7-5	4372-201-00-I	0,15	1,00	5,5 to 7,5	0,045	0,030[b]	16,0 to 18,0	—	3,5 to 5,5	0,05 to 0,25	—
X2CrMnNiN17-7-5	4371-201-53-I	0,030	1,00	6,0 to 8,0	0,045	0,015	16,0 to 17,5	—	3,5 to 5,5	0,15 to 0,25	Cu: 1,00

Table 1 — *(continued)*

Steel designation		% (mass fraction)[a]									
Name	ISO number	C	Si	Mn	P	S	Cr	Mo	Ni	N	Others
X9CrMnNiCu17-8-5-2	4618-201-76-E	0,10	1,00	5,5 to 9,5	0,070	0,010	16,5 to 18,5	—	4,5 to 5,5	0,15	Cu: 1,00 to 2,50
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[b]	16,5 to 18,5	2,00 to 3,00	10,0 to 13,0	0,10	—
X5CrNiMo17-12-2	4401-316-00-I	0,08	1,00	2,00	0,045	0,030[b]	16,0 to 18,0	2,00 to 3,00	10,0 to 13,0	0,10	—
X6CrNiMoTi17-12-2	4571-316-35-I	0,08	1,00	2,00	0,045	0,030[b]	16,5 to 18,5	2,00 to 2,50	10,5 to 13,5	—	Ti: 5 × C to 0,70
X2CrNiMo17-12-3	4432-316-03-I	0,030	1,00	2,00	0,045	0,030[b]	16,5 to 18,5	2,50 to 3,00	10,5 to 13,0	0,10	—
X3CrNiMo17-12-3	4436-316-00-I	0,05	1,00	2,00	0,045	0,030[b]	16,5 to 18,5	2,50 to 3,00	10,5 to 13,0	0,10	—
X2CrNiMoN17-12-3	4429-316-53-I	0,030	1,00	2,00	0,045	0,030[b]	16,5 to 18,5	2,50 to 3,00	10,5 to 13,0	0,12 to 0,22	—
X2CrNiMo17-14-3	4435-316-03-X	0,030	1,00	2,00	0,045	0,030	16,0 to 18,0	2,0 to 3,0	12,0 to 15,0	—	—
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	—
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	—
X2CrNiMo19-14-4	4438-317-03-I	0,030	1,00	2,00	0,045	0,030[b]	17,5 to 20,0	3,0 to 4,0	12,0 to 15,0	0,10	—
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
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 W: 1,50 to 2,50

Table 1 — *(continued)*

Steel designation		% (mass fraction)[a]									
Name	ISO number	C	Si	Mn	P	S	Cr	Mo	Ni	N	Others
Austenitic steels with Mo											
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
X2NiCrMoN25-21-7	4478-083-67-U	0,030	1,00	2,00	0,040	0,030	20,0 to 22,0	6,0 to 7,0	23,5 to 25,5	0,18 to 0,25	Cu: 0,75
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
Austenitic-ferritic steels											
X2CrNiN22-2[f]	4062-322-02-U[f]	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	—
X2CrMnNiN21-5-1[f]	4162-321-01-E[f]	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
X2CrNiMoN22-5-3	4462-318-03-I	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	—
X2CrNiMnMoCuN24-4-3-2[f]	4662-824-41-X[f]	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
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
X2CrNiMoN25-7-3	4481-312-60-J	0,030	1,00	1,50	0,040	0,030	24,0 to 26,0	2,50 to 3,5	5,5 to 7,5	0,08 to 0,30	—
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 W: 0,50 o 1,00
Ferritic steels											
X2CrTi12	4512-409-10-I	0,030	1,00	1,00	0,040	0,030[b]	10,5 to 12,5	—	0,50	—	Ti: 6 × (C+N) to 0,65
X2CrNi12	4003-410-77-I	0,030	1,00	2,00	0,040	0,015	10,5 to 12,5	—	0,30 to 1,10	0,030	—

Table 1 — *(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[d]	1,00	1,00	0,040	0,030[b]	11,5 to 14,0	—	0,75	—	—
X6Cr17	4016-430-00-I	0,08[d]	1,00	1,00	0,040	0,030[b]	16,0 to 18,0	—	—	—	—
X2CrNb17	4510-430-36-X	0,030	0,75	1,00	0,040	0,030	16,0 to 19,0	—	—	—	Nb or Ti: 0,10 to 1,00
X3CrTi17	4510-430-35-I	0,05	1,00	1,00	0,040	0,030[b]	16,0 to 19,0	—	—	—	Ti: 0,15 to 0,75[c]
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
X6CrNi17-1	4017-430-91-E	0,08	1,00	1,00	0,040	0,015	16,0 to 18,0	—	1,20 to 1,60	—	—
X2CrCuTi18	4664-430-75-J	0,025	1,00	1,00	0,040	0,030	16,0 to 20,0	—	—	0,025	Ti: 8 × (C+N) to 0,80[c] Cu: 0,30 to 0,80
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 Nb: 0,30 + 3 × C to 1,00
X2CrNbCu21	4621-445-00-E	0,030	1,00	1,00	0,040	0,015	20, 0 to 21,5	—	—	0,030	Nb: 0,20 to 1,00 Cu: 0,10 to 1,00
X2CrTiCu22	4621-443-30-J	0,025	1,00	1,00	0,040	0,030	20,0 to 23,0	—	—	0,025	Cu:0,30 to 0,80 Ti: 8 × (C+N) to 0,80[c]
X6CrMoNb17-1	4526-436-00-I	0,08	1,00	1,00	0,040	0,015	16,0 to 18,0	0,80 to 1,40	—	0,040	Nb: 5 × C to 1,00
X2CrMo19	4609-436-77-J	0,025	1,00	1,00	0,040	0,030	17,0 to 20,0	0,40 to 0,80	—	0,025	Ti+Nb+Zr: 8 × (C+N) to 0,80
X2CrMoNbTi18-1	4513-436-00-J	0,025	1,00	1,00	0,040	0,030	16,0 to 19,0	0,75 to 1,50	—	0,025	Ti+Nb+Zr: 8 × (C+N) to 0,80
X2CrMoTi18-2	4521-444-00-I	0,025	1,00	1,00	0,040	0,015	17,0 to 20,0	1,75 to 2,50	—	0,030	Ti: 4 × (C+N) +0,15 to 0,80[c]
X2CrMo23-1	4128-445-92-J	0,025	1,00	1,00	0,040	0,030	21,0 to 24, 0	0,70 to 1,50	—	0,025	—

Table 1 — *(continued)*

Steel designation		% (mass fraction)[a]									
Name	**ISO number**	C	Si	Mn	P	S	Cr	Mo	Ni	N	Others
X1CrMo30-2	4135-447-92-C	0,010	0,40	0,40	0,030	0,020	28,5 to 32,0	1,50 to 2,50	—	0,015	—
Martensitic steels											
X12Cr13	4006-410-00-I	0,08 to 0,15	1,00	1,50	0,040	0,030[b]	11,5 to 13,5	—	0,75	—	—
X20Cr13	4021-420-00-I	0,16 to 0,25	1,00	1,50	0,040	0,030[b]	12,0 to 14,0	—	—	—	—
X30Cr13	4028-420-00-I	0,26 to 0,35	1,00	1,50	0,040	0,030[b]	12,0 to 14,0	—	—	—	—
X39Cr13	4031-420-00-I	0,36 to 0,42	1,00	1,00	0,040	0,030[b]	12,5 to 14,5	—	—	—	—
X46Cr13	4034-420-00-I	0,43 to 0,50	1,00	1,00	0,040	0,030[b]	12,5 to 14,5	—	—	—	—
X38CrMo14	4419-420-97-E	0,36 to 0,42	1,00	1,00	0,040	0,015	13,0 to 14,5	0,60 to 1,00	—	—	—
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	—
Precipitation-hardening steels											
X5CrNiCuNb16-4	4542-174-00-I	0,07	1,00	1,50	0,040	0,030[b]	15,0 to 17,0	0,60	3,0 to 5,0	—	Cu: 3,0 to 5,0 Nb: 0,15 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[e]	—	Al: 0,70 to 1,50

NOTE Elements not quoted 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] Particular ranges of sulfur content can provide improvement of particular properties. For machinability, a controlled sulfur content of 0,015 % to 0,030 % is recommended. For weldability, a controlled sulfur content of 0,008 % to 0,020 % can be beneficial. For polishability, a controlled sulfur content of 0,015 % maximum is recommended.

[c] Stabilization can be by the use of titanium and/or niobium and/or zirconium. According to the atomic mass of these elements and the content of carbon and nitrogen, the equivalence shall be the following: Nb (% by mass) ≡ Zr (% by mass) ≡ 7/4 Ti (% by mass).

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

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

[f] Patented steel grades.

Table 2 — Permissible deviations between the product analysis and the limiting values given in Table 1 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

[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 1, but not both at the same time.

Table 2 *(continued)*

Element	Specified limits, cast analysis % (mass fraction)		Permissible deviation[a] % (mass fraction)
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 1, but not both at the same time.

Table 3 — Types of process route and surface finish of flat products[a]

	Abbreviation[b]	Type of process route	Surface finish	Notes
Hot rolled	1U	Hot rolled, not heat treated, not descaled	Covered with the rolling scale	Suitable for products which are to be further worked, e.g. strip for rerolling.
	1C	Hot rolled, heat treated, not descaled	Covered with the rolling scale	Suitable for parts which will be descaled or machined in subsequent production or for certain heat-resistant applications.
	1E	Hot rolled, heat treated, mechanically descaled	Free of scale	The type of mechanical descaling, e.g. coarse grinding or shot blasting, depends on the steel grade and the product, and is left to the manufacturer's discretion, unless otherwise agreed upon.
	1D	Hot rolled, heat treated, pickled	Free of scale	Usually standard for most steel types to ensure good corrosion resistance; also common finish for further processing. It is permissible for grinding marks to be present. Not as smooth as 2D or 2B.
Cold rolled	2H	Work hardened	Bright	Cold worked to obtain higher strength level.
	2C	Cold rolled, heat treated, not descaled	Smooth with scale from heat treatment	Suitable for parts which will be descaled or machined in subsequent production or for certain heat-resistant applications.
	2E	Cold rolled, heat treated, mechanically descaled	Free of scale[f]	Usually applied to steels with scale that are very resistant to pickling solutions. Can be followed by pickling.
	2D	Cold rolled, heat treated, pickled	Smooth	Finish for good ductility, but not as smooth as 2B or 2R.
	2B	Cold rolled, heat treated, pickled, skin passed	Smoother than 2D	Most common finish for most steel types to ensure good corrosion resistance, smoothness, and flatness. Also common finish for further processing. Tension levelling can be used as an alternative to skin passing.
	2A	Cold rolled, heat treated, bright pickled, skin passed	Smoother and more reflective than 2B	Typical finish for ferritic grades when high reflectivity is desired.
	2Q	Cold rolled, hardened and tempered, scale free	Free of scale	Either hardened and tempered in a protective atmosphere or descaled after heat treatment.
	2R	Cold rolled, bright annealed[c]	Smooth, bright, reflective	Smoother and brighter than 2B. Also common finish for further processing.

Table 3 *(continued)*

	Abbreviation[b]	Type of process route	Surface finish	Notes
Special finishes	1G or 2G	Ground[d]	[e]	Grade of grit or surface roughness can be specified. Undirectional texture, not very reflective.
	1J or 2J	Brushed or dull polished[d]	Smoother than ground[e]	Grade of brush or polishing belt or surface roughness can be specified. Unidirectional texture, not very reflective.
	1K or 2K	Satin polish[d]	[e]	Additional specific requirements to a "J"-type finish, in order to achieve adequate corrosion resistance for marine and external architectural applications. Transverse $Ra < 0{,}5$ µm with clean cut surface finish.
	1N or 2N	Hair line polish	[e]	
	1P or 2P	Bright polished[d]	[e]	Mechanical polishing. Process or surface roughness can be specified. Non-directional finish, reflective with high degree of image clarity.
	2F	Cold rolled, heat treated, skin passed on roughened rolls	Uniform non-reflective matt surface	Heat treatment by bright annealing or by annealing and pickling.
	1M	Patterned	Design to be agreed upon; 2nd surface flat	Chequer plates used for floors.
	2M			A fine texture finish mainly used for architectural applications.
	2W	Corrugated	Design to be agreed upon	Used to increase strength and/or for cosmetic effect.
	2L	Coloured[d]	Colour to be agreed upon	
	1S or 2S	Surface coated[d]		Coated with e.g. tin, aluminium, titanium.

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

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

[c] Can be skin passed.

[d] One surface only, unless specifically agreed upon at the time of enquiry and order.

[e] Within each finish description, the surface characteristics can vary, and more specific requirements might have to be agreed upon between manufacturer and purchaser (e.g. grade of grit or surface roughness).

[f] Different methods of mechanical descaling can be used. Shot blasting will result in a rough and dull surface while brushing can result in a smooth surface.

Table 4 — Mechanical properties at room temperature for austenitic steels in the solution-annealed condition (see Table A.1)

Steel designation		Product form[a]	Thickness t	Proof strength		Tensile strength	Elongation after fracture	Impact energy[e]		Resistance to intergranular corrosion[f]	
Name	ISO number	(Class)	mm max.	$R_{p0,2}$	$R_{p1,0}$	R_m	A_{80}[d]	KV_2		in the delivery condition	in the sensitized condition[g]
				MPa min. (tr.)[bc]		MPa	% min. (tr.)	J min. l.	J min. tr.		
Austenitic steels											
X5CrNi17-7	4319-301-00-I	C	6	205	235	min. 520	40	—	—	yes	no
		H	9	205	235	min. 520	40	—	—		
		P	75	205	235	min. 520	40	—	—		
X12CrNi17-7	4310-301-09-X	C	6	205	—	min. 520	40	—	—	yes	no
		H	9	205	—	min. 520	40	—	—		
		P	75	205	—	min. 520	40	—	—		
X2CrNiN18-7	4318-301-53-I	C	8	350	380	650 to 850	40	—	—	yes	yes
		H	13,5	350	370	650 to 850	40	90	60		
		P	75	330	370	630 to 830	45	90	60		
X6CrNiCu17-8-2	4567-304-76-I	C	8	155	—	min. 450	40	—	—	no	no
		H	13,5	155	—	min. 450	40	—	—		
		P	75[i]	155	—	min. 450	40	—	—		
X10CrNi18-8	4310-301-00-I	C	8	250	280	600 to 800	40	—	—	no	no
		H	13,5	230	270	600 to 800	40	—	—		
X2CrNi18-9	4307-304-03-I	C (+AT1)	8	220	250	520 to 720	45	—	—	yes	yes
		C (+AT2)[h]		175	—	480 to 680		—	—		
		H	13,5	200	240	520 to 720	45	100	60		
		P	75[i]	200	240	500 to 700	45	100	60		
X12CrNiSi18-9-3	4326-302-15-I	C	8	205	—	min. 520	40	—	—	no	no
		H	13,5	205	—	min. 520	40	—	—		
		P	75[i]	205	—	min. 520	40	—	—		
X2CrNiN18-9	4311-304-53-I	C	8	290	320	550 to 750	40	—	—	yes	yes
		H	13,5	270	310	550 to 750	40	100	60		
		P	75[i]	270	310	530 to 730	40	100	60		

Table 4 *(continued)*

Steel designation		Product form[a]	Thickness t	Proof strength		Tensile strength	Elongation after fracture	Impact energy[e]		Resistance to intergranular corrosion[f]	
Name	ISO number	(Class)	mm max.	$R_{p0,2}$	$R_{p1,0}$	R_m	A_{80}[d]	KV_2		in the delivery condition	in the sensitized condition[g]
				MPa min. (tr.)[bc]		MPa	% min. (tr.)	J min. l.	J min. tr.		
X5CrNi18-10	4301-304-00-I	C	8	230	260	540 to 740	45[j]	—	—	yes	no[k]
		H	13,5	210	250	540 to 740	45[j]	100	60		
		P	75[i]	210	250	520 to 720	45	100	60		
X6CrNiTi18-10	4541-321-00-I	C	8	220	250	520 to 720	40	—	—	yes	yes
		H	13,5	200	240	520 to 720	40	100	60		
		P	75[i]	200	240	500 to 700	40	100	60		
X6CrNiNb18-10	4550-347-00-I	C	8	220	250	520 to 720	40	—	—	yes	yes
		H	13,5	200	240	520 to 720	40	100	60		
		P	75[i]	200	240	500 to 700	40	100	60		
X2CrNi19-11	4306-304-03-I	C	8	220	250	520 to 720	45	—	—	yes	yes
		H	13,5	200	240	520 to 720	45	100	60		
		P	75[i]	200	240	500 to 700	45	100	60		
X6CrNi18-12	4303-305-00-I	C	6	175	205	min. 480	40	—	—	yes	no
		H	9	175	205	min. 480	40	—	—		
		P	75	175	205	min. 480	40	—	—		
X8CrMnCuN17-8-3	4597-204-76-I	C	8	300	330	580 to 780	40	—	—	yes	no
		H	13,5	300	330	580 to 780	40	100	60		

Table 4 — *(continued)*

Steel designation		Product form[a]	Thick-ness t	Proof strength		Tensile stre ngth	Elonga tion after fracture	Impact energy[e] KV_2		Resistance to intergranular corrosion[f]	
Name	ISO number	(Class)	mm max.	$R_{p0,2}$ MPa min. (tr.)[bc]	$R_{p1,0}$ MPa min. (tr.)[bc]	R_m MPa	A_{80}[d] J min. l.	J min. l.	J min. tr.	in the deli very condi tion	in the sensi tized condi tion[g]
X12CrMnNIN17-7-5	4372-201-00-I	C	8	350	380	680 to 880	45	—	—	yes	no
		H	13,5	330	370	680 to 880	45	100	60		
		P	75	330	370	680 to 880	40	100	60		
X2CrMnNiN17-7-5	4371-201-53-I	C	8	300	330	650 to 850	45	—	—	yes	yes
		H	13,5	280	320	650 to 850	45	100	60		
		P	75	280	320	630 to 830	35	100	60		
X9CrMn-NiCu17-8-5-2	4618-201-76-E	C	8	230	250	540 to 850	45	100	60	yes	yes
		H	13,5	230	250	520 to 830	45	100	60		
		P	75	210	240	520 to 830	45	100	60		
X11CrNiMnN19-8-6	4369-202-91-I	C	4	340	370	750 to 950	35	—	—	yes	no
X1CrNi25-21	4335-310-02-I	P	75[i]	200	240	470 to 670	40	100	60	yes	yes
Austenitic steels with Mo											
X2CrNiMo17-12-2	4404-316-03-I	C (+AT1)	8	240	270	530 to 730	40	—	—	yes	yes
		C (+AT2)[h]	8	175	—	480 to 680	40	—	—		
		H	13,5	220	260	530 to 730	40	100	60		
		P	75[i]	220	260	510 to 710	40	100	60		
X5CrNiMo17-12-2	4401-316-00-I	C (+AT1)	8	240	270	530 to 730	40	—	—	yes	no[k]
		C (+AT2)[h]	8	205	—	520 to 720	40	—	—		
		H	13,5	220	260	530 to 730	40	100	60		
		P	75[i]	220	260	510 to 710	40	100	60		
X6CrNiMoTi17-12-2	4571-316-35-I	C	8	240	270	530 to 730	40	—	—	yes	yes
		H	13,5	220	260	530 to 730	40	100	60		
		P	75[i]	220	260	510 to710	40	100	60		

Table 4 *(continued)*

Steel designation		Product form[a]	Thick-ness t	Proof strength		Tensile stre ngth	Elonga tion after fracture	Impact energy[e] KV_2		Resistance to intergranular corrosion[f]	
Name	ISO number	(Class)	mm max.	$R_{p0,2}$ MPa min. (tr.)[bc]	$R_{p1,0}$ MPa min. (tr.)[bc]	R_m MPa	A_{80}[d] J min. l.	J min. l.	J min. tr.	in the deli very condi tion	in the sensi tized condi tion[g]
X2CrNiMo17-12-3	4432-316-03-I	C	8	240	270	530 to 730	40	—	—	yes	yes
		H	13,5	220	260	530 to 730	40	100	60		
		P	75[i]	220	260	510 to 710	40	100	60		
X3CrNiMo17-12-3	4436-316-00-I	C	8	240	270	530 to 730	40	—	—	yes	no[k]
		H	13,5	220	260	530 to 730	40	100	60		
		P	75[i]	220	260	510 to 710	40	100	60		
X2CrNiMoN17-12-3	4429-316-53-I	C	8	300	330	580 to 780	35	—	—	yes	yes
		H	13,5	280	320	580 to 780	35	100	60		
		P	75[i]	280	320	580 to 780	40	100	60		
X2CrNiMo17-14-3	4435-316-03-X	C	8	175	—	min. 480	40	—	—	yes	yes
		H	13,5	175	—	min. 480	40	—	—		
		P	75	175	—	min. 480	40	—	—		
X2CrNiMo18-14-3	4435-316-91-I	C	6	240	270	550 to 750	40	—	—	yes	yes
		H	12	220	260	550 to 750	40	100	60		
		P	75[h]	220	260	520 to 720	45	100	60		
X2CrNiMoN17-13-5	4439-317-26-E	C	8	290	320	580 to 780	35	—	—	yes	yes
		H	13,5	270	310	580 to 780	35	100	60		
		P	75[i]	270	310	580 to 780	40	100	60		
X2CrNiMo19-14-4	4438-317-03-I	C	8	240	270	550 to 700	35	—	—	yes	yes
		H	13,5	220	260	550 to 700	35	100	60		
		P	75	220	260	550 to 700	40	100	60		
X1CrNiMo-CuN20-18-7	4547-312-54-I	C	8	320	350	650 to 850	35	—	—	yes	yes
		H	13,5	300	340	650 to 850	35	100	60		
		P	75	300	340	650 to 850	40	100	60		
X1CrNiMoN25-22-2	4466-310-50-E	P	75[i]	250	290	540 to 740	40	100	60	yes	yes
X1CrNiMo-CuNW24-22-6	4659-312-66-I	P	75[i]	420	460	800 to 1 000	40	100	60	yes	yes

Table 4 *(continued)*

Steel designation		Product form[a]	Thickness t	Proof strength		Tensile strength	Elongation after fracture	Impact energy[e] KV_2		Resistance to intergranular corrosion[f]	
Name	ISO number	(Class)	mm max.	$R_{p0,2}$ MPa min. (tr.)[bc]	$R_{p1,0}$ MPa min. (tr.)[bc]	R_m MPa	A_{80}[d] J min. l.	J min. l.	J min. tr.	in the delivery condition	in the sensitized condition[g]
X1CrNiMo-CuN24-22-8	4652-326-54-I	C	8	430	470	750 to 950	40	—	—	yes	yes
		H	13,5	430	470	750 to 950	40	100	60		
		P	15	430	470	750 to 950	40	100	60		
X2CrNiMn-MoN25-18-6-5	4565-345-65-I	C	6	420	460	800 to 1 000	35	120	90	yes	yes
		H	10	420	460	800 to 1 000	35	120	90		
		P	40	420	460	800 to 1 000	35	120	90		
Austenitic steels with Ni/Co as main alloying elements											
X1NiCrMoCu25-20-5	4539-089-04-I	C	6	240	270	530 to 730	35	—	—	yes	yes
		H	12	220	260	530 to 730	35	100	60		
		P	75[i]	220	260	510 to 710	35	100	60		
X1NiCrMo-CuN25-20-7	4529-089-26-I	P	75	300	340	650 to 850	40	100	60	yes	yes
X1NiCrMoCu25-20-5	4539-089-04-I	C	6	240	270	530 to 730	35	—	—	yes	yes
		H	12	220	260	530 to 730	35	100	60		
		P	75[i]	220	260	510 to 710	35	100	60		
X2NiCrMoN25-21-7	4478-083-67-U	C	6	275	305	min. 640	40	—	—	yes	yes
		H	9	275	305	min. 640	40	—	—		
		P	75	275	305	min. 640	40	—	—		
X1NiCrMo-CuN25-20-7	4529-089-26-I	P	75	300	340	650 to 850	40	100	60	yes	yes

Table 4 *(continued)*

Steel designation		Product form[a]	Thick-ness t	Proof strength		Tensile stre ngth	Elonga tion after fracture	Impact energy[e] KV_2		Resistance to intergranular corrosion[f]	
Name	ISO number	(Class)	mm max.	$R_{p0,2}$ MPa min. (tr.)[bc]	$R_{p1,0}$ MPa min. (tr.)[bc]	R_m MPa	A_{80}[d] J min. l.	J min. l.	J min. tr.	in the deli very condi tion	in the sensi tized condi tion[g]
X1NiCrMoCu 31-27-4	4563-080-28-I	P	75[i]	220	260	500 to 700	40	100	60	yes	yes

NOTE 1 MPa = 1 N/mm^2.

a C = cold-rolled strip; H = hot-rolled strip; P = hot-rolled plate.

b If, in the case of strip in rolling widths < 300 mm, longitudinal test pieces are taken, the minimum values are reduced as follows:

— proof stress: minus 15 MPa;

— elongation for constant gauge length: minus 5 %;

— elongation for proportional gauge length: minus 2 %.

c For continuously hot-rolled products, 20 MPa higher minimum values of $R_{p0,2}$ and 10 MPa higher minimum values of $R_{p1,0}$ can be agreed upon at the time of enquiry and order.

d For thickness t < 3 mm, the values apply for test pieces with a gauge length of 80 mm and a width of 20 mm; test pieces with a gauge length of 50 mm and a width of 12,5 mm can also be used. For thickness t ≥ 3 mm, the values apply for test pieces with a gauge length of $5{,}65\sqrt{S_o}$.

e Impact test only for thickness above 10 mm.

f When tested in accordance with ISO 3651-2.

g See 7.4.

h This condition is only supplied if specially agreed at the time of enquiry and order. Otherwise, condition "+AT1" is supplied.

i For thicknesses above 75 mm, the mechanical properties can be agreed upon.

j For stretcher levelled material, the minimum value is 5 % lower.

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

Table 5 — Mechanical properties at room temperature for austenitic-ferritic steels in the solution-annealed condition (see Table A.2)

Steel designation		Product form[a]	Thickness t	0,2 %-proof strength	Tensile strength	Elongation after fracture	Impact energy KV_2[f]		Resistance to intergranular corrosion[e]	
Name	ISO number		mm max.	$R_{p0,2}$ MPa min. (tr.)[bc]	R_m MPa min.	A_{80}[d] % min. (long. + tr.)	J min. l.	J min. tr.	in the delivery condition	in the sensitized condition[g]
X2CrNiN22-2	4062-322-02-U	C	6,4	530	700 to 900	20	80	80	yes	yes
		H	10	480	680 to 900	30	80	80		
		P	75	400	650 to 850	30	80	60		
X2CrMnNIN21-5-1	4162-321-01-E	C	6,4	530	700 to 900	20	80	80	yes	yes
		H	10	480	680 to 900	30	80	80		
		P	75	450	650 to 850	30	60	60		
X2CrNiN23-4	4362-323-04-I	C	6	420	600	20	—	—	yes	yes
		H	12	400	600	20	100	60		
		P	75[h]	400	630	25	100	60		
X2CrNiMoN22-5-3	4462-318-03-I	C	6	480	660	20	—	—	yes	yes
		H	12	460	660	20	100	60		
		P	75[h]	460	640	20	100	60		
X2CrNiMnMo-CuN24-4-3-2	4662-824-41-X	C	6,4	550	750 to 900	20	80	80	yes	yes
		H	13	550	750 to 900	20	80	80		
		P	75	480	680 to 900	20	60	60		
X2CrNiMoCuN25-6-3	4507-325-20-I	C	8	550	750	17	—	—	yes	yes
		H	13,5	530	750	17	100	60		
		P	75[h]	530	730	25	100	60		
X2CrNiMoN25-7-3	4481-312-60-J	C	6	450	620	18	—	—	yes	yes
		H	9	450	620	18	—	—		
		P	75	450	620	18	—	—		
X2CrNiMoN25-7-4	4410-327-50-E	C	6	550	750	15	—	—	yes	yes
		H	12	530	750	15	100	60		
		P	75[h]	530	730	20	100	60		
X2CrNi-MoCuWN25-7-4	4501-327-60-I	P	75[h]	530	730	25	100	60	yes	yes

NOTE 1 MPa = 1 N/mm^2.

[a] C = cold-rolled strip; H = hot-rolled strip; P = hot-rolled plate.

[b] If, in the case of strip in rolling widths < 300 mm, longitudinal test pieces are taken, the minimum proof stress values are reduced by 15 MPa.

[c] For continuously hot-rolled products, 20 MPa higher minimum values of $R_{p0,2}$ can be agreed upon at the time of enquiry and order.

[d] For thickness t < 3 mm, the values apply for test pieces with a gauge length of 80 mm and a width of 20 mm; test pieces with a gauge length of 50 mm and a width of 12,5 mm can also be used. For thickness $t \geq 3$ mm, the values apply for test pieces with a gauge length of $5{,}65\sqrt{S_o}$.

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

[f] Impact test only for thickness above 10 mm.

[g] See 7.4.

[h] For thicknesses above 75 mm, the mechanical properties can be agreed upon.

Table 6 — Mechanical properties at room temperature for ferritic steels in the annealed condition (see Table A.3)

Steel designation		Product form[a]	Thickness t mm max.	0,2 %-proof strength $R_{p0,2}$[b] MPa min. (tr.)	Tensile strength R_m MPa min.	Elongation after fracture A_{80}[c] % min. (long. + tr.)	Resistance to intergranular corrosion[d]	
Name	ISO number	(Class)					in the delivery condition	in the welded condition
X2CrTi12	4512-409-10-I	C (+A1)	6	220	380	25	no	no
		C (+A2)[f]		175	360			
		H (+A1)	12	200	380	25		
		H (+A2)[f]		175	360			
X2CrNi12	4003-409-77-I	C	6	320	450	20	no	no
		H	12	320	450	20		
		P	25[e]	280	430	20		
X6Cr13	4000-410-08-I	C	8	240	400	19	no	no
		H	13,5	220	400			
		P	25[e]	220	400			
X6Cr17	4016-430-00-I	C (+A1)	6	250	450	20	yes	no
		C (+A2)[f]		205	420			
		H (+A1)	12	230	450	20		
		H (+A2)[f]		205	420			
		P	25[e]	230	430	20		
X2CrNb17	4510-430-36X	C	6	175	360	22	yes	yes
		H	12	175	360			
		P	25[e]	175	360			
X3CrTi17	4510-430-35-I	C (+A1)	6	240	420	23	yes	yes
		C (+A2)[f]		175	360			
		H (+A1)	12	220	420	23		
		H (+A2)[f]		175	360			
X3CrNb17	4511-430-71-I	C	6	230	420	23	yes	yes
X6CrNi17-1	4017-430-91-E	C	8	330	500	12	yes	no
X2CrCuTi18	4664-430-75-J	C	6	205	390	22	yes	yes
X2CrTiNb18	4509-439-40-X	C	8	230	430	18	yes	yes
X2CrNbCu21	4621-445-00-E	C	6	230	400	22	yes	yes
		H	13	230	400	22		
X2CrTiCu22	4621-443-30-J	C	6	205	390	22	yes	yes
		H	12	205	390	22		
X6CrMoNb17-1	4526-436-001-I	C	8	280	480	25	yes	yes

NOTE 1 MPa = 1 N/mm^2.

[a] C = cold-rolled strip; H = hot-rolled strip; P = hot-rolled plate.

[b] If, in the case of strip in rolling width < 300 mm, longitudinal test pieces are taken, the minimum proof stress values are reduced by 20 MPa.

[c] For thickness t < 3 mm, the values apply for test pieces with a gauge length of 80 mm and a width of 20 mm. Test pieces with a gauge length of 50 mm and a width of 12,5 mm can also be used. For thickness t ≥ 3 mm, the values apply for test pieces with a gauge length of $5{,}65\sqrt{S_o}$.

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

[e] For thicknesses above 25 mm, the mechanical properties can be agreed upon.

[f] This condition is only supplied if specially agreed at the time of enquiry and order. Otherwise, condition "+A1" is supplied.

Table 6 *(continued)*

Steel designation		Product form[a]	Thickness t mm max.	0,2 %-proof strength $R_{p0,2}$[b] MPa min. (tr.)	Tensile strength R_m MPa min.	Elongation after fracture A_{80}[c] % min. (long. + tr.)	Resistance to intergranular corrosion[d]	
Name	ISO number	(Class)					in the delivery condition	in the welded condition
X2CrMo19	4609-436-77-J	C	8	245	410	20	yes	yes
X2CrMoN-bTi18-1	4513-436-00-J	C	8	245	410	20	yes	yes
X2CrMoTi18-2	4521-444-00-I	C	8	300	420	20	yes	yes
		H	13,5	300	420	20		
		P	12	280	420	20		
X2CrMo23-1	4128-445-92-J	C	8	245	410	20	yes	yes
X1CrMo30-2	4135-447-92-C	C	8	295	450	22	yes	yes

NOTE 1 MPa = 1 N/mm2.

[a] C = cold-rolled strip; H = hot-rolled strip; P = hot-rolled plate.

[b] If, in the case of strip in rolling width < 300 mm, longitudinal test pieces are taken, the minimum proof stress values are reduced by 20 MPa.

[c] For thickness t < 3 mm, the values apply for test pieces with a gauge length of 80 mm and a width of 20 mm. Test pieces with a gauge length of 50 mm and a width of 12,5 mm can also be used. For thickness $t \geq 3$ mm, the values apply for test pieces with a gauge length of $5{,}65\sqrt{S_o}$.

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

[e] For thicknesses above 25 mm, the mechanical properties can be agreed upon.

[f] This condition is only supplied if specially agreed at the time of enquiry and order. Otherwise, condition "+A1" is supplied.

Table 7 — Mechanical properties at room temperature for martensitic steels in the heat-treated condition (see Table A.4)

Steel designation		Product form[a]	Thickness t	Heat treatment[b]	Hardness HBW	0,2 %-proof strength[c] $R_{p0,2}$	Tensile strength R_m MPa		Elongation after fracture[d] A %	Impact energy[e] KV_2 J	Hardness	
Name	ISO number		mm max.		max.	MPa min.	min.	max.	min.	min.	HRC	HV
X12Cr13	4006-410-00-I	C	8	+A	200	—	440	600	20	—	—	—
		H	13,5	+A	200	—	440	600	20	—	—	—
		P	75[f]	+QT1	—	400	550	750	15	—	—	—
		P	75[e]	+QT2	—	450	650	850	12	—	—	—

NOTE 1 MPa = 1 N/mm2.

[a] C = cold-rolled strip; H = hot-rolled strip; P = hot-rolled plate.

[b] +A: soft annealed; +QT: quenched and tempered.

[c] If, in the case of strip in rolling width < 300 mm, longitudinal test pieces are taken, the minimum proof stress values are reduced by 20 MPa.

[d] For thickness t < 3 mm, the values apply for test pieces with a gauge length of 80 mm and a width of 20 mm. Test pieces with a gauge length of 50 mm and a width of 12,5 mm can also be used. For thickness $t \geq 3$ mm, the values apply for test pieces with a gauge length of $5{,}65\sqrt{S_o}$.

[e] Impact test only for thickness above 10 mm.

[f] For thicknesses above 75 mm, the mechanical properties can be agreed upon.

Table 7 *(continued)*

Steel designation		Product form[a]	Thickness t	Heat treatment[b]	Hardness HBW	0,2 %-proof strength[c] $R_{p0,2}$	Tensile strength R_m MPa		Elongation after fracture[d] A %	Impact energy[e] KV_2 J	Hardness	
Name	ISO number		mm max.		max.	MPa min.	min.	max.	min.	min.	HRC	HV
X20Cr13	4021-420-00-I	C	3	+QT	—	—	—	—	—	—	44 to 50	440 to 530
		C	8	+A	225	—	520	700	15	—	—	—
		H	13,5	+A	225	—	520	700	15	—	—	—
		P	75[f]	+QT1	—	450	650	850	12	—	—	—
				+QT2		550	750	950	10	—	—	—
X30Cr13	4028-420-00-I	C	3	+QT	—	—	—	—	—	—	45 to 51	450 to 550
		C	8	+A	235	—	540	740	15	—	—	—
		H	13,5	+A	235	—	540	740	15	—	—	—
		P	75[f]	+QT1	—	600	800	1 000	10	—	—	—
X39Cr13	4031-420-00-I	C	3	+QT	—	—	—	—	—	—	47 to 53	480 to 580
		C	8	+A	240	—	—	760	12	—	—	—
		H	13,5	+A	240	—	—	760	12	—	—	—
X46Cr13	4034-420-00-I	C	8	+A	245	—	—	780	12	—	—	—
		H	13,5	+A	245	—	—	780	12	—	—	—
X38CrMo14	4419-420-97-E	C	3	+QT	—	—	—	—	—	—	46 to 52	450 to 560
		C	4	+A	235	—	—	760	15	—	—	—
		H	6,5	+A	235	—	—	760	15	—	—	—
X50CrMoV15	4116-420-77-E	C	8	+A	280	—	—	850	12	—	—	—
		H	13,5	+A	280	—	—	850	12	—	—	—
X3CrNiMo13-4	4313-415-00-I	P	75	+QT1	—	630	780	930	15	70	—	—
		P	75	+QT2	—	800	900	1 100	11	70	—	—
X4CrNiMo16-5-1	4418-431-77-E	P	75	+QT1	—	660	840	1 100	14	55	—	—

NOTE 1 MPa = 1 N/mm^2.

[a] C = cold-rolled strip; H = hot-rolled strip; P = hot-rolled plate.

[b] +A: soft annealed; +QT: quenched and tempered.

[c] If, in the case of strip in rolling width < 300 mm, longitudinal test pieces are taken, the minimum proof stress values are reduced by 20 MPa.

[d] For thickness t < 3 mm, the values apply for test pieces with a gauge length of 80 mm and a width of 20 mm. Test pieces with a gauge length of 50 mm and a width of 12,5 mm can also be used. For thickness $t \geq 3$ mm, the values apply for test pieces with a gauge length of $5{,}65\sqrt{S_o}$.

[e] Impact test only for thickness above 10 mm.

[f] For thicknesses above 75 mm, the mechanical properties can be agreed upon.

Table 8 — Mechanical properties at room temperature for the precipitation-hardening steel in the heat-treated condition (see Table A.5)

Steel designation		Product form[a]	Thickness	Heat treatment[b]	0,2 %-proof strength	Tensile strength R_m MPa		Elongation after fracture A
Name	ISO number		mm max.		$R_{p0,2}$ MPa min.	min.	max.	% min.
X5CrNi-CuNb16-4	4542-174-00-I	C	8	+AT[d]	—	—	1 275	5
				+P1300[e]	1 150	1 300	—	3
				+P900[e]	700	900	—	6
		P	50	+P1070[f]	1 000	1 070	1 270	8
				+P950[f]	800	950	1 150	10
				+P850[f]	600	850	1 050	12
				+SR630[g]	—	1 050	—	—
X7CrNiAl17-7	4568-177-00-I	C	8	+AT	—	—	1 030	19
				+P1300	1 200	1 300	—	—
				+P1450	1 310	1 450	—	2

NOTE 1 MPa = 1 N/mm^2.

[a] C = cold-rolled strip.

[b] +AT = solution annealed; +P = precipitation hardened; +SR = strength relieved.

[c] For thickness t < 3 mm, the values apply for test pieces with a gauge length of 80 mm and a width of 20 mm. Test pieces with a gauge length of 50 mm and a width of 12,5 mm can also be used. For thickness t ≥ 3 mm, the values apply for test pieces with a gauge length of $5{,}65\sqrt{S_o}$.

[d] Delivery condition.

[e] Condition of application; other precipitation-hardening temperatures can be agreed.

[f] If ordered in the finally treated condition.

[g] Delivery condition for further processing; final treatment according to Table A.5.

Table 9 — 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[b]										Minimum 1 %-proof strength, MPa[b]									
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
X5CrNi17-7	4319-301-00-I	+AT	157	142	127	118	110	104	98	95	92	90	191	172	157	145	135	129	125	122	120	120
X2CrNiN18-7	4318-301-53-I	+AT	265	200	185	180	170	165	—	—	—	—	300	235	215	210	200	195	—	—	—	—
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	147	132	118	108	100	94	89	85	81	80	181	162	147	137	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	161	156	152	149	147
X5CrNi18-10	4301-304-00-I	+AT	157	142	127	118	110	104	98	95	92	90	191	172	157	145	135	129	125	122	120	120
X6CrNiTi18-10	4541-321-00-I	+AT	176	167	157	147	136	130	125	121	119	118	208	196	186	177	167	161	156	152	149	147
X6CrNiNb18-10	4550-347-00-I	+AT	177	167	157	147	136	130	125	121	119	118	211	196	186	177	167	161	156	152	149	147
X2CrNi19-11	4306-304-03-I	+AT	147	132	118	108	100	94	89	85	81	80	181	162	147	137	127	121	116	112	109	108
X6CrNi18-12	4303-305-00-I	+AT	155	142	127	118	110	104	98	95	92	90	188	172	157	145	135	129	125	122	120	120
X8CrMnCuNB17-8-3	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
X12CrMnNiN17-7-5	4372-201-00-I	+AT	295	260	230	220	205	185	—	—	—	—	325	295	265	250	230	205	—	—	—	—
X2CrMnNiN17-7-5	4371-201-53-I	+AT	275	235	190	180	165	145	—	—	—	—	305	265	220	205	180	165	—	—	—	—
X9CrMnNICu17-8-5-2	4618-201-76-E	+AT	160	150	125	120	110	104	100	95	92	90	200	180	157	145	135	129	125	122	120	120
X11CrNiMnN19-8-6	4369-202-91-I	+AT	295	260	230	220	205	185	—	—	—	—	325	295	265	250	230	205	—	—	—	—
X1CrNi25-21	4335-310-02-I	+AT	150	140	130	120	115	110	105	—	—	—	180	170	160	150	140	135	130	—	—	—
X2CrNiMo17-12-2	4404-316-03-I	+AT	166	152	137	127	118	113	108	103	100	98	199	181	167	157	145	139	135	130	128	127
X5CrNiMo17-12-2	4401-316-00-I	+AT	177	162	147	137	127	120	115	112	110	108	211	191	177	167	156	150	144	141	139	137
X6CrNiMoTi17-12-2	4571-316-35-I	+AT	185	177	167	157	145	140	135	131	129	127	218	206	196	186	175	169	164	160	158	157
X2CrNiMo17-12-3	4432-316-03-I	+AT	166	152	137	127	118	113	108	103	100	98	199	181	167	157	145	139	135	130	128	127
X3CrNiMo17-13-3	4436-316-00-I	+AT	177	162	147	137	127	120	115	112	110	108	211	191	177	167	156	150	144	141	139	137
X2CrNiMoN17-12-3	4429-316-53-I	+AT	211	185	167	155	145	140	135	131	129	127	246	218	198	183	175	169	164	160	158	157
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	—	—	—
X2CrNiMo19-14--4	4438-317-03-I	+AT	172	157	147	137	127	120	115	112	110	108	206	188	177	167	156	148	144	140	138	136
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	—

[a] +AT = solution annealed.

[b] 1 MPa = 1 N/mm^2.

Table 9 *(continued)*

Steel designation		Heat treatment condition[a]	Minimum 0,2 %-proof strength, MPa[b]										Minimum 1 %-proof strength, MPa[b]									
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
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
X1CrNiMoCuN25-20-7	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

[a] +AT = solution annealed.

[b] 1 MPa = 1 N/mm^2.

Table 10 — 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
X2CrNi22-2	4062-322-02-U	+AT	380	350	330	315
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
X2CrNiMnMo-CuN24-4-3-2	4662-824-41-X	+AT	385	345	325	315
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 11 — 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
Standard grades									
X2CrTi12	4512-409-10-I	+A	200	195	190	185	180	160	—
X2CrNi12	4003-409-77-I	+A	240	235	230	220	215	—	—
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
X3CrTi17	4510-430-35-I	+A	195	190	185	175	165	155	—
X3CrNb17	4511-430-71-I	+A	230	220	205	190	180	165	—
X2CrTiNb18	4509-439-40-X	+A	230	220	210	205	200	180	—
X2CrNbCu21	4621-445-00-E	+A	240	230	220	210	205	200	—
X6CrMoNb17-1	4526-436-00-I	+A	270	265	250	235	215	205	—
X2CrMoTi18-2	4521-444-00-I	+A	250	240	230	220	210	205	200

[a] +A = annealed.

[b] 1 MPa = 1 N/mm^2.

Table 12 — 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
Standard grades									
X12Cr13	4006-410-00-I	+QT650	420	410	400	385	365	335	305
X20Cr13	4021-420-00-I	+QT650	420	410	400	385	365	335	305
X3CrNiMo13-4	4313-415-00-I	+QT780	590	575	560	545	530	515	—
		+QT900	720	690	665	640	620	—	—
X4CrNiMo16-5-1	4418-431-77-E	+QT840	660	640	620	600	580	—	—

[a] +QT = quenched and tempered.

[b] 1 MPa = 1 N/mm2.

Table 13 — 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
Special grades							
X5CrNiCuNb16-4	4542-174-00-I	+P1070	880	830	800	770	750
		+P950	730	710	690	670	650
		+P850	680	660	640	620	600

[a] +P = precipitation hardened.

[b] 1 MPa = 1 N/mm2.

Table 14 — 0,2 %-proof strength levels in the cold-worked condition (process route 2H)

Symbol	0,2 %-proof strength[ab] MPa[c]
+CP350	350 to 500
+CP500	500 to 700
+CP700	700 to 900
+CP900	900 to 1 100
+CP1100	1 100 to 1 300

[a] Intermediate proof strength values can be agreed.

[b] Maximum product thickness for each proof strength level decreases with the proof strength.

[c] 1 MPa = 1 N/mm2.

Table 15 — Available 0,2 %-proof strength levels of steel grades in the cold-worked condition (process route 2H)

Steel designation		Available 0,2 %-proof strength level				
Name	Number	+CP350	+CP500	+CP700	+CP900	+CP1100
X2CrNiN18-7	4318-301-53-I	—	X	X	—	—
X10CrNi18-8	4310-310-00-I	—	X	X	X	X[a]
X5CrNi18-10	4301-304-00-I	X	X	X	X	X
X6CrNiTi18-10	4541-321-00-I	X	X	—	—	—
X6CrNiNb18-10	4550-347-00-I	X	X	—	—	—
X8CrMnCuNB17-8-3	4597-204-76-I	X	X	X	—	—
X12CrMnNiN17-7-5	4372-201-00-I	—	X	X	X	X[b]
X2CrMnNiN17-7-5	4371-201-53-I	—	X	X	—	—
X9CrMnNiCu17-8-5-2	4618-201-76-I	X	X	X	X	—
X12CrMnNiN18-9-5	4373-202-00-I	—	X	X	—	—
X11CrNiMn19-8-6	4369-202-91-I	—	X	X	X	X
X5CrNiMo17-12-2	4401-316-00-I	X	X[a]	—	—	—
X6CrNiMoTi17-12-2	4571-316,35-I	X	X	—	—	—
X6Cr17	4016-430-00-I	X	X	—	—	—

[a] For higher $R_{p0,2}$ values, see EN 10151.

[b] Higher values up to proof strength level +CP1300 can be agreed.

Table 16 — Tensile strength levels in the cold-worked condition (process route 2H)

Symbol	Tensile strength[ab] MPa[c]
+C700	700 to 850
+C850	850 to 1 000
+C1000	1 000 to 1 150
+C1150	1 150 to 1 300
+C1300	1 300 to 1 500

[a] Intermediate tensile strength values can be agreed. Alternatively, the steels can be specified in terms of minimum 0,2 %-proof strength (see Table 18) or hardness, but only one parameter can be specified in the order.

[b] Maximum product thickness for each tensile strength level decreases with the tensile strength. The maximum product thickness and remaining elongation are also dependent on the work hardening behaviour of the steel and the cold working conditions. Consequently, more exact information can be requested from the manufacturer.

[c] 1 MPa = 1 N/mm^2.

Table 17 — Available tensile strength levels of steel grades in the cold-worked condition (process route 2H)

Steel designation		Available tensile strength level				
Name	Number	+C700	+C850	+C1000	+C1150	+C1300
X2CrNiN18-7	4318-301-53-I	—	X	X	—	—
X10CrNi18-8	4310-310-00-I	X	X	X	X	X[a]
X5CrNi18-10	4301-304-00-I	X	X	X	X	X
X6CrNiTi18-10	4541-321-00-I	X	X	—	—	—
X6CrNiNb18-10	4550-347-00-I	X	X	—	—	—
X8CrMnCuNB17-8-3	4597-204-76-I	X	X	X	—	—
X12CrMnNiN17-7-5	4372-201-00-I	—	X	X	X	X[b]
X2CrMnNiN17-7-5	4371-201-53-I	X	X	—	—	—
X9CrMnNiCu17-8-5-2	4618-201-76-I	X	X	X	X	—
X12CrMnNiN18-9-5	4373-202-00-I	X	X	—	—	—
X11CrNiMnN19-8-6	4369-202-91-I	—	X	X	X	X[b]
X5CrNiMo17-12-2	4401-316-00-I	X	X[a]	—	—	—
X6CrNiMoTi17-12-2	4571-316-35-I	X	X	—	—	—
X6Cr17	4016-430-00-I	X	X	—	—	—

[a] For higher R_m values, see EN 10151.

[b] Higher values up to tensile strength level +C1500 can be agreed.

Table 18 — Tests to be carried out, test units, and extent of testing in specific testing

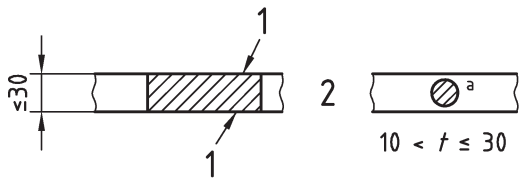
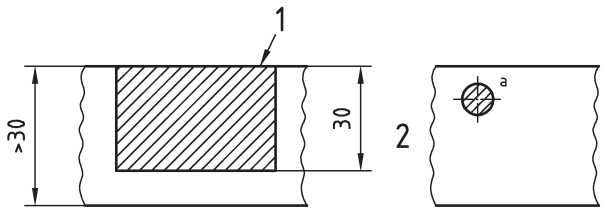
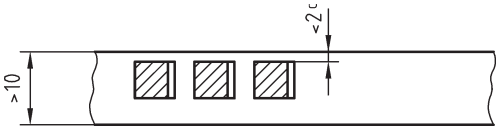
Test	Test category[a]	Test unit	Product form			Number of test pieces per test sample
			Strip and sheet cut from strip (C, H), in rolling width		Rolled plate (P)	
			< 600 mm	≥ 600 mm		
Chemical analysis	m	Cast	The cast analysis is given by the manufacturer.[b]			
Tensile test at room temperature or hardness test at room temperature	m	Same cast, same nominal thickness ±10 %, same final-treatment condition (i.e. same heat treatment and/or same degree of cold deformation)	The extent of testing shall be agreed at the time of ordering.	One test sample from each coil	a) Plates processed under identical conditions can be collected into a batch with a maximum total weight of 30 000 kg comprising no more than 40 plates. One test sample per batch shall be taken from heat-treated plates up to 15 m in length. One test sample shall be taken from each end of the longest plate in the batch where heat-treated plates are longer than 15 m. b) If the plate cannot be tested in batches, one test sample shall be taken from one end from heat-treated plates up to 15 m long and one test sample shall be taken from each end of heat-treated plates longer than 15 m.	1
Tensile test at elevated temperature	o		To be agreed at the time of ordering (see Tables 9 to 13)			1
Impact test at room temperature	o		To be agreed at the time of ordering (see Tables 4, 5, and 7)			3
Resistance to intergranular corrosion	o[c]		To be agreed upon 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 upon at the time of ordering; the extent of testing shall be specified at the same time.

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

Table 19 — Position of test pieces for flat products

Type of test piece	Product thickness mm	Direction of the longitudinal axis of the test piece in relation to the principal direction of rolling at a product width of		Distance of the test piece from the rolled surface mm
		<300 mm	≥300 mm	
Tensile[a]	≤30	Longitudinal	Transverse	 **Key** 1 rolled surface 2 flat or round test piece can be used
	>30			 **Key** 1 rolled surface 2 flat or round test piece can be used
Impact[bc]	>10	Longitudinal	Transverse	

[a] In cases of doubt or dispute, the gauge length shall be $L_o = 5{,}65\sqrt{S_o}$ for test pieces from products ≥3 mm.

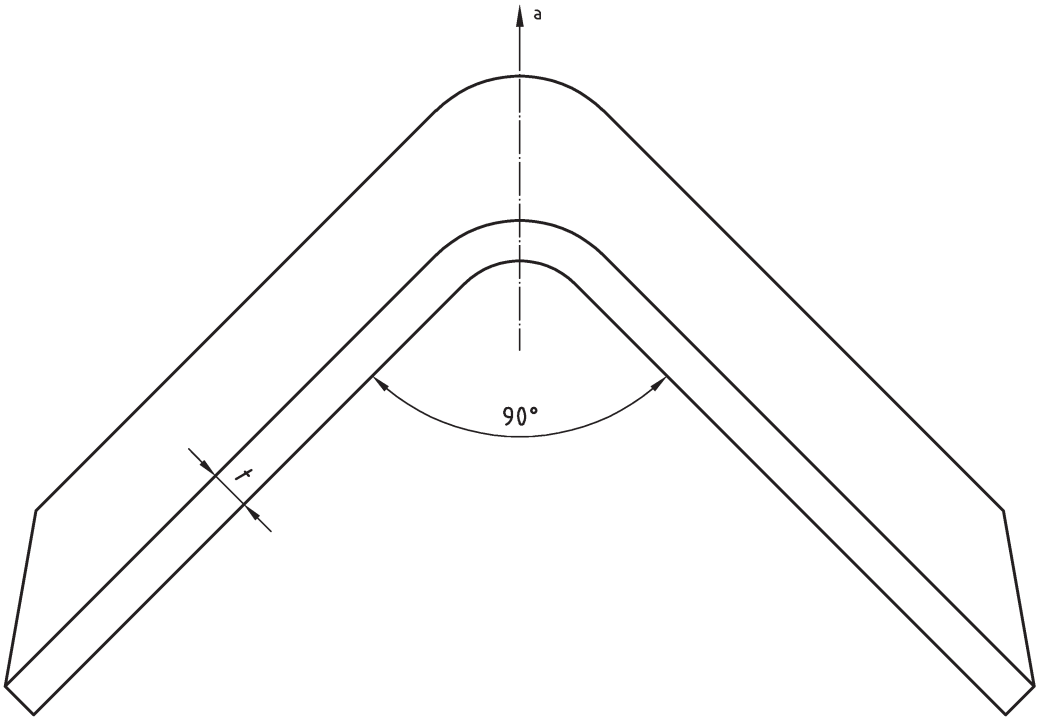
For products <3 mm in thickness, non-proportional test pieces with a gauge length of 80 mm and a width of 20 mm shall be used, but test pieces with a gauge length of 50 mm and a width of 12,5 mm can also be applied. For products with a thickness of 3 mm to 10 mm, flat proportional test pieces with two rolled surfaces and a maximum width of 30 mm shall be used. For products with thickness >10 mm, one of the following proportional test pieces can be used:

— a flat test piece with a maximum thickness of 30 mm; the thickness can be reduced to 10 mm by machining, but one rolled surface shall be preserved;

— a round test piece with a diameter ≥5 mm, the axis of which shall be located as near as possible to a plane in the outer third of half the product thickness.

[b] Longitudinal axis of the notch shall always be perpendicular to the rolled surface of the product.

[c] In the case of product thickness greater than 30 mm, the impact test piece can be taken at quarter of the product thickness.



Key

a Rolling direction.

Figure 1 — Direction of bending the test piece in relation to the rolling direction in the resistance to intergranular corrosion test

Annex A
(informative)

Guidelines for further treatment (including heat treatment) in fabrication

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

Flame cutting can adversely affect edge areas; where necessary, they should be machined.

As the corrosion resistance of stainless steels is only ensured with a metallically clean surface, 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 a smoother 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	Solution annealing	
Name	ISO number	Temperature °C	Type of cooling	Symbol	Temperature[bc] °C	Type of cooling
X5CrNi17-7	4319-301-00-I	1 150 to 850	Air	+AT	1 000 to 1 100	Water, air[e]
X12CrNi17-7	4310-301-09-X	1 150 to 850	Air	+AT	1 000 to 1 100	Water, air[e]
X2CrNiN18-7	4318-301-53-I	1 150 to 850	Air	+AT	1 020 to 1 100	Water, air[e]
X6CrNiCu17-8-2	4567-304-76-I	1 150 to 850	Air	+AT	1 010 to 1 150	Water, air[e]
X10CrNi18-8	4310-301-00-I	1 150 to 850	Air	+AT	1 010 to 1 090	Water, air[e]
X2CrNi18-9[d]	4307-304-03-I	1 150 to 850	Air	+AT	1 000 to 1 100	Water, air[e]
X12CrNiSi18-9-3	4326-302-15-I	1 150 to 850	Air	+AT	1 010 to 1 150	Water, air[e]
X2CrNiN18-9	4311-304-53-I	1 150 to 850	Air	+AT	1 000 to 1 100	Water, air[e]
X5CrNi18-10	4301-304-00-I	1 150 to 850	Air	+AT	1 000 to 1 100	Water, air[e]

[a] The temperature 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.

[c] The lower end of the range specified for solution annealing should be aimed at for heat treatment that is part of further processing, 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 %, and a temperature of 1 020 °C for steels with Mo contents exceeding 3 %.

[d] This procedure applies to both classes given in Table 4.

[e] Rapid cooling.

Table A.1 *(continued)*

Steel designation		Hot forming		Heat treatment	Solution annealing	
Name	ISO number	Temperature °C	Type of cooling	Symbol	Temperature[bc] °C	Type of cooling
X6CrNiTi18-10	4541-321-00-I	1 150 to 850	Air	+AT	1 000 to 1 100	Water, air[e]
X6CrNiNb18-10	4550-347-00-I	1 150 to 850	Air	+AT	1 020 to 1 120	Water, air[e]
X2CrNi19-11	4306-304-03-I	1 150 to 850	Air	+AT	1 000 to 1 100	Water, air[e]
X6CrNi18-12	4303-305-00-I	1 150 to 850	Air	+AT	1 000 to 1 100	Water, air[e]
X8CrMnCuN17-8-3	4597-204-76-I	1 150 to 850	Air	+AT	1 000 to 1 100	Water, air[e]
X12CrMnNiN17-7-5	4372-201-00-I	1 150 to 850	Air	+AT	1 000 to 1 100	Water, air[e]
X2CrMnNiN17-7-5	4371-201-53-I	1 150 to 850	Air	+AT	1 000 to 1 100	Water, air[e]
X9CrMnNiCu17-8-5-2	4618-201-76-E	1 150 to 850	Air	+AT	1 000 to 1 100	Water, air[e]
X11CrNiMnN19-8-6	4369-202-91-I	1 150 to 850	Air	+AT	1 000 to 1 100	Water, air[e]
X1CrNi25-21	4335-310-02-I	1 150 to 850	Air	+AT	1 030 to 1 110	Water, air[e]
X2CrNiMo17-12-2[d]	4404-316-03-I	1 150 to 850	Air	+AT	1 030 to 1 110	Water, air[e]
X5CrNiMo17-12-2[d]	4401-316-00-I	1 150 to 850	Air	+AT	1 030 to 1 110	Water, air[e]
X6CrNiMoTi17-12-2	4571-316-35-I	1 150 to 850	Air	+AT	1 030 to 1 110	Water, air[e]
X2CrNiMo17-12-3	4432-316-03-I	1 150 to 850	Air	+AT	1 030 to 1 110	Water, air[e]
X3CrNiMo17-13-3	4436-316-00-I	1 150 to 850	Air	+AT	1 030 to 1 110	Water, air[e]
X2CrNiMoN17-12-3	4429-316-53-I	1 150 to 850	Air	+AT	1 030 to 1 110	Water, air[e]
X2CrNiMo17-14-3	4435-316-03-X	1 150 to 850	Air	+AT	1 030 to 1 110	Water, air[e]
X2CrNiMo18-14-3	4435-316-91-I	1 150 to 850	Air	+AT	1 030 to 1 110	Water, air[e]

[a] The temperature 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.

[c] The lower end of the range specified for solution annealing should be aimed at for heat treatment that is part of further processing, 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 %, and a temperature of 1 020 °C for steels with Mo contents exceeding 3 %.

[d] This procedure applies to both classes given in Table 4.

[e] Rapid cooling.

Table A.1 *(continued)*

Steel designation		Hot forming		Heat treatment	Solution annealing	
Name	ISO number	Temperature °C	Type of cooling	Symbol	Temperature[bc] °C	Type of cooling
X2CrNiMoN17-13-5	4439-317-26-E	1 150 to 850	Air	+AT	1 060 to 1 140	Water, air[e]
X2CrNiMo19-14-4	4438-317-03-I	1 150 to 850	Air	+AT	1 070 to 1 150	Water, air[e]
X1CrNiMoCuN20-18-7	4547-312-54-I	1200 to 1000	Air	+AT	1 150 to 1 200	Water, air[e]
X1CrNiMoN25-22-2	4466-310-50-E	1 150 to 850	Air	+AT	1 070 to 1 150	Water, air[e]
X1CrNiMo-CuN24-22-6	4659-312-66-I	1 150 to 850	Air	+AT	1 040 to 1 200	Water, air[e]
X1CrNiMoCuN24-22-8	4652-326-54-I	1 200 to 1 000	Air	+AT	1 150 to 1 200	Water, air[e]
X2CrNiMn-MoN25-18-6-5	4565-345-65-I	1 200 to 950	Air	+AT	1 120 to 1 170	Water, air[e]
X1NiCrMoCu25-20-5	4539-089-04-I	1 150 to 850	Air	+AT	1 060 to 1 140	Water, air[e]
X1NiCrMoCuN25-20-7	4529-089-26-I	1 150 to 850	Air	+AT	1 120 to 1 180	Water, air[e]
X2NiCrMoN25-21-7	4478-083-67-U	1 150 to 850	Air	+AT		Water, air[e]
X1NiCrMoCu31-27-4	4563-080-28-I	1 150 to 850	Air	+AT	1 070 to 1 150	Water, air[e]

[a] The temperature 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.

[c] The lower end of the range specified for solution annealing should be aimed at for heat treatment that is part of further processing, 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 %, and a temperature of 1 020 °C for steels with Mo contents exceeding 3 %.

[d] This procedure applies to both classes given in Table 4.

[e] 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	
Name	ISO number	Temperature °C	Type of cooling		Temperature[b] °C	Typer 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	
X2CrNiN23-4	4362-323-04-I	1 150 to 950			950 to 1 050	
X2CrNiMoN22-5-3	4462-318-03-I				1 020 to 1 100	
X2CrNiMnMo-CuN24-4-3-2	4662-824-41-X	1 150 to 900			1 000 to 1 150	
X2CrNiMoCuN25-6-3	4507-325-20-I	1 150 to 1 000			1 040 to 1 120	
X2CrNiMoN25-7-3	4481-312-60-J					
X2CrNiMoN25-7-4	4410-327-50-E					
X2CrNi-MoCuWN25-7-4	4501-327-60-I					

[a] The temperature 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.

[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
X2CrTi12	4512-409-10-I	1 100 to 800	Air	+A	Class A1: 770 to 830 Class A2: 830 to 950	Air, water
X2CrNi12	4003-409-77-I				680 to 740	
X6Cr13	4000-410-08-I				750 to 810	
X6Cr17[c]	4016-430-00-I				Class A1: 770 to 830 Class A2: 780 to 850	
X2CrNb17	4510-430-36-X				800 to 1 050	
X3CrTi17	4510-430-35-I				Class A1: 770 to 830 Class A2: 830 to 950	
X3CrNb17	4511-430-71-I				790 to 850	
X6CrNi17-1	4017-430-91-E				750 to 810	
X2CrCuTi18	4664-430-75-J				800 to 1 050	
X2CrTiNb18	4509-439-40-X				870 to 930	
X2CrNbCu21	4621-445-00-E				850 to 950	
X2CrTiCu22	4621-443-30-J				850 to 950	
X6CrMoNb17-1	4526-436-00-I				800 to 860	
X2CrMo19	4609-436-77-J				800 to 1 050	
X2CrMoNbTi18-1	4513-436-00-J				800 to 1 050	
X2CrMoTi18-2	4521-444-00-I				820 to 880	
X2CrMo23-1	4128-445-92-J				850 to 1 050	
X1CrMo30-2	4135-447-92-C				900 to 1 050	

[a] The temperature 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.

[c] This procedure applies to both classes given in Table 6.

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	750 to 810	—	—	—	—
				+QT1	—	—	950 to 1 010	Oil, air	700 to 780
				+QT2	—	—	950 to 1 010	Oil, air	620 to 700
X20Cr13	4021-420-00-I		Slow cooling	+QT[c]	—	—	950 to 1 050	Oil, air	200 to 350
				+A	730 to 790	—	—	—	—
				+QT1	—	—	950 to 1 010	Oil, air	700 to 780
				+QT2	—	—	950 to 1 010	Oil, air	620 to 700
X30Cr13	4028-420-00-I			+QT [c]	—	—	950 to 1 050	Oil, air	200 to 350
				+A	730 to 790	—	—	—	—
				+QT1	—	—	950 to 1 010	Oil, air	650 to 730
X39Cr13	4031-420-00-I			+QT [c]	—	—	1 000 to 1 100	Oil, air	200 to 350
				+A	730 to 790	—	—	—	—
X46Cr13	4034-420-00-I			+A	730 to 790	—	—	—	—
X38CrMo14	4419-420-97-E			+QT1	—	—	1 000 to 1 100	Oil, air	200 to 350
				+A	750 to 830	—	—	—	—
X50CrMoV15	4116-420-77-E			+A	770 to 830	—	—	—	—
X3CrNiMo13-4	4313-415-00-I			+QT1	—	—	950 to 1 050	Oil, air	560 to 640
				+QT2	—	—	950 to 1 050	Oil, air	510 to 590
X4CrNiMo16-5-1	4418-431-77-E			+QT1	—	—	900 to 1 000	—	570 to 650

[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] For cold-rolled strip only.

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

Steel designation		Hot forming		Heat treatment symbol	Stress relieving	Annealing		Precipitation hardening °C
Name	ISO number	Temperature °C	Type of cooling			Temperature[b] °C	Type of cooling	
X5CrNi-CuNb16-4	4542-174-00-I	1 150 to 900	Air	+AT[d]	—	1 025 to 1 055	Air	—
				+P1300[e]	—	1 025 to 1 055	Air	4 h (160 to 630)
				+P900[e]	—			1 h (590 to 610)
				+P1070[f]	—			1 h (580 to 600)
				+P950[f]	—			1 h (540 to 560)
				+P850[f]	—			1 h (470 to 490)
				+SR630[g]	≥4 h (600 °C to 660 °C)	—	—	—
X7CrNiAl17-7	4568-177-00-I			+AT	—	1 030 to 1 050	Air	—
				+P1300	—	760 (40 min) to 820 (30 min)	[c]	2 h (480) to 1 h (550)
				+P1450	—	945 to 965 (10 min)	[d]	1 h (500 to 520)

[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] Quick cooling to ≤20 °C; cooling within 1 h at 12 °C; reheating in air to +20 °C.

[d] Quick cooling to ≤20 °C; cooling within 1 h to −70 °C; holding time 8 h; reheating in air to +20 °C.

Annex B
(informative)

Designations of the steels given in Table 1 and of comparable grades covered in ASTM, EN, JIS, and GB standards

Table B.1 — Designations of the steels given in Table 1 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										
4319-301-00-I	X5CrNi17-7	AP24H	S30100	W	1.4319	I	SUS301	W	S30110	W
4310-301-09-X	X12CrNi17-7	AP24N	S30100	I	(1.43XX)	I	SUS301	I	—	—
4318-301-53-I	X2CrNiN18-7	AP25A	S30153	W	1.4318	N	SUS301L	W	S30153	W
4567-304-76-I	X6CrNiCu17-8-2	AP25J	—	—	(1.4567)	W	SUS304J1	I	S30480	W
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
4326-302-15-I	X12CrNiSi18-9-3	AP27P	S30215	W	(1.4326)	I	SUS302B	I	S30240	N
4311-304-53-I	X2CrNiN18-9	AP27A	S30453	W	1.4311	N	SUS304LN	W	S30453	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	—	—	—	—
4372-201-00-I	X12CrMnNiN17-7-5	AP29O	S20100	N	1.4372	N	SUS201	W	S35350	N
4371-201-53-I	X2CrMnNiN17-7-5	AP29B	S20153	N	1.4371	N	—	—	—	—
4618-201-76-E	X9CrMnNiCu17-8-5-2	AP30L	—	—	1.4618	I	—	—	—	—
4369-202-91-I	X11CrNiMnN19-8-6	AP33L	—	—	1.4369	I	—	—	—	—
4335-310-02-I	X1CrNi25-21	AP46A	S31002	W	1.4335	I	—	—	—	—

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]
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
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
4435-316-03-X	X2CrNiMo17-14-3	AM34C	—	—	(1.44xx)	I	SUS316L	I	—	—
4435-316-91-I	X2CrNiMo18-14-3	AM35A	—	—	1.4435	N	SUS316L	W	S31603	W
4439-317-26-E	X2CrNiMoN17-13-5	AM35B	S31726	N	1.4439	I	—	—	S31723	W
4438-317-03-I	X2CrNiMo19-14-4	AM37A	S31703	W	1.4438	W	SUS317L	W	S31703	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	—	—	—	—
4478-083-67-U	X2NiCrMoN25-21-7	AN53A	N08367	I	1.4478	I	SUS836L	W	—	—
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	SUS329 J3L	W	S22053	N
4662-824-41-X	X2CrNiMnMo-CuN24-4-3-2	DM33A	—	—	1.4662	I	—	—	—	—
4507-325-20-I	X2CrNiMo-CuN25-6-3	DM34A	S32520	W	1.4507	I	—	—	S25554	—
4481-312-60-J	X2CrNiMoN25-7-3	DM35A	S31260	W	(1.4481)	I	SUS329 J4L	I	S22583	W
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
e) Ferritic steels										
4512-409-10-I	X2CrTi12	FP12B	S40900	W	1.4512	N	SUH409L	W	S11163	—
4003-410-77-I	X2CrNi12	FP12C	S41003	N	1.4003	N	—	—	S11213	N
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

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]
4510-430-36-X	X2CrNb17	FP17B	—	—	1.4510	N	SUS430LX	I	S11863	I
4510-430-35-I	X3CrTi17	FP17F	S43035	W	1.4510	N	SUS430LX	W	S11863	W
4511-430-71-I	X3CrNb17	FP17G	—	—	1.4511	N	SUS430LX	W	—	—
4017-430-91-E	X6CrNi17-1	FP17H	—	—	1.4017	I	—	—	—	—
4664-430-75-J	X2CrCuTi18	FP18A	—	—	(1.4664)	I	SUS430J 1L	I	—	—
4509-439-40-X	X2CrTiNb18	FP18B	S43940	I	1.4509	N	SUS430LX	W	S11873	I
4621-445-00-E	X2CrNbCu21	FP21B	S44500	W	(1.4621)	I	—	—	—	—
4621-443-30-J	X2CrTiCu22	FP22A	—	—	(1.4621)	N	SUS443J1	I	—	—
4526-436-00-I	X6CrMoNb17-1	FM18J	S43600	W	1.4526	N	—	—	S11770	W
4609-436-77-J	X2CrMo19	FM19B	—	—	(1.4609)	I	SUS436 J1L	I	—	—
4513-436-00-J	X2CrMoNbTi18-1	FM19A	S43600	W	(1.4513)	N	SUS436L	I	S11862	W
4521-444-00-I	X2CrMoTi18-2	FM20B	S44400	W	1.4521	N	SUS444	W	S11972	W
4128-445-92-J	X2CrMo23-1	FM24B	—	—	(1.4128)	I	SUS445J1	I	—	—
4135-447-92-C	X1CrMo30-2	FM32A	S44700	N	(1.4135)	I	SUS447J1	N	S13091	I
f) Martensitic steels										
4006-410-00-I	X12Cr13	MP13B	S41000	W	1.4006	I	SUS410	W	S41010	W
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
4031-420-00-I	X39Cr13	MP13P	S42000	W	1.4031	I	—	—	S42040	W
4034-420-00-I	X46Cr13	MP13Q	S42000	W	1.4034	I	—	—	S42040	W
4419-420-97-E	X38CrMo14	MM14P	—	—	1.4419	I	—	—	S45830	W
4313-415-00-I	X3CrNiMo13-4	MM14A	S41500	W	1.4313	N	SUSF6NM	W	S41595	W
4116-420-77-E	X50Cr MoV15	MM15U	—	—	1.4116	I	—	—	—	—
4418-431-77-E	X4CrNi Mo16-5-1	MM17A	—	—	1.4418	I	—	—	—	—

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]
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 1. 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)

Comparison list of abbreviations for process route/surface finish of flat products given in Table 3 covered in ASTM and JIS standards

Table C.1

Product form[a]	Usual finishes		Abbreviations for process route/surface finish according to		
	Type of process route	Surface finish	Table 3[bc]	ASTM[d]	JIS
H, P	Hot rolled, not heat treated, not descaled	Covered with the rolling scale	1U		
H, P	Hot rolled, heat treated, not descaled	Covered with the rolling scale	1C		
H, P	Hot rolled, heat treated, mechanically descaled	Free of scale	1E	1	1
H, P	Hot rolled, heat treated, pickled	Free of scale	1D[e]	1	1
C	Work hardened	Bright	2H	TR	
C	Cold rolled, heat treated, not descaled	Smooth with scale from heat treatment	2C		
C	Cold rolled, heat treated, mechanically descaled	Free of scale	2E		
C	Cold rolled, heat treated, pickled	Smooth	2D[e]	2D	2D
C	Cold rolled, heat treated, pickled, skin passed	Smoother than 2D	2B[e]	2B	2B
C	Cold rolled, heat treated, bright pickled, skin passed	Smoother and more reflective than 2B	2A		
C	Cold rolled, hardened and tempered, scale free	Free of scale	2Q		
C	Cold rolled, bright annealed	Smooth, bright, reflective	2R	BA	BA
C, H, P	Ground		1G or 2G		
C, H, P	Brushed or dull polished	Smoother than ground	1J or 2J	6	
C, H, P	Satin polish		1K or 2K	3,4	3,4,#240, #320 #400
C, H, P	Hair line polish		1N/2N		HL
C, H, P	Bright polished		1P or 2P	7,8	
C	Cold rolled, heat treated, skin passed on roughened rolls	Uniform non-reflective matt surface	2F		2D
C, H, P	Patterned	Design to be agreed; 2nd surface flat	1M		
			2M		
C	Corrugated	Design to be agreed	2W		

a C = cold-rolled strip, H = hot-rolled strip, P = hot-rolled plate (quarto).

b The same process routes/surface finishes are comprised in EN 10088-2.

c First digit: 1 = hot rolled, 2 = cold rolled.

d ASTM A480.

e Underlined abbreviations represent the most common finishes.

Table C.1

Product form[a]	Usual finishes		Abbreviations for process route/surface finish according to		
	Type of process route	Surface finish	Table 3[bc]	ASTM[d]	JIS
C	Coloured	Colour to be agreed	2L		
C, H	Surface coated		1S or 2S		

a C = cold-rolled strip, H = hot-rolled strip, P = hot-rolled plate (quarto).

b The same process routes/surface finishes are comprised in EN 10088-2.

c First digit: 1 = hot rolled, 2 = cold rolled.

d ASTM A480.

e Underlined abbreviations represent the most common finishes.

Annex D
(informative)

Applicable dimensional standards

ISO 9444-1, *Continuously hot-rolled stainless steel — Tolerances on dimensions and form — Part 1: Narrow strip and cut lengths*

ISO 9444-2, *Continuously hot-rolled stainless steel — Tolerances on dimensions and form — Part 2: Wide strip and sheet/plate*

ISO 9445-1, *Continuously cold-rolled stainless steel — Tolerances on dimensions and form — Part 1: Narrow strip and cut lengths*

ISO 9445-2, *Continuously cold-rolled stainless steel — Tolerances on dimensions and form — Part 2: Wide strip and plate/sheet*

ISO 18286, *Hot-rolled stainless steel plates — Tolerances on dimensions and shape*

Bibliography

[1] ISO 4955, *Heat-resistant steels*

[2] ISO 6931-2, *Stainless steels for springs — Part 2: Narrow strip*

[3] ISO 9328-1, *Steel flat products for pressure purposes — Technical delivery conditions — Part 1: General requirements*

[4] ISO 9328-7, *Steel flat products for pressure purposes — Technical delivery conditions — Part 7: Stainless steels*

[5] EN 10088-2:1995, *Stainless steels — Part 2: Technical delivery conditions for sheet/plate and strip for general purposes*

[6] ASTM A480-03, *Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip*

[7] JIS G 4304, *Hot-rolled stainless steel plate, sheet and strip*

[8] JIS G 4305, *Cold-rolled stainless steel plate, sheet and strip*

[9] EN 10151, *Stainless steel strip for springs — Technical delivery conditions*

[10] ISO 9444-1, *Continuously hot-rolled stainless steel — Tolerances on dimensions and form — Part 1: Narrow strip and cut lengths*

[11] ISO 9444-2, *Continuously hot-rolled stainless steel — Tolerances on dimensions and form — Part 2: Wide strip and sheet/plate*

[12] ISO 9445-1, *Continuously cold-rolled stainless steel — Tolerances on dimensions and form — Part 1: Narrow strip and cut lengths*

[13] ISO 9445-2, *Continuously cold-rolled stainless steel — Tolerances on dimensions and form — Part 2: Wide strip and plate/sheet*

[14] ISO 18286, *Hot-rolled stainless steel plates — Tolerances on dimensions and shape*

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