INTERNATIONAL STANDARD

ISO 16143-1

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Stainless steels for general purposes —

Part 1: Flat products

Aciers inoxydables pour usage général —

Partie 1: Produits plats

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.

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

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

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 16143-1 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 4, *Heat treatable and alloy steels*.

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

— *Part 1: Flat products*

— *Part 2: Semi-finished products, bars, rods and sections*

— *Part 3: Wire*

Stainless steels for general purposes —

Part 1:
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 In the text, under the term “general purposes”, purposes other than the special purposes mentioned in the bibliographic references [1] — [4] are understood.

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 paragraph 1 where quality characteristics are altered as a result of such processing.

2 Normative references

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

ISO 377:1997, *Steel and steel products — Location and preparation of samples and test pieces for mechanical testing*

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

ISO 3651-2:1998, *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/TS 4949:2003, *Steel names based on letter symbols*

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

ISO 6507-1:1997, *Metallic materials — Vickers hardness test — Part 1: Test method*

ISO 6508-1:1999, *Metallic materials — Rockwell hardness test — Part 1: Test method (scales A, B, C, D, E, F, G, H, K, N, T)*

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

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

ISO 9444:2002, *Continuously hot-rolled stainless steel strip, plate/sheet and cut lengths — Tolerances on dimensions and form*

ISO 9445:2002, *Continuously cold-rolled stainless steel narrow strip, wide strip, plate/sheet and cut lengths — Tolerances on dimensions and form*

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

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

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

ISO/TS 15510:2003, *Stainless steels — Chemical composition*

ISO 18286:2004, *Hot-rolled stainless steel plates — Tolerances on dimensions and shape*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
corrosion-resistant stainless steels
steels, 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 forms
See ISO 6929

4 Designation

The steel names given in Tables 1, 4, 5, 6, 7 and 8 are allocated in accordance with ISO/TS 4949.

5 Information to be supplied by the purchaser

It shall be the responsibility of the purchaser to specify all requirements that are necessary for products covered by this specification. 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 (see ISO 9444, ISO 9445 and ISO 18286), the nominal dimensions, plus any choice of requirements;

d) the type of material (steel);

e) the number of this International Standard, i.e. ISO 16143-1;

f) the steel name;

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;

h) the desired process route (see Table 3);

i) if an inspection document is required, its designation in accordance with ISO 10474.

EXAMPLE 5 t of cold-rolled narrow strip in accordance with ISO 9445 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 steel grade X5CrNi18-9 as specified in ISO 16143-1, in process route 2D and inspection certificate 3.1.B as specified in ISO 10474 is designated as follows:

5 t cold-rolled narrow strip ISO 9445 — 0,25P × 250P — R
Steel ISO 16143-1-X5CrNi18-9 + 2D
3.1 B

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;

— 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 (also see 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 may 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 specification in Tables 4, 5 and 6 apply.

NOTE 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).

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

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

7.7 Internal soundness

For the internal soundness, where appropriate, requirements together with the conditions for their verification may 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, ISO 9445 and ISO 18286.

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 B of ISO/TS 15510:2003.

7.9.2 If the tolerances on mass are not specified in the dimensional standards mentioned in 7.8, they may 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 assure himself that the delivery complies with the requirements of the order.

This includes the following:

— a suitable frequency of verification of the dimensions of the products;

— an adequate intensity of visual examination of the surface quality of the products;

— an appropriate frequency and type of test to ensure that the correct grade of steel is delivered.

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

8.2 Inspection and testing procedures and types of inspection document

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

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

a) the statement that the material complies with the requirements of the order;

b) the results of the cast analysis for all elements specified for the type of steel supplied.

8.2.3 If, in accordance with the agreements in the order, an inspection certificate 3.1.A, 3.1.B or 3.1.C or an inspection report 3.2 of ISO 10474:1991 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 9 by an “m”;

b) the results of any optional test or inspection agreed when ordering, marked in the second column of Table 9 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 9.

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 Figure 1 in such a way that they are located halfway between the centre and a longitudinal edge.

The samples shall be taken from products in the delivery condition. If agreed, the samples may be taken 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 direction of bending the test piece in the resistance to intergranular corrosion test, see Figure 2.

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 at room temperature shall be carried out in accordance with ISO 6892 taking into account the additional or deviating conditions specified in footnote [a] of Figure 1.

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.

8.4.3 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.

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

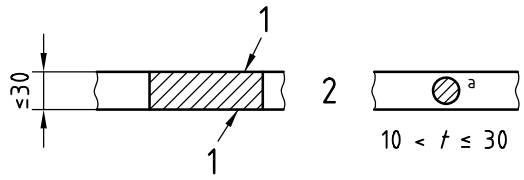
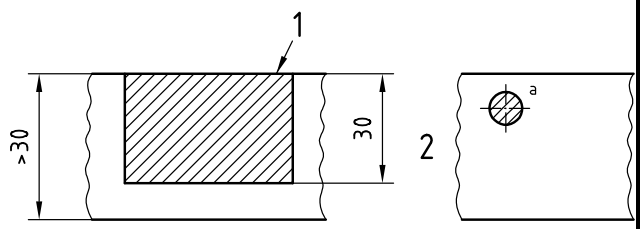
8.4.5 Dimensions and dimensional tolerances of the products shall be verified in accordance with the requirements of the relevant dimensional standards (see 7.8).

8.5 Retests

See ISO 404.

9 Marking

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

Type of test piece	Product thickness	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	mm
Tensile [a]	⩽ 30	Longitudinal	Transverse	 **Key** 1 rolled surface 2 flat or round test piece may be used
	> 30			 **Key** 1 rolled surface 2 flat or round test piece may be used

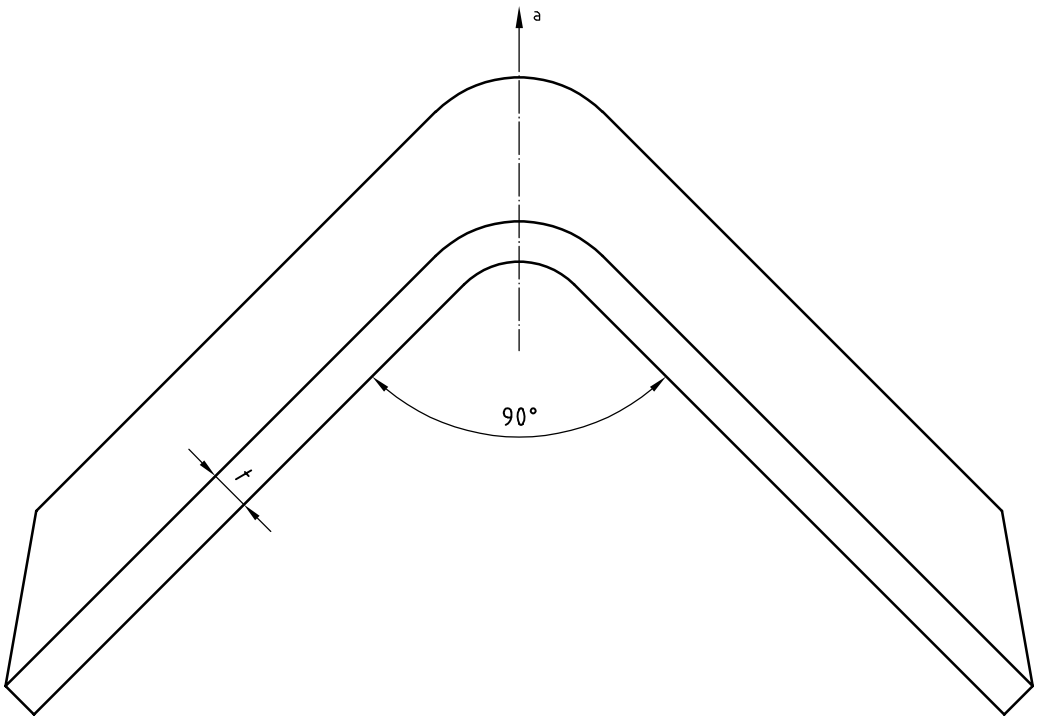
[a] In cases of doubt or dispute, the gauge length shall be $L_o = 5,65\sqrt{S_o}$ for test pieces from products ⩾ 3 mm.

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 may 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 may be used:

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

— or 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.

Figure 1 — Position of test pieces for flat products



a Rolling direction.

Figure 2 — Direction of bending the test piece in relation to the rolling direction in the resistance to intergranular corrosion test.

Table 1 — Chemical composition (cast analysis) [a]

Designation	Line number of ISO/TS 15510:2003	% (mass fraction)									
Name		C	Si	Mn	P max.	S max.	N	Cr	Mo	Ni	Others
Austenitic steels											
X2CrNi18-9	1	max. 0,030	max. 1,00	max. 2,00	0,045	0,030 [b]	max. 0,11	17,5 to 19,5	—	8,0 to 10,0	—
X2CrNi19-11	2	max. 0,030	max. 1,00	max. 2,00	0,045	0,030 [b]	max. 0,11	18,0 to 20,0	—	10,0 to 12,0	—
X2CrNiN18-9	3	max. 0,030	max. 1,00	max. 2,00	0,045	0,030 [b]	0,12 to 0,22	17,5 to 19,5	—	8,0 to 10,0	—
X5CrNi18-9	6	max. 0,07	max. 1,00	max. 2,00	0,045	0,030 [b]	max. 0,11	17,5 to 19,5	—	8,0 to 10,5	—
X10CrNi18-8	11	0,05 to 0,15	max. 2,00	max. 2,00	0,045	0,030 [b]	max. 0,11	16,0 to 19,0	max. 0,80	6,0 to 9,5	—
X1CrNi25-21	12	max. 0,02	max. 0,25	max. 2,00	0,025	0,010	max. 0,11	24,0 to 26,0	max. 0,20	20,0 to 22,0	—
X12CrMnNiN17-7-5	13	max. 0,15	max. 1,00	5,5 to 7,5	0,045	0,030 [b]	0,05 to 0,25	16,0 to 18,0	3,5 to 5,5	—	—
X6CrNiTi18-10	16	max. 0,08	max. 1,00	max. 2,00	0,045	0,030 [b]	—	17,0 to 19,0	—	9,0 to 12,0	Ti: 5xC to 0,70
X6CrNiNb18-10	19	max. 0,08	max. 1,00	max. 2,00	0,045	0,030 [b]	—	17,0 to 19,0	—	9,0 to 12,0	Nb: 10xC to 1,00
X2CrNiMo17-12-2	21	max. 0,030	max. 1,00	max. 2,00	0,045	0,030 [b]	max. 0,11	16,5 to 18,5	2,00 to 3,00	10,0 to 13,0	—
X2CrNiMo17-12-3	22	max. 0,030	max. 1,00	max. 2,00	0,045	0,030 [b]	max. 0,11	16,5 to 18,5	2,50 to 3,00	10,5 to 13,0	—
X2CrNiMo18-14-3	23	max. 0,030	max. 1,00	max. 2,00	0,045	0,015	max. 0,11	17,0 to 19,0	2,50 to 3,00	12,5 to 15,0	—
X2CrNiMoN17-12-3	26	max. 0,030	max. 1,00	max. 2,00	0,045	0,030 [b]	0,12 to 0,22	16,5 to 18,5	2,50 to 3,00	10,5 to 13,0	—
X1CrNiMoN25-22-2	29	max. 0,020	max. 0,70	max. 2,00	0,025	0,010	0,10 to 0,16	24,0 to 26,0	2,00 to 2,50	21,0 to 23,0	—
X5CrNiMo17-12-2	30	max. 0,07	max. 1,00	max. 2,00	0,045	0,030 [b]	max. 0,11	16,5 to 18,5	2,00 to 3,00	10,0 to 13,0	—
X3CrNiMo17-12-3	31	max. 0,05	max. 1,00	max. 2,00	0,045	0,030 [b]	max. 0,11	16,5 to 18,5	2,50 to 3,00	10,5 to 13,0	—
X6CrNiMoTi17-12-2	32	max. 0,08	max. 1,00	max. 2,00	0,045	0,030 [b]	—	16,5 to 18,5	2,00 to 2,50	10,5 to 13,5	Ti: 5xC to 0,70
X1NiCrMoCu25-20-5	35	max. 0,020	max. 0,75	max. 2,00	0,035	0,015	max. 0,15	19,0 to 22,0	4,0 to 5,0	23,5 to 26,0	Cu: 1,20 to 2,00
X1NiCrMoCu31-27-4	36	max. 0,020	max. 0,70	max. 2,00	0,030	0,010	max. 0,11	26,0 to 28,0	3,0 to 4,0	30,0 to 32,0	Cu: 0,70 to 1,50
X1CrNiMoCuN24-22-8	38	max. 0,020	max. 0,50	2,0 to 4,0	0,030	0,005	0,45 to 0,55	23,0 to 25,0	7,0 to 8,0	21,0 to 23,0	Cu: 0,30 to 0,60
X8CrMnCuN17-8-3	40	max. 0,10	max. 2,00	6,5 to 8,5	0,040	0,030	0,15 to 0,30	16,0 to 18,0	max. 1,00	max. 2,00	Cu: 2,00 to 3,5
X1CrNiMoCuNW24-22-6	41	max. 0,020	max. 0,70	2,0 to 4,0	0,030	0,010	0,35 to 0,50	23,0 to 25,0	5,5 to 6,5	21,0 to 23,0	Cu: 1,00 to 2,00 W: 1,50 to 2,50
X2CrNiMnMoN25-18-6-5	42	max. 0,030	max. 1,00	5,0 to 7,0	0,030	0,015	0,30 to 0,60	24,0 to 26,0	4,0 to 5,0	16,0 to 19,0	Nb: max. 0,15
X11CrNiMnN19-8-6	43	0,07 to 0,15	0,50 to 1,00	5,0 to 7,5	0,030	0,015	0,20 to 0,30	17,5 to 19,5	—	6,5 to 8,5	—

Table 1 (*continued*)

Designation	Line number of ISO/TS 15510:2003	% (mass fraction)									
Name		C	Si	Mn	P max.	S max.	N	Cr	Mo	Ni	Others
X6CrNiCu17-8-2	45	max. 0,08	max. 1,70	max. 3,00	0,045	0,030	—	15,0 to 18,0	—	6,0 to 9,0	Cu: 1,00 to 3,00
X12CrNiSi18-9-3	46	max. 0,15	2,00 to 3,00	max. 2,00	0,045	0,030	—	17,0 to 19,0	—	8,0 to 10,0	—
Austenitic-ferritic steels											
X2CrNiN23-4	51	max. 0,030	max. 1,00	max. 2,00	0,035	0,015	0,05 to 0,20	22,0 to 24,0	0,10 to 0,60	3,5 to 5,5	Cu: 0,10 to 0,60
X2CrNiMoN22-5-3	52	max. 0,030	max. 1,00	max. 2,00	0,035	0,015	0,10 to 0,22	21,0 to 23,0	2,5 to 3,5	4,5 to 6,5	—
X2CrNiMoCuN25-6-3	53	max. 0,030	max. 0,70	max. 2,00	0,035	0,015	0,15 to 0,30	24,0 to 26,0	2,5 to 4,0	5,0 to 7,5	Cu: 1,00 to 2,50
X2CrNiMoN25-7-4	54	max. 0,030	max. 1,00	max. 2,00	0,035	0,015	0,24 to 0,35	24,0 to 26,0	3,0 to 4,5	6,0 to 8,0	—
X2CrNiMoCuWN25-7-4	56	max. 0,030	max. 1,00	max. 1,00	0,035	0,015	0,20 to 0,30	24,0 to 26,0	3,0 to 4,0	6,0 to 8,0	Cu: 0,50 to 1,00 W: 0,50 to 1,00
Ferritic steels											
X2CrNi12	61	max. 0,030	max. 1,00	max. 1,50	0,040	0,015	max. 0,030	10,5 to 12,5	—	0,30 to 1,10	—
X2CrTi12	62	max. 0,030	max. 1,00	max. 1,00	0,040	0,030 [b]	—	10,5 to 12,5	—	max. 0,50	Ti: 6x(C+N) to 0,65
X6Cr17	67	max. 0,08	max. 1,00	max. 1,00	0,040	0,030 [b]	—	16,0 to 18,0	—	—	—
X3CrTi17	70	max. 0,05	max. 1,00	max. 1,00	0,040	0,030 [b]	—	16,0 to 19,0	—	—	Ti: [4x(C+N) +0,20] to 0,75
X3CrNb17	73	max. 0,05	max. 1,00	max. 1,00	0,040	0,015	—	16,0 to 18,0	—	—	Nb: 12xC to 1,00
Martensitic steels											
X12Cr13	82	0,08 to 0,15	max. 1,00	max. 1,50	0,040	0,030 [b]	—	11,5 to 13,5	—	max. 0,75	—
X20Cr13	84	0,16 to 0,25	max. 1,00	max. 1,50	0,040	0,030 [b]	—	12,0 to 14,0	—	—	—
X30Cr13	85	0,26 to 0,35	max. 1,00	max. 1,50	0,040	0,030 [b]	—	12,0 to 14,0	—	—	—
X39Cr13	86	0,36 to 0,42	max. 1,00	max. 1,00	0,040	0,030 [b]	—	12,5 to 14,5	—	—	—
Precipitation-hardening steel											
X7CrNiAl17-7	102	max. 0,09	max. 0,70	max. 1,00	0,040	0,015	—	16,0 to 18,0	—	6,5 to 7,8 [c]	Al: 0,70 to 1,50

[a] Elements not listed in this table may not 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.

[b] Particular ranges of sulfur content may 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 % may be beneficial. For polishability, a controlled sulfur content of 0,015 % maximum is recommended.

[c] By special agreement, the steel when intended for cold deformation may also be ordered with 7,00 % to 8,30 % Ni.

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

Element	Permissible maximum content in the cast analysis % (mass fraction)		Permissible deviation [a] % (mass fraction)
Carbon		⩽ 0,030	+ 0,005
	> 0,030	⩽ 0,20	± 0,01
	> 0,20	⩽ 0,5	± 0,02
Silicon		⩽ 1,00	± 0,04
	> 1,00	⩽ 3,00	± 0,07
Manganese		⩽ 1,00	+ 0,04
	> 1,00	⩽ 2,00	+ 0,07
	> 2,00	⩽ 10,0	± 0,1
Phosphorus		⩽ 0,045	+ 0,005
Sulfur		⩽ 0,015	+ 0,003
	> 0,015	⩽ 0,030	+ 0,005
Nitrogen	⩾ 0,03	⩽ 0,11	± 0,01
	> 0,11	⩽ 0,60	± 0,02
Chromium	⩾ 10,5	⩽ 28,0	± 0,2
Molybdenum		⩽ 0,60	± 0,03
	> 0,60	< 1,75	± 0,07
	⩾ 1,75	⩽ 8,0	± 0,1
Nickel		⩽ 1,00	± 0,04
	> 1,00	⩽ 5,0	± 0,1
	> 5,0	⩽ 32,0	± 0,2
Aluminium	⩾ 0,30	⩽ 1,50	± 0,1
Copper		⩽ 1,00	± 0,04
	> 1,00	⩽ 5,00	± 0,1
Niobium	⩽ 1,00		± 0,05
Titanium	⩽ 0,75		± 0,03
Tungsten	⩽ 2,50		± 0,05

[a] ± means that in one cast the deviation may 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	Rough and dull	Usually applied to steels with scale that is very resistant to pickling solutions. May 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. Skin passing may be by tension levelling.
	2R	Cold rolled, bright annealed [c]	Smooth, bright, reflective	Smoother and brighter than 2B. Also common finish for further processing.
Special finishes	1G or 2G	Ground [d]	See footnote [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. See footnote [e]	Grade of brush or polishing belt or surface roughness can be specified. Unidirectional texture, not very reflective.
	1K or 2K	Satin polish [d]	See footnote [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.
	1P or 2P	Bright polished [d]	See footnote [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] May 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 may need to be agreed upon between manufacturer and purchaser (e.g. grade of grit or surface roughness).

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

Designation		Product form [a]	Thickness t	Proof stress		Tensile strength	Elongation after fracture	Resistance to intergranular corrosion [e]	
Name	Line number of ISO/TS 15510:2003	(Class)	mm max.	$R_{p0,2}$ MPa min. (tr.) [b, c]	$R_{p1,0}$ MPa min. (tr.) [b, c]	R_m MPa	A_{80} [d] % min. (tr.)	in the delivery condition	in the sensitized condition [f]
X2CrNi18-9	1	C (+AT1)	8	220	250	520 to 720	45	yes	yes
		C (+AT2) [g]		175	—	480 to 680			
		H	13,5	200	240	520 to 720	45		
		P	75 [h]	200	240	500 to 700	45		
X2CrNi19-11	2	C	8	220	250	520 to 720	45	yes	yes
		H	13,5	200	240	520 to 720	45		
		P	75 [h]	200	240	500 to 700	45		
X2CrNiN18-9	3	C	8	290	320	550 to 750	40	yes	yes
		H	13,5	270	310	550 to 750	40		
		P	75 [h]	270	310	530 to 730	40		
X5CrNi18-9	6	C	8	230	260	540 to 740	45 [i]	yes	no [j]
		H	13,5	210	250	540 to 740	45 [i]		
		P	75 [h]	210	250	520 to 720	45		
X10CrNi18-8	11	C	8	250	280	600 to 800	40	no	no
		H	13,5	230	270	600 to 800	40		
X1CrNi25-21	12	P	75 [h]	200	240	470 to 670	40	yes	yes
X12CrMnNIN17-7-5	13	C	8	350	380	750 to 950	45	yes	no
		H	13,5	330	370	750 to 950	45		
		P	75 [h]	330	370	750 to 950	40		
X6CrNiTi18-10	16	C	8	220	250	520 to 720	40	yes	yes
		H	13,5	200	240	520 to 720	40		
		P	75 [h]	200	240	500 to 700	40		
X6CrNiNb18-10	19	C	8	220	250	520 to 720	40	yes	yes
		H	13,5	200	240	520 to 720	40		
		P	75 [h]	200	240	500 to 700	40		
X2CrNiMo17-12-2	21	C (+AT1)	8	240	270	530 to 730	40	yes	yes
		C (+AT2) [g]		175	—	480 to 680			
		H	13,5	220	260	530 to 730	40		
		P	75 [h]	220	260	510 to 710	40		
X2CrNiMo17-12-3	22	C	8	240	270	530 to 730	40	yes	yes
		H	13,5	220	260	530 to 730	40		
		P	75 [h]	220	260	510 to 710	40		
X2CrNiMo18-14-3	23	C	6	240	270	550 to 750	40	yes	yes
		H	12	220	260	550 to 750	40		
		P	75 [h]	220	260	520 to 720	45		
X2CrNiMoN17-12-3	26	C	8	300	330	580 to 780	35	yes	yes
		H	13,5	280	320	580 to 780	35		
		P	75 [h]	280	320	580 to 780	40		
X1CrNiMoN25-22-2	29	P	75 [h]	250	290	540 to 740	40	yes	yes
X5CrNiMo17-12-2	30	C (+AT1)	8	240	270	530 to 730	40	yes	no [j]
		C (+AT2) [g]		205	—	520 to 720			
		H	13,5	220	260	530 to 730	40		
		P	75 [h]	220	260	510 to 710	40		

Table 4 (*continued*)

Designation		Product form [a]	Thickness t	Proof stress		Tensile strength	Elongation after fracture	Resistance to intergranular corrosion [e]	
Name	Line number of ISO/TS 15510:2003	(Class)	mm max.	$R_{p0,2}$ MPa min. (tr.) [b, c]	$R_{p1,0}$ MPa min. (tr.) [b, c]	R_m MPa	A_{80} [d] % min. (tr.)	in the delivery condition	in the sensitized condition [f]
X3CrNiMo17-12-3	31	C	8	240	270	530 to 730	40	yes	no [j]
		H	13,5	220	260	530 to 730	40		
		P	75 [h]	220	260	510 to 710	40		
X6CrNiMoTi17-12-2	32	C	8	240	270	530 to 730	40	yes	yes
		H	13,5	220	260	530 to 730	40		
		P	75 [h]	220	260	510 to710	40		
X1NiCrMoCu25-20-5	35	C	6	240	270	530 to 730	35	yes	yes
		H	12	220	260	530 to 730	35		
		P	75 [h]	220	260	510 to 710	35		
X1NiCrMoCu31-27-4	36	P	75 [h]	220	260	500 to 700	40	yes	yes
X1CrNiMoCuN24-22-8	38	C	8	430	470	750 to 950	40	yes	yes
		H	13,5	430	470	750 to 950	40		
		P	15	430	470	750 to 950	40		
X8CrMnCuN17-8-3	40	C	8	300	330	580 to 780	40	yes	no
		H	13,5	300	330	580 to 780	40		
X1CrNiMoCuNW24-22-6	41	P	75 [h]	420	460	800 to 1 000	40	yes	yes
X2CrNiMnMoN25-18-6-5	42	C	6	420	460	800 to 1 000	35	yes	yes
		H	10	420	460	800 to 1 000	35		
		P	40	420	460	800 to 1 000	35		
X11CrNiMnN19-8-6	43	C	4	340	370	750 to 950	35	yes	no
X6CrNiCu17-8-2	45	C	8	155	—	min. 450	40	no	no
		H	13,5	155	—	min. 450	40		
		P	75 [h]	155	—	min. 450	40		
X12CrNiSi18-9-3	46	C	8	205	—	min. 520	40	no	no
		H	13,5	205	—	min. 520	40		
		P	75 [h]	205	—	min. 520	40		

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 $R_{p1,0}$ may 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 $t \geqslant 3$ 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] See NOTE to 7.4.

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

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

[i] For stretcher levelled material, the minimum value is 5 % lower.

[j] 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)

Designation		Product form [a]	Thickness, t	0,2 % proof stress, $R_{p0,2}$	Tensile strength, R_m	Elongation after fracture, A_{80} [d]	Resistance to intergranular corrosion [e]	
Name	Line number of ISO/TS 15510:2003		mm max.	MPa min., (tr.) [b, c]	MPa min.	% min. (long. + tr.)	in the delivery condition	in the sensitized condition [f]
X2CrNiN23-4	51	C	6	420	600	20	yes	yes
		H	12	400	600	20		
		P	75 [g]	400	630	25		
X2CrNiMoN22-5-3	52	C	6	480	660	20	yes	yes
		H	12	460	660	20		
		P	75 [g]	460	640	20		
X2CrNiMoCuN25-6-3	53	C	8	550	750	17	yes	yes
		H	13,5	530	750	17		
		P	75 [g]	530	730	25		
X2CrNiMoN25-7-4	54	C	6	550	750	15	yes	yes
		H	12	530	750	15		
		P	75 [g]	530	730	20		
X2CrNiMoCuWN25-7-4	56	P	75 [g]	530	730	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 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 $R_{p0,2}$ may 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 $t \geqslant 3$ 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] See NOTE to 7.4.

[g] 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)

Designation		Product form [a] (Class)	Thickness t	0,2 % proof stress $R_{p0,2}$ [b]	Tensile strength R_m	Elongation after fracture A_{80} [c]	Resistance to intergranular corrosion [d]	
Name	Line number of ISO/TS 15510:2003		mm max.	MPa min. (tr.)	MPa min.	% min. (long. + tr.)	in the delivery condition	in the welded condition
X2CrNi12	61	C	6	320	450	20	no	no
		H	12	300	450	20		
		P	25 [e]	280	430	20		
X2CrTi12	62	C (+A1)	6	220	380	25	no	no
		C (+A2) [f]		175	360			
		H (+A1)	12	200	380	25		
		H (+A2) [f]		175	360			
X6Cr17	67	C (+A1)	6	250	450	20	yes	no
		C (+A2) [f]		205	450			
		H (+A1)	12	230	450	20		
		H (+A2) [f]		205	450			
		P	25 [e]	230	430	20		
X3CrTi17	70	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	73	C	6	230	420	23	yes	yes

NOTE 1 MPa = 1N/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 $t \geqslant 3$ 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)

Designation		Product form [a]	Thickness	Heat treatment [b]	Hardness	0,2 % proof stress [c]	Tensile strength		Elongation after fracture [d]	Hardness	
Name	Line number of ISO/TS 15510:2003		t mm max.		HWB max.	$R_{p0,2}$ MPa min.	R_m MPa min.	R_m MPa max.	A % min.	HRC	HV
X12Cr13	82	C	8	+A	200	—	440	600	20	—	—
		H	13,5	+A	200	—	440	600	20	—	—
		P	75 [e]	+QT1	—	400	550	750	15	—	—
		P	75 [e]	+QT2	—	450	650	850	12	—	—
X20Cr13	84	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 [e]	+QT1	—	450	650	850	12	—	—
				+QT2		550	750	950	10	—	—
X30Cr13	85	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 [e]	+QT1	—	600	800	1000	10	—	—
X39Cr13	86	C	3	+QT	—	—	—	—	—	47 to 53	480 to 580
		C	8	+A	240	—	—	760	12	—	—
		H	13,5	+A	240	—	—	760	12	—	—

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 $t \geqslant 3$ mm, the values apply for test pieces with a gauge length of $5{,}65\sqrt{S_o}$.

[e] 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)

Designation		Product form [a]	Thickness	Heat treatment [b]	0,2 % proof stress	Tensile strength		Elongation after fracture
Name	Line number of ISO/TS 15510:2003		mm		$R_{p0,2}$ MPa	R_m MPa		A %
			max.		min.	min.	max.	min.
X7CrNiAl17-7	102	C	8	+AT			1030	19
				+P1300	1200	1300		
				+P1450	1310	1450		2

NOTE 1 MPa = 1 N/mm^2.

[a] C = cold-rolled strip.

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

Table 9 — 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 may 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
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 may 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.

Annex A
(normative)

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 may 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

Designation		Hot forming		Heat treatment	Solution annealing	
Name	Line number of ISO/TS 15510:2003	Temperature °C	Type of cooling	symbol	Temperature [b, c] °C	Type of cooling
X2CrNi18-9 [d]	1	1 150 to 850	Air	+AT	1 000 to 1 100	Water, air [e]
X2CrNi19-11	2				1 000 to 1 100	
X2CrNiN18-9	3				1 000 to 1 100	
X5CrNi18-9	6				1 000 to 1 100	
X10CrNi18-8	11				1 010 to 1 090	
X1CrNi25-21	12				1 030 to 1 110	
X12CrMnNiN17-7-5	13				1 000 to 1 100	
X6CrNiTi18-10	16				1 000 to 1 100	
X6CrNiNb18-10	19				1 020 to 1 120	
X2CrNiMo17-12-2 [d]	21				1 030 to 1 110	
X2CrNiMo17-12-3	22				1 030 to 1 110	
X2CrNiMo18-14-3	23				1 030 to 1 110	
X2CrNiMoN17-12-3	26				1 030 to 1 110	
X1CrNiMoN25-22-2	29				1 070 to 1 150	
X5CrNiMo17-12-2 [d]	30				1 030 to 1 110	
X3CrNiMo17-13-3	31				1 030 to 1 110	
X6CrNiMoTi17-12-2	32				1 030 to 1 110	
X1NiCrMoCu25-20-5	35				1 060 to 1 140	
X1NiCrMoCu31-27-4	36				1 070 to 1 150	
X1CrNiMoCuN24-22-8	38	1 200 to 1 000			1 150 to 1 200	
X8CrMnCuN17-8-3	40	1 150 to 850			1 000 to 1 100	
X1CrNiMoCuN24-22-6	41				1 040 to 1 200	
X2CrNiMnMoN25-18-6-5	42	1 200 to 950			1 120 to 1 170	
X11CrNiMnN19-8-6	43	1 150 to 850			1 000 to 1 100	
X6CrNiCu17-8-2	45				1 010 to 1 150	
X12CrNiSi18-9-3	46					

[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

Designation		Hot forming		Heat-treatment symbol	Solution annealing	
Name	Line number of ISO/TS 15510:2003	Temperature °C	Type of cooling		Temperature [b] °C	Type of cooling
X2CrNiN23-4	51	1 150 to 950	Air	+AT	950 to 1 050	Water, air [c]
X2CrNiMoN22-5-3	52				1 020 to 1 100	
X2CrNiMoCuN25-6-3	53	1 150 to 1 000			1 040 to 1 120	
X2CrNiMoN25-7-4	54					
X2CrNiMoCuWN25-7-4	56					

[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

Designation		Hot forming		Heat-treatment symbol	Annealing	
Name	Line number of ISO/TS 15510:2003	Temperature °C	Type of cooling		Temperature [b] °C	Type of cooling
X2CrNi12	61	1 100 to 800	Air	+A	680 to 740	Air, water
X2CrTi12	62				Class A1: 770 to 830 Class A2: 830 to 950	
X6Cr17 [c]	67				770 to 830	
X3CrTi17	70				Class A1: 770 to 830 Class A2: 830 to 950	
X3CrNb17	73				790 to 850	

[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	Line number of ISO/TS 15510:2003	Temperature °C	Type of cooling		Temperature [b] °C	Type of cooling	Temperature [b] °C	Type of cooling	Temperature °C
X12Cr13	82	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	84		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	85			+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	86			+QT [c]	—	—	1 000 to 1 100	oil, air	200 to 350
				+A	730 to 790	—	—	—	—

[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	Annealing		Precipitation hardening °C
Name	Line number of ISO/TS 15510:2003	Temperature °C	Type of cooling		Temperature [b] °C	Type of cooling	
X7CrNiAl17-7	102	1 150 to 900	air	+AT	1 030 to 1 050	air	—
				+P1300	760 / 40 min to 820 / 30 min	[c]	480 / 2 h to 550 / 1 h
				+P1450	945 to 965 10 min	[d]	(500 to 520) 1 h

[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 $\leqslant$ 20 °C; cooling within 1 h at 12 °C; reheating in air to + 20 °C.

[d] Quick cooling to $\leqslant$ 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- and JIS-Standards

Steel designations according to					
Table 1		ASTM/UNS	EN		JIS
Name	Line number of ISO/TS 15510:2003		Name	Number	
Austenitic steels					
X2CrNi18-9	1	S30403	X2CrNi18-9	1.4307	SUS304L
X2CrNi19-11	2	S30403	X2CrNi19-11	1.4306	SUS304L
X2CrNiN18-9	3	S30453	X2CrNiN18-10	1.4311	SUS304LN
X5CrNi18-9	6	S30400	X5CrNi18-10	1.4301	SUS304
X10CrNi18-8	11	S30100	X10CrNi18-8	1.4310	
X1CrNi25-21	12	S31002	X1CrNi25-21	1.4335	
X12CrMnNiN17-7-5	13	S20100	X12CrMnNiN17-7-5	1.4372	SUS201
X6CrNiTi18-10	16	S32100	X6CrNiTi18-10	1.4541	SUS321
X6CrNiNb18-10	19	S34700	X6CrNiNb18-10	1.4550	SUS347
X2CrNiMo17-12-2	21	S31603	X2CrNiMo17-12-2	1.4404	SUS316L
X2CrNiMo17-12-3	22	S31603	X2CrNiMo17-12-3	1.4432	SUS316L
X2CrNiMo18-14-3	23	S31603	X2CrNiMo18-14-3	1.4435	
X2CrNiMoN17-12-3	26	S31653	X2CrNiMoN17-13-3	1.4429	SUS316LN
X1CrNiMoN25-22-2	29	S31050	X1CrNiMoN25-22-2	1.4466	
X5CrNiMo17-12-2	30	S31600	X5CrNiMo17-12-2	1.4401	SUS316
X3CrNiMo17-12-3	31	S31600	X3CrNiMo17-13-3	1.4436	SUS316
X6CrNiMoTi17-12-2	32	S31635	X6CrNiMoTi17-12-2	1.4571	SUS316Ti
X1NiCrMoCu25-20-5	35	N08904	X1NiCrMoCu25-20-5	1.4539	SUS890L
X1NiCrMoCu31-27-4	36	N08028	X1NiCrMoCu31-27-4	1.4563	
X1CrNiMoCuN24-22-8	38	S32654	X1CrNiMoCuN24-22-8	1.4652	
X8CrMnCuN17-8-3	40		(X8CrMnCuNB17-8-3)	(1.4597)	
X1CrNiMoCuNW24-22-6	41		X1CrNiMoCuNW24-22-6	1.4659	
X2CrNiMnMoN25-18-6-5	42	S34565	X2CrNiMnMoN25-18-6-5	1.4565	
X11CrNiMnN19-8-6	43		X11CrNiMnN19-8-6	1.4369	
X6CrNiCu17-8-2	45				SUS304J1
X12CrNiSi18-9-3	46	S30215			SUS302B
Austenitic-ferritic steels					
X2CrNiN23-4	51	S32304	X2CrNiN23-4	1.4362	
X2CrNiMoN22-5-3	52	S31803	X2CrNiMo22-5-3	1.4462	SUS329J3L
X2CrNiMoCuN25-6-3	53	S32550	X2CrNiMoCuN25-6-3	1.4507	SUS329J4L
X2CrNiMoN25-7-4	54	S32750	X2CrNiMoN25-7-4	1.4410	
X2CrNiMoCuWN25-7-4	56	S32760	X2CrNiMoCuWN25-7-4	1.4501	
Ferritic steels					
X2CrNi12	61	S41003	X2CrNi12	1.4003	—
X2CrTi12	62	S40900	X2CrTi12	1.4512	SUH409L
X6Cr17	67	S43000	X6Cr17	1.4016	SUS430
X3CrTi17	70	S43035	X3CrTi17	1.4510	SUS430LX
X3CrNb17	73		X3CrNb17	1.4511	
Martensitic steels					
X12Cr13	82	S41000	X12Cr13	1.4006	SUS410
X20Cr13	84	S42000	X20Cr13	1.4021	SUS420J1
X30Cr13	85	S42000	X30Cr13	1.4028	SUS420J2
X39Cr13	86	S42000	X39Cr13	1.4031	
Precipitation-hardening steel					
X7CrNiAl17-7	102	S17700	X7CrNiAl17-7	1.4568	SUS631

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

Product form [a]	Usual finishes		Abbreviations for process route/surface finish according to		
	Type of process route	Surface finish	Table 3 [b, c]	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	Rough and dull	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, 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, #400
C, H, P	Hair line polish				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		
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 A 480.

[e] Underlined abbreviations represent the most common finishes.

Bibliography

[1] ISO 4955:1994, *Heat-resisting steels and alloys*

[2] ISO 6931-2:1989, *Stainless steels for springs — Part 2: Strip*

[3] ISO 9328-1:1991, *Steel plates and strips for pressure purposes — Technical delivery conditions — Part 1: General requirements*

[4] ISO 9328-5:1991, *Steel plates and strips for pressure purposes — Technical delivery conditions — Part 5: Austenitic steels*

[5] ISO 16143-2, *Stainless steels for general purposes — Part 2: Semi-finished products, bars, rods and sections*

[6] ISO 16143-3, *Stainless steels for general purposes — Part 3: Wire*

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

[8] ASTM A 480-03, *Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip*

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