BS EN 10088-2:2014

BSI Standards Publication

Stainless steels

Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes

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National foreword

This British Standard is the UK implementation of EN 10088-2:2014. It supersedes BS EN 10088-2:2005 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee ISE/105, Steels for Heat Treatment, Alloy Steels, Free-Cutting Steels and Stainless Steels.

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

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Aciers inoxydables - Partie 2: Conditions techniques de livraison des tôles et bandes en acier de résistance à la corrosion pour usage général

Nichtrostende Stähle - Teil 2: Technische Lieferbedingungen für Blech und Band aus korrosionsbeständigen Stählen für allgemeine Verwendung

This European Standard was approved by CEN on 9 August 2014.

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Foreword

This document (EN 10088-2:2014) has been prepared by Technical Committee ECISS/TC 105 “Steels for heat treatment, alloy steels, free-cutting steels and stainless steels”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2015 and conflicting national standards shall be withdrawn at the latest by April 2015.

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

This document supersedes EN 10088-2:2005.

This standard mainly differs from the 2005 edition as follows:

a) addition of austenitic grades 1.4618, 1.4376, 1.4640, 1.4646, addition of austenitic-ferritic (duplex) grades 1.4162, 1.4662, 1.4482, 1.4062, addition of ferritic grades 1.4600, 1.4607, 1.4611, 1.4613, 1.4630, 1.4634;

b) chemical composition was changed for following grades: austenitic grade 1.4371, 1.4597, austenitic-ferritic grade 1.4362;

c) standard inspection document is now a test report 2.2 according to EN 10204;

d) products delivered with hot-rolled or cold-rolled finishes shall be supplied with a prime surface;

e) a new cold rolled surface finish (2A) has been introduced for ferritic stainless steel grades that have been 'bright-pickled and skin passed;'

f) mechanical values have been changed for austentic grade 1.4372, for ferritic grades 1.4016 and for martensitic grade 1.4034.

EN 10088, under the general title *Stainless steels*, consists of the following parts:

— *Part 1: List of stainless steels* (including a table of European Standards, in which these stainless steels are further specified, see Annex B);

— *Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes* [the present document];

— *Part 3: Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes*;

— *Part 4: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for construction purposes*;

— *Part 5: Technical delivery conditions for bars, rods, wire, sections and bright products of corrosion resisting steels for construction purposes*.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

The European Organization for Standardization (CEN) draws attention to the fact that it is claimed that compliance with this document may involve the use of patents applied to seven steel grades.

CEN takes no position concerning the evidence, validity and scope of these patent rights.

The holder of these patent rights has ensured CEN that they are willing to negotiate licenses, under reasonable and non-discriminatory terms and conditions, with applicants throughout the world. In this respect, the statements of the holders of these patent rights are registered with CEN. Information may be obtained from:

Grade 1.4162, 1.4662
Outokumpu Stainless AB
SE-77480 Avesta, Sweden

Grade 1.4062
Ugitech
F-73403 Ugine Cedex, France

Grade 1.4062
Industeel
F-71200 Creusot, 56 Rue Clemenceau, France

Grade 1.4646, 1.4611, 1.4613
Acciai Speciali Terni
I-05100 Terni, Italy

1 Scope

This European Standard specifies the technical delivery conditions for hot or cold rolled sheet/plate and strip of standard grades and special grades of corrosion resisting stainless steels for general purposes.

NOTE General purposes include the use of stainless steels in contact with foodstuffs.

The general technical delivery conditions specified in EN 10021 apply in addition to the specifications of this European Standard, unless otherwise specified in this European Standard.

This European Standard does not apply to components manufactured by further processing of the product forms listed above with quality characteristics altered as a result of such further processing.

2 Normative references

The following referenced 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.

EN 10021, *General technical delivery conditions for steel products*

EN 10027-1, *Designation systems for steels — Part 1: Steel names*

EN 10027-2, *Designation systems for steels — Part 2: Numerical system*

EN 10052:1993, *Vocabulary of heat treatment terms for ferrous products*

EN 10079:2007, *Definition of steel products*

EN 10088-1:2014, *Stainless steels — Part 1: List of stainless steels*

EN 10163-2, *Delivery requirements for surface condition of hot-rolled steel plates, wide flats and sections — Part 2: Plate and wide flats*

EN 10168, *Steel products — Inspection documents — List of information and description*

EN 10204, *Metallic products — Types of inspection documents*

EN 10307, *Non-destructive testing — Ultrasonic testing of austenitic and austenitic-ferritic stainless steels flat products of thickness equal to or greater than 6 mm (reflection method)*

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

EN ISO 377, *Steel and steel products — Location and preparation of samples and test pieces for mechanical testing (ISO 377)*

EN 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 3651-2)*

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

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

EN 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 6508-1)*

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

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

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

3 Terms and definitions

For the purposes of this document, the terms and definitions regarding types of heat-treatment in EN 10052:1993, regarding product forms in EN 10079:2007 and the following apply.

3.1
stainless steels
steels with at least 10,5 % of chromium and maximum 1,2 % of carbon

[SOURCE: EN 10020:2000, 3.2.2]

Note 1 to entry: Stainless steels are further subdivided in accordance with their main property into corrosion resisting steels, heat resisting steels and creep resisting steels.

Note 2 to entry: One type steel in Table 7 in EN 10088-1:2014 and five types of steel in Table 9 in EN 10088-1:2014 contain less chromium than the minimum defined for stainless steels, but are included in the heat-resisting and creep-resisting steels standards respectively, because they form a part of these two families of steels.

3.2
corrosion resisting steels
steels with at least 10,5 % Cr and max. 1,20 % C if their resistance to corrosion is of primary importance

3.3
general purposes
purposes other than the special purposes mentioned in the Bibliography

3.4
standard grades
grades with a relatively good availability and a wider range of application

3.5
special grades
grades for special use and/or with limited availability

4 Designation and ordering

4.1 Designation of steel grades

The steel names and steel numbers (see Tables 1 to 4) were formed in accordance with EN 10027-1 and EN 10027-2 respectively.

4.2 Designation to be used on ordering

The complete designation for ordering a product according to this document shall contain the following information:

— desired quantity;

— product form (strip or sheet/plate);

— where an appropriate dimensional standard is available (see Annex B) the number of the standard, plus any choice of requirements;

— if there is no dimensional standard, the nominal dimensions and tolerances required;

— type of material (steel);

— number of this document;

— steel name or steel number;

— if for the relevant steel in the table for the mechanical properties more than one treatment condition is covered, the symbol for the desired heat treatment or cold worked condition;

— desired process route (see symbols in Table 6);

— if a verification of internal soundness is required, flat products with thickness ≥ 6 mm shall be tested in accordance with EN 10307;

— any additional optional tests or inspections (see 7.2.3 d));

— standard designation for a test report 2.2 or, if required, any other type of inspection document in accordance with EN 10204 (see 7.2.1).

EXAMPLE 10 plates according to EN ISO 18286 with thickness = 8 mm, width = 2000 mm, length = 5 000 mm; tolerances on width and length class B, flatness tolerance class N made of steel EN 10088–2 with the name X5CrNi18–10 and the number 1.4301 in process route 1D (see Table 6), inspection certificate 3.1 as specified in EN 10204:

10 plates EN ISO 18286 —, 8 × 2000 × 5000 B
Steel EN 10088–2 — X5CrNi18–10+1D
EN 10204 — 3.1

or

10 plates EN ISO 18286 —, 8 × 2000 × 5000 B
Steel EN 10088–2 — 1.4301+1D
EN 10204 — 3.1

5 Classification of grades

Steels covered in this document are classified according to their structure into:

— austenitic steels,

— austenitic-ferritic steels,

— ferritic steels,

— martensitic steels,

— precipitation hardening steels.

See also EN 10088-1:2014, Annex C.

6 Requirements

6.1 Steelmaking process

Unless a special steelmaking process is agreed at the time of enquiry and order, the steelmaking process for steels conforming to this document shall be at the discretion of the manufacturer.

6.2 Delivery condition

The products shall be supplied in the delivery condition agreed at the time of enquiry and order by reference to the process route given in Table 6 and, where different alternatives exist, to the treatment conditions given in Tables 7 to 11, 17 and 18 (see also Annex A).

6.3 Chemical composition

6.3.1 The chemical composition requirements given in Tables 1 to 4 apply with respect to the chemical composition according to the cast analysis.

6.3.2 The product analysis may deviate from the limiting values for the cast analysis given in Tables 1 to 4 by the values listed in Table 5.

6.4 Chemical corrosion properties

Referring to resistance to intergranular corrosion as defined in EN ISO 3651-2, for austenitic and austenitic-ferritic and ferritic steels the specification in Tables 7, 8 and 9 applies.

NOTE 1 EN ISO 3651-2 is not applicable for testing martensitic and precipitation hardening steels.

NOTE 2 The corrosion resistance of stainless steels is very dependent on the type of environment and can therefore not always be clearly ascertained through laboratory tests. It is therefore advisable to draw on the available experience of the use of the steels.

6.5 Mechanical properties

6.5.1 The mechanical properties at room temperature as specified in Tables 7 to 11 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 7, 8, 9, 10 and 11 shall be obtained from reference test pieces which have received the appropriate heat treatment (simulated heat treatment).

For cold worked products, the tensile strength levels at ambient temperature as specified in Table 17 apply. The available tensile strength levels in the cold worked condition are indicated in Table 19.

Alternatively, cold worked products can be ordered according to their 0,2 %-proof strength as given in Tables 18 and 20.

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

6.5.2 The values in Tables 12 to 16 apply for the 0,2 %- and 1 %-proof strength at elevated temperatures.

6.6 Surface quality

Slight surface imperfections, inherent in the rolling process, are permitted.

When products are delivered in coil form, the degree and extent of such imperfections may be expected to be greater, due to the impractibility of removing short lengths of coil. For hot-rolled quarto-plates (symbol P in Tables 7 to 11), the requirements in EN 10163-2, class A2, apply unless otherwise agreed. For other products, where necessary, more precise requirements on surface quality may be agreed at the time of enquiry and order.

Products delivered with hot-rolled or cold-rolled finishes (see Table 6) 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.

6.7 Internal soundness

The products shall be free of internal defects which would exclude them from being used for their usual purpose. Ultrasonic testing of austenitic and austenitic-ferritic stainless steel flat products ≥ 6 mm may be agreed at the time of enquiry and order in accordance with EN 10307.

6.8 Formability at room temperature

Cold formability may be verified by elongation in the tensile test.

6.9 Dimensions and tolerances on dimensions and shape

The dimensions and the tolerances on dimensions and shape are to be agreed at the time of enquiry and order, as far as possible with reference to the dimensional standards listed in Annex B. EN ISO 18286 shall normally only be applied for product form P (individually rolled plates, “quarto plates”) and not for product form H (continuously rolled strip and plate), for which EN ISO 9444-2 is to be applied. When applying EN ISO 18286, tolerances on width and length class A shall apply, unless specifically agreed otherwise at the time of enquiry and order.

6.10 Calculation of mass and tolerances on mass

6.10.1 When calculating the nominal mass from the nominal dimensions the values given in EN 10088-1 shall be used as a basis for the density of the steel concerned.

6.10.2 If the tolerances on mass are not specified in the dimensional standard listed in Annex B, they may be agreed at the time of enquiry and order.

7 Inspection and testing

7.1 General

The appropriate process control, inspection and testing shall be carried out to ensure that the product complies with the requirements of the order.

This includes the following:

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

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

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

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

7.2 Agreement on tests and inspection documents

7.2.1 Products complying with this European Standard shall be ordered and delivered with one of the inspection documents as specified in EN 10204. 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.

7.2.2 If it is agreed to issue a test report 2.2 in accordance with EN 10204 it shall indicate the following information:

a) information groups A, B and Z of EN 10168;

b) results of the cast analysis in accordance with the code numbers C71 to C92 in EN 10168.

7.2.3 If the issuing of an inspection certificate 3.1 or 3.2 according to EN 10204 has been agreed, specific inspections according to 7.3 are to be carried out and the following information shall be given in the inspection document with the code numbers and details required by EN 10168:

a) under 7.2.2 a);

b) under 7.2.2 b);

c) results of the mandatory tests marked in Table 21, second column, by “m”*;*

d) results of any optional tests or inspections agreed at the time of enquiry and order.

7.3 Specific inspection and testing

7.3.1 Extent of testing

The tests to be carried out, either mandatorily (m) or by agreement (o) and the composition and size of the test units, and the number of sample products, samples and test pieces to be taken are given in Table 21.

7.3.2 Selection and preparation of samples and test pieces

7.3.2.1 Sampling and sample preparation shall be in accordance with the requirements of EN ISO 14284 and EN ISO 377. In addition, the stipulations in 7.3.2.2 apply for the mechanical tests.

7.3.2.2 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. If it has been agreed that impact tests shall be carried out, the test samples shall be taken from the same location.

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, hardening and tempering shall be agreed.

7.3.2.3 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.

7.4 Test methods

7.4.1 The chemical analysis shall be carried out using appropriate European Standards. The choice of a suitable physical or chemical analytical method for the analysis shall be at the discretion of the manufacturer. The manufacturer shall declare the test method used if required.

NOTE The list of available European Standards on chemical analysis is given in CEN/TR 10261.

7.4.2 The tensile test at room temperature shall be carried out in accordance with EN ISO 6892-1 taking into account the additional or deviating conditions specified in Figure 1, footnote a.

The tensile strength, elongation after fracture and the 0,2 % proof strength shall be determined. In addition for austenitic steels only, the 1 %-proof strength shall be determined.

7.4.3 If a tensile test at elevated temperature has been ordered, this shall be carried out in accordance with EN 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.

7.4.4 If an impact test has been ordered, it shall be carried out in accordance with EN ISO 148-1 on test pieces with a V-notch. The impact test shall be performed according to EN ISO 148-1 with a striker radius of 2 mm (KV_2). The average obtained from three test pieces is considered to be the test result (see also EN 10021).

7.4.5 The Brinell hardness test shall be carried out in accordance with EN ISO 6506-1, the Rockwell hardness test in accordance with EN ISO 6508-1, and the Vickers hardness test in accordance with EN ISO 6507-1.

7.4.6 The resistance to intergranular corrosion shall be tested in accordance with EN ISO 3651-2.

7.4.7 Dimensions and dimensional tolerances of the products shall be tested in accordance with the requirements of the relevant dimensional standards, where available.

7.5 Retests

See EN 10021.

8 Marking

8.1 Unless otherwise agreed in the order, with the exception mentioned in 8.4, each product shall be marked with the information given in Table 22.

8.2 Unless otherwise agreed the method of marking and the material of marking in accordance to 8.1 shall be at the option of the manufacturer.

Its quality shall be such that it shall be durable for at least one year in unheated storage under cover. Corrosion resistance of the product shall not be impaired by the marking.

8.3 One surface of the product shall be marked. This will normally be the prime surface of products, where only one surface is guaranteed to the required standard.

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

Table 1 — Chemical composition (cast analysis) of austenitic corrosion resisting steels

Steel designation		% by mass [a]										
Name	Number	C	Si	Mn	P	S	Cr	Mo	Ni	N	Cu	Others
Standard grades												
X2CrNiN18–7	1.4318	0,030	1,00	2,00	0,045	0,015	16,5 to 18,5	-	6,0 to 8,0	0,10 to 0,20	-	-
X10CrNi18–8	1.4310	0,05 to 0,15	2,00	2,00	0,045	0,015	16,0 to 19,0	0,80	6,0 to 9,5	0,10	-	-
X2CrNi18–9	1.4307	0,030	1,00	2,00	0,045	0,015[b]	17,5 to 19,5	-	8,0 to 10,5	0,10	-	-
X8CrNiS18–9	1.4305	0,10	1,00	2,00	0,045	0,15 to 0,35	17,0 to 19,0	-	8,0 to 10,0	0,10	1,00	-
X2CrNiN18–10	1.4311	0,030	1,00	2,00	0,045	0,015[b]	17,5 to 19,5	-	8,5 to 11,5	0,12 to 0,22	-	-
X5CrNi18–10	1.4301	0,07	1,00	2,00	0,045	0,015[b]	17,5 to 19,5	-	8,0 to 10,5	0,10	-	-
X6CrNiTi18–10	1.4541	0,08	1,00	2,00	0,045	0,015[b]	17,0 to 19,0	-	9,0 to 12,0	-	-	Ti: 5 x C to 0,70
X2CrNi19–11	1.4306	0,030	1,00	2,00	0,045	0,015[b]	18,0 to 20,0	-	10,0 to 12,0	0,10	-	-
X4CrNi18–12	1.4303	0,06	1,00	2,00	0,045	0,015[b]	17,0 to 19,0	-	11,0 to 13,0	0,10	-	-
X2CrNiMoN17–11–2	1.4406	0,030	1,00	2,00	0,045	0,015[b]	16,5 to 18,5	2,00 to 2,50	10,0 to 12,5	0,12 to 0,22	-	-
X2CrNiMo17–12–2	1.4404	0,030	1,00	2,00	0,045	0,015[b]	16,5 to 18,5	2,00 to 2,50	10,0 to 13,0	0,10	-	-
X5CrNiMo17–12–2	1.4401	0,07	1,00	2,00	0,045	0,015[b]	16,5 to 18,5	2,00 to 2,50	10,0 to 13,0	0,10	-	-
X6CrNiMoTi17–12–2	1.4571	0,08	1,00	2,00	0,045	0,015[b]	16,5 to 18,5	2,00 to 2,50	10,5 to 13,5	-	-	Ti: 5 x C to 0,70
X2CrNiMo17–12–3	1.4432	0,030	1,00	2,00	0,045	0,015[b]	16,5 to 18,5	2,50 to 3,00	10,5 to 13,0	0,10	-	-
X2CrNiMo18–14–3	1.4435	0,030	1,00	2,00	0,045	0,015[b]	17,0 to 19,0	2,50 to 3,00	12,5 to15,0	0,10	-	-
X2CrNiMoN17–13–5	1.4439	0,030	1,00	2,00	0,045	0,015[b]	16,5 to18,5	4,0 to 5,0	12,5 to 14,5	0,12 to 0,22	-	-
X1NiCrMoCu25–20–5	1.4539	0,020	0,70	2,00	0,030	0,010	19,0 to 21,0	4,0 to 5,0	24,0 to 26,0	0,15	1,20 to 2,00	-
Special grades												
X5CrNi17–7	1.4319	0,07	1,00	2,00	0,045	0,030	16,0 to 18,0	-	6,0 to 8,0	0,10	-	-
X5CrNiN19–9	1.4315	0,06	1,00	2,00	0,045	0,015	18,0 to 20,0	-	8,0 to 11,0	0,12 to 0,22	-	-
X5CrNiCu19–6-2	1.4640	0,030 to 0,08	0,50	1,50 to 4,0	0,045	0,015	18,0 to 19,0	-	5,5 to 6,9	0,03 to 0,11	1,30 to 2,00	-

Steel designation		% by mass [a]										
Name	Number	C	Si	Mn	P	S	Cr	Mo	Ni	N	Cu	Others
X6CrNiNb18–10	1.4550	0,08	1,00	2,00	0,045	0,015	17,0 to 19,0	-	9,0 to 12,0	-	-	Nb: 10 x C to 1,00
X1CrNiSi18–15–4	1.4361	0,015	3,7 to 4,5	2,00	0,025	0,010	16,5 to 18,5	0,20	14,0 to 16,0	0,10	-	-
X8CrMnCuN17–8-3	1.4597	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	2,00 to 3,5	-
X8CrMnNi19–6-3	1.4376	0,10	1,00	5,0 to 8,0	0,045	0,015	17,0 to 20,5		2,00 to 4,5	0,30	-	-
X12CrMnNiN17–7-5	1.4372	0,15	1,00	5,5 to 7,5	0,045	0,015	16,0 to 18,0	-	3,5 to 5,5	0,05 to 0,25	-	-
X2CrMnNiN17–7-5	1.4371	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	1,00	-
X9CrMnNiCu17–8-5–2	1.4618	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	1,00 to 2,50	-
X12CrMnNiN18–9-5	1.4373	0,15	1,00	7,5 to 10,5	0,045	0,015	17,0 to 19,0	-	4,0 to 6,0	0,05 to 0,25	-	-
X11CrNiMnN19–8-6	1.4369	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	-	-
X6CrMnNiCuN18–12–4-2[*)]	1.4646[*)]	0,02 to 0,10	1,00	10,5 to 12,5	0,050	0,015	17,0 to 19,0	0,50	3,5 to 4,5	0,20 to 0,30	1,50 to 3,00	-
X1CrNi25–21	1.4335	0,020	0,25	2,00	0,025	0,010	24,0 to 26,0	0,20	20,0 to 22,0	0,10	-	-
X6CrNiMoNb17–12–2	1.4580	0,08	1,00	2,00	0,045	0,015	16,5 to 18,5	2,00 to 2,50	10,5 to 13,5	-	-	Nb: 10 x C to 1,00
X3CrNiMo17–13–3	1.4436	0,05	1,00	2,00	0,045	0,015[b]	16,5 to 18,5	2,50 to 3,00	10,5 to 13,0	0,10	-	-
X2CrNiMoN17–13–3	1.4429	0,030	1,00	2,00	0,045	0,015	16,5 to 18,5	2,50 to 3,00	11,0 to 14,0	0,12 to 0,22	-	-
X2CrNiMoN18–12–4	1.4434	0,030	1,00	2,00	0,045	0,015	16,5 to 19,5	3,0 to 4,0	10,5 to 14,0	0,10 to 0,20	-	-
X2CrNiMo18–15–4	1.4438	0,030	1,00	2,00	0,045	0,015[b]	17,5 to 19,5	3,0 to 4,0	13,0 to 16,0	0,10	-	-
X1CrNiMoCuN20–18–7	1.4547	0,020	0,70	1,00	0,030	0,010	19,5 to 20,5	6,0 to 7,0	17,5 to 18,5	0,18 to 0,25	0,50 to 1,00	-
X1CrNiMoN25–22–2	1.4466	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	1.4659	0,020	0,70	2,00 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	1,00 to 2,00	W: 1,50 to 2,50
X1CrNiMoCuN24–22–8	1.4652	0,020	0,50	2,00 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	0,30 to 0,60	-
X2CrNiMnMoN25–18–6-5	1.4565	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
X1CrNiMoCuN25–25–5	1.4537	0,020	0,70	2,00	0,030	0,010	24,0 to 26,0	4,7 to 5,7	24,0 to 27,0	0,17 to 0,25	1,00 to 2,00	-

Steel designation		% by mass [a]										
Name	Number	C	Si	Mn	P	S	Cr	Mo	Ni	N	Cu	Others
X1NiCrMoCuN25–20–7	1.4529	0,020	0,50	1,00	0,030	0,010	19,0 to 21,0	6,0 to 7,0	24,0 to 26,0	0,15 to 0,25	0,50 to 1,50	-
X1NiCrMoCu31–27–4	1.4563	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	0,70 to 1,50	-

Elements not quoted in this table shall not be intentionally added to the steel without the agreement of the purchaser except for finishing the cast. All appropriate precautions are to 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 may provide improvement of particular properties. For machinability a controlled sulfur content of 0,015 % to 0,030 % is recommended and permitted. For weldability, a controlled sulfur content of 0,008 % to 0,015 % is recommended and permitted. For polishability, a controlled sulfur content of 0,015 % max. is recommended.

[*)] Patented steel grade.

Table 2 — Chemical composition (cast analysis) of austenitic-ferritic corrosion resisting steels

Steel designation		% by mass [a]										
Name	Number	C	Si	Mn	P	S	Cr	Mo	Ni	N	Cu	W
Standard grades												
X2CrNiN23–4	1.4362	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	0,10 to 0,60	-
X2CrNiMoN22–5-3[b]	1.4462[b]	0,030	1,00	2,00	0,035	0,015	21,0 to 23,0	2,50 to 3,5	4,5 to 6,5	0,10 to 0,22	-	-
Special grades												
X2CrNiN22-2[*)]	1.4062[*)]	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	-	-
X2CrNiMoSi18–5-3	1.4424	0,030	1,40 to 2,00	1,20 to 2,00	0,035	0,015	18,0 to 19,0	2,50 to 3,0	4,5 to 5,2	0,05 to 0,10	-	-
X2CrNiCuN23–4	1.4655	0,030	1,00	2,00	0,035	0,015	22,0 to 24,0	0,10 to 0,60	3,5 to 5,5	0,05 to 0,20	1,00 to 3,00	-
X2CrMnNiN21–5-1 [*)]	1.4162[*)]	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	0,10 to 0,80	-
X2CrMnNiMoN21–5-3	1.4482	0,030	1,00	4,0 to 6,0	0,035	0,030	19,5 to 21,5	0,10 to 0,60	1,50 to 3,50	0,05 to 0,20	1,00	-
X2CrNiMnMoCuN24–4-3–2 [*)]	1.4662[*)]	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	0,10 to 0,80	-
X2CrNiMoCuN25–6-3	1.4507	0,030	0,70	2,00	0,035	0,015	24,0 to 26,0	3,0 to 4,0	6,0 to 8,0	0,20 to 0,30	1,00 to 2,50	-
X2CrNiMoN25–7-4	1.4410	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	1.4501	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	0,50 to 1,00	0,50 to 1,00
X2CrNiMoN29–7-2	1.4477	0,030	0,50	0,80 to 1,50	0,030	0,015	28,0 to 30,0	1,50 to 2,60	5,8 to 7,5	0,30 to 0,40	0,80	-

Elements not quoted in this table shall not be intentionally added to the steel without the agreement of the purchaser except for finishing the cast. All appropriate precautions are to 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] By agreement, this grade can be delivered with a Pitting Resistance Equivalent Number (PRE = Cr + 3,3 Mo + 16 N, compare Table D.1 of EN 10088-1:2014) greater than 34.

[*)] Patented steel grade.

Table 3 — Chemical composition (cast analysis) of ferritic corrosion resisting steels

Steel designation		% by mass [a]											
Name	Number	C	Si	Mn	P	S	Cr	Mo	Ni	N	Nb	Ti	Others
Standard grades													
X2CrNi12	1.4003	0,030	1,00	1,50	0,040	0,015	10,5 to12,5	-	0,30 to 1,00	0,030	-	-	-
X2CrTi12	1.4512	0,030	1,00	1,00	0,040	0,015	10,5 to 12,5	-	-	-	-	[6x (C+N)] to 0,65 [c]	-
X6CrNiTi12	1.4516	0,08	0,70	1,50	0,040	0,015	10,5 to 12,5	-	0,50 to 1,50	-	-	0,05 to 0,35	-
X6Cr13	1.4000	0,08	1,00	1,00	0,040	0,015[b]	12,0 to 14,0	-	-	-	-	-	-
X6CrAl13	1.4002	0,08	1,00	1,00	0,040	0,015[b]	12,0 to 14,0	-	-	-	-	-	Al: 0,10 to 0,30
X6Cr17	1.4016	0,08	1,00	1,00	0,040	0,015[b]	16,0 to 18,0	-	-	-	-	-	-
X3CrTi17	1.4510	0,05	1,00	1,00	0,040	0,015[b]	16,0 to 18,0	-	-	-	-	[4x(C+N) + 0,15] to 0,80[c]	-
X3CrNb17	1.4511	0,05	1,00	1,00	0,040	0,015	16,0 to 18,0	-	-	-	12 x C to 1,00	-	-
X6CrMo17–1	1.4113	0,08	1,00	1,00	0,040	0,015[b]	16,0 to 18,0	0,90 to 1,40	-	-	-	-	-
X2CrMoTi18–2	1.4521	0,025	1,00	1,00	0,040	0,015	17,0 to 20,0	1,80 to 2,50	-	0,030	-	[4x(C+N) + 0,15] to 0,80[c]	-
Special grades													
X2CrMnNiTi12	1.4600	0,030	1,00	1,00 to 2,50	0,040	0,015	11,0 to 13,0	-	0,30 to 1,00	0,025	-	6 x C to 0,35	-
X2CrSiTi15	1.4630	0,030	0,20 to 1,50	1,00	0,050	0,050	13,0 to 16,0	0,50	0,50	-	-	[4x(C+N) + 0,15] to 0,80[c]	Al: 1,50 Cu:0.50
X1CrNb15	1.4595	0,020	1,00	1,00	0,025	0,015	14,0 to 16,0	-	-	0,020	0,20 to 0,60	-	-
X2CrTi17	1.4520	0,025	0,50	0,50	0,040	0,015	16,0 to 18,0	-	-	0,015	-	[4x(C+N) + 0,15] to 0,80[c]	-
X2CrNbZr17	1.4590	0,030	1,00	1,00	0,040	0,015	16,0 to 17,5	-	-	-	0,35 to 0,55	-	Zr ≥ 7x (C+N) +0,15
X6CrNi17–1	1.4017	0,08	1,00	1,00	0,040	0,015	16,0 to 18,0	-	1,20 to 1,60	-	-	-	-

Steel designation		% by mass [a]											
Name	Number	C	Si	Mn	P	S	Cr	Mo	Ni	N	Nb	Ti	Others
X2CrTiNb18	1.4509	0,030	1,00	1,00	0,040	0,015	17,5 to 18,5	-	-	-	[3xC+0,30] to 1,00	0,10 to 0,60	-
X2CrAlSiNb18	1.4634	0,030	0,20 to 1,50	1,00	0,050	0,050	17,5 to 18,5	0,50	0,50	-	[3xC+0,30] to 1,00 [c]	-	Al: 0,20 to 1,50 Cu:0.50
X2CrNbTi20	1.4607	0,030	1,00	1,00	0,040	0,015	18,5 to 20,5	–		0,030	1,00	[4 × (C+N) + 0.15] to 0,80 [c]	-
X2CrTi21 [*)]	1.4611 [*)]	0,030	1,00	1,00	0,050	0,050	19,0 to 22,0	0,50	0,50	-	-	[4x(C+N) + 0.20] to 1.00 [c]	Cu: 0,50, Al: 0,05
X2CrNbCu21	1.4621	0,030	1,00	1,00	0,040	0,015	20,0 to 21,5	-	-	0,030	0,20 to 1,00	-	Cu: 0,10 to 1,00
X2CrTi24 [*)]	1.4613 [*)]	0,030	1,00	1,00	0,050	0,050	22,0 to 25,0	0,50	0,50	-	-	[4x(C+N) + 0.20] to 1.00 [c]	Cu: 0,50, Al:0,05
X5CrNiMoTi15–2	1.4589	0,08	1,00	1,00	0,040	0,015	13,5 to 15,5	0,20 to 1,20	1,00 to 2,50	-	-	0,30 to 0,50	-
X2CrMoTi17–1	1.4513	0,025	1,00	1,00	0,040	0,015	16,0 to 18,0	0,80 to 1,40	-	0,020	-	[4x(C+N) + 0,15] to 0,80[c]	-
X6CrMoNb17–1	1.4526	0,08	1,00	1,00	0,040	0,015	16,0 to 18,0	0,80 to 1,40	-	0,040	[7x(C+N)+0,10] to 1,00	-	-
X2CrMoTi29–4	1.4592	0,025	1,00	1,00	0,030	0,010	28,0 to 30,0	3,5 to 4,5	-	0,045	-	[4x(C+N) + 0,15] to 0,80[c]	-

Elements not quoted in this table shall not be intentionally added to the steel without the agreement of the purchaser except for finishing the cast. All precautions are to 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 may provide improvement of particular properties. For machinability a controlled sulfur content of 0,015 % to 0,030 % is recommended and permitted. For weldability, a controlled sulfur content of 0,008 % to 0,015 % is recommended and permitted. For polishability, a controlled sulfur content of 0,015 % max. is recommended.

[c] Stabilization may be by 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).

[*)] Patented steel grade.

Table 4 — Chemical composition (cast analysis) of martensitic and precipitation hardening corrosion resisting steels

Steel designation		% by mass [a]									
Name	Number	C	Si	Mn	P	S	Cr	Mo	Ni	Cu	Others
Standard grades (martensitic steels)[c]											
X12Cr13	1.4006	0,08 to 0,15	1,00	1,50	0,040	0,015[b]	11,5 to 13,5	-	0,75	-	-
X15Cr13	1.4024	0,12 to 0,17	1,00	1,00	0,040	0,015[b]	12,0 to 14,0	-	-	-	-
X20Cr13	1.4021	0,16 to 0,25	1,00	1,50	0,040	0,015[b]	12,0 to 14,0	-	-	-	-
X30Cr13	1.4028	0,26 to 0,35	1,00	1,50	0,040	0,015[b]	12,0 to 14,0	-	-	-	-
X39Cr13	1.4031	0,36 to 0,42	1,00	1,00	0,040	0,015[b]	12,5 to 14,5	-	-	-	-
X46Cr13	1.4034	0,43 to 0,50	1,00	1,00	0,040	0,015[b]	12,5 to 14,5	-	-	-	-
X38CrMo14	1.4419	0,36 to 0,42	1,00	1,00	0,040	0,015	13,0 to 14,5	0,60 to 1,00	-	-	-
X55CrMo14	1.4110	0,48 to 0,60	1,00	1,00	0,040	0,015[b]	13,0 to 15,0	0,50 to 0,80	-	-	V: 0,15
X3CrNiMo13–4	1.4313	0,05	0,70	1,50	0,040	0,015	12,0 to 14,0	0,30 to 0,70	3,5 to 4,5	-	N: ≥ 0,020
X50CrMoV15	1.4116	0,45 to 0,55	1,00	1,00	0,040	0,015[b]	14,0 to 15,0	0,50 to 0,80	-	-	V: 0,10 to 0,20 N: see [e]
X4CrNiMo16–5-1	1.4418	0,06	0,70	1,50	0,040	0,015[b]	15,0 to 17,0	0,80 to 1,50	4,0 to 6,0	-	N: ≥ 0,020
X39CrMo17–1	1.4122	0,33 to 0,45	1,00	1,50	0,040	0,015[b]	15,5 to 17,5	0,80 to 1,30	1,00	-	-
Special grades (martensitic steels)											
X1CrNiMoCu12–5-2	1.4422	0,020	0,50	2,00	0,040	0,003	11,0 to 13,0	1,30 to 1,80	4,0 to 5,0	0,20 to 0,80	N: 0,020
X1CrNiMoCu12–7-3	1.4423	0,020	0,50	2,00	0,040	0,003	11,0 to 13,0	2,30 to 2,80	6,0 to 7,0	0,20 to 0,80	N: 0,020

Steel designation		% by mass [a]									
Name	Number	C	Si	Mn	P	S	Cr	Mo	Ni	Cu	Others
Special grades (precipitation hardening steels)											
X5CrNiCuNb16–4	1.4542	0,07	0,70	1,50	0,040	0,015[b]	15,0 to 17,0	0,60	3,0 to 5,0	3,0 to 5,0	Nb: 5 x C to 0,45
X7CrNiAl17–7	1.4568	0,09	0,70	1,00	0,040	0,015	16,0 to 18,0	-	6,5 to 7,8[d]	-	Al: 0,70 to 1,50

Elements not quoted in this table shall not be intentionally added to the steel without the agreement of the purchaser except for finishing the cast. All precautions are to 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 may provide improvement of particular properties. For machinability a controlled sulfur content of 0,015 % to 0,030 % is recommended and permitted. For weldability, a controlled sulfur content of 0,008 % to 0,015 % is recommended and permitted. For polishability, a controlled sulfur content of 0,015 % max. is recommended.

[c] Tighter carbon ranges may be agreed at the time of enquiry and order.

[d] For better cold deformability, the upper limit may be increased to 8,3 %.

[e] For increased mechanical properties, nitrogen may be added up to 0,15 %.

Table 5 — Permissible product analysis tolerances on the limiting values given in Tables 1 to 4 for the cast analysis

Element	Specified limits, cast analysis % by mass		Permissible tolerance[a] % by mass
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

Element	Specified limits, cast analysis % by mass		Permissible tolerance[a] % by mass
Tungsten		≤ 3,00	+ 0,05
Vanadium		≤ 0,50	+ 0,03

[a] If several product analysis are carried out on one cast, and the contents of an individual element determined lies outside the permissible range of the chemical composition specified for the cast analysis, then it is only allowed to exceed the permissible maximum value or to fall short of the permissible minimum value, but not both at the same time.

Table 6 — Type of process route and surface finish of sheet, plate and strip[a]

	Symbol[b]	Type of process route	Surface finish	Notes
Hot rolled	1U	Hot rolled, not heat treated, not descaled	Covered with 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 rolling scale	Suitable for parts which will be descaled or machined in subsequent production or for certain heat-resisting 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.
	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-resisting applications.
	2E	Cold rolled, heat treated, mechanically descaled	Free of scale	Usually applied to steels with a scale which is very resistant to pickling solutions. May be followed by pickling. Surface roughness is depending on the mechanical descaling method and may differ if the surface is e.g. shot blasted or brushed.
	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.
	2A	Cold rolled, heat treated, bright-pickled, skin passed	Smoother and more reflective than 2D	Typical finish for ferritic grades when high reflectivity is desired.
	2R	Cold rolled, bright annealed[c]	Smooth, bright, reflective	Smoother and brighter than 2B. Also common finish for further processing.
	2Q	Cold rolled, hardened and tempered, scale free	Free of scale	Either hardened and tempered in a protective atmosphere or descaled after heat treatment.
Special finishes	1G or 2G	Ground[d]	See Footnote [e].	Grade of grit or surface roughness can be specified. Unidirectional texture, not very reflective.
	1J or 2J	Brushed[d] 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 R_a < 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; 2nd surface flat	Chequer plates used for floors.
	2M			A fine texture finish mainly used for architectural applications.
	2W	Corrugated	Design to be agreed	Used to increase strength and/or for cosmetic effect.

	Symbol[b]	Type of process route	Surface finish	Notes
	2L	Coloured[d]	Colour to be agreed	
	1S or 2S	Surface coated[d]		Coated with e.g. tin, aluminium.

[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 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 between manufacturer and purchaser (e.g. grade of grit or surface roughness).

Table 7 — Mechanical properties at room temperature of austenitic steels in the solution annealed condition [a] (see Table A.1) and resistance to intergranular corrosion

Steel designation		Product form[b]	Thick-ness	0,2 %-proof strength	1 % -proof-strength	Tensile strength	Elongation after fracture		Impact energy (ISO-V)		Resistance to intergranular corrosion[h]	
Name	Number			$R_{p0,2}$	$R_{p1,0}$[c]	R_m	A_{80}[d, f] < 3 mm thick	A[d, g] ≥ 3 mm thick	KV_2 > 10 mm thick		in the delivery condition	in the sensitized condition[i]
			mm max.	MPa [*)] min. (tr.)[d,e]		MPa [*)]	% min. (tr.)	% min. (tr.)	J min. (long.)	J min. (tr.)		
Standard grades												
X2CrNiN18–7	1.4318	C	8	350	380	650 to 850	35	40	-	-	yes	yes
		H	13,5	330	370				90	60		
		P	75	330	370	630 to 830	45	45				
X10CrNi18–8	1.4310	C	8	250	280	600 to 950	40	40	-	-	no	no
X2CrNi18–9	1.4307	C	8	220	250	520 to 700	45	45	-	-	yes	yes
		H	13,5	200	240				100	60		
		P	75	200	240	500 to 700						
X8CrNiS18–9	1.4305	P	75	190	230	500 to 700	35	35	-	-	no	no
X2CrNiN18–10	1.4311	C	8	290	320	550 to 750	40	40	-	-	yes	yes
		H	13,5	270	310				100	60		
		P	75	270	310							
X5CrNi18–10	1.4301	C	8	230	260	540 to 750	45 [j]	45 [j]	-	-	yes	no[k]
		H	13,5	210	250	520 to 720			100	60		
		P	75	210	250		45	45				
X6CrNiTi18–10	1.4541	C	8	220	250	520 to 720	40	40	-	-	yes	yes
		H	13,5	200	240				100	60		
		P	75	200	240	500 to 700						
X2CrNi19–11	1.4306	C	8	220	250	520 to 700	45	45	-	-	yes	yes
		H	13,5	200	240				100	60		
		P	75	200	240	500 to 700						

Steel designation		Product form[b]	Thick-ness	0,2 %-proof strength	1 % -proof-strength	Tensile strength	Elongation after fracture		Impact energy (ISO-V)		Resistance to intergranular corrosion[h]	
Name	Number			$R_{p0,2}$	$R_{p1,0}$[c]	R_m	A_{80}[d, f] < 3 mm thick	A[d, g] ≥ 3 mm thick	KV_2 > 10 mm thick		in the delivery condition	in the sensitized condition[i]
			mm max.	MPa [*)] min. (tr.)[d,e]		MPa [*)]	% min. (tr.)	% min. (tr.)	J min. (long.)	J min. (tr.)		
X4CrNi18–12	1.4303	C	8	220	250	500 to 650	45	45	-	-	yes	no[k]
X2CrNiMoN17–11–2	1.4406	C	8	300	330	580 to 780	40	40	-	-	yes	yes
		H	13,5	280	320				100	60		
		P	75	280	320							
X2CrNiMo17–12–2	1.4404	C	8	240	270	530 to 680	40	40	-	-	yes	yes
		H	13,5	220	260				100	60		
		P	75	220	260	520 to 670	45	45				
X5CrNiMo17–12–2	1.4401	C	8	240	270	530 to 680	40	40	-	-	yes	no[k]
		H	13,5	220	260				100	60		
		P	75	220	260	520 to 670	45	45				
X6CrNiMoTi17–12–2	1.4571	C	8	240	270	540 to 690	40	40	-	-	yes	yes
		H	13,5	220	260				100	60		
		P	75	220	260	520 to 670						
X2CrNiMo17–12–3	1.4432	C	8	240	270	550 to 700	40	40	-	-	yes	yes
		H	13,5	220	260				100	60		
		P	75	220	260	520 to 670	45	45				
X2CrNiMo18–14–3	1.4435	C	8	240	270	550 to 700	40	40	-	-	yes	yes
		H	13,5	220	260				100	60		
		P	75	220	260	520 to 670	45	45				
X2CrNiMoN17–13–5	1.4439	C	8	290	320	580 to 780	35	35	-	-	yes	yes
		H	13,5	270	310				100	60		
		P	75	270	310		40	40				
X1NiCrMoCu25–20–5	1.4539	C	8	240	270	530 to 730	35	35	-	-	yes	yes
		H	13,5	220	260				100	60		
		P	75			520 to 720						

Steel designation		Product form[b]	Thick-ness	0,2 %-proof strength	1 % -proof-strength	Tensile strength	Elongation after fracture		Impact energy (ISO-V)		Resistance to intergranular corrosion[h]	
Name	Number			$R_{p0,2}$	$R_{p1,0}$[c]	R_m	A_{80}[d, f] < 3 mm thick	A[d, g] ≥ 3 mm thick	KV_2 > 10 mm thick		in the delivery condition	in the sensitized condition[i]
			mm max.	MPa [*)] min. (tr.)[d,e]		MPa [*)]	% min. (tr.)	% min. (tr.)	J min. (long.)	J min. (tr.)		
Special grades												
X5CrNi17–7	1.4319	C	3	230	260	550 to 750	45	-	-	-	yes	no[k]
		H	6	230	260	550 to 750	45	45	-	-		
X5CrNiN19–9	1.4315	C	8	290	320	500 to 750	40	40	100	60	yes	no
		H	13,5	270	310							
		P	75	270	310							
X5CrNiCu19–6-2	1.4640	C	8	230	260	540 to 750	45	45	-	-	yes	no
		H	13,5	210	240	520 to 720			-	-		
X6CrNiNb18–10	1.4550	C	8	220	250	520 to 720	40	40	-	-	yes	yes
		H	13,5	200	240				100	60		
		P	75	200	240	500 to 700						
X1CrNiSi18–15–4	1.4361	P	75	220	260	530 to 730	40	40	100	60	yes	yes
X8CrMnCuNB17–8-3	1.4597	C	8	300	330	580 to 780	40	40	-	-	yes	no
		H	13,5	300	330				100	60		
X8CrMnNi19–6-3	1.4376	C	4	400	420	600 to 900	40	40	-	-	yes	no
		H	13,5	400	420				-	-		
X12CrMnNiN17–7-5	1.4372	C	8	350	380	680 to 880	45	45	-	-	yes	no
		H	13,5	330	370				100	60		
		P	75	330	370		40	40				

Steel designation		Product form[b]	Thick-ness	0,2 %-proof strength	1 % -proof-strength	Tensile strength	Elongation after fracture		Impact energy (ISO-V)		Resistance to intergranular corrosion[h]	
Name	Number			$R_{p0,2}$	$R_{p1,0}$[c]	R_m	A_{80}[d, f] < 3 mm thick	A[d, g] ≥ 3 mm thick	KV_2 > 10 mm thick		in the delivery condition	in the sensitized condition[i]
			mm max.	MPa [*)] min. (tr.)[d,e]		MPa [*)]	% min. (tr.)	% min. (tr.)	J min. (long.)	J min. (tr.)		
X2CrMnNiN17–7-5	1.4371	C	8	300	330	650 to 850	45	45	-	-	yes	yes
		H	13,5	280	320				100	60		
		P	75	280	320	630 to 830	35	35				
X9CrMnNICu17–8-5–2	1.4618	C	8	230	250	540 to 850	45	45	100	60	yes	no
		H	13,5	230	250	520 to 830						
		P	75	210	240	520 to 830						
X12CrMnNiN18–9-5	1.4373	C	8	340	370	680 to 880	45	45	-	-	yes	no
		H	13,5	320	360				100	60		
		P	75	320	360	600 to 800	35	35				
X11CrNiMnN19–8-6	1.4369	C	4	340	370	750 to 950	35	35	-	-	yes	no
X6CrMnNiCuN18–12–4-2	1.4646	C	8	380	400	650 to 850	30	30	100	60	yes	yes
X1CrNi25–21	1.4335	P	75	200	240	470 to 670	40	40	100	60	yes	yes
X6CrNiMoNb17–12–2	1.4580	P[j]	75	220	260	520 to 720	40	40	100	60	yes	yes
X3CrNiMo17–13–3	1.4436	C	8	240	270	550 to 700	40	40	-	-	yes	no[k]
		H	13,5	220	260				100	60		
		P	75	220	260	530 to 730	40	40				
X2CrNiMoN17–13–3	1.4429	C	8	300	330	580 to 780	35	35	-	-	yes	yes
		H	13,5	280	320				100	60		
		P	75	280	320		40	40				

Steel designation		Product form[b]	Thick-ness	0,2 %-proof strength	1 % -proof-strength	Tensile strength	Elongation after fracture		Impact energy (ISO-V)		Resistance to intergranular corrosion[h]	
Name	Number			$R_{p0,2}$	$R_{p1,0}$[c]	R_m	A_{80}[d, f] < 3 mm thick	A[d, g] ≥ 3 mm thick	KV_2 > 10 mm thick		in the delivery condition	in the sensitized condition[i]
			mm max.	MPa [*)] min. (tr.)[d,e]		MPa [*)]	% min. (tr.)	% min. (tr.)	J min. (long.)	J min. (tr.)		
X2CrNiMoN18–12–4	1.4434	C	8	290	320	570 to 770	35	35	-	-	yes	yes
		H	13,5	270	310				100	60		
		P	75	270	310	540 to 740	40	40				
X2CrNiMo18–15–4	1.4438	C	8	240	270	550 to 700	35	35	-	-	yes	yes
		H	13,5	220	260				100	60		
		P	75	220	260	520 to 720	40	40				
X1CrNiMoCuN20–18–7	1.4547	C	8	320	350	650 to 850	35	35	-	-	yes	yes
		H	13,5	300	340				100	60		
		P	75	300	340		40	40				
X1CrNiMoN25–22–2	1.4466	P	75	250	290	540 to 740	40	40	100	60	yes	yes
X1CrNiMoCuNW24–22–6	1.4659	P	75	420	460	800 to 1000	-	40	100	60	yes	yes
X1CrNiMoCuN24–22–8	1.4652	C	8	430	470	750 to 1000	40	40	-	-	yes	yes
		H	13,5	430	470	750 to 1000			100	60		
		P	15	430	470	750 to 1000						
X2CrNiMnMoN25–18–6-5	1.4565	C	6	420	460	800 to 950	30	30	120	90	yes	yes
		H	10									
		P	40									

Steel designation		Product form[b]	Thick-ness	0,2 %-proof strength	1 % -proof-strength	Tensile strength	Elongation after fracture		Impact energy (ISO-V)		Resistance to intergranular corrosion[h]	
Name	Number			$R_{p0,2}$	$R_{p1,0}$[c]	R_m	A_{80}[d, f] < 3 mm thick	A[d, g] ≥ 3 mm thick	KV_2 > 10 mm thick		in the delivery condition	in the sensitized condition[i]
			mm max.	MPa[*] min. (tr.)[d,e]		MPa[*]	% min. (tr.)	% min. (tr.)	J min. (long.)	J min. (tr.)		
X1CrNiMoCuN25–25–5	1.4537	P	75	290	330	600 to 800	40	40	100	60	yes	yes
X1NiCrMoCuN25–20–7	1.4529	P	75	300	340	650 to 850	40	40	100	60	yes	yes
X1NiCrMoCu31–27–4	1.4563	P	75	220	260	500 to 700	40	40	100	60	yes	yes
For bigger sizes the mechanical values shall be agreed at the time of enquiry and order.												

[a] Solution treatment may be omitted if the conditions for hot working and subsequent cooling are such that the requirements for the mechanical properties of the product and the resistance to intergranular corrosion as defined in EN ISO 3651-2 are obtained.

[b] C = cold rolled strip; H = hot rolled strip; *P* = hot rolled plate.

[c] Only for guidance.

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

- proof strength - minus 15 MPa,
- elongation for constant gauge length - minus 5 %;
- elongation for proportional gauge length - minus 2 %.

[e] 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 at the time of enquiry and order.

[f] 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.

[g] Values apply for test pieces with a gauge length of 5,65 $\sqrt{S_0}$.

[h] When tested according to EN ISO 3651-2.

[i] See NOTE 2 to 6.4.

[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.

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

Table 8 — Mechanical properties at room temperature of austenitic-ferritic steels in the solution annealed condition (see Table A.2) and resistance to intergranular corrosion

Steel designation		Product form [a]	Thickness	0,2 %-proof strength	Tensile strength	Elongation after fracture		Impact energy (ISO-V)		Resistance to intergranular corrosion[f]	
Name	Number			$R_{p0,2}$	R_m	A_{80} < 3 mm thick[d]	A ≥ 3 mm thick[e]	KV_2 > 10 mm thick		in the delivery condition	in the sensitized condition[g]
			mm max.	MPa[*)] min. (tr.)[b,c]	MPa[*)]	% min. (long.+ tr.)	% min. (long.+tr.)	J min. (long.)	(tr.)		
Standard grades											
X2CrNiN23–4	1.4362	C	8	450	650 to 850	20	20	-	-	yes	yes
		H	13,5	400				100	60		
		P	75	400	630 to 800	25	25				
X2CrNiMoN22–5-3	1.4462	C	8	500	700 to 950	20	20	-	-	yes	yes
		H	13,5	460		25	25	100	60		
		P	75	460	640 to 840	25	25				
Special grades											
X2CrNiN22-2	1.4062	C	6,4	530	700 to 900	20	20	-	-	yes	yes
		H	10	480	680 to 900	30	30	80	80		
		P	75	450	650 to 850	30	30	80	60		
X2CrNiMoSi18–5-3	1.4424	C	8	450	700 to 900	25	25	100	60	yes	yes
		H	13,5								
		P	75	400	680 to 900						
X2CrNiCuN23–4	1.4655	C	8	420	600 to 850	20	20	-	-	yes	yes
		H	13,5	400				100	60		
		P	75	400	630 to 800	25	25				
X2CrMnNiN21–5-1	1.4162	C	6,4	530	700 to 900	20	30	-	-	yes	yes
		H	10	480	680 to 900	30	30	80	80		
		P	75	450	650 to 850	30	30	60	60		

Steel designation		Product form [a]	Thickness	0,2 %-proof strength	Tensile strength	Elongation after fracture		Impact energy (ISO-V)		Resistance to intergranular corrosion[f]	
Name	Number			$R_{p0,2}$	R_m	A_{80} < 3 mm thick[d]	A ≥ 3 mm thick[e]	KV_2 > 10 mm thick		in the delivery condition	in the sensitized condition[g]
			mm max.	MPa[*)] min. (tr.)[b,c]	MPa[*)]	% min. (long.+ tr.)	% min. (long.+tr.)	J min. (long.)	(tr.)		
X2CrMnNiMoN21–5-3	1.4482	C	6,4	500	700 to 900	20	30	-	-	yes	yes
		H	10	480	660 to 900	30	30	100	60		
		P	75	450	650 to 850	30	30	100	60		
X2CrNiMnMoCuN24–4-3–2	1.4662	C	6,4	550	750 to 900	20	25	-	-	yes	Yes
		H	13	550	750 to 900	-	25	80	80		
		P	75	480	680 to 900	-	25	60	60		
X2CrNiMoCuN25–6-3	1.4507	C	8	550	750 to 1000	20	20	-	-	yes	yes
		H	13,5	530				100	60		
		P	75	530	730 to 930	25	25				
X2CrNiMoN25–7-4	1.4410	C	8	550	750 to 1000	20	20	-	-	yes	yes
		H	13,5	530				100	60		
		P	75	530	730 to 930	20	20				
X2CrNiMoCuWN25–7-4	1.4501	P	75	530	730 to 930	25	25	100	60	yes	yes
Special grades											
X2CrNiMoN29–7-2	1.4477	C	8	650	800 to 1050	20	20	-	-	yes	yes
		H	13,5	550	750 to 1000	20	20	100	60		
		P	75	550							
For bigger sizes the mechanical values shall be agreed at the time of enquiry and order.											

[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 strength values are reduced by 15 MPa.

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

[d] 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.

[e] Values apply for test pieces with a gauge length of 5,65 $\sqrt{S_o}$.

[f] When tested according to EN ISO 3651-2.

[g] See NOTE 2 to 6.4.

[*)] 1 MPa = 1 N/mm^2.

Table 9 — Mechanical properties at room temperature of ferritic steels in the annealed condition (see Table A.3) and resistance to intergranular corrosion

Steel designation		Product form	Thickness	0,2 %- proof strength		Tensile strength	Elongation after fracture		Resistance to intergranular corrosion [d]	
Name	Number	[a]	mm max.	$R_{p0,2}$ MPa [*)] min. (long.)	$R_{p0,2}$ MPa [*)] min. (tr.)	R_m MPa [*)]	$A_{80\,mm}$ [b] < 3 mm thick % min. (long. + tr.)	A [c] ≥ 3 mm thick % min. (long. + tr.)	In the delivery condition	in the welded condition
Standard grades										
X2CrNi12	1.4003	C	8	280	320	450 to 650	20		no	no
		H	13,5							
		P	25	250	280		18			
X2CrTi12	1.4512	C	8	210	220	380 to 560	25		no	no
		H	13,5							
X6CrNiTi12	1.4516	C	8	280	320	450 to 650	23		no	no
		H	13,5							
		P	25	250	280		20			
X6Cr13	1.4000	C	8	240	250	400 to 600	19		no	no
		H	13,5	220	230					
		P	25	220	230					
X6CrAl13	1.4002	C	8	230	250	400 to 600	17		no	no
		H	13,5	210	230					
		P	25	210	230					
X6Cr17	1.4016	C	8	260	280	430 to 600	20		yes	no
		H	13,5	240	260		18			
		P	25	240	260	430 to 630	20			
X3CrTi17	1.4510	C	8	230	240	420 to 600	23		yes	yes
		H	13,5							
X3CrNb17	1.4511	C	8	230	240	420 to 600	23		yes	yes
X6CrMo17–1	1.4113	C	8	260	280	450 to 630	18		yes	no
		H	13,5							
X2CrMoTi18–2	1.4521	C	8	300	320	420 to 640	20		yes	yes
		H	13,5	280	300	400 to 600				
		P	12	280	300	420 to 620				

Steel designation		Product form	Thickness	0,2 %- proof strength		Tensile strength	Elongation after fracture		Resistance to intergranular corrosion [d]	
Name	Number	[a]	mm max.	$R_{p0,2}$ MPa [*)] min. (long.)	$R_{p0,2}$ MPa [*)] min. (tr.)	R_m MPa [*)]	$A_{80\ mm}$ [b] < 3 mm thick % min. (long. + tr.)	A [c] ≥ 3 mm thick % min. (long. + tr.)	In the delivery condition	in the welded condition
Special grades										
X2CrMnNiTi12	1.4600	H	10	-	375	500 to 650	20		yes	yes
X2CrSiTi15	1.4630	C	8	210	230	380 to 580	20		yes	yes
X1CrNb15	1.4595	C	8	210	220	380 to 560	25		yes	yes
X2CrTi17	1.4520	C	8	180	200	380 to 530	24		yes	yes
X2CrNbZr17	1.4590	C	8	230	250	400 to 550	23		yes	yes
X6CrNi17–1	1.4017	C	8	330	350	500 to 750	12		yes	no
X2CrTiNb18	1.4509	C	8	230	250	430 to 630	18		yes	yes
X2CrAlSiNb18	1.4634	C	8	240	260	430 to 650	18		yes	yes
X2CrNbTi20	1.4607	C	8	230	250	430 to 630	18		yes	yes
X2CrTi21	1.4611	C	8	230	250	430 to 630	18		yes	yes
X2CrNbCu21	1.4621	C	6	230	250	400 to 600	22		yes	yes
		H	13							
X2CrTi24	1.4613	C	8	230	250	430 to 630	18		yes	yes
X5CrNiMoTi15–2	1.4589	C	8	400	420	550 to 750	16		yes	yes
		H	13,5	360	380		14		yes	yes
X2CrMoTi17–1	1.4513	C	8	200	220	400 to 550	23		yes	yes
X6CrMoNb17–1	1.4526	C	8	280	300	480 to 560	25		yes	yes
X2CrMoTi29–4	1.4592	C	8	430	450	550 to 700	20		yes	yes
For bigger sizes the mechanical values shall be agreed at the time of enquiry and order.										

Steel designation		Product form	Thickness	0,2 %- proof strength		Tensile strength	Elongation after fracture		Resistance to intergranular corrosion [d]	
Name	Number	[a]	mm max.	$R_{p0,2}$ MPa [*)] min. (long.)	$R_{p0,2}$ MPa [*)] min. (tr.)	R_m MPa [*)]	$A_{80\,mm}$ [b] < 3 mm thick % min. (long. + tr.)	A [c] ≥ 3 mm thick % min. (long. + tr.)	In the delivery condition	in the welded condition

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

[b] 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 width of 12,5 mm can also be used.

[c] Values apply for test pieces with a gauge length of 5,65 $\sqrt{S_o}$.

[d] When tested according to EN ISO 3651-2.

[*)] 1 MPa = 1 N/mm^2.

Table 10 — Mechanical properties at room temperature of martensitic steels in the heat-treated condition (see Table A.4)

Steel designation		Product form[a]	Thick-ness mm max.	Heat-treat-ment-condi-tion[b]	Hardness[c]		0,2 %-proof strength	Tensile strength	Elongation after fracture		Impact energy (ISO-V)	Hardness	
Name	Number				HRB max.	HBW or HV max.	$R_{p0,2}$ MPa[*)] min.	R_m MPa[*)]	$A_{80\,mm}$[d] < 3 mm thick % min. (long. + tr.)	A[e] ≥ 3 mm thick % min. (long.+tr.)	KV_2 > 10 mm thick J min.	HRC	HV
Standard grades													
X12Cr13	1.4006	C	8	+A	90	200	-	max. 600	20		-	-	-
		H	13,5										
		P[f]	75	+QT550	-		400	550 to 750	15		by agreement	-	-
				+QT650			450	650 to 850	12				
X15Cr13	1.4024	C	8	+A	90	200	-	max. 650	20		-	-	-
		H	13,5	+A	90	200	-	max. 650	20		-	-	-
		P	75	+A	-	-	-	-	-		by agreement	-	-
		P	75	+QT550	-	-	400	550 to 750	15			-	-
		P	75	+QT650	-	-	450	650 to 850	12			-	-
X20Cr13	1.4021	C	3	+QT	-	-	-	-	-		-	44 to 50	440 to 530
		C	8	+A	95	225	-	max. 700	15		-	-	-
		H	13,5										
		P[f]	75	+QT650	-		450	650 to 850	12		by agreement	-	-
				+QT750			550	750 to 950	10				

Steel designation		Product form[a]	Thick-ness mm max.	Heat-treat-ment-condi-tion[b]	Hardness[c] max.		0,2 %-proof strength	Tensile strength	Elongation after fracture		Impact energy (ISO-V)	Hardness	
Name	Number				HRB	HBW or HV	$R_{p0,2}$ MPa[*)] min.	R_m MPa[*)]	$A_{80\,mm}$[d] < 3 mm thick % min. (long. + tr.)	A[e] ≥ 3 mm thick % min. (long.+tr.)	KV_2 > 10 mm thick J min.	HRC	HV
X30Cr13	1.4028	C	3	+QT	-	-	-	-	-		-	45 to 51	450 to 550
		C	8	+A	97	235	-	max. 740	15		-	-	-
		H	13,5										
		P[f]	75	+QT800	-		600	800 to 1000	10		-	-	-
X39Cr13	1.4031	C	3	+QT	-	-	-	-	-		-	47 to 53	480 to 580
		C	8	+A	98	240	-	max. 760	12		-	-	-
		H	13,5										
X46Cr13	1.4034	C	3	+QT	-	-	-	-	-		-	49 to 55	510 to 610
		C	8	+A	99	245	-	max. 780	12		-	-	-
		H	13,5										
X38CrMo14	1.4419	C	3	+QT	-	-	-	-	-		-	46 to 52	450 to 560
		C	4	+A	97	235	-	max. 760	15		-	-	-
		H	6,5										
X55CrMo14	1.4110	C	3	+QT	-	-	-	-	-		-	50 to 56	530 to 640
		C	8	+A	100	280	-	max. 850	12		-	-	-
		H	13,5										
		P	75		-	-	-	-	-		-	-	-
X3CrNiMo13–4	1.4313	P	75	+QT780	-		630	780 to 980	15		70	-	-
				+QT900			800	900 to 1100	11				

Steel designation		Product form[a]	Thick-ness mm max.	Heat-treat-ment-condi-tion[b]	Hardness[c] max.		0,2 %-proof strength	Tensile strength	Elongation after fracture		Impact energy (ISO-V)	Hardness	
Name	Number				HRB	HBW or HV	$R_{p0,2}$ MPa[*)] min.	R_m MPa[*)]	$A_{80\ mm}$[d] < 3 mm thick % min. (long. + tr.)	A[e] ≥ 3 mm thick % min. (long.+tr.)	KV_2 > 10 mm thick J min.	HRC	HV
X50CrMoV15	1.4116	C	8	+A	100	280	-	max. 850	12		-	-	-
		H	13,5										
X4CrNiMo16–5-1	1.4418	P	75	+QT840	-		660	840 to 1100	14		55	-	-
X39CrMo17–1	1.4122	C	3	+QT	-	-	-	-	-		-	47 to 53	480 to 580
		C	8	+A	100	280	-	max. 900	12		-	-	-
		H	13,5										
Special grades													
X1CrNiMoCu12–5-2	1.4422	H	13,5	+A	100	300	550	750 to 950	-	15	100	-	-
		P	75	+QT650	-	-	550	750 to 950	-	15	100	-	max. 300
X1CrNiMoCu12–7-3	1.4423	H	13,5	+A	100	300	550	750 to 950	-	15	100	-	-
		P	75	+QT650	-	-	550	750 to 950	-	15	100	-	max. 300
For bigger sizes the mechanical values shall be agreed at the time of enquiry and order.													

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

[b] +A = annealed, +QT = quenched and tempered.

[c] Brinell or Vickers or Rockwell hardness is normally determined for product forms C and H in heat treatment condition +A. The tensile test shall be carried out in referee testing.

[d] 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 may also be used.

[e] Values apply for test pieces with a gauge length of 5,65 $\sqrt{S_o}$.

[f] Plates may also be delivered in the annealed condition; in such cases the mechanical properties are to be agreed at the time of enquiry and order.

[*)] 1 MPa = 1 N/mm^2 .

Table 11 — Mechanical properties at room temperature of precipitation hardening steels in the heat treated condition (see Table A.5)

Steel designation		Product form[a]	Thick-ness	Heat-treatment condition[b]	0,2 %-proof strength	Tensile strength	Elongation after fracture	
Name	Number		mm max.		$R_{p0,2}$ MPa[*)] min.	R_m MPa[*)]	$A_{80\ mm}$[c] < 3 mm thick % min. (long. + tr.)	A[d] ≥ 3 mm thick % min. (long. + tr.)
Special grades								
X5CrNiCuNb16–4	1.4542	C	8	+AT[e]	-	≤ 1275	5	
				+P1300[f]	1150	≥ 1300	3	
				+P900[f]	700	≥ 900	6	
		P	50	+P1070[g]	1000	1070 to 1270	8	10
				+P950[g]	800	950 to 1150	10	12
				+P850[g]	600	850 to 1050	12	14
				+SR 630[h]	-	≤ 1050	-	
X7CrNiAl17–7	1.4568	C	8	+AT[e,i]	-	≤ 1030	19	
				+P1450[f]	1310	≥ 1450	2	
For bigger sizes the mechanical values shall be agreed at the time of enquiry and order.								

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

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

[c] 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.

[d] Values apply for test pieces with a gauge length of 5,65 $\sqrt{S_o}$.

[e] Delivery condition.

[f] Condition of application; other precipitation hardening temperatures may be agreed.

[g] If ordered in the finally treated condition.

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

[i] For spring-hard rolled condition see EN 10151.

[*)] 1 MPa = 1 N/mm^2.

Table 12 — 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[*)]										Minimum 1 %-proof strength, MPa[*)]									
Name	Number		at a temperature (in °C) of:																			
			100	150	200	250	300	350	400	450	500	550	100	150	200	250	300	350	400	450	500	550
Standard grades																						
X2CrNiN18–7	1.4318	+AT	265	200	185	180	170	165	-	-	-	-	300	235	215	210	200	195	-	-	-	-
X10CrNi18–8	1.4310	+AT	210	200	190	185	180	180	-	-	-	-	230	215	205	200	195	195	-	-	-	-
X2CrNi18–9	1.4307	+AT	147	132	118	108	100	94	89	85	81	80	181	162	147	137	127	121	116	112	109	108
X2CrNiN18–10	1.4311	+AT	205	175	157	145	136	130	125	121	119	118	240	210	187	175	167	161	156	152	149	147
X5CrNi18–10	1.4301	+AT	157	142	127	118	110	104	98	95	92	90	191	172	157	145	135	129	125	122	120	120
X6CrNiTi18–10	1.4541	+AT	176	167	157	147	136	130	125	121	119	118	208	196	186	177	167	161	156	152	149	147
X2CrNi19–11	1.4306	+AT	147	132	118	108	100	94	89	85	81	80	181	162	147	137	127	121	116	112	109	108
X4CrNi18–12	1.4303	+AT	155	142	127	118	110	104	98	95	92	90	188	172	157	145	135	129	125	122	120	120
X2CrNiMoN17–11–2	1.4406	+AT	211	185	167	155	145	140	135	131	128	127	246	218	198	183	175	169	164	160	158	157
X2CrNiMo17–12–2	1.4404	+AT	166	152	137	127	118	113	108	103	100	98	199	181	167	157	145	139	135	130	128	127
X5CrNiMo17–12–2	1.4401	+AT	177	162	147	137	127	120	115	112	110	108	211	191	177	167	156	150	144	141	139	137
X6CrNiMoTi17–12–2	1.4571	+AT	185	177	167	157	145	140	135	131	129	127	218	206	196	186	175	169	164	160	158	157
X2CrNiMo17–12–3	1.4432	+AT	166	152	137	127	118	113	108	103	100	98	199	181	167	157	145	139	135	130	128	127
X2CrNiMo18–14–3	1.4435	+AT	165	150	137	127	119	113	108	103	100	98	200	180	165	153	145	139	135	130	128	127
X2CrNiMoN17–13–5	1.4439	+AT	225	200	185	175	165	155	150	-	-	-	255	230	210	200	190	180	175	-	-	-
X1NiCrMoCu25–20–5	1.4539	+AT	205	190	175	160	145	135	125	115	110	105	235	220	205	190	175	165	155	145	140	135
Special grades																						
X5CrNi17–7	1.4319	+AT	157	142	127	118	110	104	98	95	92	90	191	172	157	145	135	129	125	122	120	120
X5CrNiN19–9	1.4315	+AT	205	175	157	145	136	130	125	121	119	118	240	210	187	175	167	161	156	152	149	147
X5CrNiCu19–6-2	1.4640	+AT	157	142	127	118	110	104	98	95	92	90	191	172	157	145	135	129	125	122	120	120
X6CrNiNb18–10	1.4550	+AT	177	167	157	147	136	130	125	121	119	118	211	196	186	177	167	161	156	152	149	147

Steel designation		Heat treatment condition[a]	Minimum 0,2 %-proof strength, MPa[*)]										Minimum 1 %-proof strength, MPa[*)]									
Name	Number		at a temperature (in °C) of:																			
			100	150	200	250	300	350	400	450	500	550	100	150	200	250	300	350	400	450	500	550
X1CrNiSi18–15–4	1.4361	+AT	185	160	145	135	125	120	115	-	-	-	210	190	175	165	155	150	-	-	-	-
X8CrMnCuNB17–8-3	1.4597	+AT	225	205	190	177	165	152	145	140	137	135	260	235	218	204	190	180	175	168	165	165
X8CrMnNi19–6-3	1.4376	+AT	157	142	127	118	110	104	98	95	92	90	191	172	157	145	135	129	125	122	120	120
X12CrMnNiN17–7-5	1.4372	+AT	295	260	230	220	205	185	-	-	-	-	325	295	265	250	230	205	-	-	-	-
X2CrMnNiN17–7-5	1.4371	+AT	275	235	190	180	165	145	-	-	-	-	305	265	220	205	180	165	-	-	-	-
X9CrMnNICu17–8-5–2	1.4618	+AT	160	150	125	120	110	104	100	95	92	90	200	180	157	145	135	129	125	122	120	120
X12CrMnNiN18–9-5	1.4373	+AT	295	260	230	220	205	185	-	-	-	-	325	295	265	250	230	205	-	-	-	-
X11CrNiMnN19–8-6	1.4369	+AT	295	260	230	220	205	185	-	-	-	-	325	295	265	250	230	205	-	-	-	-
X6CrMnNiCuN18–12–4-2	1.4646	+AT	295	260	230	220	205	180	-	-	-	-	325	295	265	250	230	205	-	-	-	-
X1CrNi25–21	1.4335	+AT	150	140	130	120	115	110	105	-	-	-	180	170	160	150	140	135	130	-	-	-
X6CrNiMoNb17–12–2	1.4580	+AT	186	177	167	157	145	140	135	131	129	127	221	206	196	186	175	169	164	160	158	157
X3CrNiMo17–13–3	1.4436	+AT	177	162	147	137	127	120	115	112	110	108	211	191	177	167	156	150	144	141	139	137
X2CrNiMoN17–13–3	1.4429	+AT	211	185	167	155	145	140	135	131	129	127	246	218	198	183	175	169	164	160	158	157
X2CrNiMoN18–12–4	1.4434	+AT	211	185	167	155	145	140	135	131	129	127	-	218	198	183	175	169	164	160	158	157
X2CrNiMo18–15–4	1.4438	+AT	172	157	147	137	127	120	115	112	110	108	206	188	177	167	156	148	144	140	138	136
X1CrNiMoCuN20–18–7	1.4547	+AT	230	205	190	180	170	165	160	153	148	-	270	245	225	212	200	195	190	184	180	-
Special grades																						
X1CrNiMoN25–22–2	1.4466	+AT	195	170	160	150	140	135	-	-	-	-	225	205	190	180	170	165	-	-	-	-
X1CrNiMoCuNW24–22–6	1.4659	+AT	350	330	315	307	300	298	295	288	280	270	390	365	350	342	335	328	325	318	310	300
X1CrNiMoCuN24–22–8	1.4652	+AT	350	320	315	310	300	295	295	285	280	275	390	370	355	345	335	330	330	320	310	305

Steel designation		Heat treatment condition[a]	Minimum 0,2 %-proof strength, MPa[*)]										Minimum 1 %-proof strength, MPa[*)]									
Name	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
X2CrNiMnMoN25–18–6-5	1.4565	+AT	350	310	270	255	240	225	210	210	210	200	400	355	310	290	270	255	240	240	240	230
X1CrNiMoCuN25–25–5	1.4537	+AT	240	220	200	190	180	175	170	-	-	-	270	250	230	220	210	205	200	-	-	-
X1CrNiMoCuN25–20–7	1.4529	+AT	230	210	190	180	170	165	160	-	-	-	270	245	225	215	205	195	190	-	-	-
X1NiCrMoCu31–27–4	1.4563	+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.

[*)] 1 MPa = 1 N/mm^2.

Table 13 — 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[*], at a temperature (in °C) of:			
Name	Number		100	150	200	250
Standard grades						
X2CrNiN23–4	1.4362	+AT	330	300	280	265
X2CrNiMoN22–5-3	1.4462	+AT	360	335	315	300
Special grades						
X2CrNiN22-2	1.4062	+AT	380	350	330	315
X2CrNiMoSi18–5-3	1.4424	+AT (t ≤ 20)	370	350	330	325
		+AT (20 < t ≤ 75)	320	305	290	285
X2CrNiCuN23–4	1.4655	+AT	330	300	280	265
X2CrMnNiN21–5-1	1.4162	+AT	365	325	295	275
X2CrMnNiMoN21–5-3	1.4482	+AT	340	315	300	280
X2CrNiMnMoCuN24–4-3–2	1.4662	+AT	385	345	325	315
X2CrNiMoCuN25–6-3	1.4507	+AT	450	420	400	380
X2CrNiMoN25–7-4	1.4410	+AT	450	420	400	380
X2CrNiMoCuWN25–7-4	1.4501	+AT	450	420	400	380
X2CrNiMoN29–7-2	1.4477	+AT	500	460	430	400

[a] +AT = solution annealed.

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

Table 14 — 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*) at a temperature (in °C) of:						
Name	Number		100	150	200	250	300	350	400
Standard grades									
X2CrNi12	1.4003	+A	240	235	230	220	215	-	-
X2CrTi12	1.4512	+A	200	195	190	185	180	160	-
X6CrNiTi12	1.4516	+A	300	270	250	245	225	215	-
X6Cr13	1.4000	+A	220	215	210	205	200	195	190
X6CrAl13	1.4002	+A	220	215	210	205	200	195	190
X6Cr17	1.4016	+A	220	215	210	205	200	195	190
X3CrTi17	1.4510	+A	195	190	185	175	165	155	-
X3CrNb17	1.4511	+A	230	220	205	190	180	165	-
X6CrMo17–1	1.4113	+A	250	240	230	220	210	205	200
X2CrMoTi18–2	1.4521	+A	250	240	230	220	210	205	200
Special grades									
X2CrSiTi15	1.4630	+A	195	190	185	175	165	155	-
X1CrNb15	1.4595	+A	200	195	190	185	180	160	-
X2CrTi17	1.4520	+A	195	180	170	160	155	-	-
X2CrNbZr17	1.4590	+A	230	220	210	205	200	180	-
X2CrTiNb18	1.4509	+A	230	220	210	205	200	180	-
X2CrAlSiNb18	1.4634	+A	230	220	210	205	200	180	-
X2CrNbTi20	1.4607	+A	250	240	230	220	210	205	200
X2CrTi21	1.4611	+A	230	220	210	205	200	180	-
X2CrNbCu21	1.4621	+A	240	230	220	210	205	200	-
X2CrTi24	1.4613	+A	230	220	210	205	200	180	-
X6CrMoNb17–1	1.4526	+A	270	265	250	235	215	205	-
X2CrMoTi29–4	1.4592	+A	395	370	350	335	325	310	-

[a] +A = annealed.

*) 1 MPa = 1 N/mm^2.

Table 15 — 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[*)] at a temperature (in °C) of						
Name	Number		100	150	200	250	300	350	400
Standard grades									
X12Cr13	1.4006	+QT650	420	410	400	385	365	335	305
X15Cr13	1.4024	+QT650	420	410	400	385	365	335	305
X20Cr13	1.4021	+QT650	420	410	400	385	365	335	305
X3CrNiMo13–4	1.4313	+QT780	590	575	560	545	530	515	-
		+QT900	720	690	665	640	620	-	-
X4CrNiMo16–5-1	1.4418	+QT840	660	640	620	600	580	-	-

[a] +QT = quenched and tempered.

[*)] 1 MPa = 1 N/mm^2.

Table 16 — 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[*)] at a temperature (in °C) of				
Name	Number		100	150	200	250	300
Special grade							
X5CrNiCuNb16–4	1.4542	+P1070	880	830	800	770	750
		+P950	730	710	690	670	650
		+P850	680	660	640	620	600

[a] +*P* = precipitation hardened.

[*)] 1 MPa = 1 N/mm^2.

Table 17 — Tensile strength levels in the cold worked condition (process route 2H)

Symbol	Tensile strength [a,b] MPa[*)]
+C700	700 to 850
+C850	850 to 1000
+C1000	1 000 to 1 150
+C1150	1 150 to 1 300
+C1300	1 300 to 1 500

[a] Intermediate tensile strength values may be agreed. Alternatively, the steels may be specified in terms of minimum 0,2 %-proof strength (see Tables 18 and 20) 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 may be requested from the manufacturer.

[*)] 1 MPa = 1 N/mm^2.

Table 18 — 0,2 %-proof strength levels in the cold worked condition (process route 2H)

Symbol	0,2 %-proof strength [a,b] MPa[*)]
+CP350	350 to 500
+CP500	500 to 700
+CP700	700 to 900
+CP900	900 to 1100
+CP1100	1100 to 1300

[a] Intermediate proof strength values may be agreed.

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

[*)] 1 MPa = 1 N/mm^2.

Table 19 — 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
Standard grades						
X6Cr17	1.4016	X	X	-	-	-
X2CrNiN18–7	1.4318	-	X	X	-	-
X10CrNi18–8	1.4310	X	X	X	X	X[a]
X5CrNi18–10	1.4301	X	X	X	X	X
X6CrNiTi18–10	1.4541	X	X	-	-	-
X5CrNiMo17–12–2	1.4401	X	X[a]	-	-	-
X6CrNiMoTi17–12–2	1.4571	X	X	-	-	-
Special grades						
X6CrNiNb18–10	1.4550	X	X	-	-	-
X8CrMnCuNB17–8-3	1.4597	X	X	X	-	-
X12CrMnNiN17–7-5	1.4372	-	X	X	X	X[b]
X2CrMnNiN17–7-5	1.4371	X	X	-	-	-
X9CrMnNiCu17–8-5–2	1.4618	X	X	X	X	-
X12CrMnNiN18–9-5	1.4373	X	X	-	-	-
X11CrNiMnN19–8-6	1.4369	-	X	X	X	X[b]

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

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

Table 20 — 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
Standard grades						
X6Cr17	1.4016	X	X	-	-	-
X2CrNiN18–7	1.4318	-	X	X	-	-
X10CrNi18–8	1.4310	-	X	X	X	X[a]
X5CrNi18–10	1.4301	X	X	X	X	X
X6CrNiTi18–10	1.4541	X	X	-	-	-
X5CrNiMo17–12–2	1.4401	X	X[a]	-	-	-
X6CrNiMoTi17–12–2	1.4571	X	X	-	-	-
Special grades						
X6CrNiNb18–10	1.4550	X	X	-	-	-
X8CrMnCuNB17–8-3	1.4597	X	X	X	-	-
X12CrMnNiN17–7-5	1.4372	-	X	X	X	X[b]
X2CrMnNiN17–7-5	1.4371	-	X	X	-	-
X9CrMnNiCu17–8-5–2	1.4618	X	X	X	X	-
X12CrMnNiN18–9-5	1.4373	-	X	X	-	-
X11CrNiMn19–8-6	1.4369	-	X	X	X	X

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

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

Table 21 — Tests to be carried out, test units and extent of testing in specific testing

Test	[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	m[c]	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	1 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
Hardness test on martensitic steels[d]	m[e,f]		To be agreed at the time of ordering (see Table 10).			1
Tensile test at elevated temperature	o		To be agreed at the time of ordering (see Tables 12 to 16).			1
Impact test at room temperature	o[g]		To be agreed at the time of ordering (see Tables 7, 8 and 10).			3
Resistance to intergranular corrosion	o[h]		To be agreed at the time of ordering if intergranular corrosion is a hazard (see Tables 7, 8 and 9).			1

[a] Tests marked with a “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 enquiry and order.

[b] Product analysis may be agreed at the time of enquiry and order; the extent of testing shall be specified at the same time.

[c] Except for martensitic steels in heat treatment condition +A (see, however, footnote e).

[d] Hardness test on martensitic steels is to be performed on the product surface.

[e] Mandatory for heat treatment condition +A. However, in cases of dispute or at the manufacturer's discretion, the tensile test may be carried out.

[f] Mandatory for product form C in heat treatment condition +QT.

[g] For austenitic steels, the impact test is normally not carried out (see NOTE in 6.5.1).

[h] Test for resistance to intergranular corrosion is normally not carried out. The tests are not relevant for austenitic steel grades with a carbon content below 0,040 %.

Table 22 — Marking of the products

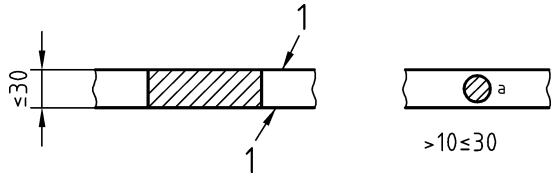
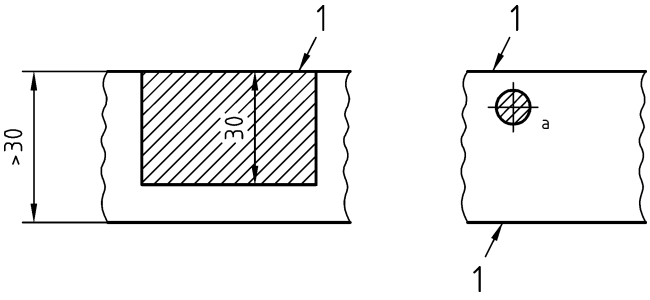
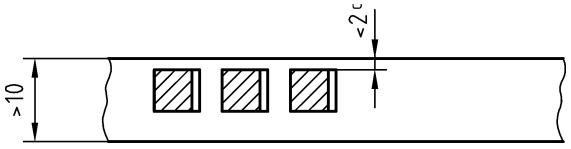
Marking of:	Products	
	with specific testing[a]	without specific testing[a]
Manufacturer's name, trade mark or logo	+	+
The number of this document	(+)	(+)
Steel number or name	+	+
Type of finish	(+)	(+)
Cast number	+	+
Identification number[b]	+	(+)
Direction of rolling[c]	(+)	(+)
Nominal thickness	(+)	(+)
Nominal dimensions other than thickness	(+)	(+)
Inspector's mark	(+)	-
Customer's order No.	(+)	(+)

[a] Symbols in the table mean:

+ = the marking shall be applied;
(+) = the marking shall be applied if so agreed, or at the manufacturer's discretion.
- = no marking necessary.

[b] If specific tests are to be carried out, the numbers or letters used for identification shall allow the product(s) to be related to the relevant inspection certificate.

[c] Direction of rolling is normally obvious from the shape of the product and the position of the marking. Marking may either be longitudinally applied by roller stamping or it may be near to one end of the piece and transverse to the rolling direction. A specific separate indication of the principal rolling direction will not normally be required, but may be requested by the customer.

Type of test piece	Product thickness *t*	Direction of the longitudinal axis of the test piece in relation to the principal direction of rolling at a final rolling width of:		Distance of the test piece from the rolled surface
	mm	< 300 mm	≥ 300 mm	mm
Tensile[a]	≤ 30	longitudinal	transverse	
	> 30			
Impact[b]	> 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 $t \geq 3$ mm. For products $t < 3$ mm 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 3 mm < $t \leq 10$ mm, flat proportional test pieces with two rolled surfaces and a maximum width of 30 mm shall be used. For products with a thickness $t > 10$ mm, one of the following proportional test pieces shall 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 of ≥ 5 mm the axis of which shall be located as close as possible to a plane in the outer sixth of the product thickness *t*.

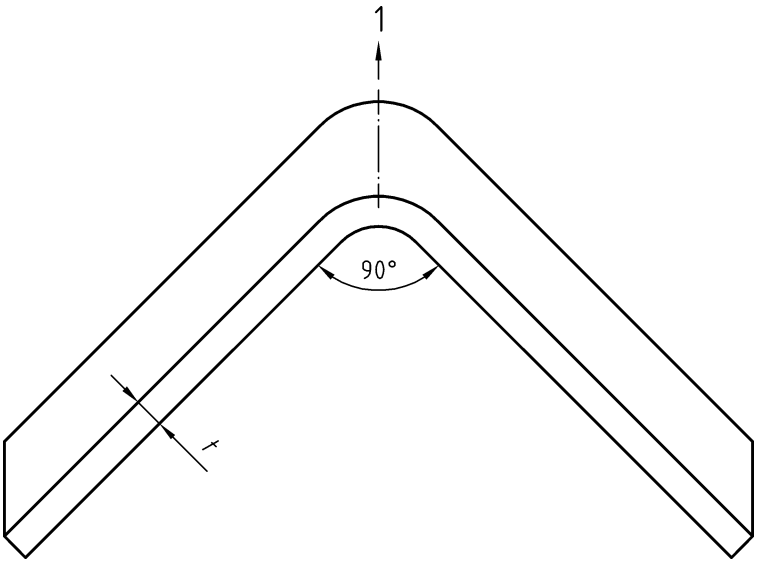
[b] Longitudinal axis of the notch shall always be perpendicular to the rolled surface of the product.

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

Key

1 rolled surface

Figure 1 — Position of test pieces for flat products



Key

1 rolling direction

Figure 2 — 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

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

A.2 Flame cutting may adversely affect edge areas; where necessary, they should be machined.

A.3 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. Finished parts made of steels with approximately 13 % Cr also require the best surface condition (e.g. polished) in order to achieve maximum resistance to corrosion.

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

Steel designation		Hot forming		Heat treatment symbol	Solution annealing	
Name	Number	Temperature °C	Type of cooling		Temperature[b,c,d] °C	Type of cooling
Standard grades						
X2CrNiN18–7	1.4318	1150 to 850	air	+AT	1020 to 1100	water, air [e]
X10CrNi18–8	1.4310				1010 to 1090	
X2CrNi18–9	1.4307				1000 to 1100	
X8CrNiS18–9	1.4305				1000 to 1100	
X2CrNiN18–10	1.4311				1000 to 1100	
X5CrNi18–10	1.4301				1000 to 1100	
X6CrNiTi18–10	1.4541				1000 to 1100	
X2CrNi19–11	1.4306				1000 to 1100	
X4CrNi18–12	1.4303				1000 to 1100	
X2CrNiMoN17–11–2	1.4406				1030 to 1110	
X2CrNiMo17–12–2	1.4404				1030 to 1110	
X5CrNiMo17–12–2	1.4401				1030 to 1110	
X6CrNiMoTi17–12–2	1.4571				1030 to 1110	
X2CrNiMo17–12–3	1.4432				1030 to 1110	
X2CrNiMo18–14–3	1.4435				1030 to 1110	
X2CrNiMoN17–13–5	1.4439				1060 to 1140	
X1NiCrMoCu25–20–5	1.4539				1060 to 1140	

Steel designation		Hot forming		Heat treatment symbol	Solution annealing	
Name	Number	Temperature °C	Type of cooling		Temperature[b,c,d] °C	Type of cooling
Special grades						
X5CrNiN17–7	1.4319	1150 to 850	air	+AT	1000 to 1100	water, air [e]
X5CrNiN19–9	1.4315				1000 to 1100	
X5CrNiCu19–6-2	1.4640				1000 to 1100	
X6CrNiNb18–10	1.4550				1020 to 1120	
X1CrNiSi18–15–4	1.4361				1100 to 1160	
X8CrMnCuNB17–8-3	1.4597				1000 to 1100	
X8CrMnNi19–6-3	1.4376				1020 to 1100	
X12CrMnNiN17–7-5	1.4372				1000 to 1100	
X2CrMnNiN17–7-5	1.4371				1000 to 1100	
X9CrMnNiCu17–8-5–2	1.4618				1000 to 1100	
X12CrMnNiN18–9-5	1.4373				1000 to 1100	
X11CrNiMnN19–8-6	1.4369				1000 to 1100	
X6CrMnNiCuN18–12–4-2	1.4646				1000 to 1100	
X1CrNi25–21	1.4335				1030 to 1110	
X6CrNiMoNb17–12–2	1.4580				1030 to 1110	
X3CrNiMo17–13–3	1.4436				1030 to 1110	
X2CrNiMoN17–13–3	1.4429				1030 to 1110	
X2CrNiMoN18–12–4	1.4434				1070 to 1150	
X2CrNiMo18–15–4	1.4438				1070 to 1150	
X1CrNiMoN25–22–2	1.4466				1070 to 1150	
X1CrNiMoCuNW24–22–6	1.4659				1140 to 1200	
X1CrNiMoCuN20–18–7	1.4547	1200 to 1000			1150 to 1200	
X1CrNiMoCuN24–22–8	1.4652	1200 to 1000			1150 to 1200	
X2CrNiMnMoN25–18–6-5	1.4565	1200 to 950			1120 to 1170	
X1CrNiMoCuN25–25–5	1.4537	1150 to 850			1120 to 1180	
X1NiCrMoCuN25–20–7	1.4529				1120 to 1180	
X1NiCrMoCu31–27–4	1.4563				1070 to 1150	

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

[b] Solution annealing may be omitted if the conditions for hot working and subsequent cooling are such that the requirements for the mechanical properties of the product and the resistance to intergranular corrosion as defined in EN ISO 3651-2 are obtained.

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

[d] Lower end of the range specified for solution annealing should be aimed at the heat treatment as part of further processing, because otherwise the mechanical properties might be affected. If the temperature of hot forming does not drop below the lower temperature for solution annealing, a temperature of 980 °C is adequate as a lower limit for Mo-free steels, a temperature of 1000 °C for steels with Mo contents up to 3 % and a temperature of 1020 °C for steels with Mo contents exceeding 3 %.

[e] Cooling sufficiently rapidly in order to avoid the occurrence of intergranular corrosion as defined in EN ISO 3651-2.

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

Steel designation		Hot forming		Heat treatment symbol	Solution annealing	
Name	Number	Temperature °C	Type of cooling		Temperature[b] °C	Type of cooling
Standard grades						
X2CrNiN23–4	1.4362	1150 to 950	air	+AT	950 to 1050	water, air[c]
X2CrNiMoN22–5-3	1.4462				1020 to 1100	
Special grades						
X2CrNiN22-2	1.4062	1100 to 950	air	+AT	980 to 1100	water, air[c]
X2CrNiMoSi18–5-3	1.4424	1150 to 1000			1000 to 1100	
X2CrNiCuN23–4	1.4655	1150 to 1000			950 to 1050	
X2CrMnNiN21–5-1	1.4162	1100 to 900			1020 to 1080	
X2CrMnNiMoN21–5-3	1.4482	1150 to 950			950 to 1050	
X2CrNiMnMoCuN24–4-3–2	1.4662	1150 to 900			1000 to 1150	
X2CrNiMoCuN25–6-3	1.4507	1150 to 1000			1040 to 1120	
X2CrNiMoN25–7-4	1.4410					
X2CrNiMoCuWN25–7-4	1.4501					
X2CrNiMoN29–7-2	1.4477					

[a] Temperatures of solution annealing shall be agreed 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] Cooling sufficiently rapidly in order to avoid precipitation.

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

Steel designation		Hot forming		Heat treatment symbol	Annealing	
Name	Number	Temperature °C	Type of cooling		Temperature [b] °C	Type of cooling
Standard grades						
X2CrNi12	1.4003	1100 to 800	air	+A	700 to 760	air, water
X2CrTi12	1.4512				770 to 830	
X6CrNiTi12	1.4516				790 to 850	
X6Cr13	1.4000				750 to 810	
X6CrAl13	1.4002				750 to 810	
X6Cr17	1.4016				770 to 830	
X3CrTi17	1.4510				770 to 830	
X3CrNb17	1.4511				790 to 850	
X6CrMo17–1	1.4113				790 to 850	
X2CrMoTi18–2	1.4521				820 to 880	
Special grades						
X2CrMnNiTi12	1.4600	1100 to 800	air	+A	650 to 700	air, water
X2CrSiTi15	1.4630				820 to 880	
X1CrNb15	1.4595				770 to 830	
X2CrTi17	1.4520				820 to 880	
X2CrNbZr17	1.4590				870 to 930	
X6CrNi17–1	1.4017				750 to 810	
X2CrTiNb18	1.4509				870 to 930	
X2CrAlSiNb18	1.4634				900 to 950	
C2CrNbTi20	1.4607				870 to 930	
X2CrTi21	1.4611				870 to 930	
X2CrNbCu21	1.4621				850 to 950	
X2CrTi24	1.4613				870 to 930	
X5CrNiMoTi15–2	1.4589				750 to 800	
X2CrMoTi17–1	1.4513				820 to 880	
X6CrMoNb17–1	1.4526				800 to 860	
X2CrMoTi29–4	1.4592				900 to 1000	

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

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

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

Steel designation		Hot forming		Heat treatment symbol	Annealing		Quenching		Tempering Temperature °C
Name	Number	Temperature °C	Type of cooling		Temperature[b] °C	Type of cooling	Temperature[b] °C	Type of cooling	
Standard grades									
X12Cr13	1.4006	1100 to 800	air	+A	750 to 810	-	-	-	-
				+QT550	-	-	950 to 1010	oil, air	700 to 780
				+QT650	-	-			620 to 700
X15Cr13	1.4024	1100 to 800	air	+A	750 to 810	-	-	-	-
				+QT550	-	-	950 to 1050	oil, air	700 to 780
				+QT650	-	-			660 to 700
X20Cr13	1.4021	1100 to 800	slow cooling	+A	730 to 790	-	-	-	-
				+QT	-	-	950 to 1050	oil, air	200 to 350
				+QT650	-	-	950 to 1010		700 to 780
				+QT750	-	-			620 to 700
X30Cr13	1.4028	1100 to 800	slow cooling	+A	730 to 790	-	-	-	-
				+QT	-	-	950 to 1050	oil, air	200 to 350
				+QT800	-	-	950 to 1010		650 to 730
X39Cr13	1.4031	1100 to 800	slow cooling	+A	730 to 790	-	-	-	-
				+QT	-	-	1000 to 1100	oil, air	200 to 350
X46Cr13	1.4034	1100 to 800	slow cooling	+A	730 to 790	-	-	-	-
				+QT	-	-	1000 to 1100	oil, air	200 to 350
X38CrMo14	1.4419	1100 to 800	slow cooling	+A	750 to 830	-	-	-	-
				+QT	-	-	1000 to 1100	oil, air	200 to 350
X55CrMo14	1.4110	1100 to 800	slow cooling	+A	750 to 830	-	-	-	-
				+QT	-	-	1000 to 1100	oil, air	200 to 350
X3CrNiMo13–4	1.4313	1150 to 900	air	+QT780	-	-	950 to 1050	oil, air, water	560 to 640
				+QT900	-	-			510 to 590
X50CrMoV15	1.4116	1100 to 800	slow cooling	+A	770 to 830	-	-	-	-
X4CrNiMo16–5-1	1.4418	1150 to 900	air	+QT840	-	-	900 to 1000	oil, air, water	570 to 650
X39CrMo17–1	1.4122	1100 to 800	slow cooling	+A	770 to 830	-	-	-	-
				+QT	-	-	1000 to 1100	oil, air	200 to 350
Special grades									
X1CrNiMoCu12–5-2	1.4422	1150 to 900	air	+A	900 to 1000	-	-	-	-
				+QT800	-	-	900 to 1050	oil, air	600 to 640
X1CrNiMoCu12–7-3	1.4423	1150 to 900	air	+A	900 to 1000	-	-	-	-
				+QT800	-	-	900 to 1050	oil, air	600 to 640

Steel designation		Hot forming		Heat treatment symbol	Annealing		Quenching		Tempering
Name	Number	Temperature °C	Type of cooling		Temperature[b] °C	Type of cooling	Temperature[b] °C	Type of cooling	Temperature °C
[a] Temperatures of annealing, quenching and tempering shall be agreed for simulated heat-treated test pieces.									
[b] If heat treatment is carried out in a continuous furnace, the upper part of the range specified is usually preferred, or even exceeded.									

Table A.5 — Guidelines on the temperatures for hot forming and heat treatment [a] of precipitation hardening corrosion resisting steels

Steel designation		Hot forming		Heat treatment symbol	Stress relieving		Solution annealing		Precipitation hardening
Name	Number	Temperature °C	Type of cooling		Temperature °C	Type of cooling	Temperature [b] °C	Type of cooling	Temperature °C
Special grades									
X5CrNiCuNb16–4	1.4542	1150 to 900	Air	+AT	-	-	1025 to 1055	air	-
				+P850	-	-	1025 to 1055	air	4 h (610 to 630)
				+P900	-	-			1 h (590 to 610)
				+P950	-	-			1 h (580 to 600)
				+P1070	-	-			1 h (540 to 560)
				+P1300	-	-			1 h (470 to 490)
				+SR 630	≥ 4 h (600 to 660)[c]	-	-	-	-
X7CrNiAl17–7	1.4568			+AT	-	-	1030 to 1050	air	-
				+P1450	-	-	10 min 945 to 965	[d]	1 h (500 to 520)
[a] Temperatures of solution annealing shall be agreed 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] After martensitic transformation. Solution annealing at 1025 °C to 1055 °C will be necessary before precipitation hardening.									
[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)

Applicable dimensional standards

EN 10048, *Hot rolled narrow steel strip — Tolerances on dimensions and shape*

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

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

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

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

Bibliography

[1] EN 10028-7, *Flat products made of steels for pressure purposes — Part 7: Stainless steels*

[2] EN 10095, *Heat resisting steels and nickel alloys*

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

[4] EN 10163-1, *Delivery requirements for surface condition of hot-rolled steel plates, wide flats and sections — Part 1: General requirements*

[5] EN 10302, *Creep resisting steels, nickel and cobalt alloys*

[6] CEN/TR 10261, *Iron and steel — European standards for the determination of chemical composition*

[7] ISO 15510, *Stainless steels — Chemical composition*

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