BSI Standards Publication

Stainless steels

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

bsi.

National foreword

This British Standard is the UK implementation of EN 10088-3:2023. It supersedes BS EN 10088-3:2014, which is withdrawn.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 committee manager.

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Aciers inoxydables - Partie 3 : Conditions techniques de livraison pour les demi-produits, barres, fils, fils tréfilés, profils et produits transformés à froid en acier résistant à la corrosion pour usage général

Nichtrostende Stähle - Teil 3: Technische Lieferbedingungen für Halbzeug, Stäbe, Walzdraht, gezogenen Draht, Profile und Blankstahlerzeugnisse aus korrosionsbeständigen Stählen für allgemeine Verwendung

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European foreword

This document (EN 10088-3:2023) has been prepared by Technical Committee CEN/TC 459 “ECISS - European Committee for Iron and Steel Standardization[1]”, the secretariat of which is held by AFNOR.

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of an identical text or by endorsement, at the latest by June 2024, and conflicting national standards shall be withdrawn at the latest by June 2024.

This document supersedes EN 10088-3:2014.

In comparison with the previous edition, the following technical modifications have been made:

a) addition of austenitic grades 1.4681, 1.4391, addition of austenitic-ferritic (duplex) grade 1.4670, addition of ferritic grades 1.4106, 1.4114, 1.4045, addition of martensitic grade 1.4037;

b) chemical composition was changed for following grades: austenitic grades 1.4310, 1.4404, 1.4529, ferritic grade 1.4003 and for martensitic grade 1.4028, 1.4116;

c) removal of austenitic grades, 1.4319, 1.4537;

d) mechanical values for bright bars have been changed for austenitic grades 1.4301, 1.4307 for ferritic grades 1.4509, for martensitic grades 1.4028, 1.44418 and for austeno-ferritic grades 1.4362. Mechanical values for bright bars have been added for martensitic grade 1.4021 in QT800 condition and for 1.4057 in QT900 condition;

e) introduction of the possibility to use modelling for the determination of tensile properties;

f) columns have swapped places in Table 7 for better reading;

g) new Annex A lists all grades that appear in this document by ascending steel number.

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 C);

— *Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resistant steels for general purposes*;

— *Part 3: Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resistant 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*.

[1] Through its sub-committee SC 5 “Steels for heat treatment, alloy steels, free-cutting steels and stainless steels”, (secretariat: DIN).

Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

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

Introduction

The European Committee 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, given in 8.3, A and B and which is claimed to be relevant for the following clause(s) of this document:

Clauses 8, A and B.

CEN takes no position concerning the evidence, validity and scope of these patent rights. The holders of these patent rights have 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: 1.4662

Outokumpu Stainless AB

SE-77480 Avesta, Sweden

Grade 1.4062, 1.4669, 1.4670

Ugitech

F-73403 Ugine Cedex, France,

Grade 1.4062, 1.4669

Industeel

F-71200 Creusot, 56 Rue Clemenceau, France

Grade 1.4646, 1.4611, 1.4613

Acciai Speciali Terni

I-05100 Terni, Italy

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

1 Scope

This document specifies the technical delivery conditions for semi-finished products, hot or cold formed bars, rods, wire, sections and bright products of standard grades and special grades of corrosion resistant 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 document, unless otherwise specified in this document.

This document 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 documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

EN 10079, *Definition of steel products*

EN 10088-1:2023, *Stainless steels — Part 1: List of stainless steels*

EN 10163-3, *Delivery requirements for surface condition of hot-rolled steel plates, wide flats and sections — Part 3: Sections*

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

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

EN 10306, *Iron and steel — Ultrasonic testing of H beams with parallel flanges and IPE beams*

EN 10308, *Non-destructive testing — Ultrasonic testing of steel bars*

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

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

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 4885, *Ferrous materials — Heat treatments — Vocabulary (ISO 4885)*

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

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 9443, *Surface quality classes for hot-rolled bars and wire rod (ISO 9443)*

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 ISO 4885 and regarding product forms in EN 10079 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
stainless steels
steels with at least 10,5 % of chromium and maximum 1,20 % 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 resistant steels, heat resistant steels and creep resistant steels.

3.2
corrosion resistant stainless steels
standard stainless (see 3.1) where its 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 2 to 5) were formed in accordance with EN 10027-1 and EN 10027-2, respectively.

A complete overview of all grades that are in this document is given in Annex A.

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 (e.g. round bars, square bars or rod);

— where an appropriate dimensional standard is available (see Table 7 and Annex D) 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 condition (see symbols in Table 7);

— if a verification of internal soundness is required, products shall be tested in accordance with EN 10306 or EN 10308;

— 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 t round bars according to EN 10060 of 50 mm diameter made of steel grade EN 10088-3 with the name X5CrNi18-10 and the number 1.4301 in condition 1D (see Table 7), inspection certificate 3.1 as specified in EN 10204:

10 t round bars EN 10060 — 50

Steel EN 10088-3 — X5CrNi18-10+1D

EN 10204 — 3.1

or

10 t round bars EN 10060 — 50

Steel EN 10088-3-1.4301+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 10088-1:2023, Annex C.

6 Requirements

6.1 Steelmaking process

Unless otherwise agreed at the time of enquiry and order, the steelmaking and manufacturing 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 conditions given in Table 7 and, where different alternatives exist, to the treatment conditions given in Tables 8 to 19 and 25 (see also Annex B).

6.3 Chemical composition

6.3.1 The chemical composition requirements given in Tables 2 to 5 apply in respect of the chemical composition according to the cast analysis.

Elements not quoted ("-") or not listed in these tables shall not be intentionally added to the steel without the agreement of the purchaser except for finishing the cast. All precautions shall be taken to avoid the addition of such elements from scrap and other materials used in production which would impair mechanical properties and the suitability of the steel.

6.3.2 The product analysis may deviate from the limiting values for the cast analysis given in Tables 2 to 5 by the values listed in Table 6.

6.4 Chemical corrosion resistance properties

For austenitic, austenitic-ferritic and ferritic stainless steels, the specifications in Tables 8, 9 and 10, referring to resistance to intergranular corrosion as defined in EN ISO 3651-2 applies (see also 7.4.6).

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 8 to 12 apply for hot worked products of every condition, condition 1U and semi-finished products excluded, for cold processed products in condition 2D (excluding wire), and for each specified heat treatment condition.

For cold processed products of every specified condition, condition 2D and wire excluded, and each specified heat treatment condition, the mechanical properties at room temperature as specified in Tables 13 to 17 apply. For these products, the condition is the prime property with the mechanical properties secondary.

If by agreement at the time of ordering the products shall be supplied in a non-heat-treated condition, the mechanical properties specified in Tables 8 to 17 shall be obtained from reference test pieces which have received the appropriate heat treatment (simulated heat treatment).

For wire, the properties as specified in Tables 18 and 19 apply.

For bars which are intentionally cold work hardened in order to increase their tensile strength to a specified level, the mechanical properties at room temperature as specified in Table 25 apply. For these products, the mechanical properties are prime, with the condition a secondary property.

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

6.5.2 The values in Tables 20 to 24 apply for the 0,2 %- and 1,0 %-proof strength at elevated temperatures.

6.5.3 A number of grades in Tables 2 to 5 are not listed or have limited information included in Tables 13 to 25. In this case, grade dimensions and corresponding mechanical properties shall be agreed upon at the time of enquiry and order.

In case of demand for larger diameters than stated in Tables 13 to 19, appropriate mechanical property values shall be agreed at the time of enquiry and order.

6.6 Surface quality

The available surface finishes are given in Table 7. Slight surface imperfections, inherent to the production process, are permitted. Exact requirements concerning maximum depth of acceptable discontinuities for bars, rods and sections in the relevant conditions are given in Table 1.

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

Conditions	Product forms	Permissible depth of discontinuities [a]	Max. % of delivered weight in excess of permissible depth of discontinuities
1U, 1C, 1E, 1D	Sections	To be agreed upon at the time of enquiry and order on the basis of EN 10163-3.	
1U, 1C, 1E, 1D	Rounds and rod	Unless not specified otherwise at the time of enquiry and order: EN ISO 9443 - class A.	
1X [b], 2H [b], 2D [b]	Rounds	- max. 0,2 mm for d ≤ 20 mm - max. 0,01 d for 20 < d ≤ 75 mm - max. 0,75 mm for d > 75 mm	1 %
	Hexagons	- max. 0,3 mm for d ≤ 15 mm - max. 0,02 d for 15 < d ≤ 63 mm	2 %
	Other bars	- max. 0,3 mm for d ≤ 15 mm - max. 0,02 d for 15 < d ≤ 63 mm	4 %
1G, 2B, 2G, 2P	Rounds	Technically defect free by manufacture.	0,2 %

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

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

For further information, e.g. roughness in conditions 2G and 2P, see Table 7.

For wires supplied in 2H condition according to Table 18 or 2B according to Table 19 the surface quality shall be agreed upon at the time of enquiry and order.

6.7 Internal soundness

The products shall be free of internal defects which would exclude them from being used for their usual purpose. At the time of enquiry and order ultrasonic testing of H-beams with parallel flanges and IPE-beams may be agreed in accordance with EN 10306 and ultrasonic testing of steel bars may be agreed in accordance with EN 10308.

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 shall be agreed at the time of enquiry and order, as far as possible with reference to the dimensional standards listed in Table 7 and in Annex D.

6.10 Calculation of mass and tolerances on mass

6.10.1 The nominal mass shall be calculated by using the steel density given in Annex E of EN 10088-1:2023 and the nominal dimensions of the steel product.

6.10.2 The dimensional standards listed in Table 7 or in Annex D do not specify tolerances on mass, which therefore may be agreed at the time of enquiry and order.

7 Inspection and testing

7.1 General

The appropriate process control, inspection, testing and modelling 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 document 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, at least 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 Tables 2 to 5 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 shall 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) information groups A, B and Z of EN 10168;

b) results of the cast analysis in accordance with Tables 2 to 5 with the code numbers C71 to C92 in EN 10168;

c) results of all mandatory (m) tests according to Table 26*;*

d) results of any optional (o) test according to Table 26 or any further product verification 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 optionally 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 26.

7.3.2 Selection and preparation of samples

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, for the mechanical tests the stipulations in 7.3.2.2 apply.

7.3.2.2 The samples for tensile testing shall be taken in accordance with Figures 1 to 3. If it has been agreed that optional impact tests shall be carried out, the samples shall be taken from the same location.

The samples shall be taken from products in the delivery condition. If agreed, samples from bars may be taken before straightening. For samples to be given a simulated heat treatment (see also 6.5.1) the conditions for annealing, hardening and tempering shall be agreed.

7.3.2.3 The samples for hardness testing on martensitic steels and for optional testing of the resistance to intergranular corrosion, shall be taken from the same locations as those for the mechanical tests see 7.3.2.2).

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 Tensile testing at room temperature shall be carried out in accordance with EN ISO 6892-1, this generally being with proportional test pieces having a gauge length $L_0 = 5{,}65\sqrt{S_0}$. (S_0 = cross-section of the parallel length). In cases of doubt and in referee testing these test pieces shall be used.

The tensile strength, elongation after fracture and the 0,2 %-proof strength shall be determined. In addition, for austenitic steels in condition 1C, 1E, 1D, 1X, 1G and 2D only, the 1,0 %-proof strength shall also be determined.

For wire of nominal diameter < 4 mm, the tensile test is made directly on the product using a gauge length of 100 mm.

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 shall 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 1,0 %-proof strength shall be determined.

7.4.4 For the determination of the tensile properties, the manufacturer may use modelling with a verification method approved in accordance with EN 10373, if agreed with the purchaser at the time of enquiry and order.

7.4.5 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, and using a striker with a radius of 2 mm (KV_2). The test results shall be determined as an average value obtained from a set of at least three test pieces (see also EN 10021).

7.4.6 A Brinell hardness test shall be carried out in accordance with EN ISO 6506-1.

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

7.4.8 The tolerances on dimensions and form of the product, and the measurement of dimension and form shall be in accordance with the requirements of the relevant dimensional standards, where available.

7.5 Retests

Retests shall be carried out in accordance with EN 10021.

8 Marking

8.1 Marking shall be durable.

8.2 Unless otherwise agreed, the requirements listed in Table 27 apply.

8.3 Unless otherwise agreed, the products shall be marked as follows:

— semi-finished products, bars and sections in thicknesses over 35 mm by inking, adhesive labels, electrolytic etching or stamping;

— bars and sections in thicknesses up to 35 mm by labels attached to the bundle or by means of the possibilities listed in the first hyphen;

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

If the marking shall be applied by inking or adhesive label, the inks or adhesives should be carefully selected to ensure that resistance to corrosion is not impaired.

Table 2 — Chemical composition (cast analysis) of austenitic corrosion resistant steels

Steel designation		% by mass [a]										
Name	Number	C	Si	Mn	P	S	Cr	Ni	Mo	N	Cu	Others
Standard grades												
X10CrNi18-8	1.4310	0,030 to 0,15	2,00	2,00	0,045	0,015	16,0 to 19,0	6,0 to 9,5	0,80	0,10	-	-
X2CrNi18-9	1.4307	0,030	1,00	2,00	0,045	0,030 [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	-
X6CrNiCuS18-9-2	1.4570	0,08	1,00	2,00	0,045	0,15 to 0,35	17,0 to 19,0	8,0 to 10,0	0,60	0,10	1,40 to 1,80	-
X3CrNiCu18-9-4	1.4567	0,04	1,00	2,00	0,045	0,030 [b]	17,0 to 19,0	8,5 to 10,5	-	0,10	3,00 to 4,0	-
X2CrNiN18-10	1.4311	0,030	1,00	2,00	0,045	0,030 [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	0,030 [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	0,030 [b]	17,0 to 19,0	9,0 to 12,0 [c]	-	-	-	Ti: 5 × C to 0,70
X2CrNi19-11	1.4306	0,030	1,00	2,00	0,045	0,030 [b]	18,0 to 20,0	10,0 to 12,0 [c]	-	0,10	-	-
X4CrNi18-12	1.4303	0,06	1,00	2,00	0,045	0,030 [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	0,030 [b]	16,5 to 18,5	10,0 to 12,5 [c]	2,00 to 2,50	0,12 to 0,22	-	-
X2CrNiMo17-12-2	1.4404	0,030	1,00	2,00	0,045	0,030 [b]	16,5 to 18,5	10,0 to 13,0 [c]	2,00 to 3,00	0,10	-	-
X5CrNiMo17-12-2	1.4401	0,07	1,00	2,00	0,045	0,030 [b]	16,5 to 18,5	10,0 to 13,0	2,00 to 2,50	0,10	-	-
X6CrNiMoTi17-12-2	1.4571	0,08	1,00	2,00	0,045	0,030 [b]	16,5 to 18,5	10,5 to 13,5 [c]	2,00 to 2,50	-	-	Ti: 5 × C to 0,70
X2CrNiMo17-12-3	1.4432	0,030	1,00	2,00	0,045	0,030 [b]	16,5 to 18,5	10,5 to 13,0	2,50 to 3,00	0,10	-	-
X3CrNiMo17-12-3	1.4436	0,05	1,00	2,00	0,045	0,030 [b]	16,5 to 18,5	10,5 to 13,0 [c]	2,50 to 3,00	0,10	-	-
X2CrNiMoN17-13-3	1.4429	0,030	1,00	2,00	0,045	0,015	16,5 to 18,5	11,0 to 14,0 [c]	2,50 to 3,00	0,12 to 0,22	-	-

Steel designation		% by mass [a]										
Name	Number	C	Si	Mn	P	S	Cr	Ni	Mo	N	Cu	Others
X2CrNiMo18-14-3	1.4435	0,030	1,00	2,00	0,045	0,030 [b]	17,0 to 19,0	12,5 to 15,0	2,50 to 3,00	0,10	-	-
X2CrNiMoN17-13-5	1.4439	0,030	1,00	2,00	0,045	0,015	16,5 to18,5	12,5 to 14,5	4,0 to 5,0	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	24,0 to 26,0	4,0 to 5,0	0,15	1,20 to 2,00	-
Special grades												
X9CrNi18-9	1.4325	0,030 to 0,15	1,00	2,00	0,045	0,030	17,0 to 19,0	8,0 to 10,0	-	-	-	-
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	-	-
X3CrNiCu19-9-2	1.4560	0,035	1,00	1,50 to 2,00	0,045	0,015	18,0 to 19,0	8,0 to 9,0	-	0,10	1,50 to 2,00	-
X6CrNiNb18-10	1.4550	0,08	1,00	2,00	0,045	0,015	17,0 to 19,0	9,0 to 12,0 [c]	-	-	-	Nb: 10 × 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	14,0 to 16,0	0,20	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	3,00	1,00	0,10 to 0,30	2,00 to 3,5	-
X3CrMnNiCu15-8-5-3	1.4615	0,030	1,00	7,0 to 9,0	0,040	0,010	14,0 to 16,0	4,5 to 6,0	0,80	0,02 to 0,06	2,00 to 4,0	-
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	-	-
X8CrMnNiN18-9-5	1.4374	0,05 to 0,10	0,30 to 0,60	9,0 to 10,0	0,035	0,030	17,5 to 18,5	5,0 to 6,0	0,50	0,25 to 0,32	0,40	-
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	-	-
X13MnNiN18-13-2	1.4020	0,15	1,00	11,0 to 14.0	0,045	0,030	16,5 to 19,0	0,50 to 2,50	-	0,20 to 0,45	-	-
X6CrMnNiN18-13-3	1.4378	0,08	1,00	11,5 to 14,5	0,060	0,030	17,0 to 19,0	2,30 to 3,7	-	0,20 to 0,40	-	-
X6CrMnNiCuN18-12-4-2 *	1.4646 *	0,020 to 0,10	1,00	10,5 to 12,5	0,050	0,015	17,0 to 19,0	3,5 to 4,5	0,50	0,20 to 0,30	1,50 to 3,00	-

Steel designation		% by mass [a]										
Name	Number	C	Si	Mn	P	S	Cr	Ni	Mo	N	Cu	Others
X3CrMnNiN20-9-6	1.4391	0,04	1,00	8,0 to 10,0	0,045	0,030	19,0 to 21,5	5,5 to 7,5	0,75	0,15 to 0,40	-	-
X2CrNiMoCuS17-10-2	1.4598	0,030	1,00	2,00	0,045	0,10 to 0,20	16,5 to 18,5	10,0 to 13,0	2,00 to 2,50	0,10	1,30 to 1,80	-
X3CrNiCuMo17-11-3-2	1.4578	0,04	1,00	2,00	0,045	0,015	16,5 to 17,5	10,0 to 11,0	2,00 to 2,50	0,10	3,00 to 3,5	-
X6CrNiMoNb17-12-2	1.4580	0,08	1,00	2,00	0,045	0,015	16,5 to 18,5	10,5 to 13,5	2,00 to 2,50	-	-	Nb: 10 × C to 1,00
X2CrNiMo18-15-4	1.4438	0,030	1,00	2,00	0,045	0,030 [b]	17,5 to 19,5	13,0 to 16,0 [c]	3,00 to 4,0	0,10	-	-
X5CrNiMnMoNNbV22-12-5-2	1.4681	0,06	1,00	4,0 to 6,0	0,045	0,030	20,5 to 23,5	11,5 to 13,5	1,50 to 3,00	0,20 to 0,40	-	Nb: 0,10 to 0,30 V: 0,10 to 0,30
X1CrNiMoCuN20-18-7	1.4547	0,020	0,70	1,00	0,030	0,010	19,5 to 20,5	17,5 to 18,5	6,0 to 7,0	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	21,0 to 23,0	2,00 to 2,50	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	21,0 to 23,0	5,5 to 6,5	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	21,0 to 23,0	7,0 to 8,0	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	16,0 to 19,0	4,0 to 5,0	0,30 to 0,60	-	Nb ≤ 0,15
X1NiCrMoCuN25-20-7	1.4529	0,020	0,75	2,00	0,030	0,010	19,0 to 21,0	24,0 to 26,0	6,0 to 7,0	0,15 to 0,25	0,50 to 1,50	-

Steel designation		% by mass [a]										
Name	Number	C	Si	Mn	P	S	Cr	Ni	Mo	N	Cu	Others
X1NiCrMoCu31-27-4	1.4563	0,020	0,70	2,00	0,030	0,010	26,0 to 28,0	30,0 to 32,0	3,00 to 4,0	0,10	0,70 to 1,50	-

Elements not quoted ("-") or not listed 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 shall be taken to avoid the addition of such elements from scrap and other materials used in production which would impair mechanical properties and the suitability of the steel.

[a] Maximum values unless indicated otherwise.

[b] Particular ranges of sulfur content 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 0,030 % is recommended and permitted. For polishability, a controlled sulfur content of 0,015 % max. is recommended.

[c] Where for special reasons, e.g. hot workability for the fabrication of seamless tubes where it is necessary to minimize the delta ferrite content, or with the aim of low magnetic permeability, the maximum Ni content may be increased by the following amounts:
0,50 % (by mass): 1.4571
1,00 % (by mass): 1.4306, 1.4406, 1.4429, 1.4436, 1.4438, 1.4541, 1.4550
1,50 % (by mass): 1.4404.

* Patented steel grade.

Table 3 — Chemical composition (cast analysis) of austenitic-ferritic corrosion resistant steels

Steel designation		% by mass [a]										
Name	Number	C	Si	Mn	P	S	Cr	Ni	Mo	N	Cu	Others
Standard grades												
X2CrNiN22-2 *	1.4062 *	0,030	1,00	2,00	0,040	0,010	21,5 to 24,0	1,00 to 2,90	0,45	0,16 to 0,28	-	-
X2CrNiN23-4	1.4362	0,030	1,00	2,00	0,035	0,015	22,0 to 24,5	3,5 to 5,5	0,10 to 0,60	0,05 to 0,20	0,10 to 0,60	-
X2CrMnNiN21-5-1	1.4162	0,04	1,00	4,0 to 6,0	0,040	0,015	21,0 to 22,0	1,35 to 1,90	0,10 to 0,80	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	1,50 to 3,5	0,10 to 0,60	0,05 to 0,20	1,00	-
X2CrNiMoN22-5-3 [c]	1.4462 [c]	0,030	1,00	2,00	0,035	0,015	21,0 to 23,0	4,5 to 6,5	2,50 to 3,5	0,10 to 0,22	-	-
X3CrNiMoN27-5-2	1.4460	0,05	1,00	2,00	0,035	0,030 [b]	25,0 to 28,0	4,5 to 6,5	1,30 to 2,00	0,05 to 0,20	-	-
Special grades												
X2CrCuNiN23-2-2 *	1.4669 *	0,045	1,00	1,00 to 3,00	0,040	0,030	21,5 to 24,0	1,00 to 3,00	0,50	0,12 to 0,20	1,60 to 3,00	-
X2CrMnNiSiN20-5-4-2 *	1.4670 *	0,030	1,50 to 3,00	4,0 to 6,0	0,040	0,010	18,0 to 21,0	3,00 to 5,5	0,60	0,10 to 0,20	1,00	-
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	4,5 to 5,2	2,50 to 3,00	0,05 to 0,10	-	-
X2CrNiMnMoCuN24-4-3-2 *	1.4662 *	0,030	0,70	2,50 to 4,0	0,035	0,005	23,0 to 25,0	3,0 to 4,5	1,00 to 2,00	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	6,0 to 8,0	3,00 to 4,0	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	6,0 to 8,0	3,00 to 4,5	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	6,0 to 8,0	3,0 to 4,0	0,20 to 0,30	0,50 to 1,00	W: 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	5,8 to 7,5	1,50 to 2,60	0,30 to 0,40	0,80	

Steel designation		% by mass [a]										
Name	Number	C	Si	Mn	P	S	Cr	Ni	Mo	N	Cu	Others
X2CrNiMoCoN28-8-5-1	1.4658	0,030	0,50	1,50	0,035	0,010 [b]	26,0 to 29,0	5,5 to 9,5	4,0 to 5,0	0,30 to 0,50	1,00	Co: 0,50 to 2,00

Elements not quoted ("-") or not listed 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 shall be taken to avoid the addition of such elements from scrap and other materials used in production which would impair mechanical properties and the suitability of the steel.

[a] Maximum values unless indicated otherwise.

[b] Particular ranges of sulfur content 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 0,030 % is recommended and permitted. For polishability, a controlled sulfur content of 0,015 % max. is recommended.

[c] A minimum value of the Pitting Resistance Equivalent (PRE = Cr +3,3 Mo + 16 N) can be agreed upon at the time of enquiry and order.

* Patented steel grade.

Table 4 — Chemical composition (cast analysis) of ferritic corrosion-resistant steels

Steel designation		% by mass										
Name	Number	C	Si	Mn	P	S	Cr	Ni	Mo	N	Ti	Others
Standard grades												
X2CrNi12	1.4003	0,030	1,00	2,00	0,040	0,030	10,5 to 12,5	0,30 to 1,00	-	0,030	-	-
X6Cr13	1.4000	0,08	1,00	1,00	0,040	0,030 [b]	12,0 to 14,0	-	-	-	-	-
X6Cr17	1.4016	0,08	1,00	1,00	0,040	0,030 [b]	16,0 to 18,0	-	-	-	-	-
X6CrMoS17	1.4105	0,08	1,50	1,50	0,040	0,15 to 0,35	16,0 to 18,0	-	0,20 to 0,60	-	-	-
X6CrMo17-1	1.4113	0,08	1,00	1,00	0,040	0,030 [b]	16,0 to 18,0	-	0,90 to 1,40	-	-	-
X2CrMoSiS18-2-1	1.4106	0,030	2,00	1,00	0,040	0,25 to 0,35	17,0 to 19,0	-	1,00 to 2,50	-	-	-
Special grades												
X3CrS12	1.4045	0,06	2,00	1,50	0,040	0,15 to 0,35	11,0 to 13,0	-	1,00	-	-	-
X2CrTi17	1.4520	0,025	0,50	0,50	0,040	0,015 [b]	16,0 to 18,0	-	-	0,015	[4 × (C+N) + 0,15] to 0,80 [c]	-
X3CrNb17	1.4511	0,05	1,00	1,00	0,040	0,030 [b]	16,0 to 18,0	-	-	-	-	Nb: 12 × C to 1,00
X2CrTiNb18	1.4509	0,030	1,00	1,00	0,040	0,015 [b]	17,5 to 18,5	-	-	-	0,10 to 0,60	Nb: [(3 × C) + 0,30] to 1,00
X2CrTi21 *	1.4611 *	0,030	1,00	1,00	0,050	0,050 [b]	19,0 to 22,0	0,50	0,50	-	[4 × (C+N) + 0.20] to 1,00 [c]	Al: 0,050 Cu: 0,50
X2CrNbCu21	1.4621	0,030	1,00	1,00	0,040	0,015	20,0 to 21,5	-	-	0,030	-	Cu: 0,10 to 1,00 Nb: [7× (C + N) + 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	-	[4 × (C+N) + 0.20] to 1.00 [c]	Al:0,050 Cu: 0,50
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	-	Nb: [7× (C + N) + 0,10] to 1,00

Steel designation		% by mass [a]										
Name	Number	C	Si	Mn	P	S	Cr	Ni	Mo	N	Ti	Others
X2CrMoTiS18-2	1.4523	0,030	1,00	0,50	0,040	0,15 to 0,35	17,5 to 19,0	-	2,00 to 2,50	-	[4 × (C + N) + 0,15] to 0,80 [c]	(C + N) ≤ 0,040
X6CrMoS19-2	1.4114	0,08	1,00	2,50	0,040	0,15 to 0,35	17,5 to 19,5	0,75	1,50 to 2,50	-	-	-

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

[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 0,030 % 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 5 — Chemical composition (cast analysis) of martensitic and precipitation hardening corrosion resistant steels

Steel designation		% by mass [a]									
Name	Number	C	Si	Mn	P	S	Cr	Ni	Mo	Cu	Others
Standard grades (Martensitic steels) [c]											
X12Cr13	1.4006	0,08 to 0,15	1,00	1,50	0,040	0,030 [b]	11,5 to 13,5	0,75	-	-	-
X12CrS13	1.4005	0,06 to 0,15	1,00	1,50	0,040	0,15 to 0,35	12,0 to 14,0	-	0,60	-	-
X15Cr13	1.4024	0,12 to 0,17	1,00	1,00	0,040	0,030 [b]	12,0 to 14,0	-	-	-	-
X20Cr13	1.4021	0,16 to 0,25	1,00	1,50	0,040	0,030 [b]	12,0 to 14,0	-	-	-	-
X30Cr13	1.4028	0,26 to0,36	1,00	1,50	0,040	0,030 [b]	12,0 to 14,0	-	-	-	-
X39Cr13	1.4031	0,36 to 0,42	1,00	1,00	0,040	0,030 [b]	12,5 to 14,5	-	-	-	-
X46Cr13	1.4034	0,43 to 0,50	1,00	1,00	0,040	0,030 [b]	12,5 to 14,5	-	-	-	-
X65Cr13	1.4037	0,58 to 0,70	1,00	1,00	0,040	0,015 [b]	12,5 to 14,5	-	-	-	-
X17CrNi16-2	1.4057	0,12 to 0,22	1,00	1,50	0,040	0,030 [b]	15,0 to 17,0	1,50 to 2,50	-	-	-
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	0,030 [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	3,5 to 4,5	0,30 to 0,70	-	N ≥ 0,020
X50CrMoV15	1.4116	0,35 to 0,55	1,00	1,00	0,040	0,030 [b]	14,0 to 15,5	-	0,50 to 0,80	-	N: see [e] V: 0,10 to 0,20
X14CrMoS17	1.4104	0,10 to 0,17	1,00	1,50	0,040	0,15 to 0,35	15,5 to 17,5	-	0,20 to 0,60	-	-
X4CrNiMo16-5-1	1.4418	0,06	0,70	1,50	0,040	0,030 [b]	15,0 to 17,0	4,0 to 6,0	0,80 to 1,50	-	N ≥ 0,020
X39CrMo17-1	1.4122	0,33 to 0,45	1,00	1,50	0,040	0,030 [b]	15,5 to 17,5	1,00	0,80 to 1,30	-	-

Steel designation		% by mass [a]									
Name	Number	C	Si	Mn	P	S	Cr	Ni	Mo	Cu	Others
Special grades (Martensitic steels)											
X29CrS13	1.4029	0,25 to 0,32	1,00	1,50	0,040	0,15 to 0,35	12,0 to 13,5	-	0,60	-	-
X46CrS13	1.4035	0,43 to 0,50	1,00	2,00	0,040	0,15 to 0,35	12,5 to 14,0	-	-	-	-
X70CrMo15	1.4109	0,60 to 0,75	0,70	1,00	0,040	0,030 [b]	14,0 to 16,0	-	0,40 to 0,80	-	-
X2CrNiMoV13-5-2	1.4415	0,030	0,50	0,50	0,040	0,015	11,5 to 13,5	4,5 to 6,5	1,50 to 2,50	-	Ti ≤ 0,010 V: 0,10 to 0,50
X53CrSiMoVN16-2	1.4150	0,045 to 0,60	1,30 to 1,70	0,80	0,030	0,010	15,0 to 16,5	0,40	0,20 to 0,40	-	N: 0,050 to 0,20 V: 0,20 to 0,40
X105CrMo17	1.4125	0,95 to 1,20	1,00	1,00	0,040	0,030 [b]	16,0 to 18,0	-	0,40 to 0,80	-	-
X40CrMoVN16-2	1.4123	0,35 to 0,50	1,00	1,00	0,040	0,015	14,0 to 16,0	0,50	1,00 to 2,50	-	N: 0,10 to 0,30 V ≤ 1,50
X90CrMoV18	1.4112	0,85 to 0,95	1,00	1,00	0,040	0,030 [b]	17,0 to 19,0	-	0,90 to 1,30	-	V: 0,07 to 0,12
Standard grades (Precipitation hardening steels)											
X5CrNiCuNb16-4	1.4542	0,07	0,70	1,50	0,040	0,030 [b]	15,0 to 17,0	3,0 to 5,0	0,60	3,0 to 5,0	Nb: 5 x C to 0,45
X7CrNiAI17-7	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
X5CrNiMoCuNb14-5	1.4594	0,07	0,70	1,00	0,040	0,015	13,0 to 15,0	5,0 to 6,0	1,20 to 2,00	1,20 to 2,00	Nb: 0,15 to 0,60

Steel designation		% by mass [a]									
Name	Number	C	Si	Mn	P	S	Cr	Ni	Mo	Cu	Others
Special grades (Precipitation hardening steels)											
X1CrNiMoAlTi12-9-2	1.4530	0,015	0,10	0,10	0,010	0,005	11,5 to 12,5	8,5 to 9,5	1,85 to 2,15	-	N: 0,010 Al: 0,60 to 0,80 Ti: 0,28 to 0,37
X1CrNiMoAlTi12-10-2	1.4596	0,015	0,10	0,010	0,010	0,005	11,5 to 12,5	9,2 to 10,2	1,85 to 2,15	-	N ≤ 0,020 Al: 0,80 to 1,10 Ti: 0,28 to 0,40
X1CrNiMoAlTi12-11-2	1.4612	0,015	0,10	0,10	0,010	0,005	11,0 to 12,5	10,2 to 11,3	1,75 to 2,25	-	N ≤ 0,010 Al: 1,35 to 1,75 Ti: 0,20 to 0,50
X5NiCrTiMoVB25-15-2	1.4606	0,08	1,00	1,00 to 2,00	0,025	0,015	13,0 to 16,0	24,0 to 27,0	1,00 to 1,50	-	Al ≤ 0,35 B: 0,0010 to 0,010 Ti: 1,90 to 2,30 V: 0,10 to 0,50

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

[a] Maximum values unless indicated otherwise.

[b] Particular ranges of sulfur content 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 0,030 % 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 0,20 %.

Table 6 — Permissible product analysis tolerances on the limiting values given in Tables 2 to 5 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	≥ 0,10	≤ 0,30	±0,05
	> 0,30	≤ 1,50	±0,10
Boron		≤ 0,010	+0,000 5
Cobalt		≤ 0,50	-0,01
	> 0,50	≤ 2,00	±0,02

Element	**Specified limits, cast analysis % by mass**		**Permissible tolerance** [a] **% by mass**
Copper		≤ 1,00	±0,04
	> 1,00	≤ 5,0	±0,10
Niobium		≤ 1,00	±0,05
Titanium		≤ 1,00	±0,05
	> 1,00	≤ 3,0	±0,07
Tungsten		≤ 3,00	+0,05
Vanadium		≤ 0,50	-0,01 / +0,03
	> 0,50	≤ 1,50	±0,05

[a] If several product analyses 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 7 — Type of surface finish and process route of semi-finished products, rods and wires, bars, and sections [a]

	Product forms				Tolerances on nominal dimensions [b]	Symbol [c]	Condition		Recommended use and observations
	Semi-finished products	Rods	Wires	Bars, sections			Type of process route	Surface finish	
Hot formed	x	x	-	x	EN 10017, EN 10058, EN 10059, EN 10060, EN 10061	1U	Hot formed, not heat treated, not descaled.	Covered with scale (spot ground if necessary). Not free of surface imperfections.	Suitable for products to be further hot formed.
	x	x	-	x		1C	Hot formed, heat treated [e], not descaled.		Suitable for products to be further processed (hot or cold).
	x	-	-	x	≥ IT 14 [d] /EN ISO 286-1	1E	Hot formed, heat treated [e], mechanically descaled [f]	Largely free of scale (but some black spots may remain). Not free of surface imperfections.	
	-	x	-	x	EN 10017, EN 10058, EN 10059, EN 10060, EN 10061	1D	Hot formed, heat treated [e], pickled, coated (optional).	Free of scale (spot ground if necessary). Not free of surface imperfections.	Products used in their present condition or to be further processed (hot or cold).
	-	-	-	x	≥ IT 12 [d] /EN ISO 286-1	1X [m]	Hot formed, heat treated [e], rough machined [g]	Free of scale (but some marks left from machining may remain). Not free of surface imperfections.	
	-	x	-	x		1G [m]	Hot formed, heat treated [e], descaled, rough machined [g] or shaved in the case of rod. Finishing by removal of material [h].	Appearance bright, but not uniform, Free of surface defects.	Suitable for severe applications (extrusion and/or cold or hot heading). Surface roughness can be specified.

	Product forms				Tolerances on nominal dimensions [b]	Symbol [c]	Condition		Recommended use and observations
	Semi-finished products	Rods	Wires	Bars, sections			Type of process route	Surface finish	
Cold processed	-	-	x	x	Bars: IT 8 to 11 [d] /EN 10278 Wire: T3 or T4 /EN 10218-2	2H	Finishes 1E, 1D or 1X, cold processed [j], coated (optional).	Smooth and matt or bright. Not necessarily polished. Not free of surface imperfections [i].	In products formed by cold drawing without subsequent heat treatment, the tensile strength is substantially increased, particularly in austenitic materials, depending on the degree of cold processing. The surface hardness may be higher than the centre hardness.
	-	-	x	x	Bars: IT 8 to 11 [d] /EN 10278 Wire: T3 or T4 /EN 10218-2	2D	Finish 2H, heat treated [e], pickled and skin-passed (optional), coated (optional).	Smooth and matt or bright. Not free of surface imperfections [i].	This finish allows the restoration of the mechanical properties after cold processing. Products with good ductility (extrusion) and specific magnetic properties.
	-	-	-	x	Bars: IT 8 to 11 [d] /EN 10278	2B	Finishes 1E, 1D or 1X, cold processed [j], mechanically smoothed [k].	Smooth, uniform and bright. Free of surface imperfections.	Products used in their present condition or intended for better finishing. In products formed by cold drawing without subsequent heat treatment, the tensile strength is substantially increased, particularly in austenitic materials, depending on the degree of cold processing. The surface hardness may be higher than the centre hardness.
	-	-	-	x	IT ≤ 9 [d]/EN 10278	2G	Finishes 2H, 2D or 2B, centreless ground, mechanically smoothed (optional) [l].	Smooth, uniform and bright. Free of surface defects.	Finish for close tolerances. Unless otherwise agreed, the surface roughness shall be Ra ≤ 1,2.
	-	-	-	x	IT < 11 [d]/EN 10278	2P	Finishes 2H, 2D, 2B or 2G, specular polishing [l].	Smoother and brighter than finish 2B or 2G. Free of surface defects.	Products showing a well-groomed surface appearance. Surface roughness shall be specified at the time of enquiry and order.

	Product forms				Tolerances on nominal dimensions [b]	Symbol [c]	Condition		Recommended use and observations
	Semi-finished products	Rods	Wires	Bars, sections			Type of process route	Surface finish	

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

[b] For sections, the following standards are used, in practice, for tolerances on dimensions and shape: EN 10024, EN 10034, EN 10055, EN 10056-2 and EN 10279. See footnote to Annex D.

[c] First digit: 1 = Hot formed; 2 = Cold processed.

[d] Specific tolerance within this range shall be agreed upon at the time of enquiry and order.

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

[f] Type of mechanical descaling (shot blasting, grinding, peeling) is left to the manufacturer's discretion unless otherwise agreed.

[g] Type of rough machining (grinding, peeling) is left to the manufacturer's discretion unless otherwise agreed.

[h] Type of finish is left to the manufacturer's discretion unless otherwise agreed.

[i] Unless otherwise agreed at the time of order.

[j] Type of cold processing (cold drawing, turning, grinding, abrading ...) is left to the manufacturer's discretion unless otherwise agreed.

[k] Type of mechanical polishing (burnishing, abrading) is left to the manufacturer's discretion unless otherwise agreed.

[l] Type of specular polishing (electro-polishing, felting, buffing ...) is left to the manufacturer's discretion unless otherwise agreed.

[m] Tolerances IT <12 can also be obtained with no change in mechanical properties.

Table 8 — Mechanical properties at room temperature of solution annealed [a] (see Table A.1) austenitic steels and resistance to intergranular corrosion in conditions 1C, 1E, 1D, 1X, 1G and 2D

Steel designation		Thickness t or diameter [b] *d*	Hard-ness [c, d]	0,2 %-proof strength	1 %-proof strength	Tensile Strength [d, e]	Elongation after fracture [d, e]		Impact energy (ISO-V)		Resistance to intergranular corrosion [f]	
Name	Number	mm	HBW max.	$R_{p0,2}$ [e] MPa min.	$R_{p1,0}$ [c,e] MPa min.	R_m MPa	A % min.		KV_2 J min.		in the delivery condition	in the sensitized condition [g]
							(long.)	(tr.)	(long.)	(tr.)		
Standard grades												
X10CrNi18-8	1.4310	≤ 40	230	195	230	500 to 750	40	-	-	-	no	no
X2CrNi18-9	1.4307	≤ 160	215	175	210	500 to 700	45	-	100	-	yes	yes
		160 < t ≤ 250					-	35	-	60		
X8CrNiS18-9	1.4305	≤ 160	230	190	225	500 to 750	35	-	-	-	no	no
X6CrNiCuS18-9-2	1.4570	≤ 160	215	185	220	500 to 710	35	-	-	-	no	no
X3CrNiCu18-9-4	1.4567	≤ 160	215	175	210	450 to 650	45	-	-	-	yes	yes
X2CrNiN18-10	1.4311	≤ 160	230	270	305	550 to 760	40	-	100	-	yes	yes
		160 < t ≤ 250					-	30	-	60		
X5CrNi18-10	1.4301	≤ 160	215	190	225	500 to 700	45	-	100	-	yes	no [h]
		160 < t ≤ 250					-	35	-	60		
X6CrNiTi18-10	1.4541	≤ 160	215	190	225	500 to 700	40	-	100	-	yes	yes
		160 < t ≤ 250					-	30	-	60		
X2CrNi19-11	1.4306	≤ 160	215	180	215	460 to 680	45	-	100	-	yes	yes
		160 < t ≤ 250		-	-		-	35	-	60		

Steel designation		Thickness t or diameter [b] d	Hard-ness [c, d]	0,2 %-proof strength	1 %-proof strength	Tensile Strength [c]	Elongation after fracture [d, e]		Impact energy (ISO-V)		Resistance to intergranular corrosion [f]	
Name	Number	mm	HBW max.	$R_{p0,2}$ [c,e] MPa min.	$R_{p1,0}$ [c,e] MPa min.	R_m MPa	A % min.		KV_2 J min.		in the delivery condition	in the sensitized condition [g]
							(long.)	(tr.)	(long.)	(tr.)		
X4CrNi18-12	1.4303	≤ 160	215	190	225	500 to 700	45	-	100	-	yes	no [h]
		160 < t ≤ 250					-	35	-	60		
X2CrNiMoN17-11-2	1.4406	≤ 160	250	280	315	580 to 800	40	-	100	-	yes	yes
		160 < t ≤ 250					-	30	-	60		
X2CrNiMo17-12-2	1.4404	≤ 160	215	200	235	500 to 700	40	-	100	-	yes	yes
		160 < t ≤ 250					-	30	-	60		
X5CrNiMo17-12-2	1.4401	≤ 160	215	200	235	500 to 700	40	-	100	-	yes	no [h]
		160 < t ≤ 250					-	30	-	60		
X6CrNiMoTi17-12-2	1.4571	≤ 160	215	200	235	500 to 700	40	-	100	-	yes	yes
		160 < t ≤ 250					-	30	-	60		
X2CrNiMo17-12-3	1.4432	≤ 160	215	200	235	500 to 700	40	-	100	-	yes	yes
		160 < t ≤ 250					-	30	-	60		
X3CrNiMo17-12-3	1.4436	≤ 160	215	200	235	500 to 700	40	-	100	-	yes	no [h]
		160 < t ≤ 250					-	30	-	60		
X2CrNiMoN17-13-3	1.4429	≤ 160	250	280	315	580 to 800	40	-	100	-	yes	yes
		160 < t ≤ 250					-	30	-	60		

Steel designation		Thickness t or diameter [b] d	Hard-ness [c, d]	0,2 %-proof strength	1 %-proof strength	Tensile Strength [c]	Elongation after fracture [d, e]		Impact energy (ISO-V)		Resistance to intergranular corrosion [f]	
Name	Number	mm	HBW max.	$R_{p0,2}$ [c,e] MPa min.	$R_{p1,0}$ [c,e] MPa min.	R_m MPa	A % min.		KV_2 J min.		in the delivery condition	in the sensitized condition [g]
							(long.)	(tr.)	(long.)	(tr.)		
X2CrNiMo18-14-3	1.4435	≤ 160	215	200	235	500 to 700	40	-	100	-	yes	yes
		160 < t ≤ 250					-	30	-	60		
X2CrNiMoN17-13-5	1.4439	≤ 160	250	280	315	580 to 800	35	-	100	-	yes	yes
		160 < t ≤ 250					-	30	-	60		
X1NiCrMoCu25-20-5	1.4539	≤ 160	230	230	260	530 to 730	35	-	100	-	yes	yes
		160 < t ≤ 250					-	30	-	60		
Special grades												
X9CrNi18-9	1.4325	≤ 40	215	190	225	550 to 750	40	-	-	-	yes	no
X5CrNiN19-9	1.4315	≤ 40	215	270	310	550 to 750	40	-	100	-	yes	no [h]
X3CrNiCu19-9-2	1.4560	≤ 160	215	170	220	450 to 650	45	-	100	-	yes	yes
X6CrNiNb18-10	1.4550	≤ 160	230	205	240	510 to 740	40	-	100	-	yes	yes
		160 < t ≤ 250					-	30	-	60		
X1CrNiSi18-5-4	1.4361	≤ 160	230	210	240	530 to 730	40	-	100	-	yes	yes
		160 < t ≤ 250					-	30	-	60		
X8CrMnCuN17-8-3	1.4597	≤ 160	245	270	305	560 to 780	40	-	100	-	yes	no
X3CrMnNiCu15-8-5-3	1.4615	≤ 160	180	175	210	400 to 600	45	-	-	-	yes	yes
X12CrMnNiN17-7-5	1.4372	≤ 160	260	230	370	680 to 880	40	-	100	-	yes	no
		160 < t ≤ 250					-	35	-	60		
X8CrMnNiN18-9-5	1.4374	≤ 10	260	350	380	700 to 900	35	-	-	-	yes	no

Steel designation		Thickness t or diameter [b] d	Hard-ness [c, d]	0,2 %-proof strength	1 %-proof strength	Tensile Strength [c]	Elongation after fracture [d, e]		Impact energy (ISO-V)		Resistance to intergranular corrosion [f]	
Name	Number	mm	HBW max.	$R_{p0,2}$ [c,e] MPa min.	$R_{p1,0}$ [c,e] MPa min.	R_m MPa	A % min.		KV_2 J min.		in the delivery condition	in the sensitized condition [g]
							(long.)	(tr.)	(long.)	(tr.)		
X11CrNiMnN19-8-6	1.4369	≤ 15	300	340	370	750 to 950	35	35	100	60	yes	no
X13MnNiN18-13-2	1.4020	≤ 160	220	380	420	690 to 850	30	-	100	-	yes	no
		160 < t ≤ 250					-	30	-	60		
X6CrMnNiN18-13-3	1.4378	≤ 160	220	380	420	690 to 830	30	-	100	-	yes	no
		160 < t ≤ 250					-	30	-	60		
X6CrMnNiCuN18-12-4-2	1.4646 *	≤ 8	260	380	400	650 to 850	30	30	100	60	yes	yes
X3CrMnNiN20-9-6	1.4391	≤ 130	300	345		620 to 900	35	-	100	-	yes	no
X2CrNiMoCuS17-10-2	1.4598	≤ 160	215	200	235	500 to 700	40	-	100	-	no	no
X3CrNiCuMo17-11-3-2	1.4578	≤ 160	215	175	-	450 to 650	45	-	-	-	yes	yes
X6CrNiMoNb17-12-2	1.4580	≤ 160	230	215	250	510 to 740	35	-	100	-	yes	yes
		160 < t ≤ 250					-	30	-	60		
X2CrNiMo18-15-4	1.4438	≤ 160	215	200	235	500 to 700	40	-	100	-	yes	yes
		160 < t ≤ 250					-	30	-	60		
X5CrNiMnMoNNbV22-12-5-2	1.4681	≤ 100	300	380		690 to 930	35	-	100	-	yes	yes
X1CrNiMoCuN20-18-7	1.4547	≤ 160	260	300	340	650 to 850	35	-	100	-	yes	yes
		160 < t ≤ 250					-	30	-	60		
X1CrNiMoN25-22-2	1.4466	≤ 160	240	250	290	540 to 740	35	-	100	-	yes	yes
		160 < t ≤ 250					-	30	-	60		

Steel designation		Thickness t or diameter [b] d	Hard-ness [c, d]	0,2 %-proof strength	1 %-proof strength	Tensile Strength [c, e]	Elongation after fracture [d, e]		Impact energy (ISO-V)		Resistance to intergranular corrosion [f]	
Name	Number	mm	HBW max.	$R_{p0,2}$ [c,e] MPa min.	$R_{p1,0}$ [c,e] MPa min.	R_m MPa	A % min.		KV_2 J min.		in the delivery condition	in the sensitized condition [g]
							(long.)	(tr.)	(long.)	(tr.)		
X1CrNiMoCuNW24-22-6	1.4659	≤ 160	290	420	460	800 to 1000	50	-	90	-	yes	yes
X1CrNiMoCuN24-22-8	1.4652	≤ 50	310	430	470	750 to 1000	40	-	100	-	yes	yes
X2CrNiMnMoN25-18-6-5	1.4565	≤ 160	-	420	460	800 to 950	35	-	100	-	yes	yes
X1NiCrMoCuN25-20-7	1.4529	≤ 160	250	300	340	650 to 850	40	-	100	-	yes	yes
		160 < t ≤ 250					-	35	-	60		
X1NiCrMoCu31-27-4	1.4563	≤ 160	230	220	250	500 to 750	35	-	100	-	yes	yes
		160 < t ≤ 250					-	30	-	60		
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] Width across flats for hexagons.

[c] Only for guidance.

[d] The maximum HB-values may be raised by 100 HBW or the tensile strength value may be raised by 200 MPa and the minimum elongation value may be lowered to 20 % for hot formed sections of ≤ 8 mm thickness.

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

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

[g] See NOTE 2 to 6.4.

[h] Sensitization treatment of 15 min at 700 °C followed by cooling in air.

Table 9 — Mechanical properties at room temperature of solution annealed [a] (see Table 4.2) austenitic-ferritic steels and resistance to intergranular corrosion in conditions 1C, 1E, 1D, 1X, 1G and 2D

Steel designation		Thickness t or diameter [b] *d*	Hardness [c]	0,2 %-proof strength	Tensile strength	Elonga-tion after fracture	Impact energy (ISO-V)	Resistance to intergranular corrosion [e]	
Name	Number	mm	HBW max.	$R_{p0,2}$ [d] MPa min.	R_m [d] MPa	A [d] % min. (long.)	KV_2 J min. (long.)	in the delivery condition	in the sensitized condition [f]
Standard grades									
X2CrNiN22-2 *	1.4062 *	≤ 160	290	380 [g]	650 to 900	30	40	yes	yes
X2CrNiN23-4	1.4362	≤ 160	260	400	600 to 830	25	100	yes	yes
X2CrMnNiN21-5-1	1.4162	≤ 160	290	400	650 to 900	25	60	yes	yes
X2CrMnNiMoN21-5-3	1.4482	≤ 160	-	400	650 to 900	25	60	yes	yes
X2CrNiMoN22-5-3	1.4462	≤ 160	270	450	650 to 880	25	100	yes	yes
X3CrNiMoN27-5-2	1.4460	≤ 160	260	450	620 to 880	20	85	yes	yes
Special grades									
X2CrCuNiN23-2-2 *	1.4669 *	≤ 160	300	400	650 to 900	25	100	yes	yes
X2CrMnNiSiN20-5-4-2 *	1.4670 *	≤ 160	320	450	650 to 900	25	60	yes	yes
X2CrNiMoSi18-5-3	1.4424	≤ 50	260	450	700 to 900	25	100	yes	yes
		50 < t ≤ 160	260	400	680 to 900	25	100	yes	yes
X2CrNiMnMoCuN24-4-3-2 *	1.4662 *	≤ 160	290	450	650 to 900	25	60	yes	yes
X2CrNiMoCuN25-6-3	1.4507	≤ 160	270	500	700 to 900	25	100	yes	yes
X2CrNiMoN25-7-4	1.4410	≤ 160	290	530	730 to 930	25	100	yes	yes
X2CrNiMoCuWN25-7-4	1.4501	≤ 160	290	530	730 to 930	25	100	yes	yes
X2CrNiMoN29-7-2	1.4477	≤ 10	310	650	800 to 1050	25	100	yes	yes
		10 < t ≤ 160	310	550	750 to 1000	25	100	yes	yes

Steel designation		Thickness t or diameter [b] d	Hardness [c]	0,2 %-proof strength	Tensile strength	Elonga-tion after fracture	Impact energy (ISO-V)	Resistance to intergranular corrosion [e]	
Name	Number	mm	HBW max.	$R_{p0,2}$ [d] MPa min.	R_m [d] MPa	A [d] % min. (long.)	KV_2 J min. (long.)	in the delivery condition	in the sensitized condition [f]
X2CrNiMoCoN28-8-5-1	1.4658	≤ 5	300	650	800 to 1000	25	100	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 requirement for the mechanical properties of the product and the resistance to intergranular corrosion as defined in EN ISO 3651-2 are obtained.

[b] Width across flats for hexagons.

[c] Only for guidance.

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

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

[f] See NOTE 2 to 6.4.

[g] Minimum 0,2 %-proof strength is increased to 450 MPa for online solution treatment.

Table 10 — Mechanical properties at room temperature of annealed [a] (see Table A.3) ferritic steels and resistance to intergranular corrosion in conditions 1C, 1E, 1D, 1X, 1G and 2D

Steel designation		Thickness t or diameter [b] d	Hardness	0,2 % proof strength	Tensile Strength	Elongation after fracture [d]	Resistance to intergranular corrosion [e]	
Name	Number	mm max.	HBW [c] max.	$R_{p0,2}$ [d] MPa min.	R_m [d] MPa	A % min. (long.)	in the delivery condition	in the welded condition
Standard grades								
X2CrNi12	1.4003	100	200	260	450 to 600	20	no	no
X6Cr13	1.4000	25	200	230	400 to 630	20	no	no
X6Cr17	1.4016	100	200	240	400 to 630	20	yes	no
X6CrMoS17	1.4105	100	200	250	430 to 630	20	no	no
X6CrMo17-1	1.4113	100	200	280	440 to 660	18	yes	no
X2CrMoSiS18-2-1	1.4106	100	200	240	430 to 630	15	yes	no
Special grades								
X3CrS12	1.4045	100	220	250	420 to 600	20	yes	no
X2CrTi17	1.4520	50	200	200	420 to 620	20	yes	yes
X3CrNb17	1.4511	50	200	200	420 to 620	20	yes	yes
X2CrTiNb18	1.4509	50	200	200	420 to 620	18	yes	yes
X2CrTi21 *	1.4611 *	8	200	250	430 to 630	18	yes	yes
X2CrNbCu21	1.4621	50	200	240	420 to 640	20	yes	yes
X2CrTi24 *	1.4613 *	8	200	250	430 to 630	18	yes	yes

Steel designation		Thickness t or diameter [b] d	Hardness	0,2 %-proof strength	Tensile Strength	Elongation after fracture [d]	Resistance to intergranular corrosion [e]	
Name	Number	mm max.	HBW [c] max.	$R_{p0,2}$ [d] MPa min.	R_m [d] MPa	A % min. (long.)	in the delivery condition	in the welded condition
X6CrMoNb17-1	1.4526	100	200	300	480 to 680	15	yes	yes
X2CrMoTiS18-2	1.4523	100	200	280	430 to 600	15	yes	no
X6CrMoS19-2	1.4114	100	200	240	430 to 630	14	yes	no
For bigger sizes the mechanical values shall be agreed at the time of enquiry and order.								

[a] Annealing 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] Width across flats for hexagons.

[c] Only for guidance.

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

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

Table 11 — Mechanical properties at room temperature of heat-treated (see Table A.4) martensitic steels in conditions 1C, 1E, 1D, 1X, 1G and 2D

Steel designation		Thickness t or diameter [a] d	Heat-treatment condition [b]	Hardness	0,2 %-proof strength	Tensile strength	Elongation after fracture		Impact energy (ISO-V)	
Name	Number	mm		HBW [c] max.	$R_{p0,2}$ [d] MPa min.	R_m [d] MPa	A [d] % min. (long.)	(tr.)	KV_2 J min. (long.)	(tr.)
Standard grades										
X12Cr13	1.4006	-	+A	220	-	max. 730	-	-	-	-
		≤ 160	+QT650	-	450	650 to 850	15	-	25	-
X12CrS13	1.4005	-	+A	220	-	max. 730	-	-	-	-
		≤ 160	+QT650	-	450	650 to 850	12	-	-	-
X15Cr13	1.4024	-	+ A	220	-	max. 730	-	-	-	-
		≤ 160	+QT650	-	450	650 to 850	15	-	-	-
X20Cr13	1.4021	-	+A	230	-	max. 760	-	-	-	-
		≤ 160	+QT700	-	500	700 to 850	13	-	25	-
			+QT800	-	600	800 to 950	12	-	20	-
X30Cr13	1.4028	-	+A	245	-	max. 800	-	-	-	-
		≤ 160	+QT850	-	650	850 to 1000	10	-	12	-
X39Cr13	1.4031	-	+A	245	-	max. 800	-	-	-	-
		≤ 160	+QT800	-	650	800 to 1000	10	-	12	-
X46Cr13	1.4034	-	+A	245	-	max. 800	-	-	-	-
		≤ 160	+QT800	-	650	800 to 1000	10	-	12	-
X65Cr13	1.4037	≤ 160	+A	265		840				

Steel designation		Thickness t or diameter [a] d	Heat-treatment condition [b]	Hardness	0,2 % proof strength	Tensile strength	Elongation after fracture		Impact energy (ISO-V)	
Name	Number	mm		HBW [c] max.	$R_{p0,2}$ [d] MPa min.	R_m [d] MPa	A [d] % min. (long.)	A [d] % min. (tr.)	KV_2 J min. (long.)	KV_2 J min. (tr.)
X17CrNi16-2	1.4057	-	+A	295	-	max. 950	-	-	-	-
		≤ 60	+QT800	-	600	800 to 950	14	-	25	-
		60 < t ≤ 160					12		20	
		≤ 60	+QT900	-	700	900 to 1050	12	-	16	-
		60 < t ≤ 160					10		15	
X38CrMo14	1.4419	-	+A	235	-	max. 760	-	-	-	-
X55CrMo14	1.4110	≤ 100	+A	280	-	max. 950	-	-	-	-
X3CrNiMo13-4	1.4313	-	+A	320	-	max. 1100	-	-	-	-
		≤ 160	+QT700	-	520	700 to 850	15	-	70	-
		160 < t ≤ 250					-	12	-	50
		≤ 160	+QT780	-	620	780 to 980	15	-	70	-
		160 < t ≤ 250					-	12	-	50
		≤ 160	+QT900	-	800	900 to 1100	12	-	50	-
		160 < t ≤ 250					-	10	-	40
X50CrMoV15	1.4116	-	+A	280	-	max. 900	-	-	-	-
X14CrMoS17	1.4104	-	+A	220	-	max. 730	-	-	-	-
		≤ 60	+QT650	-	500	650 to 850	12	-	-	-
		60 < t ≤ 160					10	-	-	-

Steel designation		Thickness t or diameter [a] d	Heat-treatment condition [b]	Hardness	0,2 % proof strength	Tensile strength	Elongation after fracture		Impact energy (ISO-V)	
Name	Number	mm		HBW [c] max.	$R_{p0,2}$ [d] MPa min.	R_m [d] MPa	A [d] % min. (long.)	A [d] % min. (tr.)	KV_2 J min. (long.)	KV_2 J min. (tr.)
X4CrNiMo16-5-1	1.4418	-	+A	320	-	max. 1100	-	-	-	-
		≤ 160	+QT760	-	550	760 to 960	16	-	90	-
		160 < t ≤ 250		-	-		-	14	-	70
		≤ 160	+QT900	-	700	900 to 1100	16	-	80	-
		160 < t ≤ 250		-	-		-	14	-	60
X39CrMo17-1	1.4122	-	+A	280	-	max. 900	-	-	-	-
		≤ 60	+QT750	-	550	750 to 950	12	-	15	-
		60 < t ≤ 160							10	-

Steel designation		Thickness t or diameter [a] d	Heat-treatment condition [b]	Hardness	0,2 % proof strength	Tensile strength	Elongation after fracture		Impact energy (ISO-V)	
Name	Number	mm		HBW [c] max.	$R_{p0,2}$ [d] MPa min.	R_m [d] MPa	A [d] % min. (long.)	(tr.)	KV_2 J min. (long.)	(tr.)
Special grades										
X29CrS13	1.4029	≤ 160	+A	245	-	max. 800	-	-	-	-
			+QT850	-	650	850 to 1000	9	-	-	-
X46CrS13	1.4035	≤ 63	+A	245	-	max. 800	-	-	-	-
X70CrMo15	1.4109	≤ 100	+A	280	-	max. 900	-	-	-	-
X2CrNiMoV13-5-2	1.4415	≤ 160	+QT750	-	650	750 to 900	18	-	100	-
			+QT850	-	750	850 to 1000	15	-	80	-
X53CrSiMoVN16-2	1.4150	≤ 100	+A	255	-	-	-	-	-	-
			+QT	-	-	-	-	-	-	-
X105CrMo17	1.4125	≤ 100	+A	285	-	-	-	-	-	-
X40CrMoVN16-2	1.4123	≤ 100	+A	280	-	-	-	-	-	-
			+QT	-	-	-	-	-	-	-
X90CrMoV18	1.4112	≤ 100	+A	265	-	-	-	-	-	-
For bigger sizes the mechanical values shall be agreed at the time of enquiry and order.										

[a] Width across flats for hexagons.

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

[c] Only for guidance.

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

Table 12 — Mechanical properties at room temperature of heat-treated (see Table A.5) precipitation hardening steels in conditions 1C, 1E, 1D, 1X, 1G and 2D

Steel designation		Thickness t or diameter [a] d	Heat treatment condition [b]	Hard-ness [c]	0,2 %-proof strength	Tensile strength	Elongation after fracture	Impact energy (ISO-V)
Name	Number	mm max.		HBW max.	$R_{p0,2}$ MPa min.	R_m MPa	A % min. (long.)	KV_2 J min. (long.)
Standard grades								
X5CrNiCuNb16-4	1.4542	100	+AT	360	-	max. 1200	-	-
			+P800	-	520	800 to 950	18	75
			+P930	-	720	930 to 1100	16	40
			+P960	-	790	960 to 1160	12	-
			+P1070	-	1000	1070 to 1270	10	-
X7CrNiAl17-7	1.4568	30	+AT [d]	255	-	max. 850	-	-
X5CrNiMoCuNb14-5	1.4594	100	+AT	360	-	max.1200	-	-
			+P930	-	720	930 to 1100	15	40
			+P1000	-	860	1000 to 1200	10	-
			+P1070	-	1000	1070 to 1270	10	-

Steel designation		Thickness t or diameter [a] d	Heat treatment condition [b]	Hard-ness	0,2 % proof strength	Tensile strength	Elongation after fracture	Impact energy (ISO-V)
Special grades								
X1CrNiMoAlTi12-9-2	1.4530	150	+AT	363	-	max. 1200	-	-
			+P1200	-	1100	min. 1200	12	90
X1CrNiMoAlTi12-10-2	1.4596	150	+AT	363	-	max. 1200	-	-
			+P1400	-	1300	min. 1400	9	50
X1CrNiMoAlTi12-11-2	1.4612	150	+AT	331	-	-	-	-
			+P1510	-	1380	min. 1510	10	20
			+P1650	-	1515	min. 1650	10	10
X5NiCrTiMoVB25-15-2	1.4606	50	+AT	212	250	max. 700	35	-
			+P880	-	550	880 to 1150	20	50
For bigger sizes the mechanical values shall be agreed at the time of enquiry and order.								

[a] Width across flats for hexagons.

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

[c] Only for guidance.

[d] For spring hard drawn condition see EN ISO 6931-1.

Table 13 — Mechanical properties for bright bars [a] at room temperature of solution annealed [b] (see Table A.1) austenitic steels in conditions 2H, 2B, 2G or 2P

Steel designation		Thickness t or diameter D mm	Solution annealed					
Name	Number		$R_{p0,2}$ MPa min.	R_m MPa	A_5 [d] % min.		KV_2 J min.	
					(long.)	(tr.)	(long.)	(tr.)
Standard grades								
X2CrNi18-9	1.4307	≤ 10 [e]	400	600 to 930	25	-	-	-
		10 < t ≤ 16	380	600 to 930	25	-	-	-
		16 < t ≤ 40	175	500 to 830	25	-	100	-
		40 < t ≤ 63	175	500 to 830	30	-	100	-
		63 < t ≤ 160	175	500 to 700	45	-	100	-
		160 < t ≤ 250	175	500 to 700	-	35	-	60
X8CrNiS18-9	1.4305	≤ 10 [e]	400	600 to 950	15	-	-	-
		10 < t ≤ 16	400	600 to 950	15	-	-	-
		16 < t ≤ 40	190	500 to 850	20		-	-
		40 < t ≤ 63	190	500 to 850	20	-	-	-
		63 < t ≤ 160	190	500 to 750	35	-	-	-
X6CrNiCuS18-9-2	1.4570	≤ 10 [e]	400	600 to 950	15	-	-	
		10 < t ≤ 16	400	600 to 950	15	-	-	
		16 < t ≤ 40	185	500 to 910	20	-	-	
		40 < t ≤ 63	185	500 to 910	20	-	-	
		63 < t ≤ 160	185	500 to 710	35	-	-	

Steel designation		**Thickness t or diameter** [c] ***d*** mm	**Solution annealed**					
Name	Number		$R_{p0,2}$ MPa min.	R_m MPa	A_5 [d] % min.		KV_2 J min.	
					(long.)	(tr.)	(long.)	(tr.)
X3CrNiCu18-9-4	1.4567	≤ 10 [e]	400	600 to 850	25	-	-	
		10 < t ≤ 16	340	600 to 850	25	-	-	
		16 < t ≤ 40	175	450 to 800	30		100	
		40 < t ≤ 63	175	450 to 800	30	-	100	
		63 < t ≤ 160	175	450 to 650	40	-	100	
X5CrNi18-10	1.4301	≤ 10 [e]	400	600 to 950	25	-	-	-
		10 < t ≤ 16	400	600 to 950	25	-	-	-
		16 < t ≤ 40	190	600 to 850	25	-	100	-
		40 < t ≤ 63	190	580 to 850	30	-	100	-
		63 < t ≤ 160	190	500 to 700	45	-	100	-
		160 < t ≤ 250	190	500 to 700	-	35	-	60
X6CrNiTi18-10	1.4541	≤ 10 [e]	400	600 to 950	25	-	-	-
		10 < t ≤ 16	380	580 to 950	25	-	-	-
		16 < t ≤ 40	190	500 to 850	30	-	100	-
		40 < t ≤ 63	190	500 to 850	30	-	100	-
		63 < t ≤ 160	190	500 to 700	40	-	100	-

Steel designation		**Thickness** **t** **or diameter** [c] ***d*** mm	**Solution annealed**					
Name	Number		$R_{p0,2}$ MPa min.	R_m MPa	A_5 [d] % min.		KV_2 J min.	
					(long.)	(tr.)	(long.)	(tr.)
X2CrNi19-11	1.4306	≤ 10 [e]	400	600 to 930	25	-	-	-
		10 < t ≤ 16	380	600 to 930	25	-	-	-
		16 < t ≤ 40	180	460 to 830	30	-	100	-
		40 < t ≤ 63	180	460 to 830	30	-	100	-
		63 < t ≤ 160	180	460 to 680	45	-	100	-
		160 < t ≤ 250	180	460 to 680	-	35	-	60
X5CrNiMnMoNNbV22-12-5-2	1.4681	≤ 100	500	800 to 1300	10			
X2CrNiMo17-12-2	1.4404	≤ 10 [e]	400	600 to 930	25	-	-	-
		10 < t ≤ 16	380	580 to 930	25	-	-	-
		16 < t ≤ 40	200	500 to 830	30	-	100	-
		40 < t ≤ 63	200	500 to 830	30	-	100	-
		63 < t ≤ 160	200	500 to 700	40	-	100	-
		160 < t ≤ 250	200	500 to 700	-	30	-	60
X5CrNiMo17-12-2	1.4401	≤ 10 [e]	400	600 to 950	25	-	-	-
		10 < t ≤ 16	380	580 to 950	25	-	-	-
		16 < t ≤ 40	200	500 to 850	30	-	100	-
		40 < t ≤ 63	200	500 to 850	30	-	100	-
		63 < t ≤ 160	200	500 to 700	40	-	100	-
		160 < t ≤ 250	200	500 to 700	-	30	-	60

Steel designation		**Thickness t or diameter** [c] ***d*** mm	**Solution annealed**					
Name	Number		$R_{p0,2}$ MPa min.	R_m MPa	A_5 [d] % min.		KV_2 J min.	
					(long.)	(tr.)	(long.)	(tr.)
X6CrNiMoTi17-12-2	1.4571	≤ 10 [e]	400	600 to 950	25	-	-	-
		10 < t ≤ 16	380	580 to 950	25	-	-	-
		16 < t ≤ 40	200	500 to 850	30		100	-
		40 < t ≤ 63	200	500 to 850	30	-	100	-
		63 < t ≤ 160	200	500 to 700	40	-	100	-
		160 < t ≤ 250	200	500 to 700	-	30	-	60
X2CrNiMo17-12-3	1.4432	≤ 10 [e]	400	600 to 930	25	-	-	-
		10 < t ≤ 16	380	600 to 880	25	-	-	-
		16 < t ≤ 40	200	500 to 850	30		100	-
		40 < t ≤ 63	200	500 to 850	30	-	100	-
		63 < t ≤ 160	200	500 to 700	40	-	100	-
		160 < t ≤ 250	200	500 to 700	-	30	-	60
X3CrNiMo17-12-3	1.4436	≤ 10 [e]	400	600 to 950	25	-	-	-
		10 < t ≤ 16	400	600 to 950	25	-	-	-
		16 < t ≤ 40	200	500 to 850	30	-	100	-
		40 < t ≤ 63	190	500 to 850	30	-	100	-
		63 < t ≤ 160	200	500 to 700	40	-	100	-
		160 < t ≤ 250	200	500 to 700	-	30	-	60

Steel designation		**Thickness** **t** **or diameter** [c] ***d*** mm	**Solution annealed**					
Name	Number		$R_{p0,2}$ MPa min.	R_m MPa	A_5 [d] % min.		KV_2 J min.	
					(long.)	(tr.)	(long.)	(tr.)
X2CrNiMo18-14-3	1.4435	≤ 10 [e]	400	600 to 950	25	-	-	-
		10 < t ≤ 16	400	600 to 950	25	-	-	-
		16 < t ≤ 40	235	500 to 850	30	-	100	-
		40 < t ≤ 63	235	500 to 850	30	-	100	-
		63 < t ≤ 160	235	500 to 700	40	-	100	-
		160 < t ≤ 250	235	500 to 700	-	30	-	60
X1NiCrMoCu25-20-5	1.4539	≤ 10 [e]	400	600 to 930	20	-	-	-
		10 < t ≤ 16	400	600 to 930	20	-	-	-
		16 < t ≤ 40	230	530 to 880	25		100	-
		40 < t ≤ 63	230	530 to 880	25	-	100	-
		63 < t ≤ 160	230	530 to 730	35	-	100	-
		160 < t ≤ 250	230	530 to 730	-	30	-	60

Steel designation		**Thickness t or diameter** [c] ***d*** mm	**Solution annealed**					
Name	Number		$R_{p0,2}$ MPa min.	R_m MPa	A_5 [d] % min.		KV_2 J min.	
					(long.)	(tr.)	(long.)	(tr.)
Special grades								
X3CrNiCu19-9-2	1.4560	≤ 10 [e]	400	600 to 800	25	-	-	-
		10 < t ≤ 16	340	600 to 800	25	-	-	-
		16 < t ≤ 40	175	450 to 750	30	-	-	-
		40 < t ≤ 63	175	450 to 750	30	-	-	-
		63 < t ≤ 160	175	450 to 650	45	-	-	-
X13MnNiN18-13-2	1.4020	≤ 10 [e]	500	750 to 1000	20	-	-	
		10 < t ≤ 16	450	730 to 950	25	-	-	
		16 < t ≤ 40	400	690 to 950	30	-	100	-
X6CrMnNiN18-13-3	1.4378	≤ 10 [e]	450	720 to 950	20	-	-	-
		10 < t ≤ 16	400	700 to 900	25	-	-	-
		16 < t ≤ 40	380	690 to 880	30	-	100	-
X2CrNiMoCuS17-10-2	1.4598	≤ 10 [e]	400	600 to 930	15	-	-	-
		10 < t ≤ 16	400	600 to 900	20	-	-	-
		16 < t ≤ 40	200	500 to 850	25	-	-	-
		40 < t ≤ 63	200	500 to 800	30	-	-	-
		63 < t ≤ 160	200	500 to 700	40	-	-	-

Steel designation		**Thickness t or diameter [c] *d*** mm	**Solution annealed**					
Name	Number		$R_{p0,2}$ MPa min.	R_m MPa	A_5 [d] % min.		KV_2 J min.	
					(long.)	(tr.)	(long.)	(tr.)
X3CrNiCuMo17-11-3-2	1.4578	≤ 10 [e]	400	600 to 850	20	-	-	-
		10 < t ≤ 16	340	600 to 850	20	-	-	-
		16 < t ≤ 40	175	450 to 800	30	-	-	-
		40 < t ≤ 63	175	450 to 800	30	-	-	-
		63 < t ≤ 160	175	450 to 650	45	-	-	-
X1NiCrMoCuN25-20-7	1.4529	≤ 10 [e]	550	700 to 1150	15	-	-	-
		10 < t ≤ 16	550	700 to 1150	15	-	-	-
		16 < t ≤ 40	300	650 to 1050	30	-	100	-
		40 < t ≤ 63	300	650 to 900	30	-	100	-
		63 < t ≤ 160	300	650 to 850	40	-	100	-
X3CrMnNiN20-9-6	1.4391	≤ 130	450	750 to 1300	10	-		

[a] Including cut lengths from wire.

[b] Initial solution treatment may be omitted if the conditions for previous hot-working and subsequent cooling have been 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] Width across flats for hexagons.

[d] Elongation A_5 is valid only for dimensions of 5 mm and above. For smaller diameters, the minimum elongation has to be agreed upon at the time of enquiry and order.

[e] In the range 1 mm ≤ d < 5 mm valid only for rounds. The mechanical properties of non-round bars with thicknesses < 5 mm have to be agreed at the time of enquiry and order.

Table 14 — Mechanical properties for bright bars [a] at room temperature of solution annealed [b] (see Table A.2) austenitic-ferritic steels in conditions 2H, 2B, 2G or 2P

Steel designation		Thickness t or diameter [c] *d* mm	Solution annealed			
Name	Number		$R_{p0,2}$ MPa min.	R_m MPa	A_5 % min. (long.)	KV_2 J min. (long.)
Standard grades						
X2CrNiN22-2 *	1.4062 *	≤ 16	600	650 to 1100	15	-
		16 < t ≤ 40	500	700 to 1100	15	-
		40 < t	500	700 to 1100	20	-
X2CrNiN23-4	1.4362	≤ 10 [e]	600	800 to 1100	12	-
		10 < t ≤ 16	600	800 to 1050	12	-
		16 < t ≤ 40	400	600 to 1000	15	100
		40 < t ≤ 63	400	600 to 1000	15	100
		63 < t ≤ 160	400	600 to 830	25	100
X2CrMnNiN21-5-1	1.4162	≤ 10 [e]	500	700 to 1050	15	-
		10 < t ≤ 16	500	700 to 1050	20	-
		16 < t ≤ 40	500	700 to 1050	20	-
		40 < t ≤ 160	450	650 to 850	30	60
X2CrMnNiMoN21-5-3	1.4482	t ≤ 160	500	≥ 800	20	60
X2CrNiMoN22-5-3	1.4462	≤ 10 [e]	650	850 to 1150	12	-
		10 < t ≤ 16	650	850 to 1100	12	-
		16 < t ≤ 40	450	650 to 1000	15	100
		40 < t ≤ 63	450	650 to 1000	15	100
		63 < t ≤ 160	450	650 to 880	25	100
X3CrNiMoN27-5-2	1.4460	≤ 10 [e]	610	770 to 1030	12	-
		10 < t ≤ 16	560	770 to 1030	12	-
		16 < t ≤ 40	460	620 to 950	15	85
		40 < t ≤ 63	460	620 to 950	15	85
		63 < t ≤ 160	460	620 to 880	20	85
Special grade						
X2CrMnNiSiN20-5-4-2 *	1.4670 *	≤20	650	800 to 1100	15	-
		20 < t ≤ 30	450	650 to 1100	15	
		≥ 30	450	650 to 900	25	60
X2CrNiMnMoCuN24-4-3-2 *	1.4662 *	≤ 10 [e]	700	900 to 1150	15	-
		10 < t ≤ 30	700	900 to 1100	20	-
		30 < t ≤ 160	450	650 to 900	25	60

Steel designation		**Thickness** **t** **or diameter** [c] ***d*** mm	**Solution annealed**			
Name	Number		$R_{p0,2}$ MPa min.	R_m MPa	A_5 [d] % min. (long.)	KV_2 J min. (long.)
X2CrNiMoCuN25-6-3	1.4507	≤ 10 [e]	- [f]	- [f]	- [f]	-
		10 < t ≤ 16	- [f]	- [f]	- [f]	-
		16 < t ≤ 40	500	700 to 1050	25	100
		40 < t ≤ 63	500	700 to 900	25	100
		63 < t ≤ 160	500	700 to 900	25	100

[a] Including cut lengths from wire.

[b] Initial solution treatment may be omitted if the conditions for previous hot-working and subsequent cooling have been 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] Width across flats for hexagons.

[d] Elongation A_5 is valid only for dimensions of 5 mm and above. For smaller diameters, the minimum elongation shall be agreed upon at the time of enquiry and order.

[e] In the range 1 mm ≤ d < 5 mm valid only for rounds. The mechanical properties of non-round bars with thicknesses < 5 mm shall be agreed at the time of enquiry and order.

[f] To be agreed upon at the time of enquiry and order.

Table 15 — Mechanical properties for bright bars [a] at room temperature of annealed [b] (see Table A.3) ferritic steels in conditions 2H, 2B, 2G or 2P

Steel designation		**Thickness t or diameter [c] *d*** mm	**0,2 %-proof strength** $R_{p0,2}$ MPa min.	**Tensile strength** R_m MPa	**Elongation after fracture** A_5 [d] % min.
Name	Number				
Standard grades					
X6Cr17	1.4016	≤ 10 [e]	320	500 to 750	8
		10 < t ≤ 16	300	480 to 750	8
		16 < t ≤ 40	240	400 to 700	15
		40 < t ≤ 63	240	400 to 700	15
		63 < t ≤ 100	240	400 to 630	20
X6CrMoS17	1.4105	≤ 10 [e]	330	530 to 780	7
		10 < t ≤ 16	310	500 to 780	7
		16 < t ≤ 40	250	430 to 730	12
		40 < t ≤ 63	250	430 to 730	12
		63 < t ≤ 100	250	430 to 630	20
X6CrMo17-1	1.4113	≤ 10 [e]	340	540 to 700	8
		10 < t ≤ 16	320	500 to 700	12
		16 < t ≤ 40	280	440 to 700	15
		40 < t ≤ 63	280	440 to 700	15
		63 < t ≤ 100	280	440 to 660	18
X2CrMoSiS18-2-1	1.4106	≤10	350	530 to 800	10
		10 < t ≤ 16	350	530 to 800	10
		16< t ≤ 40	240	430 to 800	10
		40< t ≤ 63	240	430 to 630	15
		63 < t ≤ 100	240	430 to 630	15

Steel designation		**Thickness t or diameter** [c] ***d*** mm	**0,2 %-proof strength** $R_{p0,2}$ MPa min.	**Tensile strength** R_m MPa	**Elongation after fracture** A_5 [d] % min.
Name	Number				
Special grades					
X3CrS12	1.4045	≤10	350	480 to 800	10
		10 < t ≤16	350	480 to 780	10
		16< t ≤ 40	320	460 to 760	10
		40 < t ≤ 63	320	450 to 750	15
		63 < t ≤ 100	300	450 to 750	15
X2CrTi17	1.4520	≤ 10 [e]	320	500 to 750	8
		10 < t ≤ 16	300	480 to 750	10
		16 < t ≤ 40	240	400 to 700	15
		40 < t ≤ 50	240	400 to 700	15
X3CrNb17	1.4511	≤ 10 [e]	320	500 to 750	8
		10 < t ≤ 16	300	480 to 750	10
		16 < t ≤ 40	240	400 to 700	15
		40 < t ≤ 50	240	400 to 700	15
X2CrTiNb18	1.4509	≤ 10 [e]	320	500 to 750	8
		10 < t ≤ 16	300	480 to 750	10
		16 < t ≤ 40	240	400 to 700	10
		40 < t ≤ 50	240	400 to 700	15
X6CrMoS19-2	1.4114	≤10	350	530 to 800	10
		10 < t ≤16	350	530 to 800	10
		16< t ≤ 40	240	430 to 800	10
		40 < t ≤ 63	240	430 to 630	15
X6CrMoNb17-1	1.4526	≤ 10 [e]	340	540 to 700	8
		10 < t ≤ 16	320	500 to 700	12
		16 < t ≤ 40	280	440 to 700	15
		40 < t ≤ 50	280	440 to 700	15

[a] Including cut lengths from wire.

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

[c] Width across flats for hexagons.

[d] Elongation A_5 is valid only for dimensions of 5 mm and above. For smaller diameters, the minimum elongation shall be agreed upon at the time of enquiry and order.

[e] In the range 1 mm ≤ d < 5 mm valid only for rounds. The mechanical properties of non-round bars with thicknesses < 5 mm shall be agreed at the time of enquiry and order.

Table 16 — Mechanical properties for bright bars [a] at room temperature of heat-treated (see Table A.4) martensitic steels in conditions 2H, 2B, 2G or 2P

Steel designation		Thickness t or diameter [b] d mm	Annealed		Quenched + tempered						
Name	Number		R_m MPa max.	HBW [c] max.	Heat treatment condition	$R_{p0,2}$ MPa min.	R_m MPa	A_5 [d] % min.		KV_2 J min.	
								(long.)	(tr.)	(long.)	(tr.)
Standard grades											
X12Cr13	1.4006	≤ 10 [e]	880	280	+QT650	550	700 to 1000	9	-	-	-
		10 < t ≤ 16	880	280		500	700 to 1000	9	-	-	-
		16 < t ≤ 40	800	250		450	650 to 930	10	-	25	-
		40 < t ≤ 63	760	230		450	650 to 880	10	-	25	-
		63 < t ≤ 160	730	220		450	650 to 850	15	-	25	-
X12CrS13	1.4005	≤ 10 [e]	880	280	+QT650	550	700 to 1000	8	-	-	-
		10 < t ≤ 16	880	280		500	700 to 1000	8	-	-	-
		16 < t ≤ 40	800	250		450	650 to 930	10	-	-	-
		40 < t ≤ 63	760	230		450	650 to 880	10	-	-	-
		63 < t ≤ 160	730	220		450	650 to 850	12	-	-	-
X20Cr13	1.4021	≤ 10 [e]	910	290	+QT700	600	750 to 1000	8	-	-	-
		10 < t ≤ 16	910	290		550	750 to 1000	8	-	-	-
		16 < t ≤ 40	850	260		500	700 to 950	10	-	25	-
		40 < t ≤ 63	800	250		500	700 to 900	12	-	25	-
		63 < t ≤ 160	760	230		500	700 to 850	13	-	25	-

Steel designation		Thickness t or diameter [b] d mm	Annealed		Quenched + tempered						
Name	Number		R_m MPa max.	HBW [c] max.	Heat treatment condition	$R_{p0,2}$ MPa min.	R_m MPa	A_5 [d] % min.		KV_2 J min.	
								(long.)	(tr.)	(long.)	(tr.)
X20Cr13	1.4021	≤ 10 [e]	910	290	+QT800	700	800 to 1100	7	-	-	-
		10 < t ≤ 16	910	290		650	800 to 1100	7	-	-	-
		16 < t ≤ 40	850	260		650	800 to 1050	9	-	20	-
		40 < t ≤ 63	800	250		650	800 to 1000	12	-	20	-
		63 < t ≤ 160	760	230		650	800 to 950	12	-	16	-
X30Cr13	1.4028	≤ 10 [e]	950	305	+QT850	700	900 to 1150	7	-	-	-
		10 < t ≤ 16	950	305		650	900 to 1150	7	-	-	-
		16 < t ≤ 40	900	280		650	850 to 1100	9	-	12	-
		40 < t ≤ 63	840	260		650	850 to 1050	9	-	12	-
		63 < t ≤ 160	800	245		650	850 to 1000	10	-	15	-
X39Cr13	1.4031	≤ 10 [e]	950	305	+QT800	700	850 to 1100	7	-	-	-
		10 < t ≤ 16	950	305		700	850 to 1100	7	-	-	-
		16 < t ≤ 40	900	280		650	800 to 1050	8	-	12	-
		40 < t ≤ 63	840	260		650	800 to 1000	8	-	12	-
		63 < t ≤ 160	800	245		650	800 to 1000	10	-	12	-

Steel designation		Thickness t or diameter [b] d mm	Annealed		Quenched + tempered						
Name	Number		R_m MPa max.	HBW [c] max.	Heat treatment condition	$R_{p0,2}$ MPa min.	R_m MPa	A_5 [d] % min.		KV_2 J min.	
								(long.)	(tr.)	(long.)	(tr.)
X46Cr13	1.4034	≤ 10 [e]	950	305	+QT850	700	900 to 1150	7	-	-	-
		10 < t ≤ 16	950	305		700	900 to 1150	7	-	-	-
		16 < t ≤ 40	900	280		650	850 to 1100	8	-	12	-
		40 < t ≤ 63	840	260		650	850 to 1000	8	-	12	-
		63 < t ≤ 160	800	245		650	850 to 1000	10	-	12	-
X17CrNi16-2	1.4057	≤ 10 [e]	1050	330	+QT800	750	850 to 1100	7	-	-	-
		10 < t ≤ 16	1050	330		700	850 to 1100	7	-	-	-
		16 < t ≤ 40	1000	310		650	800 to 1050	9	-	25	-
		40 < t ≤ 63	950	295		650	800 to 1000	12	-	25	-
		63 < t ≤ 160	950	295		650	800 to 950	12	-	16	-

Steel designation		Thickness t or diameter [b] d mm	Annealed		Quenched + tempered						
Name	Number		R_m MPa max.	HBW [c] max.	Heat treatment condition	$R_{p0,2}$ MPa min.	R_m MPa	A_5 [d] % min.		KV_2 J min.	
								(long.)	(tr.)	(long.)	(tr.)
X17CrNi16-2	1.4057	≤ 10 [e]	1050	330	+QT900	750	900 to 1200	10	-	-	-
		10 < t ≤ 16	1050	330		750	900 to 1200	10	-	-	-
		16 < t ≤ 40	1000	310		700	900 to 1200	12	-	16	-
		40 < t ≤ 63	950	295		700	900 to 1100	12	-	16	-
		63 < t ≤ 160	950	295		700	900 to 1100	12	-	15	-
X3CrNiMo13-4	1.4313	≤ 10 [e]	1150	380	+QT900	800	900 to 1150	7	-	-	-
		10 < t ≤ 16	1150	380		800	900 to 1150	7	-	-	-
		16 < t ≤ 40	1150	380		800	900 to 1150	9	-	50	-
		40 < t ≤ 63	1100	320		800	900 to 1100	12	-	50	-
		63 < t ≤ 160	1100	320		800	900 to 1100	12	-	50	-
		160 < t ≤ 250	1100	320		800	900 to 1100	-	10	-	40
X14CrMoS17	1.4104	≤ 10 [e]	880	280	+QT650	580	700 to 980	7	-	-	-
		10 < t ≤ 16	880	280		530	700 to 980	7	-	-	-
		16 < t ≤ 40	800	250		500	650 to 930	9	-	-	-
		40 < t ≤ 63	760	230		500	650 to 880	10	-	-	-
		63 < t ≤ 160	730	220		500	650 to 850	10	-	-	-

Steel designation		Thickness t or diameter [b] d mm	Annealed		Quenched + tempered						
Name	Number		R_m MPa max.	HBW [c] max.	Heat treatment condition	$R_{p0,2}$ MPa min.	R_m MPa	A_5 [d] % min.		KV_2 J min.	
								(long.)	(tr.)	(long.)	(tr.)
X4CrNiMo16-5-1	1.4418	≤ 10 [e]	1150	380	+QT900	750	900 to 1200	10	-	-	-
		10 < t ≤ 16	1150	380		750	900 to 1200	10	-	-	-
		16 < t ≤ 40	1100	320		700	900 to 1200	12	-	80	-
		40 < t ≤ 63	1100	320		700	900 to 1100	16	-	80	-
		63 < t ≤ 160	1100	320		700	900 to 1100	16	-	80	-
		160 < t ≤ 250	1100	320		700	900 to 1100	-	14	-	60
X39CrMo17-1	1.4122	≤ 10 [e]	1000	340	+QT750	650	800 to 1050	8	-	-	-
		10 < t ≤ 16	1000	340		600	800 to 1050	8	-	-	-
		16 < t ≤ 40	980	310		550	750 to 1000	10	-	14	-
		40 < t ≤ 63	930	290		550	750 to 950	12	-	14	-
		63 < t ≤ 160	900	280		550	750 to 950	12	-	10	-

Steel designation		Thickness t or diameter [b] d mm	Annealed		Quenched + tempered						
Name	Number		R_m MPa max.	HBW [c] max.	Heat treatment condition	$R_{p0,2}$ MPa min.	R_m MPa	A_5 [d] % min.		KV_2 J min.	
								(long.)	(tr.)	(long.)	(tr.)
Special grades											
X29CrS13	1.4029	≤ 10 [e]	950	305	+QT850	750	900 to 1100	8	-	-	-
		10 < t ≤ 16	950	305		700	900 to 1100	8	-	-	-
		16 < t ≤ 40	900	280		650	850 to 1100	10	-	-	-
		40 < t ≤ 63	840	260		650	850 to 1050	10	-	-	-
		63 < t ≤ 160	800	245		650	850 to 1000	12	-	-	-
X46CrS13	1.4035	≤ 10e	880	280	-	-	-	-	-	-	-
		10 < t ≤ 16	880	280		-	-	-	-	-	-
		16 < t ≤ 40	800	250		-	-	-	-	-	-
		40 < t ≤ 63	760	230		-	-	-	-	-	-

[a] Including cut lengths from wire.

[b] Width across flats for hexagons.

[c] For information only.

[d] Elongation A_5 is valid only for dimensions of 5 mm and above. For smaller diameters, the minimum elongation shall be agreed upon at the time of enquiry and order.

[e] In the range 1 mm ≤ d < 5 mm valid only for rounds. The mechanical properties of non-round bars with thicknesses < 5 mm shall be agreed at the time of enquiry and order.

Table 17 — Mechanical properties for bright bars [a] at room temperature of heat-treated (see Table A.5) precipitation hardening steels in conditions 2H, 2B, 2G or 2P

Steel designation		Thickness t or diameter [b] *d*	Annealed		Precipitation hardened				
Name	Number	mm	R_m MPa max.	HBW [c] max.	Heat treatment condition	$R_{p0,2}$ MPa min.	R_m MPa	A_5 [d] % min. (long.)	KV_2 J min. (long.)
Standard grade									
X5CrNiCuNb16-4	1.4542	≤ 10 [e]	1200	360	+P800	600	900 to 1100	10	-
		10 < t ≤ 16	1200	360		600	900 to 1100	10	-
		16 < t ≤ 40	1200	360		520	800 to 1050	12	75
		40 < t ≤ 63	1200	360		520	800 to 1000	18	75
		63 < t ≤ 160	1200	360		520	800 to 950	18	75
		≤ 100	-	-	+P930	720	930 to 1100	12	40
		≤ 100	-	-	+P960	790	960 to 1160	10	-
		≤ 100	-	-	+P1070	1000	1070 to 1270	10	-
Special grade									
X5NiCrTiMoVB25-15-2	1.4606	≤ 10 [e]	850	240	+P880	750	950 to 1200	15	30
		10 < t ≤ 16	800	230		750	950 to 1150	15	30
		16 < t ≤ 40	800	230		600	900 to 1150	18	40
		40 < t ≤ 50	700	212		550	880 to 1150	20	40

[a] Including cut lengths from wire.

[b] Width across flats for hexagons.

[c] For information only.

[d] Elongation A_5 is valid only for dimensions of 5 mm and above. For smaller diameters, the minimum elongation shall be agreed upon at the time of enquiry and order.

[e] In the range 1 mm ≤ d < 5 mm valid only for rounds. The mechanical properties of non-round bars with thicknesses < 5 mm shall be agreed at the time of enquiry and order.

Table 18 — Tensile strength of wire in diameters of 0,05 mm and above in 2H condition [a]

Steel designation [b, c]		**Tensile strength levels**	**Range of tensile strength** [d]
Name	Number		MPa
Austenitic steels			
X10CrNi18-8, X2CrNi18-9, X8CrNiS18-9, X6CrNiCuS18-9-2 X3CrNiCu18-9-4, X5CrNi18-10, X6CrNiTi18-10, X2CrNi19-11, X4CrNi18-12, X8CrMnCuN17-8-3, X8CrMnNiN18-9-5, X13CrMnNiN18-13-2, X6CrMnNiN18-13-3, X2CrNiMo17-12-2, X5CrNiMo17-12-2, X6CrNiMoTi17-12-2, X2CrNiMo17-12-3, X3CrNiMo17-12-3, X2CrNiMoN18-12-4, X2CrNiMo18-14-3, X1CrNiMoCuN20-18-7, X1CrNi25-21, X1CrNiMoN25-22-2, X1NiCrMoCu25-20-5, X1NiCrMoCuN25-20-7, X1NiCrMoCu31-27-4 X3CrMnNiCu15-8-5-3	1.4310, 1.4307, 1.4305, 1.4570, 1.4567, 1.4301, 1.4541, 1.4306, 1.4303, 1.4597, 1.4374, 1.4320, 1.4378, 1.4404, 1.4401, 1.4571, 1.4432, 1.4436, 1.4434, 1.4435, 1.4547, 1.4335 1.4466, 1.4539, 1.4529, 1.4563, 1.4615	+C500	500 to 700
		+C600	600 to 800
		+C700	700 to 900
		+C800	800 to 1000
		+C900	900 to 1100
		+C1000	1000 to 1250
		+C1100	1100 to 1350
		+C1200	1200 to 1450
		+C1400	1400 to 1700
		+C1600	1600 to 1900
		+C1800	1800 to 2100
Austenitic-ferritic steels			
X2CrNiN23-4 X2CrNiMoN22-5-3 X2CrNiN22-2 * X2CrMnNiMoN21-5-3 X2CrNiMoN25-7-4 X2CrNiMoCoN28-8-5-1	1.4362 1.4462 1.4062 * 1.4482 1.4410 1.4658	+C800	800 to 1000
		+C900	900 to 1100
		+C1000	1000 to 1250
		+C1100	1100 to 1350
		+C1200	1200 to 1450
		+C1400	1400 to 1700
		+C1600	1600 to 1900
		+C1800	1800 to 2100
Ferritic steels			
X6Cr17, X3CrNb17, X6CrMoS17, X6CrMo17-1, X3CrS12	1.4016, 1.4511 1.4105, 1.4113, 1.4045	+C500	500 to 700
		+C600	600 to 800
		+C700	700 to 900
		+C800	800 to 1000
		+C900	900 to 1100

Steel designation [b, c]		**Tensile strength levels**	**Range of tensile strength** [d]
Name	Number		MPa
Martensitic and precipitation hardening steels			
X12Cr13, X12CrS13, X20Cr13, X30Cr13 X46Cr13, X14CrMoS17 X17CrNi16-2, X7CrNiAl17-7 X5NiCrTiMoVB25-12-2	1.4006, 1,4005, 1.4021, 1,4028, 1.4034, 1.4104, 1.4057, 1.4568 1.4606	+C500	500 to 700
		+C600	600 to 800
		+C700	700 to 900
		+C800	800 to 1000
		+C900	900 to 1100
		+C1000	1000 to 1250
		+C1100	1100 to 1350
		+C1200	1200 to 1450
		+C1400	1400 to 1700
		+C1600	1600 to 1900
		+C1800	1800 to 2100

[a] For spring applications, see EN ISO 6931-1. For cold heading, see EN 10263-5.

[b] Not all grades are available in all tensile strength levels or all diameters. Guidance data for nominal dimensions *d* depending on strength levels are given in Annex C.

[c] Elongation depends on nominal dimensions *d* and may be agreed upon at the time of enquiry and order.

[d] Intermediate values may be agreed.

Table 19 — Mechanical properties at room temperature of annealed wire in 2D condition [a, b]

Steel designation		**Nominal dimension** ***d*** mm	**Tensile strength** MPa max.	**Elongation** % min.
Name	Number			
Austenitic steels (+AT) [c]				
X10CrNi18-8, X2CrNi18-9, X8CrNiS18-9, X6CrNiCuS18-9-2, X3CrNiCu18-9-4, X5CrNi18-10, X6CrNiTi18-10, X2CrNi19-11, X4CrNi18-12, X8CrMnCuN17-8-3, X8CrMnNiN18-9-5, X13CrMnNiN18-13-2, X6CrMnNiN18-13-3, X2CrNiMo17-12-2, X5CrNiMo17-12-2, X6CrNiMoTi17-12-2, X2CrNiMo17-12-3, X3CrNiMo17-12-3, X2CrNiMoN18-12-4, X2CrNiMo18-14-3, X1CrNiMoCuN20-18-7, X1CrNi25-21, X1CrNiMoN25-22-2, X1NiCrMoCu25-20-5, X1NiCrMoCuN25-20-7, X1NiCrMoCu31-27-4	1.4310, 1.4307, 1.4305, 1.4570, 1.4567, 1.4301, 1.4541, 1.4306 1.4303, 1.4597, 1.4374, 1.4320, 1.4438, 1.4404, 1.4401, 1.4571, 1.4432, 1.4436 1.4434, 1.4435, 1.4547, 1.4335 1.4466, 1.4539, 1.4529, 1.4563	0,05 < d ≤ 0,10	1100	20
		0,10 < d ≤ 0,20	1050	20
		0,20 < d ≤ 0,50	1000	30
		0,50 < d ≤ 1,00	950	30
		1,00 < d ≤ 3,00	900	30
		3,00 < d ≤ 5,00	850	35
		5,00 < d ≤ 16,00	800	35
Austenitic-ferritic steels				
X2CrNiN23-4 X2CrNiMoN22-5-3 X2CrNiN22-2 * X2CrMnNiMoN21-5-3 X2CrNiMoN25-7-4 X2CrNiMoCoN28-8-5-1	1.4362 1.4462 1.4062 * 1.4482 1.4410 1.4658	0,50 < d ≤ 1,00	1050	20
		1,00 < d ≤ 3,00	1000	20
		3,00 < d ≤ 5,00	950	25
		5,00 < d ≤ 16,00	900	25
Ferritic steels (+A) [c]				
X6Cr17 X3CrNb17 X6CrMoS17 X6CrMo17-1	1.4016 1.4511 1.4105 1.4113	0,05 < d ≤ 0,10	950	10
		0,10 < d ≤ 0,20	900	10
		0,20 < d ≤ 0,50	850	15
		0,50 < d ≤ 1,00	850	15
		1,00 < d ≤ 3,00	800	15
		3,00 < d ≤ 5,00	750	15
		5,00 < d ≤ 16,00	700	20

Steel designation		**Nominal dimension**	**Tensile strength**	**Elongation**
Name	Number	***d*** mm	MPa max.	% min.
Martensitic (+A) and precipitation hardening (+AT) steels [c]				
X12Cr13	1.4006	0,50 < d ≤ 1,00	1100	10
X12CrS13	1.4005	1,00 < d ≤ 3,00	1050	10
X20Cr13	1.4021	3,00 < d ≤ 5,00	1000	10
X30Cr13	1.4028	5,00 < d ≤ 16,00	950	15
X46Cr13	1.4034			
X14CrMoS17	1.4104			
X17CrNi16-2	1.4057			
X7CrNiAl17-7	1.4568			
X5NiCrTiMoVB25-12-2	1.4606			

[a] If skin passed (i. e. less than 5 % reduction in cross section), the maximum tensile strength might be increased by up to 50 MPa.

[b] For cold heading, see EN 10263-5.

[c] +A = annealed, +AT = solution annealed.

Table 20 — Minimum values for the 0,2 %- and 1,0 %-proof strength of austenitic steels at elevated temperatures

Steel designation		Heat treatment condition [a]	Minimum 0,2 %-proof strength ($R_{p0,2}$) (MPa) at a temperature (in °C) of										Minimum 1,0 %-proof strength ($R_{p1,0}$) (MPa) at a temperature (in °C) of									
Name	Number		100	150	200	250	300	350	400	450	500	550	100	150	200	250	300	350	400	450	500	550
Standard grades																						
X10CrNi18-8	1.4310	+AT	210	200	190	185	180	180	-	-	-	-	230	215	205	200	195	195	-	-	-	-
X2CrNi18-9	1.4307	+AT	145	130	118	108	100	94	89	85	81	80	180	160	145	135	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	160	156	152	149	147
X5CrNi18-10	1.4301	+AT	155	140	127	118	110	104	98	95	92	90	190	170	155	145	135	129	125	122	120	120
X6CrNiTi18-10	1.4541	+AT	175	165	155	145	136	130	125	121	119	118	205	195	185	175	167	161	156	152	149	147
X2CrNi19-11	1.4306	+AT	145	130	118	108	100	94	89	85	81	80	180	160	145	135	127	121	116	112	109	108
X4CrNi18-12	1.4303	+AT	155	140	127	118	110	104	98	95	92	90	190	170	155	145	135	129	125	122	120	120
X2CrNiMoN17-11-2	1.4406	+AT	215	195	175	165	155	150	145	140	138	136	245	225	205	195	185	180	175	170	168	166
X2CrNiMo17-12-2	1.4404	+AT	165	150	137	127	119	113	108	103	100	98	200	180	165	153	145	139	135	130	128	127
X5CrNiMo17-12-2	1.4401	+AT	175	158	145	135	127	120	115	112	110	108	210	190	175	165	155	150	145	141	139	137
X6CrNiMoTi17-12-2	1.4571	+AT	185	175	165	155	145	140	135	131	129	127	215	205	192	183	175	169	164	160	158	157
X2CrNiMo17-12-3	1.4432	+AT	165	150	137	127	119	113	108	103	100	98	200	180	165	153	145	139	135	130	128	127
X3CrNiMo17-12-3	1.4436	+AT	175	158	145	135	127	120	115	112	110	108	210	190	175	165	155	150	145	141	139	137
X2CrNiMoN17-13-3	1.4429	+AT	215	195	175	165	155	150	145	140	138	136	245	225	205	195	185	180	175	170	168	166
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

Steel designation		Heat treatment condition [a]	Minimum 0,2 %-proof strength ($R_{p0,2}$) (MPa) at a temperature (in °C) of										Minimum 1,0 %-proof strength ($R_{p1,0}$) (MPa) at a temperature (in °C) of									
Name	Number		100	150	200	250	300	350	400	450	500	550	100	150	200	250	300	350	400	450	500	550
Special grades																						
X9CrNi18-9	1.4325	+AT	- [b]																			
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
X6CrNiNb18-10	1.4550	+AT	175	165	155	145	136	130	125	121	119	118	210	195	185	175	167	161	156	152	149	147
X1CrNiSi18-15-4	1.4361	+AT	185	160	145	135	125	120	115	-	-	-	210	190	175	165	155	150	-	-	-	-
X8CrMnCuN17-8-3	1.4597	+AT	225	205	190	177	165	152	145	140	137	135	260	235	218	204	190	180	175	168	165	165
X12CrMnNiN17-7-5	1.4372	+AT	295	260	230	220	205	185	-	-	-	-	325	295	265	250	230	205	-	-	-	-
X8CrMnNiN18-9-5	1.4374	+AT	295	260	230	220	205	185	-	-	-	-	325	295	265	250	230	205	-	-	-	-
X11CrNiMnN19-8-6	1.4369	+AT	225	200	185	175	165	155	-	-	-	-	255	230	210	200	190	180	-	-	-	-
X13MnNiN18-13-2	1.4020	+AT	350	300	250	230	210	200	130	90	-	-	380	330	270	260	250	220	150	110	-	-
X6CrMnNiN18-13-3	1.4378	+AT	350	300	250	230	210	200	130	90	-	-	350	330	270	260	250	220	150	110	-	-
X6CrMnNiCuN18-12-4-2 *	1.4646 *	+AT	295	260	230	220	205	180	-	-	-	-	325	295	265	250	230	205	-	-	-	-
X3CrMnNiN20-9-6	1.4391	+AT	280	240	190	180	170	155	130													
X2CrNiMoCuS17-10-2	1.4598	+AT	165	150	137	127	119	113	108	103	100	98	200	180	165	153	145	139	135	130	128	127
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
X2CrNiMo18-15-4	1.4438	+AT	172	157	147	137	127	120	115	112	110	108	206	186	177	167	157	150	144	140	138	136
X5CrNiMnMoNNbV22-12-5-2	1.4681	+AT	300	270	240	225	210	195	180	-	-	-	-	-	-	-	-	-	-	-	-	-
X1CrNiMoCuN20-18-7	1.4547	+AT	230	205	190	180	170	165	160	153	148	-	270	245	225	212	200	195	190	184	180	-
X1CrNiMoN25-22-2	1.4466	+AT	195	170	160	150	140	135	-	-	-	-	225	205	190	180	170	165	-	-	-	-

Steel designation		Heat treatment condition [a]	Minimum 0,2 %-proof strength ($R_{p0,2}$) (MPa) at a temperature (in °C) of										Minimum 1,0 %-proof strength ($R_{p1,0}$) (MPa) at a temperature (in °C) of									
Name	Number		100	150	200	250	300	350	400	450	500	550	100	150	200	250	300	350	400	450	500	550
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
X2CrNiMnMoN25-18-6-5	1.4565	+AT	330	310	270	255	240	225	210	210	210	200	400	355	310	290	270	255	240	240	240	230
X1NiCrMoCuN25-20-7	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.

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

* Patented steel grade.

Table 21 — 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						
X2CrNiN22-2 *	1.4062 *	+AT	430	400	390	390
X2CrNiN23-4	1.4362	+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
X2CrNiMoN22-5-3	1.4462	+AT	360	335	315	300
X3CrNiMoN27-5-2	1.4460	+AT	360	335	310	295
Special grades						
X2CrNiMoSi18-5-3	1.4424	+AT (t ≤ 50)	370	350	330	325
		+AT (50 < t ≤ 160)	320	305	290	285
X2CrMnNiSiN20-5-4-2 *	1.4670 *	+AT	360	335	315	300
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
X2CrNiMnN29-7-2	1.4477	+AT (t ≤ 10)	550	500	470	440
		+AT (10 < t ≤ 160)	500	460	430	400

[a] +AT = solution annealed.

* Patented steel grade.

Table 22 — 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	230	220	215	210	-	-
X6Cr13	1.4000	+A	220	215	210	205	200	195	190
X6Cr17	1.4016	+A	220	215	210	205	200	195	190
X6CrMoS17	1.4105	+A	230	220	215	210	205	200	195
X6CrMo17-1	1.4113	+A	250	240	230	220	210	205	200
X2CrMoSiS18-2-1	1.4106	+A	250	240	230	220	210	205	200
Special grades									
X3CrS12	1.4045	+A	240	230	220	210	200	-	-
X2CrTi17	1.4520	+A	190	180	170	160	155	-	-
X3CrNb17	1.4511	+A	190	180	170	160	155	-	-
X2CrTiNb18	1.4509	+A	190	180	170	160	155	-	-
X2CrTi21 *	1.4611 *	+A	190	180	170	160	155	-	-
X2CrTi24 *	1.4613 *	+A	190	180	170	160	155	-	-
X6CrMoNb17-1	1.4526	+A	270	265	250	235	215	205	-
X2CrMoTiS18-2	1.4523	+A	250	240	230	220	210	205	200

[a] +A = annealed.

* Patented steel grade.

Table 23 — 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	355	305
X15Cr13	1.4024	+QT650	420	410	400	385	365	330	300
X20Cr13	1.4021	+QT700	460	445	430	415	395	365	330
		+ QT800	515	495	475	460	440	405	355
X17CrNi16-2	1.4057	+ QT800	515	495	475	460	440	405	355
		+ QT900	565	525	505	490	470	430	375
X3CrNiMo13-4	1.4313	+ QT650	500	490	480	470	460	450	-
		+QT780	590	575	560	545	530	515	-
		+QT900	720	690	665	640	620	-	-
X4CrNiMo16-5-1	1.4418	+QT760	520	510	500	490	480	-	-
		+QT900	660	640	620	600	580	-	-
X39CrMo17-1	1.4122	+ QT750	540	535	530	520	510	490	470
Special grade									
X2CrNiMoV13-5-2	1.4415	+QT750	620	605	595	585	580	570	560
		+QT850	710	695	680	670	660	645	635
[a] +QT = quenched and tempered									

Table 24 — 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
Standard grades							
X5CrNiCuNb16-4	1.4542	+P800	500	490	480	470	460
		+P930	680	660	640	620	600
		+P960	730	710	690	670	650
		+P1070	880	830	800	770	750
X5CrNiMoCuNb14-5	1.4594	+P930	680	660	640	620	600
		+P1000	785	755	730	710	690
Special grade							
X5NiCrTiMoVB25-15-2	1.4606	+P880	540	530	520	510	500
[a] +P = precipitation hardened.							

Table 25 — Mechanical properties for bars at room temperature of steels in the cold work hardened (2H) condition

Steel designation		Tensile strength level	0,2 % proof strength	Tensile strength	Elongation after fracture
Name	Number		$R_{p0,2}$ MPa min.	R_m MPa	A % min.
Standard grades (Austenitic steels)					
X10CrNi18-8	1.4310	+C800	500	800 to 1000	12
X2CrNi18-9	1.4307	+C700 [b]	350	700 to 850	20
		+C800 [a]	500	800 to 1000	12
X8CrNiS18-9	1.4305	+C700 [b]	350	700 to 850	20
		+C800 [a]	500	800 to 1000	12
X5CrNi18-10	1.4301	+C700 [b]	350	700 to 850	20
		+C800 [a]	500	800 to 1000	12
X6CrNiTi18-10	1.4541	+C700 [b]	350	700 to 850	20
		+C800 [a]	500	800 to 1000	12
X2CrNi19-11	1.4306	+C700 [b]	350	700 to 850	20
		+C800 [a]	500	800 to 1000	12
X13MnNiN18-13-2	1.4020	+C800	650	800 to 1000	20
		+C900	750	900 to 1100	15
		+C1000	850	1000 to 1250	12
X6CrMnNiN18-13-3	1.4378	+C800	650	800 to 1000	20
		+C900	750	900 to 1100	15
		+C1000	850	1000 to 1250	12
X2CrNiMo17-12-2	1.4404	+C700 [b]	350	700 to 850	20
		+C800 [a]	500	800 to 1000	12
X5CrNiMo17-12-2	1.4401	+C700 [b]	350	700 to 850	20
		+C800 [a]	500	800 to 1000	12
X6CrNiMoTi17-12-2	1.4571	+C700 [b]	350	700 to 850	20
		+C800 [a]	500	800 to 1000	12
Standard grade (Martensitic steel)					
X14CrMoS17	1.4104	+C550 [a]	440	550 to 750	15

[a] Maximum diameter for this tensile strength level shall be agreed at the time of enquiry and order; it should not be greater than 25 mm.

[b] Maximum diameter for this tensile strength level shall be agreed at the time of enquiry and order; it should not be greater than 35 mm.

Table 26 — Tests to be carried out, test units and extent of testing in specific testing

Test	[a]	**Test unit**	**Product form** Rods, bars and sections	**Number of test pieces per sample**
Chemical analysis	m	Cast	The cast analysis is given by the manufacturer [b]	
Tensile test at ambient temperature	m	Batch [c]	1 sample per 25 t; maximum of 2 per batch from different sample products (e.g. bars)	1
Tensile test at elevated temperature	o		To be agreed at the time of ordering (see Tables 20 to 24)	1
Impact test at ambient temperature	o		To be agreed at the time of ordering (see Tables 8 to 17)	3
Resistance to intergranular corrosion	o		To be agreed at the time of ordering if intergranular corrosion is a hazard (see Tables 8, 9 and 10)	1

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

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

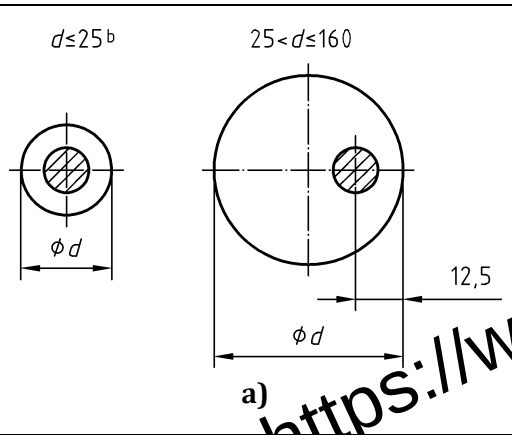
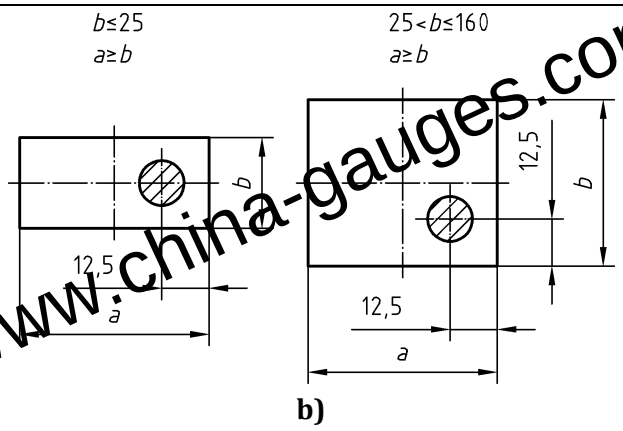
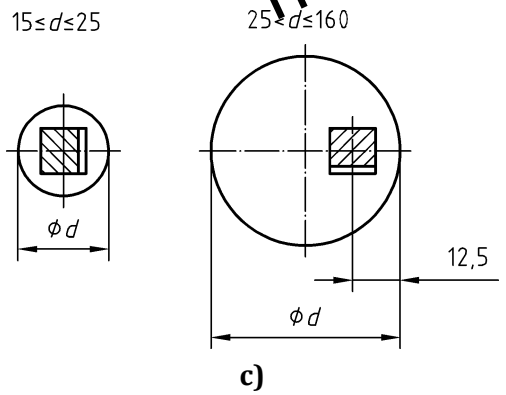
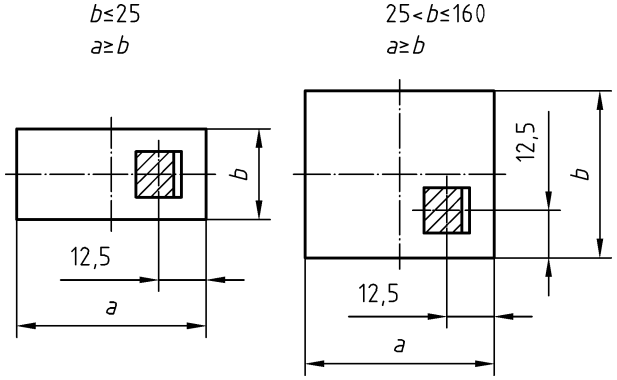
[c] Each batch consists of products coming from the same cast. The products shall have been subject to the same heat treatment cycle in the same furnace. In the case of a continuous furnace or in process annealing a batch is the lot heat treated without intermission with the same process parameters.
The shape and size of the cross-sectional area of products in a single batch may be different providing that the ratio of the largest to the smallest cross-sectional areas shall be equal or less than three.

Table 27 — Marking of the products

Marking of	**Products**	
	with specific testing [a]	**without specific testing** [a]
Manufacturer's name, trade mark or logo	+	+
Thickness or diameter (only on bundle labels)	+	+
Steel number or name	+	+
Cast number	+	+
Identification number [b]	+	(+)
Inspector's mark	(+)	-

[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.

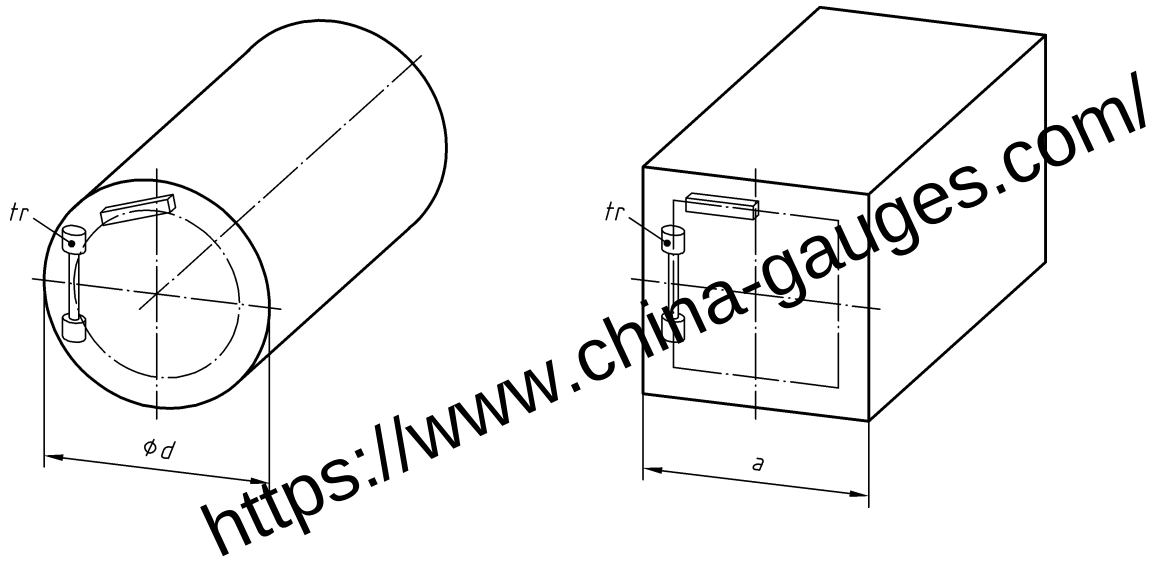
[b] If specific tests shall be carried out, the numbers or letters used for identification shall allow the product(s) to be related to the relevant inspection certificate or inspection report.

Type of test	Round cross-section products	Rectangular cross-section products
Tensile		
Impact [a]		

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

[b] Samples of product may alternatively be tested unmachined, in accordance with EN ISO 377.

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



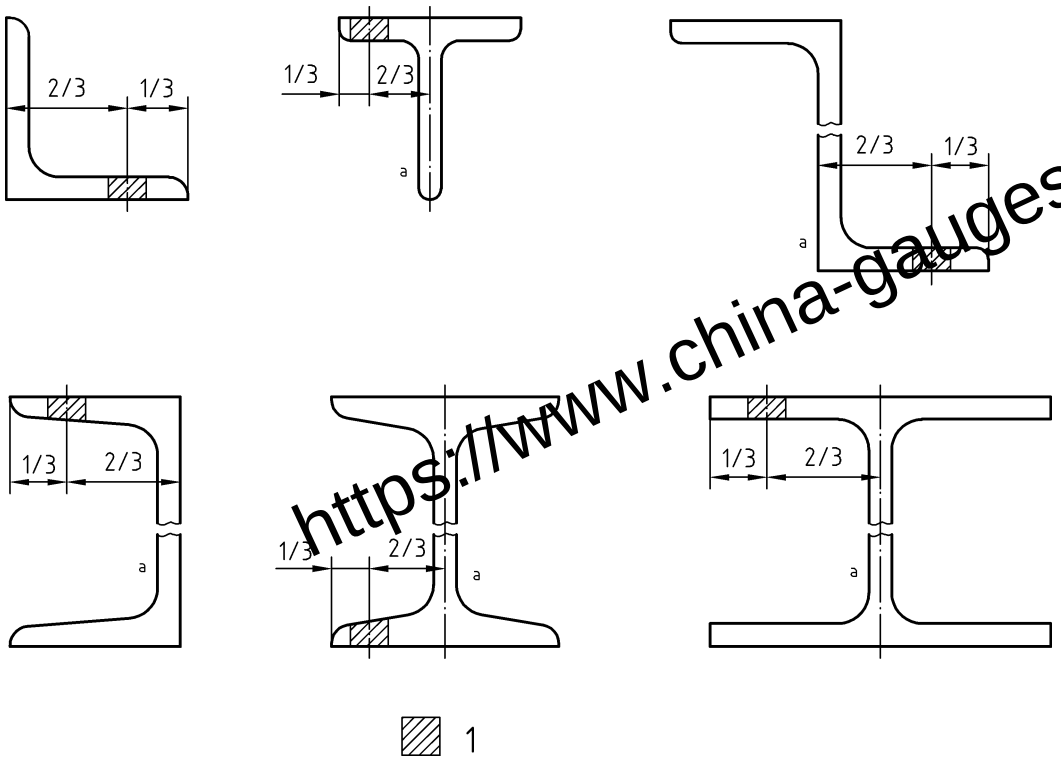
Key

tr Transverse

The axis of the notch on the impact test pieces should be radial in the case of round steel bars, and perpendicular to the nearest rolled surface for rectangular bars.

NOTE The location of the impact test piece is d/6 or a/6 with a maximum of 50 mm from the surface.

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



Key

1 location of sample

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

The axis of the notch on the impact test pieces should be perpendicular to the outside surface of the section.

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

Annex A
(informative)
List of all stainless steel grades that appear in the document

Table A.1 — List of stainless steel grades that appear in the present standard (by ascending Number)

Number	Name	Grade Group [a]	Table [b]		Number	Name	Grade Group [a]	Table [b]		Number	Name	Grade Group [a]	Table [b]
1.4000	X6Cr13	fP std	4,10		**1.4110**	X55CrMo14	mM std	5,11		**1.4362**	X2CrNiN23-4	dP std	3,9,14,18, 19
1.4003	X2CrNi12	fP std	4,10		**1.4112**	X90CrMoV1 8	mM sp	5,11		**1.4369**	X11CrNiMnN19-8-6	aP sp	2,8
1.4005	X12CrS13	mP std	5,11,16,18		**1.4113**	X6CrMo17-1	fM std	4,10,15,18, 19		**1.4372**	X12CrMnNiN17-7-5	aP sp	2,8
1.4006	X12Cr13	mP std	5,11,16,18		**1.4114**	X6CrMoS19- 2	fM sp	4,10,15		**1.4374**	X8CrMnNiN18-9-5	aP sp	2,8,18,19
1.4016	X6Cr17	fP std	4,10,15,18, 19		**1.4116**	X50CrMoV1 5	mM std	5,11		**1.4378**	X6CrMnNiN18-13-3	aP sp	2,8,13,18, 19
1.4020	X13MnNiN18- 13-2	aP sp	2,8,13,18,19		**1.4122**	X39CrMo17- 1	mM std	5,11,16		**1.4391**	X3CrMnNiN20-9-6	aP sp	2,8,13
1.4021	X20Cr13	mP std	5,11,16,18		**1.4123**	X40CrMoVN 16-2	mM sp	5,11		**1.4401**	X5CrNiMo17-12-2	aM std	2,8,13,18, 19
1.4024	X15Cr13	mP std	5,11		**1.4125**	X105CrMo1 7	mM sp	5,11		**1.4404**	X2CrNiMo17-12-2	aM std	2,8,13,18, 19
1.4028	X30Cr13	mP std	5,11,16,18		**1.4150**	X53CrSiMoV N16-2	mM sp	5,11		**1.4406**	X2CrNiMoN17-11-2	aM std	2,8
1.4029	X29CrS13	mP sp	5,11,16		**1.4162**	X2CrMnNiN 21-5-1	dP std	3,9,14		**1.4410**	X2CrNiMoN25-7-4	dM sp	3,9,18,19
1.4031	X39Cr13	mP std	5,11,16		**1.4301**	X5CrNi18- 10	aP std	2,8,13,18,19		**1.4415**	X2CrNiMoV13-5-2	mM sp	5,11
1.4034	X46Cr13	mP std	5,16,18		**1.4303**	X4CrNi18- 12	aP std	2,8,18,19		**1.4418**	X4CrNiMo16-5-1	mM std	5,11,16

Number	Name	Grade Group [a]	Table [b]		Number	Name	Grade Group [a]	Table [b]		Number	Name	Grade Group [a]	Table [b]
1.4035	X46CrS13	mP sp	5,11,16		**1.4305**	X8CrNiS18-9	aP std	2,8,13,18,19		**1.4419**	X38CrMo14	mM std	5,11
1.4037	X65Cr13	mP std	5,11		**1.4306**	X2CrNi19-11	aP std	2,8,13,18,19		**1.4424**	X2CrNiMoSi18-5-3	dM sp	39,21
1.4045	X3CrS12	fP sp	4,10,15,18		**1.4307**	X2CrNi18-9	aP std	2,8,13,18,19		**1.4429**	X2CrNiMoN17-13-3	aM std	2,8,18,19
1.4057	X17CrNi16-2	mP std	5,11,16,18		**1.4310**	X10CrNi18-8	aP std	2,8,18,19		**1.4432**	X2CrNiMo17-12-3	aM std	2,8,13,18, 19
1.4062 *[c]	X2CrNiN22-2 *[c]	dP std	3,9,14,18,19		**1.4311**	X2CrNiN18-10	aP std	2,8		**1.4435**	X2CrNiMo18-14-3	aM std	2,8,13,18, 19
1.4104	X14CrMoS17	mM std	5,11,16,18		**1.4313**	X3CrNiMo13-4	mM std	5,11,16		**1.4436**	X3CrNiMo17-12-3	aM std	2,8,13,18, 19
1.4105	X6CrMoS17	fM std	4,10,15,18, 19		**1.4315**	X5CrNiN19-9	aP sp	2,8		**1.4438**	X2CrNiMo18-15-4	aM sp	2,8
1.4106	X2CrMoSiS18-2-1	fM std	4,10,15		**1.4325**	X9CrNi18-9	aP sp	2,8		**1.4439**	X2CrNiMoN17-13-5	aM std	2,8
1.4109	X70CrMo15	mM sp	5,11		**1.4361**	X1CrNiSi18-15-4	aP sp	2,8		**1.4460**	X3CrNiMoN27-5-2	dM std	3,9,14
1.4462	X2CrNiMoN22-5-3	dM std	3,9,14,18,19		**1.4542**	X5CrNiCuNb16-4	pP std	5,12,17		**1.4598**	X2CrNiMoCuS17-10-2	aM sp	2,8,13
1.4466	X1CrNiMoN25-22-2	aM sp	2,8,18,19		**1.4547**	X1CrNiMoCuN20-18-7	aM sp	2,8,18,19		**1.4606**	X5NiCrTiMoVB25-15-2	pM sp	5,12,17,18
1.4477	X2CrNiMoN29-7-2	dM sp	3,9		**1.4550**	X6CrNiNb18-10	aP sp	2,8		**1.4611***	X2CrTi21*	fP sp	4,10,22
1.4482	X2CrMnNiMoN21-5-3	dM std	3,9,14,18,19		**1.4560**	X3CrNiCu19-9-2	aP sp	2,8,13		**1.4612**	X1CrNiMoAlTi12-11-2	pM sp	5,12
1.4501	X2CrNiMoCuWN25-7-4	dM sp	3,9,21		**1.4563**	X1NiCrMoCu31-27-4	aN sp	2,8,13,18,19		**1.4613***	X2CrTi24*	fP sp	4,10
1.4507	X2CrNiMoCuN25-6-3	dM sp	3,9,14		**1.4565**	X2CrNiMnMoN25-18-6-5	aM sp	2,8		**1.4615**	X3CrMnNiCu15-8-5-3	aP sp	2,8,18

Number	Name	Grade Group [a]	Table [b]		Number	Name	Grade Group [a]	Table [b]		Number	Name	Grade Group [a]	Table [b]
1.4509	X2CrTiNb18	fP sp	4,10,15		**1.4567**	X3CrNiCu18-9-4	aP std	2,8,13,18,19		**1.4621**	X2CrNbCu21	fP sp	4,10
1.4511	X3CrNb17	fP sp	4,10,15,18,19		**1.4568**	X7CrNiAl17-7	pP std	5,12,18		**1.4646***	X6CrMnNiCuN18-12-4-2*	aP sp	2,8
1.4520	X2CrTi17	fP sp	4,10,15		**1.4570**	X6CrNiCuS18-9-2	aP std	2,8,13,18,19		**1.4652**	X1CrNiMoCuN24-22-8	aM sp	2,8
1.4523	X2CrMoTiS18-2	fM sp	4,10		**1.4571**	X6CrNiMoTi17-12-2	aM std	2,8,13,18,19		**1.4658**	X2CrNiMoCoN28-8-5-1	dM sp	3,9,18,19
1.4526	X6CrMoNb17-1	fM sp	4,10,15		**1.4578**	X3CrNiCuMo17-11-3-2	aM sp	2,8,13		**1.4659**	X1CrNiMoCuNW24-22-6	aM sp	2,8
1.4529	X1NiCrMoCuN25-20-7	aN sp	2,8,13,18,19		**1.4580**	X6CrNiMoNb17-12-2	aM sp	2,8		**1.4662***	X2CrNiMnMoCuN24-4-3-2*	dM sp	3,9,14
1.4530	X1CrNiMoAlTi12-9-2	pM sp	5,12		**1.4594**	X5CrNiMoCuNb14-5	pM std	5,12		**1.4669***	X2CrCuNiN23-2-2*	dP sp	3,9
1.4539	X1NiCrMoCu25-20-5	aN std	2,8,13,18,19		**1.4596**	X1CrNiMoAlTi12-10-2	pM sp	5,12		**1.4670***	X2CrMnNiSiN20-5-4-2*	dP sp	3,9,14
1.4541	X6CrNiTi18-10	aP std	2,8,13,18,19		**1.4597**	X8CrMnCuN17-8-3	aP sp	2,8,18,19		**1.4681**	X5CrNiMnMoNNbV22-12-5-2	aP sp	2,8,13

[a] Type of microstructure as defined in Tables 1 to 4. 'a': austenitic, 'd': austenitic-ferritic (duplex), 'f': ferritic, 'm': martensitic and 'p': precipitation hardening, followed by 'P' (pure without Mo), 'M' (alloyed with Mo) or 'N' (with Ni as the main alloying element) as defined in EN 10088-1. 'std' refers to a standard grade and 'sp' refers to a special grade.

[b] The first number is the reference to the table containing the chemical composition. Following numbers refer to tables where mechanical properties are given.
EXAMPLE 1.4301: 2, 13, 18, 19 In this example the chemical composition of 1.4301 is given in Table 2, mechanical properties are given in Tables 13, 18 and 19.

* Patented steel grade.

Annex B
(informative)

Guidelines for further treatment (including heat treatment) in fabrication

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

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

B.3 As the corrosion resistance of stainless steels is only ensured with a metallically clean surface, layers of scale and annealing colours formed 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 B.1 — Guidelines on the temperatures for hot forming and heat treatment [a] of austenitic corrosion resistant 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						
X10CrNi18-8	1.4310	1200 to 900	Air	+AT	1000 to 1100	water, air [e]
X2CrNi18-9	1.4307				1000 to 1100	
X8CrNiS18-9	1.4305				1000 to 1100	
X6CrNiCuS18-9-2	1.4570	1150 to 900			1000 to 1100	
X2CrNiN18-10	1.4311	1200 to 900			1000 to 1100	
X5CrNi18-10	1.4301				1000 to 1100	
X6CrNiTi18-10	1.4541				1020 to 1120	
X3CrNiCu18-9-4	1.4567				1000 to 1100	
X2CrNi19-11	1.4306				1000 to 1100	
X4CrNi18-12	1.4303				1000 to 1100	
X2CrNiMoN17-11-2	1.4406				1020 to 1120	
X2CrNiMo17-12-2	1.4404				1020 to 1120	
X5CrNiMo17-12-2	1.4401				1020 to 1120	
X6CrNiMoTi17-12-2	1.4571				1020 to 1120	
X2CrNiMo17-12-3	1.4432				1020 to 1120	
X3CrNiMo17-12-3	1.4436				1020 to 1120	
X2CrNiMoN17-13-3	1.4429				1020 to 1120	
X2CrNiMo18-14-3	1.4435				1020 to 1120	
X2CrNiMoN17-13-5	1.4439				1020 to 1120	
X1NiCrMoCu25-20-5	1.4539	1200 to 900			1050 to 1150	

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						
X9CrNi18-9	1.4325	1200 to 900			1000 to 1100	water, air [e]
X5CrNiN19-9	1.4315	1150 to 850			1000 to 1100	
X3CrNiCu19-9-2	1.4560	1150 to 900			1000 to 1100	
X6CrNiNb18-10	1.4550	1150 to 850			1020 to 1120	
X1CrNiSi18-15-4	1.4361	1150 to 900			1100 to 1160	
X8CrMnCuN17-8-3	1.4597	1200 to 900			1000 to 1100	
X3CrMnNiCu15-8-5-3	1.4615	1200 to 900			1000 to 1100	
X12CrMnNiN17-7-5	1.4372	1150 to 850			1000 to 1100	
X8CrMnNiN18-9-5	1.4374	1150 to 850			1000 to 1100	
X11CrNiMnN19-8-6	1.4369	1150 to 850			1000 to 1100	
X13MnNiN18-13-2	1.4020	900 to 1200			1050 to 1080	
X6CrMnNiN18-13-3	1.4378	900 to 1200			1050 to 1080	
X6CrMnNiCuN18-12-4-2 *	1.4646 *	1150 to 850			1000 to 1100	
X2CrNiMoCuS17-10-2	1.4598	1200 to 1000			1020 to 1120	
X3CrNiCuMo17-11-3-2	1.4578	1150 to 900			1000 to 1100	
X6CrNiMoNb17-12-2	1.4580	1150 to 850			1020 to 1120	
X2CrNiMo18-15-4	1.4438	1150 to 850			1020 to 1120	
X5CrNiMnMoNNbV22-12-5-2	1.4681	1200 to 900			980 to 1120	
X1CrNiMoCuN20-18-7	1.4547	1200 to 1000			1140 to 1200	
X1CrNiMoN25-22-2	1.4466	1150 to 850			1070 to 1150	
X1CrNiMoCuNW24-22-6	1.4659	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	
X1NiCrMoCuN25-20-7	1.4529	1200 to 950			1120 to 1180	
X1NiCrMoCu31-27-4	1.4563	1150 to 850			1050 to 1150	
X3CrMnNiN20-9-6	1.4391	1200 to 900			1120 to 980	

Steel designation		**Hot forming**		**Heat treatment symbol**	**Solution annealing**	
Name	Number	Temperature °C	Type of cooling		Temperature [b, c, d] °C	Type of cooling

[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] 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.

[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 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.

* Patented steel grade.

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

Steel designation		Hot forming		Heat treatment symbol	Solution annealing	
Name	Number	Temperature °C	Type of cooling		Temperature [b, c] °C	Type of cooling
Standard grades						
X2CrNiN22-2 *	1.4062 *	1100 to 950	air	+AT	980 to 1100	water, air [d]
X2CrNiN23-4	1.4362	1200 to 1000			950 to 1050	water, air
X2CrMnNiN21-5-1	1.4162	1100 to 900			1020 to 1080	water, air
X2CrMnNiMoN21-5-3	1.4482	1150 to 950			950 to 1050	water, air
X2CrNiMoN22-5-3	1.4462	1200 to 950			1020 to 1100	water, air [d]
X3CrNiMoN27-5-2	1.4460	1200 to 950			1020 to 1100	water, air [d]
Special grades						
X2CrCuNiN23-2-2 *	1.4669 *	1200 to 1000	air	+AT	950 to 1100	water, air [d]
X2CrMnNiSiN20-5-4-2 *	1.4670 *	1200 to 950			950 to 1050	water, air [d]
X2CrNiMoSi18-5-3	1.4424	1200 to 1000			1000 to 1100	water, air [d]
X2CrNiMnMoCuN24-4-3-2 *	1.4662 *	1150 to 900			1000 to 1150	water, air
X2CrNiMoCuN25-6-3	1.4507	1200 to 1000			1040 to 1120	water
X2CrNiMoN25-7-4	1.4410				1040 to 1120	water
X2CrNiMoCuWN25-7-4	1.4501				1040 to 1120	water
X2CrNiMoN29-7-2	1.4477				1040 to 1120	water
X2CrNiMoCoN28-8-5-1	1.4658				1050 to 1150	water

[a] Temperature 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] 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.

[d] Cooling sufficiently rapidly in order to avoid precipitation.

* Patented steel grade.

Table B.3 — Guidelines on the temperatures for hot forming and heat treatment [a] of ferritic corrosion resistant 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	680 to 740	air
X6Cr13	1.4000				750 to 800	
X6Cr17	1.4016				750 to 850	
X6CrMoS17	1.4105				750 to 850	
X6CrMo17-1	1.4113				750 to 850	
X2CrMoSiS18-2-1	1.4106				750 to 850	
Special grades						
X3CrS12	1.4045	1100 to 800	air	+A	750 to 850	air
X2CrTi17	1.4520				750 to 850	
X3CrNb17	1.4511					
X2CrTiNb18	1.4509				750 to 850	
X2CrTi21 *	1.4611 *				750 to 850	
X2CrNbCu21	1.4621				850 to 950	
X2CrTi24 *	1.4613 *				750 to 850	
X6CrMoNb17-1	1.4526				800 to 860	
X2CrMoTiS18-2	1.4523				1000 to 1050	
X6CrMoS19-2	1.4114				750 to 850	

[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.

* Patented steel grade.

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

Steel designation		Hot forming		Heat treat-ment 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
Standard grades									
X12Cr13	1.4006	1100 to 800	air	+A	745 to 825	air	-	-	-
				+QT650	-	-	950 to 1000	oil, air	680 to 780
X12CrS13	1.4005			+A	745 to 825	air	-	-	-
				+QT650	-	-	950 to 1000	oil, air	680 to 780
X15Cr13	1.4024		Slow cooling	+A	750 to 800	furn., air	-	-	-
				+QT650	-	-	950 to 1030	oil, air	700 to 750
X20Cr13	1.4021			+A	745 to 825	air	-	-	-
				+QT700	-	-	950 to 1050	oil, air	650 to 750
				+QT800	-	-	950 to 1050	oil, air	600 to 700
X30Cr13	1.4028			+A	745 to 825	air	-	-	-
				+QT850	-	-	950 to 1050	oil, air	625 to 675
X39Cr13	1.4031			+A	750 to 850	furn., air	-	-	-
				+QT800	-	-	950 to 1050	oil, air	650 to 700
X46Cr13	1.4034			+A	750 to 850	furn., air	-	-	-
				+QT850	-	-	950 to 1050	oil, air	650 to 700
X65Cr13	1.4037			+A	750 to 850	furn., air			
X17CrNi16-2	1.4057		Slow cooling	+A [c]	680 to 800	furn., air	-	-	-
				+QT800 [d]	-	-	950 to 1050	oil, air	750 to 800 + 650 to 700 [d]
				+QT900	-	-	950 to 1050	oil, air	600 to 650
X38CrMo14	1.4419			+A	750 to 830	furn., air	-	-	-
X55CrMo14	1.4110			+A	750 to 850	furn., air	-	-	-
X3CrNiMo13-4	1.4313	1150 to 900	Air	+A [e]	600 to 650	furn., air	-	-	-
				+QT700	-	-	950 to 1050	oil, air	650 to 700 + 600 to 620
				+QT780	-	-	950 to 1050	oil, air	550 to 600
				+QT900	-	-	950 to 1050	oil, air	520 to 580
X50CrMoV15	1.4116	1100 to 800	sl. cool.	+A	750 to 850	furn., air	-	-	-
X14CrMoS17	1.4104	1100 to 800	air	+A	750 to 850		-	-	-
				+QT650	-	-	950 to 1070	oil, air	550 to 650

Steel designation		**Hot forming**		**Heat treat-ment 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
X4CrNiMo16-5-1	1.4418	1150 to 900	air	+A [e]	600 to 650	furn., air	-	-	-
				+QT760	-		950 to 1050	oil, air	590 to 620 [f]
				+QT900	-	-	950 to 1050	oil, air	550 to 620
X39CrMo17-1	1.4122	1100 to 800	slow cooling	+A	780 to 850	furn., air	-	-	-
				+QT750	-	-	980 to 1060	oil	650 to 750
Special grades									
X29CrS13	1.4029	1100 to 800	slow cooling	+A	740 to 820	air	-	-	-
				+QT850	-	-	950 to 1050	oil, air	625 to 675
X46CrS13	1.4035			+A	750 to 850	-	-	-	-
X70CrMo15	1.4109			+A	750 to 800	furn., air	-	-	-
X2CrNiMoV13-5-2	1.4415	1150 to 900	air	+QT750	-	-	950 to 1050	oil, air	600 to 650 + 500 to 550
				+QT850	-	-			
X53CrSiMoVN16-2	1.4150	1200 to 1000	slow cooling	+A	800 to 850	furn., air	-	-	-
				+QT	-		950 to 1050	Oil + deep freezing at −80° C	180
X40CrMoVN16-2	1.4123	1200 to 1000	slow cooling	+A	800 to 850	furn., air	-	-	-
				+QT	-		950 to 1050	Oil + deep freezing at −80° C	180
X105CrMo17	1.4125	1100 to 900	slow cooling	+A	780 to 840	furn., air	-	-	-
X90CrMoV18	1.4112	1100 to 800		+A	780 to 840		-	-	-

[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.

[c] Double annealing might be advisable.

[d] In the case that the nickel is at the lower side of the range specified in Table 3, a single tempering at 620 °C to 720 °C may be sufficient.

[e] Tempering after martensitic transformation.

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

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

Steel designation		Hot forming		Heat treatment symbol	Solution annealing		Precipitation hardening
Name	Number	Temperature °C	Type of cooling		Temperature [b] °C	Type of cooling	Temperature °C
Standard grades							
X5CrNiCuNb16-4	1.4542	1150 to 900	furnace, air	+AT [c]	1030 to 1050	oil, air	-
				+P800	1030 to 1050		2 h 760 °C/air + 4 h 620 °C/air
				+P930	1030 to 1050		4 h 620 °C/air
				+P960	1030 to 1050		4 h 590 °C/air
				+P1070	1030 to 1050		4 h 550 °C/air
X7CrNiAl17-7	1.4568		air	+AT	1060 to 1080	water, air	-
X5CrNiMoCuNb14-5	1.4594		furnace, air	+AT [c]	1030 to 1050	oil, air	-
				+P930	1030 to 1050		4 h 620 °C/air
				+P1000	1030 to 1050		4 h 580 °C/air
				+P1070	1030 to 1050		4 h 550 °C/air
Special grades							
X1CrNiMoAlTi12-9-2	1.4530	1200 to 800	air	+AT	820 to 860	oil, air	-
				+P1200	820 to 860	oil, air	4 h 540 to 560 °C/air
X1CrNiMoAlTi12-10-2	1.4596		air	+AT	820 to 860	oil, air	-
				+P1400	820 to 860	oil, air	4 h ≥ 530 °C/air
X1CrNiMoAlTi12-11-2	1.4612	1150 to 900	air	+AT	830 to 850	Oil, water+ deep freezing at - 80 °C	
				+P1510	830 to 850		8 h 538 °C
				+P1650	830 to 850		8 h 510 °C
X5NiCrTiMoVB25-12-2	1.4606	1100 to 950	air, oil, water	+AT [c]	970 to 990	water, oil	-
				+P880			16 h 720 °C/air

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

Annex C
(informative)

Availability of corrosion resistant steel wire in the cold work-hardened condition

Tables C.1 to C.4 give an overview of austenitic, austenitic-ferritic, ferritic, martensitic and precipitation hardening steels available as wire in the cold work-hardened condition (see Table 18).

Table C.1 — Austenitic grades

Steel designation		Typically available tensile strength levels for diameters in mm										
Name	Number	+C500	+C600	+C700	+C800	+C900	+C1000	+C1100	+C1200	+C1400	+C1600	+C1800
X10CrNi18-8	1.4310	-	1 to 25	< 25	< 20	< 15	< 15	< 15	< 15	< 10	< 5	< 2
X2CrNi18-9	1.4307	-	1 to 25	< 25	< 20	< 15	< 15	< 15	< 10	< 5	-	-
X8CrNiS18-9	1.4305	-	1 to 25	< 25	< 20	< 15	< 15	-	< 10	< 5	-	-
X6CrNiCuS18-9-2	1.4570	-	< 25	< 25	< 20	< 15	< 15	< 15	< 10	< 5	-	-
X3CrNiCu18-9-4	1.4567	6 to 25	1 to 25	< 20	< 20	< 15	< 15	< 15	< 10	< 6	-	-
X5CrNi18-10	1.4301	-	1 to 25	< 25	< 20	< 15	< 15	< 15	< 10	< 5	-	-
X6CrNiTi18-10	1.4541	-	1 to 25	< 25	< 20	< 15	< 15	< 15	< 10	< 5	-	-
X2CrNi19-11	1.4306	> 20	1 to 25	< 25	< 20	< 15	< 15	< 15	< 10	< 5	-	-
X4CrNi18-12	1.4303	> 20	1 to 25	< 25	< 20	< 15	< 15	< 15	< 10	< 5	-	-
X8CrMnCuN17-8-3	1.4597	-	1 to 25	< 25	< 20	< 15	< 15	< 15	< 10	< 5	-	-
X8CrNiMnN18-9-5	1.4374	-	-	0,5 to 25	< 20	< 15	< 15	< 15	< 15	< 10	< 10	< 4
X13MnNiN18-13-2	1.4020	-	-	-	< 10	< 10	< 10	< 8	< 8	< 5		
X6CrMnNiN8-13-3	1.4378	-	-	-	< 10	< 10	< 10	< 8	< 8	< 5		
X2CrNiMo17-12-2	1.4404	-	< 25	< 25	< 20	< 15	< 15	< 15	< 10	< 5	-	-
X5CrNiMo17-12-2	1.4401	> 20	< 25	< 25	< 20	< 15	< 15	< 15	< 10	< 5	-	-
X6CrNiMoTi17-12-2	1.4571	-	< 25	< 25	< 20	< 15	< 15	< 15	< 10	< 5	-	-
X2CrNiMo17-12-3	1.4432	-	< 25	< 25	< 20	< 15	< 15	< 15	< 10	< 5	-	-
X3CrNiMo17-12-3	1.4436	-	< 25	< 25	< 20	< 15	< 15	< 15	< 10	< 5	-	-
X2CrNiMo18-14-3	1.4435	-	< 25	< 25	< 20	< 15	< 15	< 15	< 10	< 5	-	-
X1CrNiMoN25-22-2	1.4466		< 25	< 25	< 20	< 15	< 15	< 15	< 10	< 5	-	-
X1CrNiMoCu25-20-5	1.4539	-	< 25	< 25	< 20	< 15	< 15	< 15	< 10	< 5	-	-
X1NiCrMoCuN25-20-7	1.4529	-	2 to 22	< 22	< 16	< 10	< 6	< 4	< 3	-	-	-

Table C.2 — Austenitic-ferritic grade

Steel designation		**Typically available tensile strength levels for diameters in mm**								
Name	Number	+C500	+C600	+C700	+C800	+C900	+C1000	+C1100	+C1200	+C1400
X2CrNiMoN22-5-3	1.4462	-	-	-	< 20	< 20	< 15	< 15	< 15	< 6

Table C.3 — Ferritic grades

Steel designation		**Typically available tensile strength levels for diameters in mm**				
Name	Number	+C500	+C600	+C700	+C800	+C900
X6Cr17	1.4016	all diam.	< 20	< 20	< 15	< 10
X3CrNb17	1.4511	1 to 25	< 20	< 20	< 15	< 10
X6CrMoS17	1.4105	all diam.	< 20	< 20	< 15	< 10
X6CrMo17-1	1.4113	< 25	< 20	< 20	< 15	< 10

Table C.4 — Martensitic and precipitation hardening grades

Steel designation		Typically available tensile strength levels for diameters in mm									
Name	Number	+C500	+C600	+C700	+C800	+C900	+C1000	+C1100	+C1200	+C1400	+C1600	+C1800
X12Cr13	1.4006	all diam.	< 20	< 20	< 15	< 10	0,5 to 2	-	-	-	-	-
X12CrS13	1.4005	all diam.	< 20	< 20	< 15	< 10	-	-	-	-	-	-
X20Cr13	1.4021	all diam.	< 20	< 20	< 15	< 10	< 3	-	-	-	-	-
X30Cr13	1.4028	all diam.	< 20	< 20	< 15	< 10	< 3	-	-	-	-	-
X46Cr13	1.4034	all diam.	< 20	< 20	< 15	< 10	-	-	-	-	-	-
X14CrMoS17	1.4104	all diam.	< 20	< 20	< 15	< 10	-	-	-	-	-	-
X7CrNiAl17-7	1.4568	-	-	-	-	-	< 4	< 4	< 4	< 4	< 3	< 2
X5NiCrTiMoVB25-12-2	1.4606	-	< 25	< 20	< 15	< 15	< 15	< 10	< 6	-	-	-

Annex D
(informative)

Applicable dimensional standards

EN 10017, *Steel rod for drawing and/or cold rolling — Dimensions and tolerances*

EN 10024 [2], *Hot-rolled taper flange I sections — Tolerances on shape and dimensions*

EN 10034 [2], *Structural steel I and H sections — Tolerances on shape and dimensions*

EN 10055 [2], *Hot rolled steel equal flange tees with radiused root and toes — Dimensions and tolerances on shape and dimensions*

EN 10056-2 [2], *Structural steel equal and unequal leg angles — Part 2: Tolerances on shape and dimensions*

EN 10058, *Hot rolled flat steel bars for general purposes — Dimensions and tolerances on shape and dimensions*

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

EN 10060, *Hot rolled round steel bars for general purposes — Dimensions and tolerances on shape and dimensions*

EN 10061, *Hot rolled hexagon steel bars for general purposes — Dimensions and tolerances on shape and dimensions*

EN 10218-2, *Steel wire and wire products — General — Part 2: Wire dimensions and tolerances*

EN 10278, *Dimensions and tolerances of bright steel products*

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

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

Bibliography

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

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

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

[4] EN 10213-4, *Technical delivery conditions for steel castings for pressure purposes — Part 4: Austenitic and austenitic-ferritic steel grades*

[5] EN 10222-5, *Steel forgings for pressure purposes — Part 5: Martensitic, austenitic and austenitic-ferritic stainless steels*

[6] EN 10250-4, *Open die steel forgings for general engineering purposes — Part 4: Stainless steels*

[7] EN 10373, *Determination of the physical and mechanical properties of steels using models*

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

[9] EN 10263-5, *Steel rod, bars and wire for cold heading and cold extrusion — Part 5: Technical delivery conditions for stainless steels*

[10] EN 10264-4, *Steel wire and wire products — Steel wire for ropes — Part 4: Stainless steel wire*

[11] EN ISO 6931-1, *Stainless steels for springs — Part 1: Wire (ISO 6931-1)*

[12] EN 10272, *Stainless steel bars for pressure purposes*

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

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

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