BRITISH STANDARD

BS EN
10088-4:2009

Stainless steels

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

ICS 77.140.20; 77.140.50

BSI
British Standards

National foreword

This British Standard is the UK implementation of EN 10088-4:2009.

The UK participation in its preparation was entrusted to Technical Committee ISE/30, Stainless steels.

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

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Nichtrostende Stähle - Teil 4: Technische Lieferbedingungen für Blech und Band aus korrosionsbeständigen Stählen für das Bauwesen

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Foreword

This document (EN 10088-4:2009) has been prepared by Technical Committee ECISS/TC 23 “Steels for heat treatment, alloy steels and free-cutting steels - Qualities and dimensions”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2009, and conflicting national standards shall be withdrawn at the latest by January 2011.

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 D);

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

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

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

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

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For relationship with EC Directive(s), see informative Annex ZA, which is an integral part of this document.

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1 Scope

The scope of this part of EN 10088 is to specify the technical delivery conditions for hot or cold rolled sheet/plate and strip of standard and special grades of corrosion resisting stainless steels for construction purposes in addition to the general technical delivery conditions specified in EN 10021.

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

2 Normative references

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

EN 10002-1, *Metallic materials - Tensile testing - Part 1: Method of test at ambient temperature*

EN 10002-5, *Metallic materials - Tensile testing - Part 5: Method of testing at elevated temperature*

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

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

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

EN 10045-1, *Metallic materials - Charpy impact test - Part 1: Test method*

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

EN 10079:2007, *Definition of steel products*

EN 10088-1:2005, *Stainless steels - Part 1: List of stainless steels*

EN 10088-2, *Stainless steels – Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes*

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

EN 10168:2004, *Steel products – Inspection documents – List of information and description*

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

CEN/TR 10261, *Iron and steel – Review of available methods of chemical analysis*

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

EN ISO 377, *Steel and steel products - Location and preparation of samples and test pieces for mechanical testing (ISO 377:1997)*

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 sulphuric acid (ISO 3651-2:1998)*

EN ISO 6506-1, *Metallic materials - Brinell hardness test - Part 1: Test method (ISO 6506-1:2005)*

EN ISO 6507-1, *Metallic materials - Vickers hardness test - Part 1: Test method (ISO 6507-1:2005)*

EN ISO 6508-1, *Metallic materials - Rockwell hardness test - Part 1: Test method (scales A, B, C, D, E, F, G, H, K, N, T) (ISO 6508-1:2005)*

EN ISO 9001:2008, *Quality management systems - Requirements (ISO 9001:2008)*

EN ISO 14284, *Steel and iron - Sampling and preparation of samples for the determination of chemical composition (ISO 14284:1996)*

3 Terms and definitions

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

3.1
stainless steels
the definition in EN 10088-1:2005 applies

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

3.3
product forms
the definitions in EN 10079:2007 apply

3.4
types of heat-treatment
the definitions in EN 10052:1993 apply

3.5
standard grades
grades with a relatively good availability and a wider range of application

3.6
special grades
grades for special use and/or with limited availability

4 Designation and ordering

4.1 Designation of steel grades

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

4.2 Order designation

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

a) the desired quantity;

b) the product form (e.g.: strip or sheet/plate);

c) the nominal dimensions, the number of the appropriate European Standard (see Annex B) plus any choice of requirements;

d) the type of material (steel);

e) the number of this European Standard;

f) the steel name or steel number;

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

h) the desired process route (see symbols in Table 6);

i) verification of internal soundness, if required (flat products with thickness ≥ 6 mm shall be tested in accordance with EN 10307);

j) the type of inspection certificate (3.1 or 3.2) according to EN 10204;

k) regulatory marking requirements (see Annex ZA).

EXAMPLE 10 plates of a steel grade with the name X5CrNi18-10 and the number 1.4301 as specified in EN 10088-4 with nominal dimensions thickness = 8 mm, width = 2000 mm, length = 5000 mm; tolerances on dimensions, shape and mass as specified in EN 10029 with thickness tolerance class B and "normal" flatness tolerance class, in process route 1D (see Table 6), inspection certificate 3.1 as specified in EN 10204 and declaration of conformity:

10 plates EN 10029-8B x 2000 x 5000
Steel EN 10088-4 - X5CrNi18-10+1D
Inspection certificate 3.1, CE

or

10 plates EN 10029-8B x 2000 x 5000
Steel EN 10088-4 - 1.4301+1D
Inspection certificate 3.1, CE

5 Classification of grades

Steels covered in this European Standard are classified according to their structure into

a) ferritic steels;

b) martensitic steels;

c) precipitation hardening steels;

d) austenitic steels;

e) austenitic-ferritic steels.

See also Annex B to EN 10088-1:2005.

6 Requirements

6.1 Steelmaking process

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

6.2 Delivery condition

The products shall be supplied by reference to the process route given in Table 6 and, where different alternatives exist, to the treatment conditions given in Tables 7 to 11, 13 and 14 (see also Annex A).

6.3 Chemical composition

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

If grades other than those included in this European Standard are required for construction purposes, they shall comply with EN 10088-2 and be in conjunction with the requirements of this European Standard.

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

6.4 Chemical corrosion properties

Referring to resistance to intergranular corrosion as defined in EN ISO 3651-2, for ferritic, austenitic and austenitic-ferritic steels the specification in Tables 7, 10 and 11 shall apply.

EN ISO 3651-2 shall not be applicable for testing martensitic and precipitation hardening steels.

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

6.5 Mechanical properties

6.5.1 The mechanical properties at room temperature as specified in Tables 7 to 11 shall apply for the relevant specified heat treatment condition. This does not apply to the process route 1U (hot rolled, not heat treated, not descaled).

If the products are to be supplied in a non-heat-treated condition, the mechanical properties specified in 7 to 11 shall be obtained from reference test pieces which have received the appropriate heat treatment (simulated heat treatment).

For cold worked products, the tensile strength levels at ambient temperature as specified in Table 13 shall apply. The available tensile strength levels in the cold worked condition are indicated in Table 15.

Alternatively, cold worked products can be ordered according to their 0,2%-proof strength as given in Tables 14 and 16.

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 Table 12 shall apply for the 0,2 %- and 1 %-proof strength of austenitic steels at elevated temperatures.

6.6 Surface quality

Slight surface imperfections, inherent in the rolling process, shall be permitted.

When products are delivered in coil form, the degree and extent of such imperfections can to be greater, due to the impractibility of removing short lengths of coil. For hot-rolled quarto-plates (symbol P in Tables 7 to 11), the requirements in EN 10163-2, class A2, shall apply unless otherwise agreed. For other products, where necessary, more precise requirements on surface quality can be agreed 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 intended purpose. If verification of internal soundness is required, ultrasonic testing of austenitic and austenitic-ferritic stainless steel flat products ≥ 6 mm shall be in accordance with EN 10307.

6.8 Formability at room temperature

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

6.9 Dimensions and tolerances on dimensions and shape

Dimensions and tolerances on dimensions and shape shall be declared by reference to the appropriate European Standard (see Annex B). EN 10029 shall normally only be applied for product form P (individually rolled plates, "quarto plates") and not for product form H (continuously rolled strip and plate), for which EN 10051 shall be applied. When applying EN 10029, thickness tolerance class B shall apply unless specifically agreed otherwise.

6.10 Calculation of mass and tolerances on mass

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

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

7 Inspection and testing

7.1 General

The process control, inspection and testing shall be carried out according to 8.3 to ensure that the product complies with the requirements of both this European Standard and the order.

This includes the following:

a) A suitable frequency of verification of the dimensions of the products;

b) An adequate intensity of visual examination of the surface quality of the products;

c) An 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 shall be in accordance with the manufacturer's written procedures in compliance with 8.3.

7.2 Agreement on tests and inspection documents

Products declaring compliance with this European Standard shall be delivered with an inspection certificate 3.1 or 3.2 as specified in EN 10204. The type of certificate shall be agreed upon at the time of enquiry and order. If the order does not contain any specification of this type, inspection certificate 3.1 shall be issued.

The specific inspection described in 7.3 shall be carried out and confirmed together with the following information in the inspection certificate with the code numbers and details required by EN 10168:2004.

a) the information groups A, B and Z of EN 10168:2004;

b) the results of the cast analysis in accordance with the code numbers C71 to C92 in EN 10168:2004;

c) the results of the tests marked in Table 17, second column, by "m";

d) the result of any optional test or inspections agreed at the time of enquiry and order;

e) the regulatory information (see Annex ZA).

7.3 Specific inspection and testing

7.3.1 Extent of testing

The tests to be carried out and the composition and size of the test units and the number of sample products, samples and test pieces to be taken shall be as in Table 17.

7.3.2 Selection and preparation of samples and test pieces

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

7.3.2.2 The samples for the tensile test shall be taken in accordance with Figure 1 in such a way that they are located halfway between the centre and a longitudinal edge. Impact test samples shall be taken from the same location.

The samples shall be taken from products in the delivery condition. If agreed, the samples may be taken before flattening. For samples to be given a simulated heat treatment the conditions for annealing, hardening and tempering shall be agreed.

7.3.2.3 Samples for the hardness test and for the resistance to intergranular corrosion test shall be taken from the same locations as those for the mechanical tests. For direction of bending the test piece in the resistance to intergranular corrosion test, see Figure 2.

7.4 Test methods

7.4.1 The chemical analysis shall be carried out using the appropriate European Standard for the element being analysed. In the absence of an appropriate European Standard, 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.

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

7.4.2 The tensile test at room temperature shall be carried out in accordance with EN 10002-1 taking into account the additional or deviating conditions specified in Figure 1, footnote a.

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

7.4.3 The tensile test for austenitic steels at elevated temperature shall be carried out in accordance with EN 10002-5. If the proof strength is to be verified for austenitic steels, the 0,2%- and the 1 %-proof strength shall be determined.

7.4.4 The impact test shall be carried out in accordance with EN 10045-1 on test pieces with a V-notch. The average obtained from three test pieces shall be considered to be the test result (see also EN 10021).

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

7.4.6 The resistance to intergranular corrosion shall be tested in accordance with EN ISO 3651-2 for ferritic, austenitic and austenitic-ferritic steels.

7.4.7 Dimensions and dimensional tolerances of the products shall be tested in accordance with the requirements of the dimensional standard relevant to the product form.

7.5 Retests

Shall be according to EN 10021.

8 Evaluation of Conformity

8.1 General

The conformity of a steel product to the requirements of this standard and with the stated values (including classes) shall be demonstrated by:

initial type testing;

factory production control by the manufacturer, including product assessment.

For the purposes of testing, steel products may be grouped into families, where it is considered that the results for one or more characteristics from any one product within the family are representative for all steel products within that same family (a product may be in different families for different characteristics).

The testing of samples taken at the works in accordance with the manufacturer's prescribed plan shall be the means of evaluation of conformity of the steel product delivered in accordance with this European Standard (see Table ZA.3). The report of such testing shall be in an inspection document in accordance with EN 10204.

NOTE The assignment of tasks is given in Table ZA.3.

8.2 Initial type testing

8.2.1 General

An initial type test is the complete set of tests or other procedures, in respect of the characteristics to be assessed, determining the performance of samples of products representative of the product type.

8.2.1.1 Initial type testing

Initial type testing (see Table ZA.3) shall be performed to show conformity with this European Standard for a steel product being put onto the market and:

a) at the beginning of the production of a new or modified steel product design;

b) at the beginning of a new or modified method of production.

8.2.1.2 Type testing of a steel product

In case of type testing of a steel product for which initial type testing in accordance with this standard was already performed, type testing may be reduced:

a) if it has been established that the performance characteristics compared with the already tested steel products have not been affected or

b) in accordance with the rules for families and/or direct or extended application of test results.

8.2.2 Characteristics

All characteristics of Clause 6 shall be subject to initial type testing, with following exceptions:

a) Weldability is covered by chemical composition;

b) Durability is covered by chemical composition;

c) Fracture toughness is covered by impact strength, no additional test available;

d) Cold formability is covered by elongation, no additional test available;

e) Release of dangerous substances is covered by chemical composition.

8.2.3 Use of historical data

Tests previously performed on the same steel product in accordance with the provisions of this European Standard (same characteristic(s), test method, sampling procedure, system of attestation of conformity, etc.) may be taken into account.

8.2.4 Sampling, testing and conformity criteria

8.2.4.1 Sampling

Initial type testing shall be performed on samples of steel products representative for the manufactured steel product type.

8.2.4.2 Testing and conformity criteria

Intensive testing shall be specific inspection and testing in accordance with 7.3 carried out on the first five casts produced.

However, for tensile and impact testing, at least 6 products from each of the five casts shall be tested and where this is not possible test pieces shall be taken from opposite ends of the products being tested.

The results of all type tests shall be recorded and held by the manufacturer for at least 10 years after the date when the last product to which they apply was delivered.

8.3 Factory production control (FPC)

8.3.1 General

The manufacturer shall establish, document and maintain an FPC system to ensure that the products placed on the market conform to the declared performance characteristics. The FPC system shall consist of written

procedures (works' manual), regular inspections and tests and/or assessments and the use of the results to control raw and other incoming materials or components, equipment, the production process and the product. Records shall remain legible, readily identifiable and retrievable.

An FPC system conforming with the requirements of EN ISO 9001:2008, and made specific to the requirements of this European Standard, shall be considered to satisfy the above requirements.

The results of inspections, tests or assessments requiring action shall be recorded, as shall any action taken. The action to be taken when control values or criteria are not met shall be recorded and retained for the period specified in the manufacturer's FPC procedures.

8.3.2 FPC requirements for all manufacturers

The manufacturer shall establish procedures to ensure that the production tolerances allow for the steel product performances to be in conformity with the declared values, derived from initial type testing.

The characteristics, and the means of verification, are given in the Table 18.

The manufacturer shall record the results of the tests specified above. These records shall at least include the following information:

a) identification of the steel product tested;

b) the date of sampling and testing;

c) the test methods performed;

d) the test results.

8.3.3 Manufacturer-specific FPC system requirements

8.3.3.1 Personnel

The responsibility, authority and the relationship between personnel that manage, perform or verify work affecting product conformity, shall be defined. This applies in particular to personnel that need to initiate actions preventing product non-conformities from occurring, actions in case of non-conformities and to identify and register product conformity problems. Personnel performing work affecting product conformity shall be competent on the basis of appropriate education, training, skills and experience for which records shall be maintained.

8.3.3.2 Equipment

All weighing, measuring and testing equipment necessary to achieve, or produce evidence of, conformity shall be calibrated or verified and regularly inspected according to documented procedures, frequencies and criteria. Control of monitoring and measuring devices shall comply with the appropriate clause of EN ISO 9001:2008.

All equipment used in the manufacturing process shall be regularly inspected and maintained to ensure use, wear or failure does not cause inconsistency in the manufacturing process.

Inspections and maintenance shall be carried out and recorded in accordance with the manufacturer's written procedures and the records retained for the period defined in the manufacturer's FPC procedures.

8.3.3.3 Raw materials

The specifications of all incoming raw materials shall be documented, as shall the inspection scheme for ensuring their conformity. The verification of conformity of the raw material with the specification shall be in accordance with EN ISO 9001:2008, 7.4.3.

8.3.3.4 In-process control

The manufacturer shall plan and carry out production under controlled conditions. Compliance with EN ISO 9001:2008, 7.5.1 and 7.5.2 shall be deemed to satisfy the requirements of this sub-clause.

8.3.3.5 Traceability and marking

Individual steel products shall be identifiable and traceable with regard to their production origin. The manufacturer shall have written procedures ensuring that processes related to affixing traceability codes and/or markings (see Clause 9) are inspected regularly. Compliance with EN ISO 9001:2008, 7.5.3 shall be deemed to satisfy the requirements of this sub-clause.

8.3.3.6 Non-conforming products

The manufacturer shall have written procedures which specify how non-conforming products shall be dealt with. Any such events shall be recorded as they occur and these records shall be kept for the period defined in the manufacturer's written procedures. Compliance with EN ISO 9001:2008, 8.3 shall be deemed to satisfy the requirements of this sub-clause.

8.3.3.7 Corrective action

The manufacturer shall have documented procedures that instigate action to eliminate the cause of non-conformities in order to prevent recurrence. Compliance with EN ISO 9001:2008, 8.5.2 shall be deemed to satisfy the requirements of this sub-clause.

8.3.3.8 Handling, storage and packaging

The manufacturer shall have written procedures providing methods of product handling and shall provide suitable storage areas preventing damage or deterioration.

9 Marking

9.1 With the exception mentioned in 9.4, as a minimum, each product shall be marked with the information given in Table 19. (See Annex ZA for regulatory marking.)

9.2 Unless otherwise agreed the method of marking and the material of marking in accordance with 9.1 shall be at the option of the manufacturer.

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

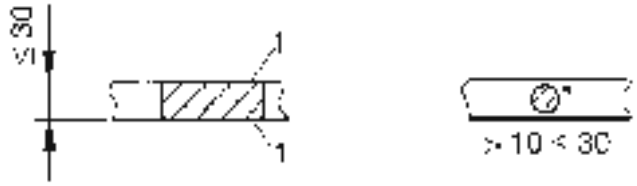
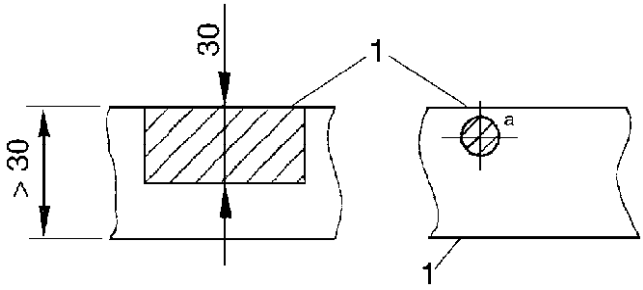
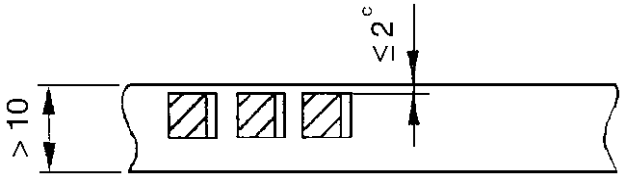
9.3 One surface of the product shall be marked. This will normally be the prime surface of products, where only one surface is guaranteed to the required standard.

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

NOTE For regulatory marking see Annex ZA.

10 Dangerous substances

Materials used in products shall not release any dangerous substances in excess of the maximum permitted levels specified in a relevant European Standard for the material or permitted in the national regulations of the member state of destination.

Type of test piece	Product thickness *t* mm	Direction of the longitudinal axis of the test piece in relation to the principal direction of rolling at a final rolling width of		Distance of the test piece from the rolled surface mm
		< 300 mm	≥ 300 mm	
Tensile[a]	≤ 30	longitudinal	transverse	
	> 30			
Impact[b]	> 10	longitudinal	transverse	

[a] In cases of doubt the gauge length shall be $L_o = 5{,}65\sqrt{S_o}$ for test pieces from products $t \geq 3$ mm. For products $t < 3$ mm thickness, non proportional test pieces with a gauge length of 80 mm and a width of 20 mm shall be used, but test pieces with a gauge length of 50 mm and a width of 12,5 mm may also be applied. For products with a thickness 3 mm < $t \leq 10$ mm, flat proportional test pieces with two rolled surfaces and a maximum width of 30 mm shall be used. For products with a thickness $t > 10$ mm, one of the following proportional test pieces shall be used:

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

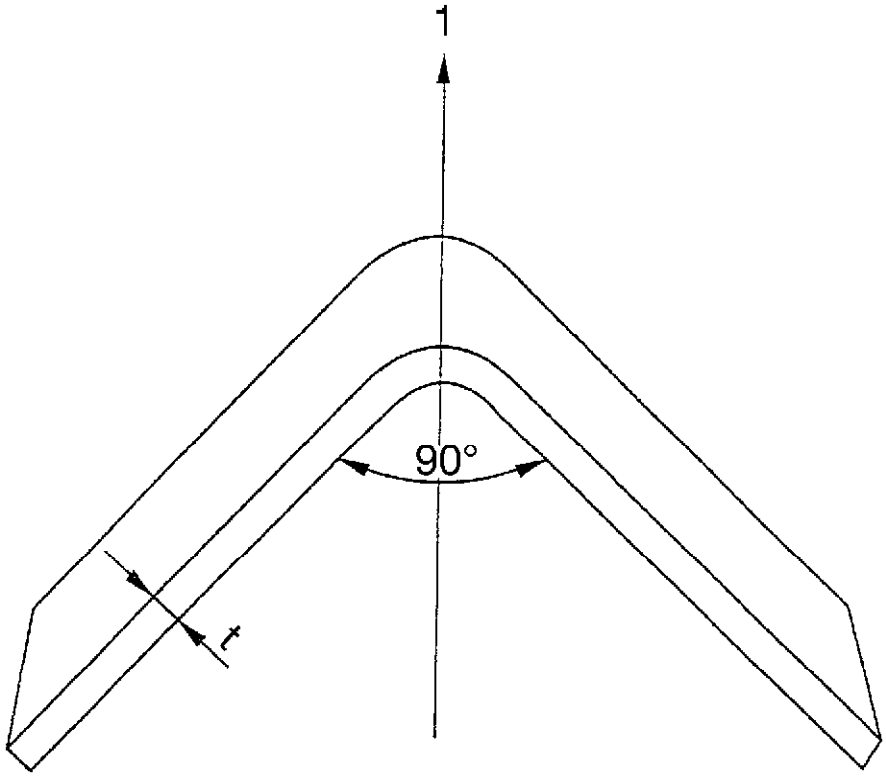
-or a round test piece with a diameter of ≥ 5 mm the axis of which shall be located as close as possible to a plane in the outer sixth of the product thickness *t*.

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

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

Key
1 Rolled surface

Figure 1 — Position of test pieces for flat products



Key

1 Rolling direction

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

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

Steel designation		% by mass									
Name	Number	C max.	Si max.	Mn max	P max.	S max.	N max.	Cr	Mo	Ni	Others
Standard grades											
X2CrNi12	1.4003	0,030	1,00	1,50	0,040	0,015	0,030	10,5 to12,5	-	0,30 to 1,00	-
X2CrTi12	1.4512	0,030	1,00	1,00	0,040	0,015	-	10,5 to 12,5	-	-	Ti: [6x(C+N)] to 0,65
X6Cr17	1.4016	0,08	1,00	1,00	0,040	0,015[a]	-	16,0 to 18,0	-	-	-
X3CrTi17	1.4510	0,05	1,00	1,00	0,040	0,015[a]	-	16,0 to 18,0	-	-	Ti: [4x(C+N) + 0,15] to 0,80[b]
X2CrMoTi18-2	1.4521	0,025	1,00	1,00	0,040	0,015	0,030	17,0 to 20,0	1,80 to 2,50	-	Ti: [4x(C+N) + 0,15] to 0,80[b]
Special grades											
X2CrMoTi17-1	1.4513	0,025	1,00	1,00	0,040	0,015	0,020	16,0 to 18,0	0,80 to 1,40	-	Ti: 0,30 to 0,60
X6CrMoNb17-1	1.4526	0,08	1,00	1,00	0,040	0,015	0,040	16,0 to 18,0	0,80 to 1,40	-	Nb: [7x(C+N)+0,10] to 1,00
X2CrTiNb18	1.4509	0,030	1,00	1,00	0,040	0,015	-	17,5 to 18,5	-	-	Ti: 0,10 to 0,60 Nb: [3xC+0,30] to 1,00

All precautions shall be taken to avoid the addition of such elements not quoted in the table from scrap and other materials used in production which would impair mechanical properties and the suitability of the steel.

[a] Particular ranges of sulphur content can provide improvement of particular properties. For machinability a controlled sulphur content of 0,015 % to 0,030 % is recommended and shall be permitted. For weldability, a controlled sulphur content of 0,008 % to 0,015 % is recommended. For polishability, a controlled sulphur content of 0,015 % max. is recommended.

[b] The stabilisation may be by use of titanium or niobium 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).

Table 2 — Chemical composition (cast analysis) of martensitic and precipitation hardening corrosion resisting steels

Steel designation		% by mass									
Name	Number	C	Si max.	Mn max	P max.	S max.	Cr	Cu	Mo	Ni	Others
Standard grades (martensitic steels)											
X12Cr13	1.4006	0,08 to 0,15	1,00	1,50	0,040	0,015[a]	11,5 to 13,5	-	-	≤ 0,75	-
X20Cr13	1.4021	0,16 to 0,25	1,00	1,50	0,040	0,015[a]	12,0 to 14,0	-	-	-	-
X4CrNiMo16-5-1	1.4418	≤ 0,06	0,70	1,50	0,040	0,015[a]	15,0 to 17,0	-	0,80 to 1,50	4,0 to 6,0	N: ≥ 0,020
Special grades (precipitation hardening steels)											
X5CrNiCuNb16-4	1.4542	≤ 0,07	0,70	1,50	0,040	0,015[a]	15,0 to 17,0	3,0 to 5,0	≤ 0,60	3,0 to 5,0	Nb: 5xC to 0,45
X7CrNiAl17-7	1.4568	≤ 0,09	0,70	1,00	0,040	0,015	16,0 to 18,0	-	-	6,5 to 7,8[b]	Al: 0,70 to 1,50

All precautions shall be taken to avoid the addition of such elements not quoted in the table from scrap and other materials used in production which would impair mechanical properties and the suitability of the steel.

[a] Particular ranges of sulphur content can provide improvement of particular properties. For machinability a controlled sulphur content of 0,015 % to 0,030 % is recommended and shall be permitted. For weldability, a controlled sulphur content of 0,008 % to 0,015 % is recommended. For polishability, a controlled sulphur content of 0,015 % max. is recommended.

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

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

Steel designation		% by mass											
Name	Number	C	Si	Mn	P max.	S	N	Cr	Cu	Mo	Nb	Ni	Others
Standard grades													
X2CrNiN18-7	1.4318	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015	0,10 to 0,20	16,5 to 18,5	-	-	-	6,0 to 8,0	-
X2CrNi18-9	1.4307	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015[a]	≤ 0,10	17,5 to 19,5	-	-	-	8,0 to 10,5	-
X2CrNi19-11	1.4306	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015[a]	≤ 0,10	18,0 to 20,0	-	-	-	10,0 to 12,0	-
X2CrNiN18-10	1.4311	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015[a]	0,12 to 0,22	17,5 to 19,5	-	-	-	8,5 to 11,5	-
X5CrNi18-10	1.4301	≤ 0,07	≤ 1,00	≤ 2,00	0,045	≤ 0,015[a]	≤ 0,10	17,5 to 19,5	-	-	-	8,0 to 10,5	-
X6CrNiTi18-10	1.4541	≤ 0,08	≤ 1,00	≤ 2,00	0,045	≤ 0,015[a]	-	17,0 to 19,0	-	-	-	9,0 to 12,0	Ti: 5 x C to 0,70
X2CrNiMo17-12-2	1.4404	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015[a]	≤ 0,10	16,5 to 18,5	-	2,00 to 2,50	-	10,0 to 13,0	-
X2CrNiMoN17-11-2	1.4406	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015[a]	0,12 to 0,22	16,5 to 18,5	-	2,00 to 2,50	-	10,0 to 12,5	-
X5CrNiMo17-12-2	1.4401	≤ 0,07	≤ 1,00	≤ 2,00	0,045	≤ 0,015[a]	≤ 0,10	16,5 to 18,5	-	2,00 to 2,50	-	10,0 to 13,0	-
X6CrNiMoTi17-12-2	1.4571	≤ 0,08	≤ 1,00	≤ 2,00	0,045	≤ 0,015[a]	-	16,5 to 18,5	-	2,00 to 2,50	-	10,5 to 13,5	Ti: 5 x C to 0,70
X2CrNiMo17-12-3	1.4432	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015[a]	≤ 0,10	16,5 to 18,5	-	2,50 to 3,00	-	10,5 to 13,0	-
X2CrNiMo18-14-3	1.4435	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015[a]	≤ 0,10	17,0 to 19,0	-	2,50 to 3,00	-	12,5 to15,0	-
X2CrNiMoN17-13-5	1.4439	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015[a]	0,12 to 0,22	16,5 to18,5	-	4,0 to 5,0	-	12,5 to 14,5	-
X1NiCrMoCu25-20-5	1.4539	≤ 0,020	≤ 0,70	≤ 2,00	0,030	≤ 0,010	≤ 0,15	19,0 to 21,0	1,20 to 2,00	4,0 to 5,0	-	24,0 to 26,0	-
Special grades													
X1CrNi25-21	1.4335	≤ 0,020	≤ 0,25	≤ 2,00	0,025	≤ 0,010	≤ 0,10	24,0 to 26,0	-	≤ 0,20	-	20,0 to 22,0	-
X1CrNiMoN25-22-2	1.4466	≤ 0,020	≤ 0,70	≤ 2,00	0,025	≤ 0,010	0,10 to 0,16	24,0 to 26,0	-	2,00 to 2,50	-	21,0 to 23,0	-
X2CrNiMoN17-13-3	1.4429	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015	0,12 to 0,22	16,5 to 18,5	-	2,50 to 3,00	-	11,0 to 14,0	-
X3CrNiMo17-13-3	1.4436	≤ 0,05	≤ 1,00	≤ 2,00	0,045	≤ 0,015[a]	≤ 0,10	16,5 to 18,5	-	2,50 to 3,00	-	10,5 to 13,0	-
X2CrNiMo18-15-4	1.4438	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015[a]	≤ 0,10	17,5 to 19,5	-	3,0 to 4,0	-	13,0 to 16,0	-
X12CrMnNiN17-7-5	1.4372	≤ 0,15	≤ 1,00	5,5 to 7,5	0,045	≤ 0,015	0,05 to 0,25	16,0 to 18,0	-	-	-	3,5 to 5,5	-
X1NiCrMoCu31-27-4	1.4563	≤ 0,020	≤ 0,70	≤ 2,00	0,030	≤ 0,010	≤ 0,10	26,0 to 28,0	0,70 to 1,50	3,0 to 4,0	-	30,0 to 32,0	-
X1CrNiMoCuN20-18-7	1.4547	≤ 0,020	≤ 0,70	≤ 1,00	0,030	≤ 0,010	0,18 to 0,25	19,5 to 20,5	0,50 to 1,00	6,0 to 7,0	-	17,5 to 18,5	-
X1NiCrMoCuN25-20-7	1.4529	≤ 0,020	≤ 0,50	≤ 1,00	0,030	≤ 0,010	0,15 to 0,25	19,0 to 21,0	0,50 to 1,50	6,0 to 7,0	-	24,0 to 26,0	-
X2CrNiMnMoN25-18-6-5	1.4565	≤ 0,030	≤ 1,00	5,0 to 7,0	0,030	≤ 0,015	0,30 to 0,60	24,0 to 26,0	-	4,0 to 5,0	≤ 0,15	16,0 to 19,0	-

All precautions shall be taken to avoid the addition of such elements not quoted in the table from scrap and other materials used in production which would impair mechanical properties and the suitability of the steel.

[a] Particular ranges of sulphur content can provide improvement of particular properties. For machinability a controlled sulphur content of 0,015 % to 0,030 % is recommended and shall be permitted. For weldability, a controlled sulphur content of 0,008 % to 0,015 % is recommended. For polishability, a controlled sulphur content of 0,015 % max. is recommended.

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

Steel designation		% by mass									
Name	Number	C max.	Si	Mn	P max.	S max.	N	Cr	Cu	Mo	Ni
Standard grades											
X2CrNiN23-4	1.4362	0,030	≤ 1,00	≤ 2,00	0,035	0,015	0,05 to 0,20	22,0 to 24,0	0,10 to 0,60	0,10 to 0,60	3,5 to 5,5
X2CrNiMoN22-5-3[a]	1.4462[a]	0,030	≤ 1,00	≤ 2,00	0,035	0,015	0,10 to 0,22	21,0 to 23,0	-	2,50 to 3,5	4,5 to 6,5
Special grades											
X2CrNiMoN29-7-2*)	1.4477*)	0,030	≤ 0,50	0,80 to 1,50	0,030	0,015	0,30 to 0,40	28,0 to 30,0	≤ 0,80	1,50 to 2,60	5,8 to 7,5
X2CrNiMoN25-7-4	1.4410	0,030	≤ 1,00	≤ 2,00	0,035	0,015	0,24 to 0,35	24,0 to 26,0	-	3,0 to 4,5	6,0 to 8,0
X2CrNiMoSi18-5-3	1.4424	0,030	1,40 to 2,00	1.20 to 2,00	0,035	0,015	0,05 to 0,10	18,0 to 19,0	-	2,50 to 3,0	4,5 to 5,2
X2CrMnNiN21-5-1*)	1.4162*)	0,040	≤ 1,00	4,0 to 6,0	0,040	0,015	0,20 to 0,25	21,0 to 22,0	0,10 to 0,80	0,10 to 0,80	1,35 to 1,70

All precautions are to be taken to avoid the addition of such elements not quoted in the table from scrap and other materials used in production which would impair mechanical properties and the suitability of the steel.

[a] By agreement, this grade can be delivered with a Pitting Resistance Equivalent Number (PRE = Cr + 3,3 Mo + 16 N, compare Table C.1 of EN 10088-1:2005) greater than 34.

*) Patented steel grade.

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

Element	Specified limits, cast analysis % by mass		Permissible tolerance[a] % by mass
Carbon		≤ 0,030	+ 0,005
	> 0,030	≤ 0,20	± 0,01
	> 0,20	≤ 0,25	± 0,02
Silicon		≤ 1,00	+ 0,05
	> 1,00	≤ 2,00	± 0,10
Manganese		≤ 1,00	+ 0,03
	> 1,00	≤ 2,00	± 0,04
	> 2,00	≤ 7,5	± 0,10
Phosphorus		≤ 0,045	+0,005
Sulphur		≤ 0,015	+0,003
	> 0,015	≤ 0,030	±0,005
Nitrogen		≤ 0,10	± 0,01
	≥ 0,10	≤ 0,60	± 0,02
Chromium	≥ 10,5	≤ 15,0	± 0,15
	> 15,0	≤ 20,0	± 0,20
	> 20,0	≤ 30,0	± 0,25
Copper		≤ 1,00	± 0,07
	> 1,00	≤ 5,0	± 0,10
Molybdenum		≤ 0,60	± 0,03
	> 0,60	≤ 1,75	± 0,05
	> 1,75	≤ 7,0	± 0,10
Niobium		≤ 1,00	± 0,05
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	≤ 32,0	± 0,20
Aluminium	> 0,30	≤ 1,50	± 0,10
Titanium		≤ 0,80	± 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 shall be only allowed to exceed the permissible maximum value or to fall short of the permissible minimum value, but not both at the same time.

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

	Symbol[a]	Type of process route	Surface finish	Notes
Hot rolled	1U	Hot rolled, not heat treated, not descaled	Covered with rolling scale	Suitable for products which are to be further worked e.g. strip for rerolling.
	1C	Hot rolled, heat treated, not descaled	Covered with rolling scale	Suitable for parts which will be descaled or machined in subsequent production or for certain heat-resisting applications.
	1E	Hot rolled, heat treated, mechanically descaled.	Free of scale	The type of mechanical descaling, e.g coarse grinding or shot blasting, depends on the steel grade and the product, and is left to the manufacturer´s discretion, unless otherwise agreed.
	1D	Hot rolled, heat treated, pickled.	Free of scale	Usually standard for most steel types to ensure good corrosion resistance; also common finish for further processing. It is permissible for grinding marks to be present. Not as smooth as 2D or 2B.
Cold rolled	2H	Work hardened	Bright	Cold worked to obtain higher strength level.
	2C	Cold rolled, heat treated, not descaled	Smooth with scale from heat treatment	Suitable for parts which will be descaled or machined in subsequent production or for certain heat-resisting applications.
	2E	Cold rolled, heat treated, mechanically descaled	Rough and dull	Usually applied to steels with a scale which is very resistant to pickling solutions. May be followed by pickling.
	2D	Cold rolled, heat treated, pickled	Smooth	Finish for good ductility, but not as smooth as 2B or 2R.
	2B	Cold rolled, heat treated, pickled, skin passed	Smoother than 2D	Most common finish for most steel types to ensure good corrosion resistance, smoothness and flatness. Also common finish for further processing. Skin passing may be by tension levelling.
	2R	Cold rolled, bright annealed[b]	Smooth, bright, reflective	Smoother and brighter than 2B. Also common finish for further processing.
	2Q	Cold rolled, hardened and tempered, scale free	Free of scale	Either hardened and tempered in a protective atmosphere or descaled after heat treatment.
Special finishes	1G or 2G	Ground[c]	See footnote d.	Grade of grit or surface roughness can be specified. Unidirectional texture, not very reflective.
	1J or 2J	Brushed[c] or dull polished[c]	Smoother than ground. See footnote d.	Grade of brush or polishing belt or surface roughness can be specified. Unidirectional texture, not very reflective.
	1K or 2K	Satin polish[c]	See footnote d.	Additional specific requirements to a "J" type finish, in order to achieve adequate corrosion resistance for marine and external architectural applications. Transverse R_a < 0,5 µm with clean cut surface finish.
	1P or 2P	Bright polished[c]	See footnote d.	Mechanical polishing. Process or surface roughness can be specified. Non-directional finish, reflective with high degree of image clarity.
	2F	Cold rolled, heat treated, skin passed on roughened rolls	Uniform non-reflective matt surface.	Heat treatment by bright annealing or by annealing and pickling.
	1M	Patterned	Design to be agreed; 2nd surface flat	Chequer plates used for floors.
	2M			A fine texture finish mainly used for architectural applications.
	2W	Corrugated	Design to be agreed	Used to increase strength and/or for cosmetic effect.
	2L	Coloured[c]	Colour to be agreed	
	1S or 2S	Surface coated[c]		Coated with e.g. tin, aluminium.

NOTE Not all process routes and surface finishes are available for all steels.

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

[b] May be skin passed.

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

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

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

Steel designation		Product form	Thickness	0,2 %- proof strength		Tensile strength	Elongation after fracture		Resistance to intergranular corrosion [d]	
Name	Number	[a]	mm max.	$R_{p0,2}$ MPa [*)] min. (long.)	$R_{p0,2}$ MPa [*)] min. (tr.)	R_m MPa [*)]	$A_{80\ mm}$ [b] < 3 mm thick % min. (long. + tr.)	A [c] ≥ 3 mm thick % min. (long. + tr.)	In the delivery condition	in the welded condition
Standard grades										
X2CrNi12	1.4003	C	8	280	320	450 to 650	20		no	no
		H	13,5							
		P	25[e]	250	280		18			
X2CrTi12	1.4512	C	8	210	220	380 to 560	25		no	no
		H	13,5							
X6Cr17	1.4016	C	8	260	280	450 to 600	20		yes	no
		H	13,5	240	260		18			
		P	25[e]	240	260	430 to 630	20			
X3CrTi17	1.4510	C	8	230	240	420 to 600	23		yes	yes
		H	13,5							
X2CrMoTi18-2	1.4521	C	8	300	320	420 to 640	20		yes	yes
		H	13,5	280	300	400 to 600				
		P	12	280	300	420 to 620				
Special grades										
X2CrMoTi17-1	1.4513	C	8	200	220	400 to 550	23		yes	yes
X6CrMoNb17-1	1.4526	C	8	280	300	480 to 560	25		yes	yes
X2CrTiNb18	1.4509	C	8	230	250	430 to 630	18		yes	yes

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

[b] The values apply for test pieces with a gauge length of 80 mm and a width of 20 mm. Test pieces with a gauge length of 50 mm and a width of 12,5 mm can also be used.

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

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

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

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

Table 8 — Mechanical properties at room temperature of martensitic steels in the heat-treated condition (see Table A.2)

Steel designation		Product form[a]	Thick-ness	Heat-treat-ment-condi-tion[b]	Hardness[c]		0,2 %-proof strength	Tensile strength	Elongation after fracture		Impact energy (ISO-V)	Hardness	
Name	Number		mm max.		*HRB*	*HB or HV* max.	$R_{p0,2}$ MPa*) min.	R_m MPa*)	$A_{80\ mm}$[d] < 3 mm thick % min. (long. + tr.)	*A*[e] ≥ 3 mm thick % min. (long.+tr.)	*KV* > 10 mm thick J min.	*HRC*	*HV*
Standard grades													
X12Cr13	1.4006	C	8	+A	90	200	-	max. 600	20		-	-	-
		H	13,5										
		P[f,g]	75	+QT550	-		400	550 to 750	15		by agreement	-	-
				+QT650			450	650 to 850	12				
X20Cr13	1.4021	C	3	+QT	-	-	-	-	-		-	44 to 50	440 to 530
		C	8	+A	95	225	-	max. 700	15		-	-	-
		H	13,5										
		P[f,g]	75	+QT650	-		450	650 to 850	12		by agreement	-	-
				+QT750			550	750 to 950	10				
X4CrNiMo16-5-1	1.4418	P[g]	75	+QT840	-		660	840 to 1100	14		55	-	-

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

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

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

[d] The values apply for test pieces with a gauge length of 80 mm and a width of 20 mm; test pieces with a gauge length of 50 mm and a width of 12,5 mm may also be used.

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

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

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

*) 1 MPa = 1 N/mm^2

Table 9 — Mechanical properties at room temperature of precipitation hardening steels in the heat treated condition (see Table A.3)

Steel designation		Product form[a]	Thick-ness	Heat-treatment condition[b]	0,2 %-proof strength	Tensile strength	Elongation after fracture	
Name	Number		mm max.		$R_{p0,2}$ MPa[*)] min.	R_m MPa[*)]	$A_{80\ mm}$[c] < 3 mm thick % min. (long. + tr.)	A[d] ≥ 3 mm thick % min. (long. + tr.)
Special grades								
X5CrNiCuNb16-4	1.4542	C	8	+AT[e]	-	≤ 1275	5	
				+P1300[f]	1150	≥ 1300	3	
				+P900[f]	700	≥ 900	6	
		P	50	+P1070[g]	1000	1070 to 1270	8	10
				+P950[g]	800	950 to 1150	10	12
				+P850[g]	600	850 to 1050	12	14
				+SR630[h]	-	≤ 1050	-	
X7CrNiAl17-7	1.4568	C	8	+AT[e]	-	≤ 1030	19	
				+P1450[f]	1310	≥ 1450	2	

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

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

[c] The values apply for test pieces with a gauge length of 80 mm and a width of 20 mm; test pieces with a gauge length of 50 mm and a width of 12,5 mm can also be used.

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

[e] Delivery condition.

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

[g] If ordered in the finally treated condition.

[h] Delivery condition for further processing; final treatment according to table A.3.

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

Table 10 — Mechanical properties at room temperature of austenitic steels in the solution annealed condition (see Table A.4) and resistance to intergranular corrosion

Steel designation		Product form[a]	Thick-ness	0,2%-proof strength	1% -proof-strength	Tensile strength	Elongation after fracture		Impact energy (ISO-V)		Resistance to intergranular corrosion[g]	
Name	Number			$R_{p0,2}$	$R_{p1,0}$[b]	R_m	A_{80}[c, e] < 3 mm thick	A[c, f] ≥ 3 mm thick	*KV* > 10 mm thick		in the delivery condition	in the sensitized condition[h]
			mm max.	MPa*) min. (tr.)[c, d]		MPa*)	% min. (tr.)	% min. (tr.)	J min. (long.)	J min. (tr.)		
Standard grades												
X2CrNiN18-7	1.4318	C	8	350	380	650 to 850	35	40	-	-	yes	yes
		H	13,5	330	370				90	60		
		P[i]	75	330	370	630 to 830	45	45				
X2CrNi18-9	1.4307	C	8	220	250	520 to 700	45	45	-	-	yes	yes
		H	13,5	200	240				100	60		
		P[i]	75	200	240	500 to 700						
X2CrNi19-11	1.4306	C	8	220	250	520 to 700	45	45	-	-	yes	yes
		H	13,5	200	240				100	60		
		P[i]	75	200	240	500 to 700						
X2CrNiN18-10	1.4311	C	8	290	320	550 to 750	40	40	-	-	yes	yes
		H	13,5	270	310				100	60		
		P[i]	75	270	310							
X5CrNi18-10	1.4301	C	8	230	260	540 to 750	45[j]	45[j]	-	-	yes	no[k]
		H	13,5	210	250	520 to 720			100	60		
		P[i]	75	210	250		45	45				
X6CrNiTi18-10	1.4541	C	8	220	250	520 to 720	40	40	-	-	yes	yes
		H	13,5	200	240				100	60		
		P[i]	75	200	240	500 to 700						
X2CrNiMo17-12-2	1.4404	C	8	240	270	530 to 680	40	40	-	-	yes	yes
		H	13,5	220	260				100	60		
		P[i]	75	220	260	520 to 670	45	45				
X2CrNiMoN17-11-2	1.4406	C	8	300	330	580 to 780	40	40	-	-	yes	yes
		H	13,5	280	320				100	60		
		P[i]	75	280	320							
X5CrNiMo17-12-2	1.4401	C	8	240	270	530 to 680	40	40	-	-	yes	no[k]
		H	13,5	220	260				100	60		
		P[i]	75	220	260	520 to 670	45	45				
X6CrNiMoTi17-12-2	1.4571	C	8	240	270	540 to 690	40	40	-	-	yes	yes
		H	13,5	220	260				100	60		
		P[i]	75	220	260	520 to 670						
X2CrNiMo17-12-3	1.4432	C	8	240	270	550 to 700	40	40	-	-	yes	yes
		H	13,5	220	260				100	60		
		P[i]	75	220	260	520 to 670	45	45				
X2CrNiMo18-14-3	1.4435	C	8	240	270	550 to 700	40	40	-	-	yes	yes
		H	13,5	220	260				100	60		
		P[i]	75	220	260	520 to 670	45	45				
X2CrNiMoN17-13-5	1.4439	C	8	290	320	580 to 780	35	35	-	-	yes	yes
		H	13,5	270	310				100	60		
		P[i]	75	270	310		40	40				
X1NiCrMoCu25-20-5	1.4539	C	8	240	270	530 to 730	35	35	-	-	yes	yes
		H	13,5	220	260				100	60		
		P[i]	75			520 to 720						

Table 10 (*continued*)

Steel designation		Product form[a]	Thickness	0,2 %-proof-strength	1 % -proof-strengt h	Tensile strength	Elongation after fracture		Impact energy (ISO-V)		Resistance to intergranular corrosion[g]	
Name	Number			$R_{p0,2}$	$R_{p1,0}$[b]	R_m	A_{80}[c, e] < 3 mm thick	A[c, f] ≥ 3 mm thick	*KV* > 10 mm thick		in the delivery condition	in the sensitized condition[h]
			mm max.	MPa[*)] min. (tr.)[c, d]		MPa[*)]	% min. (tr.)	% min. (tr.)	J min. (long.)	J min. (tr.)		
Special grades												
X1CrNi25-21	1.4335	P	75	200	240	470 to 670	40	40	100	60	yes	yes
X1CrNiMoN25-22-2	1.4466	P[j]	75	250	290	540 to 740	40	40	100	60	yes	yes
X2CrNiMoN17-13-3	1.4429	C	8	300	330	580 to 780	35	35	-	-	yes	yes
		H	13,5	280	320				100	60		
		P[i]	75	280	320		40	40				
X3CrNiMo17-13-3	1.4436	C	8	240	270	550 to 700	40	40	-	-	yes	no[k]
		H	13,5	220	260				100	60		
		P[i]	75	220	260	530 to 730	40	40				
X2CrNiMo18-15-4	1.4438	C	8	240	270	550 to 700	35	35	-	-	yes	yes
		H	13,5	220	260				100	60		
		P[i]	75	220	260	520 to 720	40	40				
X12CrMnNiN17-7-5	1.4372	C	8	350	380	750 to 950	45	45	-	-	yes	no
		H	13,5	330	370				100	60		
		P[i]	75	330	370		40	40				
X1NiCrMoCu31-27-4	1.4563	P[i]	75	220	260	500 to 700	40	40	100	60	yes	yes
X1CrNiMoCuN20-18-7	1.4547	C	8	320	350	650 to 850	35	35	-	-	yes	yes
		H	13,5	300	340				100	60		
		P[i]	75	300	340		40	40				
X1NiCrMoCuN25-20-7	1.4529	P[i]	75	300	340	650 to 850	40	40	100	60	yes	yes
X2CrNiMnMoN25-18-6-5	1.4565	C	6	420	460	800 to 950	30	30	120	90	yes	yes
		H	10									
		P	40									

The 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.

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

[b] Only for guidance.

[c] If, in the case of strip in rolling widths < 300 mm, longitudinal test pieces are taken, the minimum values shall be reduced as follows: proof strength - minus 15 MPa, elongation for constant gauge length - minus 5%; elongation for proportional gauge length - minus 2 %.

[d] For continuously hot rolled products, 20 MPa higher minimum values of $R_{p0,2}$ and 10 MPa higher minimum values of $R_{p1,0}$ may be agreed at the time of enquiry and order.

[e] The values apply for test pieces with a gauge length of 80 mm and a width of 20 mm; test pieces with a gauge length of 50 mm and a width of 12,5 mm may also be used.

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

[g] When tested according to EN ISO 3651–2.

[h] See NOTE to 6.4.

[i] For thicknesses above 75 mm, the mechanical properties may be agreed.

[j] For stretcher levelled material, the minimum value may be 5 % lower.

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

[*)] 1 MPa = 1N/mm².

Table 11 — Mechanical properties at room temperature of austenitic-ferritic steels in the solution annealed condition (see Table A.5) and resistance to intergranular corrosion

Steel designation		Product form [a]	Thickness	0,2%-proof strength	Tensile strength	Elongation after fracture		Impact energy (ISO-V)		Resistance to intergranular corrosion [f]	
Name	Number			$R_{p0,2}$	R_m	A_{80} < 3 mm thick [d]	A ≥ 3 mm thick [e]	KV > 10 mm thick		in the delivery condition	in the sensitized condition [g]
			mm max.	MPa [*)] min. (tr.) [b,c]	MPa [*)]	% min. (long.+ tr.)	% min. (long.+tr.)	J min. (long.)	J min. (tr.)		
Standard grades											
X2CrNiN23-4	1.4362	C	8	450	650 to 850	20	20	-	-	yes	yes
		H	13,5	400				100	60		
		P [h]	75	400	630 to 800	25	25				
X2CrNiMoN22-5-3	1.4462	C	8	500	700 to 950	20	20	-	-	yes	yes
		H	13,5	460		25	25	100	60		
		P [h]	75	460	640 to 840	25	25				
Special grades											
X2CrNiMoN29-7-2	1.4477	C	8	650	800 to 1050	20	20	-	-	yes	yes
		H	13,5	550	750 to 1000	20	20	100	60		
		P [h]	75	550							
X2CrNiMoN25-7-4	1.4410	C	8	550	750 to 1000	20	20	-	-	yes	yes
		H	13,5	530				100	60		
		P [h]	75	530	730 to 930	20	20				
X2CrNiMoSi18-5-3	1.4424	C	8	450	700 to 900	25	25	100	60	yes	yes
		H	13,5								
		P [h]	75	400	680 to 900						
X2CrMnNiN21-5-1	1.4162	C	6,4	530	700 to 900	20	30	-	-	yes	yes
		H	10	480	680 to 900	30	30	60	40		
		P [h]	75	450	650 to 850	30	30	60	40		

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

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

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

[d] The values shall apply for test pieces with a gauge length of 80 mm and a width of 20 mm; test pieces with a gauge length of 50 mm and a width of 12,5 mm may also be used.

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

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

[g] See NOTE to 6.4.

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

[*)] 1 MPa = 1 N/mm².

Table 12 — Minimum values for the 0,2 %-and 1 %-proof strength of austenitic steels at elevated temperatures

Steel designation		Heat treatment condition[a]	Minimum 0,2 %-proof strength, MPa[*)] at a temperature (in °C) of										Minimum 1 %-proof strength, 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																						
X2CrNiN18-7	1.4318	+AT	265	200	185	180	170	165	-	-	-	-	300	235	215	210	200	195	-	-	-	-
X2CrNi18-9	1.4307	+AT	147	132	118	108	100	94	89	85	81	80	181	162	147	137	127	121	116	112	109	108
X2CrNi19-11	1.4306	+AT	147	132	118	108	100	94	89	85	81	80	181	162	147	137	127	121	116	112	109	108
X2CrNiN18-10	1.4311	+AT	205	175	157	145	136	130	125	121	119	118	240	210	187	175	167	161	156	152	149	147
X5CrNi18-10	1.4301	+AT	157	142	127	118	110	104	98	95	92	90	191	172	157	145	135	129	125	122	120	120
X6CrNiTi18-10	1.4541	+AT	176	167	157	147	136	130	125	121	119	118	208	196	186	177	167	161	156	152	149	147
X2CrNiMo17-12-2	1.4404	+AT	166	152	137	127	118	113	108	103	100	98	199	181	167	157	145	139	135	130	128	127
X2CrNiMoN17-11-2	1.4406	+AT	211	185	167	155	145	140	135	131	128	127	246	218	198	183	175	169	164	160	158	157
X5CrNiMo17-12-2	1.4401	+AT	177	162	147	137	127	120	115	112	110	108	211	191	177	167	156	150	144	141	139	137
X6CrNiMoTi17-12-2	1.4571	+AT	185	177	167	157	145	140	135	131	129	127	218	206	196	186	175	169	164	160	158	157
X2CrNiMo17-12-3	1.4432	+AT	166	152	137	127	118	113	108	103	100	98	199	181	167	157	145	139	135	130	128	127
X2CrNiMo18-14-3	1.4435	+AT	165	150	137	127	119	113	108	103	100	98	200	180	165	153	145	139	135	130	128	127
X2CrNiMoN17-13-5	1.4439	+AT	225	200	185	175	165	155	150	-	-	-	255	230	210	200	190	180	175	-	-	-
X1NiCrMoCu25-20-5	1.4539	+AT	205	190	175	160	145	135	125	115	110	105	235	220	205	190	175	165	155	145	140	135
Special grades																						
X1CrNi25-21	1.4335	+AT	150	140	130	120	115	110	105	-	-	-	180	170	160	150	140	135	130	-	-	-
X1CrNiMoN25-22-2	1.4466	+AT	195	170	160	150	140	135	-	-	-	-	225	205	190	180	170	165	-	-	-	-
X2CrNiMoN17-13-3	1.4429	+AT	211	185	167	155	145	140	135	131	129	127	246	218	198	183	175	169	164	160	158	157
X3CrNiMo17-13-3	1.4436	+AT	177	162	147	137	127	120	115	112	110	108	211	191	177	167	156	150	144	141	139	137
X2CrNiMo18-15-4	1.4438	+AT	172	157	147	137	127	120	115	112	110	108	206	188	177	167	156	148	144	140	138	136
X12CrMnNiN17-7-5	1.4372	+AT	295	260	230	220	205	185	-	-	-	-	325	295	265	250	230	205	-	-	-	-
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
X1CrNiMoCuN20-18-7	1.4547	+AT	230	205	190	180	170	165	160	153	148	-	270	245	225	212	200	195	190	184	180	-
X1CrNiMoCuN25-20-7	1.4529	+AT	230	210	190	180	170	165	160	-	-	-	270	245	225	215	205	195	190	-	-	-
X2CrNiMnMoN25-18-6-5	1.4565	+AT	350	310	270	255	240	225	210	210	210	200	400	355	310	290	270	255	240	240	240	230

[a] +AT = solution annealed.

[*)] 1 MPa = 1 N/mm².

Table 13 — Tensile strength levels in the cold worked condition (process route 2H)

Symbol	Tensile strength [a,b] MPa[*)]
+C700	700 to 850
+C850	850 to 1000
+C1000	1000 to 1150

[a] Intermediate tensile strength values may be agreed. Alternatively, the steels may be specified in terms of minimum 0,2 %-proof strength (see Tables 14 and 16) or hardness, but only one parameter may be specified in the order.

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

[*)] 1 MPa = 1 N/mm².

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

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

[a] Intermediate proof strength values may be agreed.

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

[*)] 1 MPa = 1 N/mm².

Table 15 — Available tensile strength levels of steel grades in the cold worked condition (process route 2H)

Steel designation		Available tensile strength level		
Name	Number	+C700	+C850	+C1000
Standard grades				
X2CrNiN18-7	1.4318	-	X	X
X5CrNi18-10	1.4301	X	X	X
X6CrNiTi18-10	1.4541	X	X	-
X5CrNiMo17-12-2	1.4401	X	X	-
X6CrNiMoTi17-12-2	1.4571	X	X	-
Special grade				
X12CrMnNiN17-7-5	1.4372	-	X	X

Table 16 — Available 0,2 %-proof strength levels of steel grades in the cold worked condition (process route 2H)

Steel designation		Available 0,2 %-proof strength level		
Name	Number	+CP350	+CP500	+CP700
Standard grades				
X2CrNiN18-7	1.4318	-	X	X
X5CrNi18-10	1.4301	X	X	X
X6CrNiTi18-10	1.4541	X	X	-
X5CrNiMo17-12-2	1.4401	X	X	-
X6CrNiMoTi17-12-2	1.4571	X	X	-
Special grade				
X12CrMnNiN17-7-5	1.4372	-	X	X

Table 17 — Tests to be carried out, test units and extent of testing in specific testing

Test	a	Test unit	Product form			Number of test pieces per test sample
			Strip and sheet cut from strip (C, H) in rolling width		Rolled plate (P)	
			< 600 mm	≥ 600 mm		
Chemical analysis	m	Cast	The cast analysis is given by the manufacturer.[b]			
Tensile test at room temperature	m	Same cast, same nominal thickness ± 10 %, same final treatment condition (i.e. same heat treatment and/or same degree of cold deformation)	The extent of testing shall be agreed at the time of ordering	1 test sample from each coil	a) Plates processed under identical conditions may be collected into a batch with a maximum total weight of 30000 kg comprising no more than 40 plates. One test sample per batch shall be taken from heat treated plates up to 15 m in length. One test sample shall be taken from each end of the longest plate in the batch where heat treated plates are longer than 15 m. b) If the plate cannot be tested in batches, one test sample shall be taken from one end from heat treated plates up to 15 m long and one test sample shall be taken from each end of heat treated plates longer than 15 m.	1
Tensile test at elevated temperature	o		To be agreed at the time of ordering (see Table 12).			1
Impact test at room temperature	o		To be agreed at the time of ordering (see Tables 8, 10 and 11).			3
Resistance to intergranular corrosion	o		To be agreed at the time of ordering if intergranular corrosion is a hazard (see Tables 7, 10 and 11).			1

NOTE 1 For austenitic steels, the impact test is normally not carried out (see NOTE in 6.5.1).

NOTE 2 The test for resistance to intergranular corrosion is normally not carried out.

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

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

Table 18 – Minimum frequency of testing for product testing and evaluation as part of FPC

Property	Clause indicating the relevant test method (if any)	Threshold value (if any) and tolerances	Minimum number of samples	Minimum frequency of tests
Tolerances on dimension and shape	Annex B	Yes	1 per product form and nominal dimension	1 per sample
Elongation	7.4.2	Yes	1 per cast, product form, dimensional range (tables for mechanical properties), heat treatment batch	1 per sample
Tensile strength	7.4.2			
Yield strength	7.4.2			
Impact strength	7.4.2	yes	1 per cast, product form, dimensional range (tables for mechanical properties), heat treatment batch	3 per sample
Weldability [covered by chemical composition]	7.4.1	yes	1 per cast	1 per cast
Durability [covered by chemical composition]	7.4.1	yes	1 per cast	1 per cast

Table 19 — Marking of the products

Marking of	Products with specific testing[a]
Manufacturer's name, trade mark or logo	+
The number of this European Standard	(+)
Steel number or name	+
Type of finish	(+)
Cast number	+
Identification number[b]	+
Direction of rolling	(+)
Nominal thickness	(+)
Nominal dimensions other than thickness	(+)
Inspector's mark	(+)
Customer's order No.	(+)

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

[a] The symbols in the table mean:
+ = the marking shall be applied;
(+) = the marking shall be applied if so agreed, or at the manufacturer's discretion.

[b] The numbers or letters used for identification shall allow the product(s) to be related to the relevant inspection certificate.

Annex A
(informative)

Guidelines for further treatment (including heat treatment) in fabrication

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

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

A.3 As the corrosion resistance of stainless steels is only ensured with a metallically clean surface, layers of scale and annealing colours produced during hot forming, heat treatment or welding should be removed as far as possible before use. Finished parts made of steels with approximately 13 % Cr also require the best surface condition (e.g. polished) in order to achieve maximum resistance to corrosion.

Table A.1 — Guidelines on the temperatures for hot forming and heat treatment of ferritic corrosion resisting steels

Steel designation		Hot forming		Heat treatment symbol	Annealing	
Name	Number	Temperature °C	Type of cooling		Temperature [a] °C	Type of cooling
Standard grades						
X2CrNi12	1.4003	1100 to 800	air	+A	700 to 760	air, water
X2CrTi12	1.4512				770 to 830	
X6Cr17	1.4016				770 to 830	
X3CrTi17	1.4510				770 to 830	
X2CrMoTi18-2	1.4521				820 to 880	
Special grades						
X2CrMoTi17-1	1.4513	1100 to 800	air	+A	820 to 880	air, water
X6CrMoNb17-1	1.4526				800 to 860	
X2CrTiNb18	1.4509				870 to 930	

NOTE The temperature of annealing should be agreed for simulated heat-treated test-pieces.

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

Table A.2 — Guidelines on the temperatures for hot forming and heat treatment of martensitic corrosion resisting steels

Steel designation		Hot forming		Heat treatment symbol	Annealing		Quenching		Tempering
Name	Number	Temperature °C	Type of cooling		Temperature[a] °C	Type of cooling	Temperature[a] °C	Type of cooling	Temperature °C
X12Cr13	1.4006	1100 to 800	air	+A	750 to 810	-	-	-	-
				+QT550	-	-	950 to 1010	oil, air	700 to 780
				+QT650	-	-			620 to 700
X20Cr13	1.4021		slow cooling	+A	730 to 790	-	-	-	-
				+QT	-	-	950 to 1050	Oil, air	200 to 350
				+QT650	-	-	950 to 1010		700 to 780
				+QT750	-	-			620 to 700
X4CrNiMo16-5-1	1.4418	1150 to 900	air	+QT840	-	-	900 to 1000	oil, air, water	570 to 650

NOTE The temperatures of annealing, quenching and tempering should be agreed for simulated heat-treated test pieces.

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

Table A.3 — Guidelines on the temperatures for hot forming and heat treatment of precipitation hardening corrosion resisting steels

Steel designation		Hot forming		Heat treatment symbol	Stress relieving		Solution annealing		Precipitation hardening
Name	Number	Temperature °C	Type of cooling		Temperature °C	Type of cooling	Temperature [a] °C	Type of cooling	Temperature °C
Special grade									
X5CrNiCuNb16-4	1.4542	1150 to 900	air	+AT	-	-	1025 to 1055	air	-
				+P850	-	-	1025 to 1055	air	4 h (610 to 630)
				+P900	-	-			1 h (590 to 610)
				+P950	-	-			1 h (580 to 600)
				+P1070	-	-			1 h (540 to 560)
				+P1300	-	-			1 h (470 to 490)
				+SR630	≥ 4 h (600 to 660)[b]	-	-	-	-
X7CrNiAl17-7	1.4568			+AT	-	-	1030 to 1050	air	-
				+P1450	-	-	10 min 945 to 965	[c]	1 h (500 to 520)

NOTE The temperatures of solution annealing should be agreed for simulated heat-treated test pieces.

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

[b] After martensitic transformation. Solution annealing at 1025 to 1055 °C will be necessary before precipitation hardening.

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

Table A.4 — Guidelines on the temperatures for hot forming and heat treatment of austenitic corrosion resisting steels

Steel designation		Hot forming		Heat treatment symbol	Solution annealing	
Name	Number	Temperature °C	Type of cooling		Temperature[a, b, c] °C	Type of cooling
Standard grades						
X2CrNiN18-7	1.4318	1150 to 850	air	+AT	1020 to 1100	water, air[d]
X2CrNi18-9	1.4307				1000 to 1100	
X2CrNi19-11	1.4306				1000 to 1100	
X2CrNiN18-10	1.4311				1000 to 1100	
X5CrNi18-10	1.4301				1000 to 1100	
X6CrNiTi18-10	1.4541				1000 to 1100	
X2CrNiMo17-12-2	1.4404				1030 to 1110	
X2CrNiMoN17-11-2	1.4406				1030 to 1110	
X5CrNiMo17-12-2	1.4401				1030 to 1110	
X6CrNiMoTi17-12-2	1.4571				1030 to 1110	
X2CrNiMo17-12-3	1.4432				1030 to 1110	
X2CrNiMo18-14-3	1.4435				1030 to 1110	
X2CrNiMoN17-13-5	1.4439				1060 to 1140	
X1NiCrMoCu25-20-5	1.4539				1060 to 1140	
Special grades						
X1CrNi25-21	1.4335	1150 to 850	air	+AT	1030 to 1110	water, air[d]
X1CrNiMoN25-22-2	1.4466				1070 to 1150	
X2CrNiMoN17-13-3	1.4429				1030 to 1110	
X3CrNiMo17-13-3	1.4436				1030 to 1110	
X2CrNiMo18-15-4	1.4438				1070 to 1150	
X12CrMnNiN17-7-5	1.4372	1150 to 850			1000 to 1100	
X1NiCrMoCu31-27-4	1.4563				1070 to 1150	
X1CrNiMoCuN20-18-7	1.4547	1200 to 1000			1150 to 1200	
X1NiCrMoCuN25-20-7	1.4529	1150 to 850			1120 to 1180	
X2CrNiMnMoN25-18-6-5	1.4565	1200 to 950			1120 to 1170	

NOTE The temperatures of solution annealing should be agreed for simulated heat-treated test pieces.

[a] The 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.

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

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

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

Table A.5 — Guidelines on the temperatures for hot forming and heat treatment of austenitic-ferritic corrosion resisting steels

Steel designation		Hot forming		Heat treatment symbol	Solution annealing	
Name	Number	Temperature °C	Type of cooling		Temperature[a] °C	Type of cooling
Standard grades						
X2CrNiN23-4	1.4362	1150 to 950	air	+AT	950 to 1050	water, air[b]
X2CrNiMoN22-5-3	1.4462				1020 to 1100	
Special grades						
X2CrNiMoN29-7-2	1.4477	1150			1040 to 1120	
X2CrNiMoN25-7-4	1.4410	to	air	+AT		water, air[b]
X2CrNiMoSi18-5-3	1.4424	1000			1000 to 1100	
X2CrMnNiN21-5-1	1.4162	1100 to 900			1020 to 1080	

NOTE The temperatures of solution annealing should be agreed for simulated heat-treated test pieces.

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

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

Annex B
(normative)

Applicable dimensional standards

EN 10029, *Hot rolled steel plates 3 mm thick or above - Tolerances on dimensions, shape and mass*

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

EN 10051, *Continuously hot-rolled uncoated plate, sheet and strip of non-alloy and alloy steels – Tolerances on dimensions and shape (includes amendment A1:1997)*

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

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 89/106/EEC, EU Construction Products Directive

ZA.1 Scope and relevant characteristics

This European standard has been prepared under mandate M/120 'Structural metal products' given to CEN by the European Commission and the European Free Trade Association.

The clauses of this European Standard shown in this Annex meet the requirements of the mandate given under the EU Construction Products Directive (89/106/EEC).

Compliance with these clauses confers a presumption of fitness of the construction products covered by this Annex for the intended uses indicated herein; reference shall be made to the information accompanying the CE marking.

WARNING: Other requirements and other EU Directives, not affecting the fitness for intended uses, can be applicable to the product(s) falling within the scope of this European Standard.

NOTE 1 In addition to any specific clauses relating to dangerous substances contained in this Standard, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the EU Construction Products Directive, these requirements need also to be complied with when and where they apply.

NOTE 2 An informative database of European and national provisions on dangerous substances is available at the Construction web site on EUROPA (accessed through http://ec.europa.eu/enterprise/construction/internal/dangsub/dangmain_en.htm).

This Annex has the same scope as Clause 1 of this European Standard. It establishes the conditions for the CE marking of corrosion resistant steel products intended for the use indicated below and shows the relevant clauses applicable (see Table ZA.1). Construction products are structural metallic sections/profiles: hot rolled sections/profiles with various shapes (T, L, H, U, Z, I, channels, angle), flat products (plate, sheet, strip), bars.

Intended uses: metal structures or in composite metal and concrete structures.

NOTE 3 In this European Standard the term "steel grades" is used. It is identical with the term "technical classes".

The requirement on a certain characteristic is not applicable in those Member States (MSs) where there are no regulatory requirements on that characteristic for the intended use of the product. In this case, manufacturers placing their products on the market of these MSs are not obliged to determine nor declare the performance of their products with regard to this characteristic and the option 'No performance determined' (NPD) in the information accompanying the CE marking (see ZA.3) may be used. The NPD option may not be used, however, where the characteristic is subject to a threshold level.

Table ZA.1 — Relevant clauses for stainless steel flat products for construction purposes

Product: Stainless steel flat products for construction purposes **Intended use:** Metal structures or composite metal and concrete structures			
Essential characteristics	Requirement clause(s)	Levels/and/or classes	Notes
Tolerances on dimensions and shape	6.9 and Annex B	–	Pass/fail
Elongation	6.5.1 and EN 10002-1	–	Threshold values
Tensile strength	6.5.1 and EN 10002-1	–	Threshold values
0,2%-proof strength (yield strength)	6.5.1 and EN 10002-1	–	Threshold values
Impact strength	6.5.1 and EN 10045-1	–	Threshold values
Weldability [covered by chemical composition]	6.3	–	Threshold values
Durability [covered by chemical composition]	6.3 + 6.4	–	Threshold values
Fracture toughness/brittle strength [covered by impact strength]	6.5.1 and EN 10045-1	–	Threshold values
Cold formability [covered by elongation]	6.8 and EN 10002-1	–	Threshold values

ZA.2 Procedures for the attestation of conformity of steel products

ZA.2.1 System of attestation of conformity

The system of attestation of conformity for corrosion resistant steel products indicated in Table ZA.1 in accordance with the Decision of the Commission 98/214/EC of 1998-03-18 amended by the Decision 01/596EC of 8 January (published as document L 209 of 2.08.01) and as given in Annex III of the mandate for Structural metallic products and ancillaries, is shown in Table ZA.2 for the indicated intended use.

Table ZA.2 — Products, intended uses and attestation of conformity system

Product(s)	**Intended use(s)**	**Level(s) or class(es)**	**Attestation of conformity system**
STRUCTURAL METALLIC SECTIONS/PROFILES: hot rolled sections/profiles with various shapes (T, L, H, U, Z, I, channels, angle), flat products (plate, sheet, strip), bars.	to be used in metal structures or in composite metal and concrete structures	–	2+
System 2+: See Directive 89/106/EEC (CPD) Annex III.2.(ii), First possibility, including certification of the factory production control by an approved body on the basis of its initial inspection of the works and of factory control as well as continuous surveillance, assessment and approval of factory production control.			

The attestation of conformity of corrosion resistant steel products in Table ZA.1 shall be according to the evaluation of conformity procedures indicated in Table ZA.3 resulting from the application of Clause 8 of this European Standard.

Table ZA.3 — Assignment of evaluation of conformity tasks for corrosion resistant steel products under system 2+

Tasks			Content of the task	Evaluation of conformity clauses to apply
Tasks under the responsibility of the manufacturer	Factory production control (FPC)		Parameters related to all relevant characteristics of Table ZA.1	See 8.3
	Initial type testing by the manufacturer		Tolerances on dimension and shape; elongation; tensile strength; yield strength; impact strength; weldability (possibly);	See 8.2
	Testing of samples taken at the factory		All characteristics of Table ZA.1	See 8.2
	Certification of FPC by the FPC certification body on the basis of	Initial inspection of factory and of FPC	Parameters related to all relevant characteristics of Table ZA.1, in particular: Tolerances on dimension and shape; elongation; tensile strength; yield strength; impact strength; weldability; durability.	See 8.3
		Continuous surveillance, assessment and approval of FPC	Parameters related to all relevant characteristics of Table ZA.1, in particular: Tolerances on dimension and shape; elongation; tensile strength; yield strength; impact strength; weldability; durability.	See 8.3

ZA.2.2 EC certificate and declaration of conformity

When compliance with the conditions of this Annex is achieved, and once the notified body has drawn up the certificate mentioned below, the manufacturer or his agent established in the European Economic Area (EEA) shall prepare and retain a declaration of conformity, which entitles the manufacturer to affix the CE marking. This declaration shall include:

a) name and address of the manufacturer, or his authorised representative established in the EEA, and the place of production;

NOTE 1 The manufacturer may also be the person responsible for placing the product onto EEA market, if he takes responsibility for CE marking.

b) description of the product (type, identification, use …), and a copy of the information accompanying the CE marking;

NOTE 2 Where some of the information required for the Declaration is already given in the CE marking information, it does not need to be repeated.

c) provisions to which the product conforms (e.g. Annex ZA of this European Standard);

d) particular conditions applicable to the use of the product (e.g. provisions for use under certain conditions);

e) the number of the accompanying factory production control certificate;

f) name of, and position held by, the person empowered to sign the declaration on behalf of the manufacturer or his authorized representative.

The declaration shall be accompanied by a factory production control certificate, drawn up by the notified body, which shall contain in addition to the information above, the following:

g) name and address of the notified body;

h) the number of the factory production control certificate;

i) conditions and period of validity of the certificate, where applicable;

j) name of and position held by, the person empowered to sign the certificate.

The above mentioned declaration and certificate shall be presented in the official language(s) acceptable to the Member State in which the product is to be used.

ZA.3 CE marking and labelling

The manufacturer or his authorised representative established within the EEA is responsible for the affixing of the CE marking. The CE marking shall be in accordance with Directive 93/68/EEC[1)] EC and shall be shown on the construction product or when not possible it may be on the accompanying label, the packaging or on the accompanying commercial documents (inspection document). The CE marking consists of the letters "CE" in the specified form and shall be accompanied by the following information:

a) identification number of the certification body;

b) name or identifying mark and registered address of the producer;

c) the last two digits of the year in which the marking is affixed;

d) the number of the factory production control certificate;

e) reference to this European Standard;

f) description of the product (see 4.2) in accordance with the relevant dimensional tolerance standard (see 2): generic name, intended use, dimensions and material;

g) information on those relevant essential characteristics listed in Table ZA.1 which are to be declared presented as:

   1) declared values and, where relevant, level or class (including 'pass' for pass/fail requirements, where necessary) to declare for each essential characteristic as indicated in 'Notes' in Table ZA.1;

   2) 'No performance determined' for characteristics where this is relevant;

   3) as an alternative, a standard designation which shows some or all of the relevant characteristics (where the designation covers only some characteristics, it will need to be supplemented with declared values for other characteristics as above).

Figures ZA.1 and ZA.2 give examples of the information to be given on the product, label, packaging and/or commercial documents.

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1) Council Directive 93/68/EEC of 22 July 1993 amending 12 Directives, including Directive 89/106/EEC harmonising the provisions for CE marking

CE 01234	*CE conformity marking, consisting of the "CE"-symbol given in Directive 93/68/EEC.* *Identification number of the certification body (where relevant)*
Any Co Ltd, PO Box 21, B-1050 **09** 01234-CPD-00234	*Name or identifying mark and registered address of the producer* *Last two digits of the year in which the marking was affixed* *Certificate number (where relevant)*
EN 10088-4:2009 Corrosion resistant steel plate Intended uses: Building construction or civil engineering. **Tolerances on dimensions and shape: Plate EN 10029** **Elongation** **Tensile strength** **Yield strength** **Impact strength** **Weldability** **Durability** **Steel 1.4301 EN 10088-4** **Regulated substance: No performance determined**	*No. of European standard* *Description of product* *and* *information on regulated characteristics*

Figure ZA.1 — First example CE marking information

CE 01234	*CE conformity marking, consisting of the "CE"-symbol given in Directive 93/68/EEC.* *Identification number of the certification body (where relevant)*
Any Co Ltd, PO Box 21, B-1050 **09** 01234-CPD-00234	*Name or identifying mark and registered address of the producer* *Last two digits of the year in which the marking was affixed* *Certificate number (where relevant)*
EN 10088-4:2009 Corrosion resistant steel strip for building construction or civil engineering. **Tolerances on dimensions and shape: Strip EN ISO 9445** **Steel 1.4301 – EN 10088-4** **Regulated substance: No performance determined**	*No. of European standard* *Description of product* *and* *information on regulated characteristics*

Figure ZA.2 — Second example CE marking information

In addition to any specific information relating to dangerous substances shown above, the product should also be accompanied, when and where required and in the appropriate form, by documentation listing any other legislation on dangerous substances for which compliance is claimed, together with any information required by that legislation.

NOTE 1 European legislation without national derogations need not be mentioned.

NOTE 2 Affixing the CE marking symbol means, if a product is subject to more than one directive, that it complies with all applicable directives.

Bibliography

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

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

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

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

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