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

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

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

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Contents

Foreword

This document (EN 10088-2:2005) 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of an identical text or by endorsement, at the latest by December 2005, and conflicting national standards shall be withdrawn at the latest by December 2005.

This document supersedes EN 10088-2:1995.

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.

The European Organisation for Standardisation (CEN) draws attention to the fact that it is claimed that compliance with this document may involve the use of patents concerning four steel grades.

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Grades 1.4362, 1.4410 and 1.4477

Sandvik AB
SE-811 81 SANDVIKEN
Sweden

Grade 1.4652

Outokumpu Stainless AB
SE-77480 AVESTA
Sweden

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1 Scope

1.1 This part of EN 10088 specifies the technical delivery conditions for hot or cold rolled sheet/plate and strip of standard grades and special grades of corrosion resisting stainless steels for general purposes.

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

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

1.3 This European Standard does not apply to components manufactured by further processing of the product forms listed in 1.1 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 test at elevated temperature.*

EN 10021, *General technical delivery requirements for steel and iron products.*

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

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, *Vocabulary of heat treatment terms for ferrous products.*

EN 10079, *Definition of steel products.*

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

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

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

EN 10204:2004, *Metallic products - Types of inspection documents.*

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

EN ISO 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 sulfuric acid (ISO 3651-2:1998).*

EN ISO 6506-1, *Metallic materials - Brinell hardness test - Part 1: Test method (ISO 6506-1:1999).*

EN ISO 6507-1, *Metallic materials - Vickers hardness test - Part 1: Test method (ISO 6507-1:1997).*

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 6508-1:1999).*

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 European Standard, the following terms and definitions apply:

3.1
stainless steels
definition in EN 10088-1 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
definitions in EN 10079 apply

3.4
types of heat-treatment
definitions in EN 10052 apply

3.5
general purposes
purposes other than the special purposes mentioned in the Bibliography

3.6
standard grades
grades with a relatively good availability and a wider range of application

3.7
special grades
grades for special use and/or with limited availability

4 Designation and ordering

4.1 Designation of steel grades

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

4.2 Designation to be used on ordering

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

— desired quantity;

— product form (strip or sheet/plate);

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

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

— type of material (steel);

— number of this document;

— steel name or steel number;

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

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

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

— if an inspection document is required, its designation according to EN 10204.

EXAMPLE 10 plates of a steel grade with the name X5CrNi18-10 and the number 1.4301 as specified in EN 10088-2 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 A and flatness tolerance class N, in process route 1D (see Table 6), inspection document 3.1 as specified in EN 10204:

10 plates EN 10029-8A x 2000 x 5000
Steel EN 10088-2 - X5CrNi18-10+1D
Inspection document 3.1

or

10 plates EN 10029-8A x 2000 x 5000
Steel EN 10088-2 - 1.4301+1D
Inspection document 3.1

5 Classification of grades

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

— ferritic steels,

— martensitic steels,

— precipitation hardening steels,

— austenitic steels,

— austenitic-ferritic steels.

See also Annex B to EN 10088-1

6 Requirements

6.1 Steelmaking process

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

6.2 Delivery condition

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

6.3 Chemical composition

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

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

6.4 Chemical corrosion properties

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

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 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 apply for the relevant specified heat treatment condition. This does not apply to the process route 1U (hot rolled, not heat treated, not descaled).

If by agreement at the time of ordering the products are to be supplied in a non-heat-treated condition, the mechanical properties specified in Tables 7, 8, 9, 10 and 11 shall be obtained from reference test pieces which have received the appropriate heat treatment (simulated heat treatment).

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

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

NOTE Austenitic steels are insensitive to brittle fracture in the solution annealed condition. 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 12 to 16 apply for the 0,2 %- and 1 %-proof strength at elevated temperatures.

6.6 Surface quality

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

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

6.7 Internal soundness

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

6.8 Formability at room temperature

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

6.9 Dimensions and tolerances on dimensions and shape

The dimensions and the tolerances on dimensions and shape are to be agreed at the time of enquiry and order, as far as possible with reference to the dimensional standards listed in Annex B. EN 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 is to be applied. When applying EN 10029, thickness tolerance class B shall apply, unless specifically agreed otherwise at the time of enquiry and order.

6.10 Calculation of mass and tolerances on mass

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

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

7 Inspection and testing

7.1 General

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

This includes the following:

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

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

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

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

7.2 Agreement on tests and inspection documents

7.2.1 At the time of ordering the type of inspection document in accordance with EN 10204 may be agreed for each delivery.

7.2.2 If it is agreed to issue a test report 2.2 in accordance with EN 10204:2004 it shall indicate the following information:

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

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

7.2.3 If the issuing of an inspection certificate 3.1 or 3.2 according to EN 10204:2004 has been agreed, specific inspections according to 7.3 are to be carried out and the following information shall be given in the inspection document with the code numbers and details required by EN 10168:2004:

a) under 7.2.2 a);

b) under 7.2.2 b);

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

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

7.3 Specific inspection and testing

7.3.1 Extent of testing

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

7.3.2 Selection and preparation of samples and test pieces

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

7.3.2.2 The test samples for the tensile test shall be taken in accordance with Figure 1 in such a way that they are located halfway between the centre and a longitudinal edge. If it has been agreed that impact tests shall be carried out, the test samples shall be taken from the same location.

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

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

7.4 Test methods

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

NOTE The list of available European Standards on chemical analysis is given in CR 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 If a tensile test at elevated temperature has been ordered, this shall be carried out in accordance with EN 10002-5. If the proof strength is to be verified, the 0,2 %-proof strength shall be determined, for ferritic, martensitic, precipitation hardening and austenitic-ferritic steels. In the case of austenitic steels, the 0,2 %- and the 1 %-proof strength shall be determined.

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

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

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

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

7.5 Retests

See EN 10021.

8 Marking

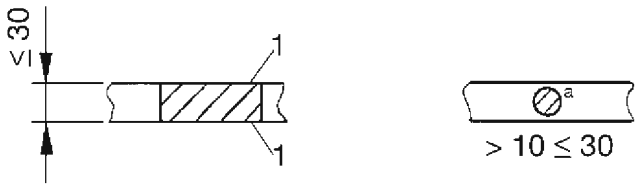
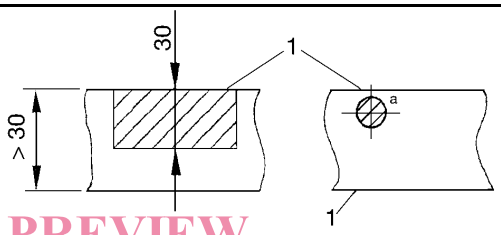
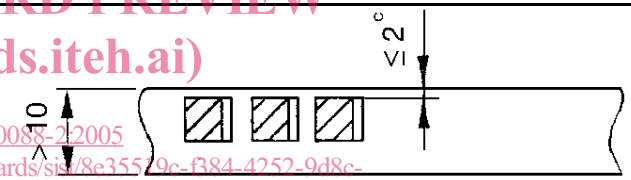
8.1 Unless otherwise agreed in the order, with the exception mentioned in 8.4, each product shall be marked with the information given in Table 22.

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

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

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

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

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

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