BRITISH STANDARD

BS EN 10028-1:2007 +A1:2009

Flat products made of steels for pressure purposes —

Part 1: General requirements

ICS 77.140.30; 77.140.50

National foreword

This British Standard is the UK implementation of EN 10028-1:2007 +A1:2009. It supersedes BS EN 10028-1:2007 which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to CEN text carry the number of the CEN amendment. For example, text altered by CEN amendment A1 is indicated by [A1] 〈A1〉.

The UK participation in its preparation was entrusted by Technical Committee ISE/73, Steels for pressure purposes, to Subcommittee ISE/73/2, Steel plates and bars for pressure purposes.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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EN 10028-1:2007+A1

April 2009

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English Version

Flat products made of steels for pressure purposes - Part 1: General requirements

Produits plats en acier pour appareils à pression - Partie 1: Prescriptions générales

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Contents

Foreword

This document (EN 10028-1:2007+A1:2009) has been prepared by Technical Committee ECISS/TC 22 “Steels for pressure purposes - Qualities”, 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of an identical text or by endorsement, at the latest by October 2009, and conflicting national standards shall be withdrawn at the latest by October 2009.

This document includes Amendment 1, approved by CEN on 2009-03-14.

This document supersedes ⟦A1⟩ EN 10028-1:2007 ⟨A1⟧.

The start and finish of text introduced or altered by amendment is indicated in the text by tags ⟦A1⟩ ⟨A1⟧.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive 97/23/EC.

For relationship with EU Directive 97/23/EC, see informative Annex ZA, which is an integral part of this document.

EN 10028 consists of the following parts under the general title *Flat products made of steels for pressure purposes*:

— *Part 1: General requirements*

— *Part 2: Non-alloy and alloy steels with specified elevated temperature properties*

— *Part 3: Weldable fine grain steels, normalized*

— *Part 4: Nickel alloy steels with specified low temperature properties*

— *Part 5: Weldable fine grain steels, thermomechanically rolled*

— *Part 6: Weldable fine grain steels, quenched and tempered*

— *Part 7: Stainless steels*

NOTE The clauses marked with a point (•) contain information relating to agreements which are to be made at the time of enquiry and order. The clauses marked by two points (••) contain information relating to agreements that may be made at the time of enquiry and order.

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

1 Scope

This European Standard specifies general technical delivery conditions for flat products for the construction of pressure equipment.

The general technical delivery conditions in EN 10021 also apply.

NOTE Once this European Standard is published in the EU Official Journal (OJEU) under Directive 97/23/EC, presumption of conformity to the Essential Safety Requirements (ESRs) of Directive 97/23/EC is limited to technical data of materials in this European Standard (Part 1 and the other relevant part of the series) and does not presume adequacy of the material to a specific item of equipment. Consequently, the assessment of the technical data stated in this material standard against the design requirements of this specific item of equipment to verify that the ESRs of Directive 97/23/EC are satisfied, needs to be done.

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 10002-1:2001, *Metallic materials — Tensile testing — Part 1: Method of test at ambient temperature*

EN 10002-5:1991, *Metallic materials — Tensile testing — Part 5: Method of testing at elevated temperatures*

EN 10020:2000, *Definition and classification of grades of steel*

EN 10021:2006, *General technical delivery conditions for steel products*

EN 10028-2:2003, *Flat products made of steels for pressure purposes — Part 2: Non-alloy and alloy steels with specified elevated temperature properties*

EN 10028-3:2003, *Flat products made of steels for pressure purposes — Part 3: Weldable fine grain steels, normalized*

EN 10028-4:2003, *Flat products made of steels for pressure purposes — Part 4: Nickel alloy steels with specified low temperature properties*

EN 10028-5:2003, *Flat products made of steels for pressure purposes — Part 5: Weldable fine grain steels, thermomechanically rolled*

EN 10028-6:2003, *Flat products made of steels for pressure purposes — Part 6: Weldable fine grain steels, quenched and tempered*

EN 10028-7:2007, *Flat products made of steels for pressure purposes — Part 7: Stainless steels*

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

EN 10045-1:1990, *Metallic materials — Charpy impact test — Part 1: Test method*

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*

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

EN 10079:2007, *Definitions of steel products*

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

EN 10160, *Ultrasonic testing of steel flat product of thickness equal or greater than 6 mm (reflection method)*

EN 10163-2:2004, *Delivery requirements for surface condition of hot-rolled steel plates, wide flats and sections — Part 2: Plates and wide flats*

EN 10164:2004, *Steel products with improved deformation properties perpendicular to the surface of the product — Technical delivery conditions*

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

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

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

EN ISO 2566-1, *Steel — Conversion of elongation values — Part 1: Carbon and low alloy steels (ISO 2566-1:1984)*

EN ISO 2566-2, *Steel — Conversion of elongation values — Part 2: Austenitic steels (ISO 2566-2:1984)*

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

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 terms and definitions given in EN 10020:2000, EN 10079:2007 and EN 10052:1993 (but see 3.1 to 3.3) and the following apply.

3.1
normalizing rolling
rolling process in which the final deformation process is carried out in a certain temperature range leading to a material condition equivalent to that obtained after normalizing so that the specified values of the mechanical properties are retained even after normalizing

NOTE The symbol for this delivery condition and for the normalized condition is N

[deviating from EN 10052:1993]

3.2
thermomechanical rolling

[as defined in EN 10052:1993 for thermomechanical treatment]

NOTE Thermomechanical rolling (symbol M) may include processes of increased cooling rates with or without tempering including self-tempering but excluding definitively direct quenching and tempering.

3.3
quenching and tempering

[as defined in EN 10052:1993]

NOTE Quenching and tempering (symbol QT) also includes direct hardening plus tempering.

3.4
purchaser
person or organization that orders products in accordance with this European Standard

NOTE 1 The purchaser is not necessarily, but may be, a manufacturer of pressure equipment in accordance with the EU Directive listed in Annex ZA

NOTE 2 Where a purchaser has responsibilities under this EU Directive, this European Standard will provide a presumption of conformity with the essential requirements of the Directive so identified in Annex ZA.

4 Dimensions and tolerances on dimensions

• The nominal dimensions and tolerances on dimensions for the products shall be agreed at the time of enquiry and order with reference to the dimensional standards listed below.

a) For non-continuously hot-rolled flat products, refer to EN 10029.

   •• Unless otherwise agreed at the time of enquiry and order, class B as specified in EN 10029 shall apply to the tolerance on thickness of plates.

b) For continuously hot-rolled coil or sheet/plate cut from coils (rolled width 600 mm or above) and hot-rolled slit coil in widths less than 600 mm, refer to EN 10051.

c) For hot-rolled narrow strip (rolled width less than 600 mm) refer to EN 10048.

d) For stainless cold-rolled sheet/plate, cold-rolled coil and slit coil (rolled width 600 mm or above) and stainless cold-rolled coil and slit coil in rolled widths less than 600 mm refer to EN ISO 9445.

   NOTE EN ISO 9445 contains options providing wider dimensional choice.

5 Calculation of mass

A density of 7,85 kg/dm³ shall be used as the basis for the calculation of the nominal mass from the nominal dimensions of all steels of EN 10028-2 to EN 10028-6. Calculations for density of stainless steels shall be based on density values given in EN 10088-1:2005, Annex A.

6 Classification and designation

6.1 Classification

6.1.1 The classification of the steel grades in accordance with EN 10020 is given in the specific parts of EN 10028.

6.1.2 Steels covered in EN 10028-7 are additionally classified according to their structure into

— ferritic steels;

— martensitic steels;

— austenitic steels;

— austenitic-ferritic steels.

NOTE For more details see EN 10088-1.

6.2 Designation

The steel grades specified in the individual parts of EN 10028 are designated with steel names and steel numbers. The steel names have been allocated in accordance with EN 10027-1. The corresponding steel numbers have been allocated in accordance with EN 10027-2.

7 Information to be supplied by the purchaser

7.1 Mandatory information

The following information shall be supplied by the purchaser at the time of enquiry and order:

a) quantity required;

b) type of flat product;

c) European Standard specifying the tolerances on dimensions, shape and mass (see Clause 4) and, if the relevant European Standard permits the purchaser certain options, e.g. regarding edge finishing or tolerance classes, specific information on these aspects;

d) nominal dimensions of the product;

e) number of the relevant part of this European Standard;

f) steel name or number;

g) delivery condition, if it differs from the usual condition specified in EN 10028-2, EN 10028-3, EN 10028-4, EN 10028-5 or EN 10028-6; for stainless steels – the process route selected from the relevant table of EN 10028-7;

h) inspection document to be issued (see 9.1.1).

7.2 Options

A number of options are specified in this part of EN 10028 and listed below. If the purchaser does not indicate a wish to implement any of these options at the time of enquiry and order, the products shall be supplied in accordance with the basic specification (see 7.1).

1) deviating tolerance class (see 4.1 a));

2) specification of the steelmaking process (see 8.1.1);

3) mechanical properties after additional heat treatment (see 8.4.1);

4) specification of special classes for the reduction of area (see 8.4.2);

5) verification of internal soundness (see 8.6);

6) one or several of the optional tests (see Table 1);

7) deviating frequency of testing (see 10.1.1 and 10.1.3);

8) deviating delivery condition (see 10.2.1.3);

9) use of longitudinal test pieces for the impact test (see 10.2.2.3);

10) specification of an analytical method (see 11.1);

11) temperature of the tensile test at elevated temperature (see 11.3);

12) deviating testing temperature for the impact test (see 11.4);

13) marking method (see 12.1);

14) special marking (see 12.2 and 12.3).

7.3 Examples of ordering

Examples of ordering are given in the relevant Part 2, 3, 4, 5, 6 or 7 of this European Standard.

8 Requirements

8.1 Steelmaking process

8.1.1 ●● Unless a special steelmaking process has been agreed at the time of enquiry and order, the steelmaking process shall be left at the discretion of the manufacturer.

8.1.2 Steels other than stainless steels shall be fully killed.

8.2 Delivery condition

See the individual parts of EN 10028 (see also 3.1 to 3.3).

8.3 Chemical composition

8.3.1 Cast analysis

The cast analysis reported by the steel producer shall apply and comply with the requirements of the individual parts of EN 10028.

8.3.2 Product analysis

The permissible product analysis tolerances on the limiting values given for the cast analysis are specified in the individual parts of EN 10028.

8.4 Mechanical properties

8.4.1 The values given in the individual parts of EN 10028 apply for test pieces taken and prepared in accordance with 10.2.2. The values relate to the nominal thickness (thickness on ordering) of the products and apply to the usual delivery conditions (see the specific parts of EN 10028).

●● Agreement shall be reached, where appropriate, at the time of enquiry and order about the mechanical properties to be adhered to after additional heat treatment.

〖A1〉 The minimum impact energy values specified in the relevant parts of EN 10028 apply, even if they are not to be verified in the case of product thicknesses < 6 mm (see 10.2.2.3 c)). 〈A1〗

8.4.2 ●● For products (except products made of stainless steels) of thickness 15 mm and above, it may be agreed at the time of enquiry and order to meet the requirements of one of the quality classes Z 15, Z 25, or Z 35 as specified in EN 10164:2004 characterized by minimum values for the reduction of area perpendicular to the product surface.

8.5 Surface condition

For plates, the requirements of surface quality as specified in EN 10163-2:2004 shall apply as follows:

a) class B2 for plates in accordance with EN 10028-2 to -6;

b) class B3 for plates in accordance with EN 10028-7.

8.6 Internal soundness

The products shall be sound and free from defects that preclude their intended use.

●● Where appropriate, requirements together with the conditions for their verification may be agreed at the time of enquiry and order (see Table 1 and 11.5.3).

9 Inspection

9.1 Types of inspection and inspection documents

9.1.1 The compliance with the requirements of the order shall be checked for products in accordance with this European Standard by specific inspection.

• The purchaser shall specify the required type of inspection document (3.1 or 3.2) in accordance with EN 10204.

〚A1〛 If an inspection document 3.1 is specified, the manufacturer shall operate a quality assurance system, certified by a competent Body established within the European Community and having undergone a specific assessment for materials.

NOTE See Directive 97/23/EC, Annex I, section 4.3, third paragraph and for further information the Guidelines of the EU Commission and the Member States for its interpretation (see e. g. Guidelines 7/2 and 7/16 [4]). 〚A1〛

If an inspection certificate 3.2 is specified, the purchaser shall notify the manufacturer of the name and address of the organization or person who is to carry out the inspection and produce the inspection document. It shall also be agreed which party shall issue the certificate.

9.1.2 The inspection document shall include, in accordance with EN 10168, the following codes and information:

A commercial transactions and parties involved;

B description of products to which the inspection certificate applies (including tempering temperature in the case of quenched and tempered or tempered products);

C03 test temperature;

C10-C29 tensile test at room temperature (including, if applicable, the test perpendicular to the product surface) and, if applicable, at elevated temperatures;

C40-C43 impact test, if applicable;

C70 steelmaking process, if applicable

C71-C92 cast analysis and, if applicable, product analysis;

D01 marking, dimensional and visual inspection and, if applicable, verification of the resistance to intergranular corrosion;

D02-D50 non-destructive tests , if applicable;

Z validation.

9.2 Tests to be carried out

The mandatory and optional tests to be carried out and the extent of testing are specified in Table 1.

Table 1 — Summary of tests and extent of testing

Type of inspection and test			Extent of testing	Refer to
Mandatory tests	Cast analysis		1 per cast	8.3.1
	Tensile test at room temperature		1 per test unit	10.1.2, 10.2.2.2 and 11.2
	Impact test (except for austenitic steels of EN 10028-7)		1 per test unit	10.1.2, 10.2.2.3 and 11.4
	Dimensional inspection		each product	11.5.1
	Visual inspection		each product	11.5.2
Optional tests	Product analysis		1 per cast	10.1.1, 10.2.1 and 11.1
	Tensile test at elevated temperature for verification of $R_{p0,2}$	⟨A1⟩ for steels of EN 10028-2, EN 10028-3 and EN 10028-6 ⟨A1⟩	1 per cast	10.1.3, 10.2.2.2 and 11.3
		for steels of EN 10028-7 (except austenitic steels)	a	
	⟨A1⟩ Tensile test for (simultaneous) verification of one, all, or any combination of the values of $R_{p0,2}$, $R_{p1,0}$ and R_m at elevated temperature for austenitic steels of EN 10028-7 ⟨A1⟩		a	⟨A1⟩ 10.1.3, 10.2.2.2 and 11.3 ⟨A1⟩
	Tensile test perpendicular to the product surface for verification of corresponding minimum reduction of area (except for steels of EN 10028-7)		1 per test unit	⟨A1⟩ 8.4.2 and 10.2.1.2 ⟨A1⟩
	Impact test for austenitic steels of EN 10028-7 at room temperature		a	10.1.2, 10.2.2.3 and 11.4
	Impact test for steels of EN 10028-7 (except ferritic steels) at low temperature		a	10.1.2, 10.2.2.3 and 11.4
	Ultrasonic test for verification of internal soundness		each product	8.6 and 11.5.3
	Test for resistance to intergranular corrosion for steels of EN 10028-7		a	11.5.4

a See EN 10028-7.

9.3 Retests, sorting and reprocessing

For retests, sorting and reprocessing the requirements of EN 10021 shall apply.

10 Sampling

10.1 Frequency of testing

10.1.1 •• For the product analysis, unless otherwise agreed, one test piece per cast shall be taken for determining the elements indicated with numerical values for the particular steel grade in the relevant tables of the specific parts of EN 10028.

For the test unit for the other tests for products in accordance with EN 10028-2 to EN 10028-6, the requirements of 10.1.2, 10.1.3 and Table 1 apply.

For stainless steels see EN 10028-7.

10.1.2 The test unit for the tensile test at room temperature and the impact test shall be as follows:

— for strip and sheet cut from strip: the coil;

— for sheet or plate: the rolled plate.

If a rolled plate or a coil is split up into several heat treatment batches for liquid quenching, then each individual heat treatment batch shall be regarded as a test unit. One sample shall be taken for preparing the test pieces indicated in 10.2.2 from each test unit.

10.1.3 ●● For tensile tests at elevated temperature, unless otherwise agreed, the test unit shall be the cast.

10.2 Selection and preparation of samples and test pieces

10.2.1 Sampling and sample preparation

10.2.1.1 Sampling and sample preparation shall be in accordance with the requirements of EN ISO 377, EN ISO 14284 and Table 2. In addition, the requirements in 10.2.1.2 and, if applicable, 10.2.1.3 shall apply for sampling and sample preparation for the mechanical tests.

10.2.1.2 The samples shall be taken at 1/4 product width (see Table 2) for the tensile test at room temperature, the impact test and the tensile test at elevated temperature. In the case of strip, the samples shall be taken at a sufficient distance from the end of the strip.

NOTE If samples have to be taken from the mid-width position in accordance with the requirements for through-thickness testing as specified in EN 10164, the samples to be taken as specified in 10.2.1.2 may also be taken from there except in cases of arbitration.

10.2.1.3 ●● If, following agreement at the time of enquiry and order, the products is not to be delivered in the usual delivery condition, the samples shall be treated to the usual delivery condition prior to the test.

10.2.2 Preparation of test pieces

10.2.2.1 General

The test pieces shall be prepared in accordance with Table 3 (products in accordance with EN 10028-2 to EN 10028-6) or Table 4 (products in accordance with EN 10028-7).

10.2.2.2 Test pieces for the tensile test

a) One test piece shall be prepared in accordance with EN 10002-1 for the tensile test from each test unit and this shall be a rectangular test piece, unless a circular test piece may be used (see 10.2.2.2 c)).

b) At least one rolled surface shall be retained on rectangular test pieces. However, both rolled surfaces shall generally be retained on the test piece in the case of product thicknesses ≤ 30 mm for products in accordance with EN 10028-2 to EN 10028-6 or ≤ 10 mm in the case of products in accordance with EN 10028-7. Additionally, rectangular test pieces for products in accordance with EN 10028-6, shall represent either the full product thickness or half of the product thickness retaining one rolled surface.

c) Circular test pieces are permissible, but shall only be provided for product thicknesses > 30 mm for products in accordance with EN 10028-2 to EN 10028-6 or > 10 mm for products in accordance with EN 10028-7. Test piece diameters shall be at least 10 mm for products in accordance with EN 10028-2 to EN 10028-6 or at least 5 mm for products in accordance with EN 10028-7, respectively.

10.2.2.3 Test pieces for the impact test

a) Three transverse standard V-notched test pieces shall be prepared from the samples for the impact test, in accordance with EN 10045-1.

b) ●● For products in accordance with EN 10028-3, EN 10028-4 and EN 10028-7 longitudinal test pieces may be agreed.

c) ▌A1⟩ In the case of product thicknesses t 6 mm ≤ t ≤ 11 mm, one of the following alternatives for the test pieces width shall be used, at the discretion of the manufacturer:

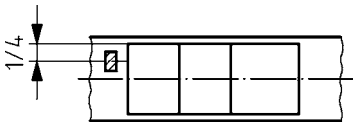
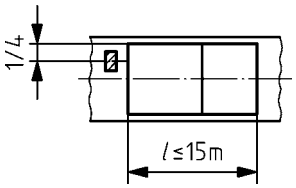
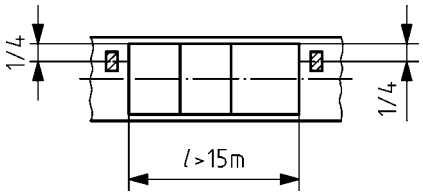
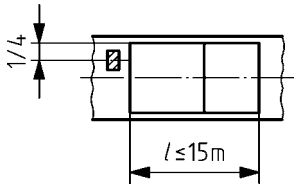
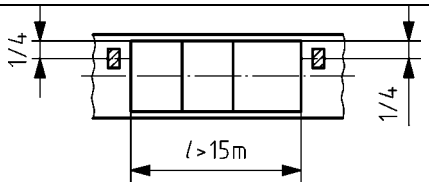
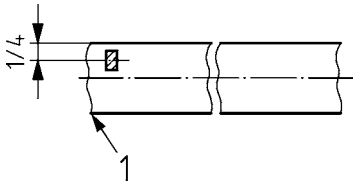
   i. 10 mm;

   ii. largest obtainable width between 5 mm and 10 mm;

   iii. 7,5 mm or 5 mm. ⟨A1▌

d) The notch shall be perpendicular to the surface of the product.

Table 2 — Position from which the sample is taken

Products	Steel grade	Sheet/plate thickness mm	Product length supplied per rolled plate m	Position of samples (plan view) (▨)
Plate sheet	Non-alloy steels	≤ 50	No limitation	
		> 50	≤ 15	
			> 15	a 
	Alloy steels	No limitation	≤ 15	
			> 15	 a
Strip	No distinction	No limitation	–	 b

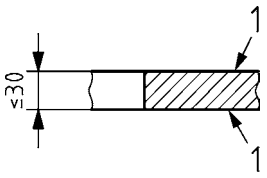
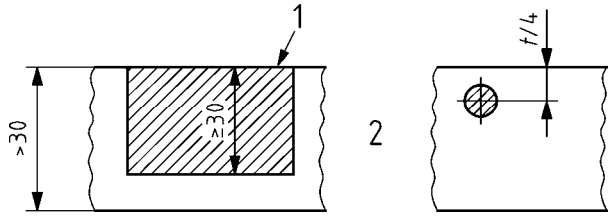
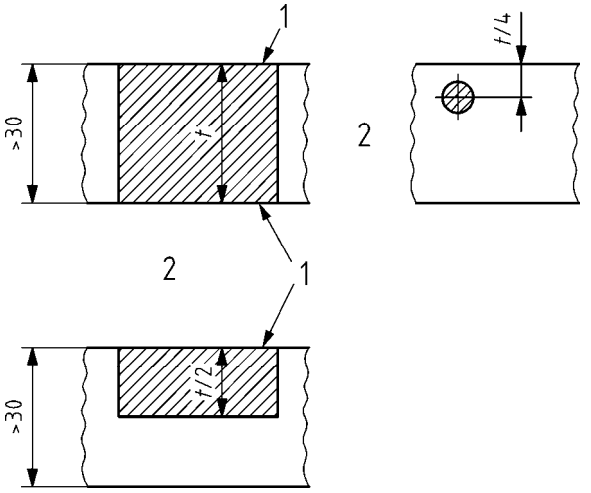
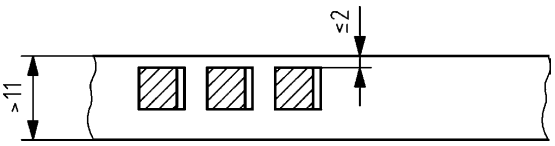
a The samples may also be taken from the other side of the products.

b For the plate/sheet cut from strip, the coil remains the test unit as long as the plate/sheet is not quenched and tempered (see 10.1.2).

Key

1 outside end

Table 3 — Position of test pieces for products in accordance with EN 10028-2 to EN 10028-6

Type of test piece	Product thickness mm	Direction of the longitudinal axis of the test piece in relation to the principal direction of rolling	Distance of the test piece from the rolled surface mm
Tensile	≤ 30	Transverse	
	> 30		a 
			b 
Impact [c]	[A1] > 11 [d] [A1]	Transverse [e]	f 

a For products in accordance with EN 10028-2 to EN 10028-5.

b For products in accordance with EN 10028-6.

c The longitudinal axis of the notch shall always be perpendicular to the rolled surface of the product.

d For impact test pieces to plate thicknesses ≤ [A1] 11 mm [A1], see 10.2.2.3.

e Unless longitudinal test pieces are agreed (see 10.2.2.3).

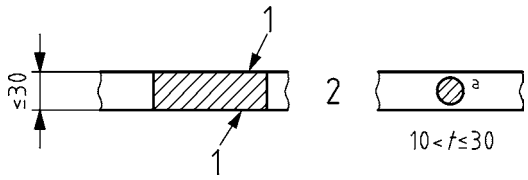
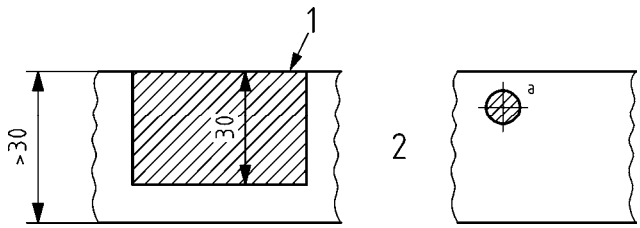
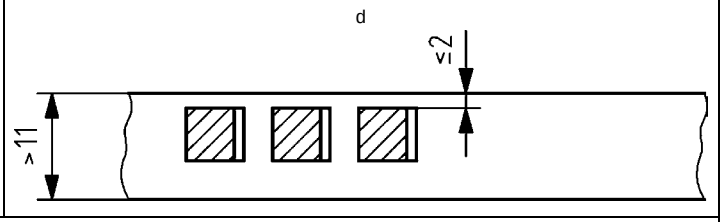
f In the case of product thickness greater than 40 mm, the impact test piece shall be taken at quarter of the product thickness.

Key

1 rolled surface

2 alternatives

Table 4 — Position of test pieces for products in accordance with EN 10028-7

Type of test piece	Product thickness	Direction of the longitudinal axis of the test piece in relation to the principal direction of rolling		Distance of the test piece from the rolled surface
	mm	< 300 mm	≥ 300 mm	mm
Tensile[a]	≤ 30	Longitudinal	Transverse	
	> 30			
Impact [b]	[A1] > 11 [c] [A1]	Longitudinal	Transverse	

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

[A1] For products < 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. [A1] For products with a thickness of 3 to 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 > 10 mm the following proportional test pieces may be used:

- either a flat test piece with a maximum thickness of 30 mm, the thickness may be reduced to 10 mm by machining but one rolled surface shall be preserved.
- or a round test piece with a diameter of ≥ 5 mm, the axis of which shall be located as near as possible to a plane in the outer third of half the product thickness.

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

c For impact test pieces for plate thicknesses ≤ [A1] 11 mm [A1], see 10.2.2.3.

d In 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
2 alternatives

11 Test methods

11.1 Chemical analysis

●● Unless otherwise agreed at the time of enquiry and order, the choice of a suitable physical or chemical analytical method for the product analysis shall be at the discretion of the manufacturer. In cases of dispute, the analysis shall be carried out by a laboratory approved by both parties. In this case, the analysis method to be used shall be agreed taking into account the relevant existing European Standards. The list of available European Standards is given in [A1] CEN/TR 10261 [A1].

11.2 Tensile test at room temperature

11.2.1 For the steels of EN 10028-2 to EN 10028-6 the tensile test at room temperature shall be carried out in accordance with EN 10002-1, generally using a proportional test piece of gauge length $L_0 = 5{,}65\sqrt{S_0}$ (S_0 : initial cross-sectional area of the test piece). Test pieces with a constant gauge length may be used; in this case, the elongation value shall be converted in accordance with EN ISO 2566-1 for the steels of EN 10028-2 to EN 10028-6.

The tensile strength R_m, the elongation after fracture A and the yield strength shall be determined. The yield strength to be determined shall be the upper yield strength R_{eH} or, wherever this is not pronounced, the 0,2 % proof strength $R_{p0,2}$.

11.2.2 For the steels of EN 10028-7 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 Table 4. For non-proportional test pieces, the elongation values shall be converted in accordance with EN ISO 2566-2. The tensile strength and elongation after fracture shall be determined and additionally for ferritic, martensitic and austenitic-ferritic steels the 0,2 % proof strength and for austenitic steels the 0,2 % and 1,0 % proof strength.

In cases of dispute, and where permitted (see 10.2.2.2 c)), the tensile test shall be carried out on circular test pieces.

11.3 Tensile test at elevated temperature

$R_{p0,2}$ and R_m, for austenitic steels in accordance with EN 10028-7 additionally $R_{p1,0,}$ values at elevated temperature shall be determined in accordance with EN 10002-5.

•• Unless a test temperature for which a value is specified for the relevant product has been agreed at the time of enquiry and order, the test shall be carried out at 300 °C except for austenitic-ferritic steels of EN 10028-7 for which the test shall be carried out at 250 °C.

11.4 Impact test

The impact test on V-notched test pieces shall be carried out in accordance with EN 10045-1. The specifications of the individual parts of EN 10028 shall apply.

•• Where minimum impact energy values are specified for several temperatures, verification of the impact energy, unless otherwise agreed, shall be carried out at the temperature for which the value of 27 J is specified.

Where the minimum impact energy value specified at the lowest temperature is higher than 27 J, this higher value shall be verified.

The impact energy values apply to transverse test pieces for the steel grades specified in EN 10028-2, EN 10028-5 and EN 10028-6 and for longitudinal and/or transverse test pieces for the steel grades specified in EN 10028-3, EN 10028-4 and EN 10028-7.

Where subsidiary test pieces are used (see 10.2.2.3), the minimum impact energy values given in the specific parts of EN 10028 shall be reduced in proportion to the cross-sectional area of the test piece. For product thicknesses < 6 mm, the impact test shall not be carried out.

The minimum impact values given in the individual parts of EN 10028 apply for the mean of three test pieces. One individual value may be lower than the specified value provided that it is not less than 70 % of this value.

If the above conditions are not met, an additional set of three test pieces shall be taken from the same sample and shall be tested. In order to regard the test unit as acceptable after testing the second set, the following requirements shall be met:

a) mean value of six tests shall be equal to or greater than the specified value;

b) not more than two of the six individual values shall be less than the specified value;

c) not more than one of the six individual values shall be less than 70 % of the specified value.

If these requirements are not met, the sample product shall be rejected and re-tests shall be carried out on the remainder of the test unit.

11.5 Other testing

11.5.1 The surface condition of the products shall be checked for conformity with Clause 4.

11.5.2 The dimensions of the products shall be checked for conformity with 8.5 by visual examination without optical aids or, at the discretion of the manufacturer, by an approved automated process.

11.5.3 If an ultrasonic test has been agreed for plate of thicknesses ≥ 6 mm for verification of internal soundness, the requirements of EN 10160 shall apply.

11.5.4 If a test on the resistance to intergranular corrosion has been agreed, this shall be carried out in accordance with EN ISO 3651-2.

11.5.5 The manufacturer shall take suitable measures to prevent materials becoming mixed up and to ensure traceability.

12 Marking

12.1 The products shall be marked with the information given in Table 5.

•• The method of marking and the material of marking shall, unless otherwise agreed, be at the option of the manufacturer.

Plates and sheets shall be marked by low stress stamping or stencilling or ink marking.

Sheets in bundles and strip in coil shall be marked on a securely attached label. If requested, this may also be applied to ground or polished plates.

For products in accordance with EN 10028-7, the quality of marking shall be such that it shall be durable for at least one year in untreated storage under cover. Care shall be taken that the corrosion resistance of those products is not impaired by the marking method.

12.2 •• If agreed at the time of enquiry and order, a mark applied by stamping shall have a coloured frame.

12.3 •• Any other marking may be agreed at the time of enquiry and order (see also Table 5).

Table 5 — Marking of the products

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

a The symbols 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.

c 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 purchaser.

d This shall permit the traceability of the cast number.

e The inspector's mark may be omitted if the relevant inspector can be identified in another way.

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 97/23/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive 97/23/EC.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the clauses of this standard given in Table ZA.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

Table ZA.1 — Correspondence between this European Standard and the essential requirements of the EU Directive 97/23/EC, Annex I

Clauses/subclauses of this European Standard	Essential Requirements (ERs) of the Directive 97/23/EC, Annex I	Qualifying remarks/ Notes
8.4	4.1a	Appropriate material properties
8.3	4.1 c	Ageing
8.2 and 8.6	4.1d	Suitable for the processing procedures
9.1	4.3	Documentation

WARNING: Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

Bibliography

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

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

[3] ▌A1⟩ CEN/TR 10261 ⟨A1▐, *Iron and steel — Review of available methods of chemical analysis*

▌A1⟩

[4] Guidelines 7/2 (1999-01-29/2006-03-31) and 7/16 (2001-10-19/2006-03-31) to the Directive 97/23/EC, published by EU Commission's Working Group "Pressure", see web-site of the EU Commission http://ec.europa.eu/enterprise/pressure_equipment/ped/guidelines/guideline7_en.html . ⟨A1▐

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