



SLOVENSKI STANDARD
SIST EN 10028-2:1996

01-avgust-1996

Ploščati izdelki iz jekel za tlačne posode - 2. del: Nelegirana in legirana jekla za povišane temperature

Flat products made of steels for pressure purposes - Part 2: Non-alloy and alloy steels with specified elevated temperature properties

Flacherzeugnisse aus Druckbehälterstählen - Teil 2: Unlegierte und legierte warmfeste Stähle

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Produits plats en aciers pour appareils a pression - Partie 2: Aciers non alliés et alliés avec caractéristiques spécifiées a température élevée

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ICS:

77.140.30 Jekla za uporabo pod tlakom Steels for pressure purposes

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EUROPEAN STANDARD

EN 10028-2:1992

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Descriptors: Iron and steel products, metal plates, strips, unalloyed steels, heat resistant steels, pressure equipment, designation, specifications, delivery condition, tests, marking

English version

Flat products made of steels for pressure purposes - Part 2: Non-alloy and alloy steels with specified elevated temperature properties

Produits plats en aciers pour appareils à pression - Partie 2: Aciers non alliés et alliés avec caractéristiques spécifiées à température élevée
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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

Foreword

This European Standard has been prepared by ECISS/TC 22 'Steels for pressure purposes — Qualities', the Secretariat of which is held by Normenausschuß Eisen und Stahl (FES) im DIN.

Within the framework of the ECISS (European Committee for Iron and Steel Standardization) programme of work, TC 22 was allocated the task of revising EURONORM 28-85 'Steel plate, sheet and strip with elevated temperature properties — Technical delivery conditions' and (where relevant to pressure vessel fabrication) EURONORM 113-72 'Weldable fine-grain structural steels' and replacing them with a European Standard.

At its meeting in November 1990, ECISS/TC 22 approved this document. The following ECISS members were represented at the meeting:

Austria, Finland, France, Germany, Italy, Norway, Sweden, United Kingdom.

This European Standard was adopted and in accordance with the CEN/CENELEC Internal Regulations, the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 1993, and conflicting national standards shall be withdrawn at the latest by June 1993.

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NOTE. The clauses marked with two points (. .) contain information relating to agreements that may be made at the time of ordering.

1 Scope

1.1 This Part 2 of EN 10028 specifies requirements for flat products for pressure purposes made of weldable non-alloy and alloy steels with elevated temperature properties as specified in table 1.

1.2 The requirements of EN 10028-1 also apply.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 10020	Definition and classification of grades of steel
EN 10028-1	Flat products made of steels for pressure purposes — Part 1: General requirements

3 Definitions

See EN 10028-1.

4 Dimensions and tolerances on dimensions

See EN 10028-1.

5 Calculation of mass

See EN 10028-1.

6 Designation and ordering

See EN 10028-1.

7 Classification into grades

This EN covers the steel grades given in table 1. In accordance with EN 10020, grades P235GH, P265GH, P295GH and P355GH are non alloy quality steels and grades 16 Mo 3, 13 CrMo 4-5, 10 CrMo 9-10 and 11 CrMo 9-10 are alloy special steels.

8 Requirements

8.1 Steelmaking process

See EN 10028-1.

8.2 Delivery condition

8.2.1 . . Unless otherwise agreed at the time of ordering, the products covered by this EN shall be supplied in the usual conditions given in table 3.

8.2.2 Normalizing may be replaced by normalizing rolling for steel grades P235GH, P265GH, P295GH and P355GH. This means that the requirements have to be met again even after subsequent normalizing.

8.2.3 . . If specially agreed, products made of steel grades P235GH, P265GH, P295GH, P355GH and 16 Mo 3 may also be delivered in the untreated condition. Products made of steel grades 13 CrMo 4-5, 10 CrMo 9-10 and 11 CrMo 9-10 may be supplied in the tempered or normalized condition or, in exceptional cases, in the untreated condition if so agreed. (Annex B contains heat treatment information for the purchaser.)

In these cases, the test pieces shall be tested in the usual delivery condition as indicated in table 3.

NOTE. The testing of the test pieces in a simulated heat treated condition does not discharge the processor from the obligation of providing proof of the specified properties in the finished product.

Table 1. Chemical composition (cast analysis)

Steel grade	Classification ¹⁾		% by mass ²⁾													
	Name	Material number	C	Si	Mn	P	S	Al _{ges.}	Cr	Cr ³⁾	Mo	Nb	Ni	Ti	V	Cr + Cu + Mo + Ni
P235GH	1.0345	UQ	max 0,16	max.	0,40 to 1,20	0,030	max.	min. 0,020	max. 0,30	max.	max. 0,08	0,010	0,30	0,03	0,02	max.
P265GH	1.0425	UQ	max. 0,20	0,40	0,50 to 1,40	0,030	0,025	min. 0,020	max. 0,30	0,30	max. 0,08	0,010	0,30	0,03	0,02	0,70
P295GH	1.0481	UQ	0,08 to 0,20	0,40	0,90 to 1,50	0,030	0,025	min. 0,020	max. 0,30	0,30	max. 0,08	0,010	0,30	0,03	0,02	0,70
P355GH	1.0473	UQ	0,10 to 0,22	0,60	1,00 to 1,70	0,030	0,025	min. 0,020	max. 0,30	0,30	max. 0,08	0,010	0,30	0,03	0,02	0,70
16 Mo 3	1.5415	LE	0,12 to 0,20	0,35	0,40 to 0,90	0,030	0,025	4)	max. 0,30	0,30	0,25 to 0,35	—	0,30	—	—	—
13 CrMo 4-5	1.7335	LE	0,08 to 0,18	0,35	0,40 to 1,00	0,030	0,025	4)	0,70 to 1,15 ⁵⁾	0,30	0,40 to 0,60	—	—	—	—	—
10 CrMo 9-10	1.7380	LE	0,08 ⁶⁾ to 0,14 ⁷⁾	0,50	0,40 to 0,80	0,030	0,025	4)	2,00 to 2,50	0,30	0,90 to 1,10	—	—	—	—	—
11 CrMo 9-10	1.7383	LE	0,08 ⁶⁾ to 0,15	0,50	0,40 to 0,80	0,030	0,025	4)	2,00 to 2,50	0,30	0,90 to 1,10	—	—	—	—	—

1) UQ = non-alloy quality steel; LE = alloy special steel.

2) Elements not listed in this table shall not be intentionally added to the steel without the agreement of the purchaser except for finishing the cast. All appropriate measures shall be taken to prevent the addition from scrap or other materials used in steelmaking of these elements which may adversely affect the mechanical properties and usability.

3) ... A lower Cu content and a maximum tin content may be agreed upon at the time of ordering, e.g. with regard to formability.

4) The Al content of the cast shall be determined and given in the inspection document.

5) ... If resistance to pressurized hydrogen is of importance, a minimum percentage by mass of Cr of 0,80 % may be agreed upon at the time of ordering.

6) ... For product thicknesses less than 10 mm, a minimum content of 0,06 % C may be agreed upon at the time of ordering.

7) ... For product thicknesses greater than 150 mm, a maximum content of 0,17 % C may be agreed upon at the time of ordering.

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8.3 Chemical composition

8.3.1 The requirements of table 1 shall apply for the chemical composition determined from the cast analysis.

8.3.2 The product analysis may deviate from the specified values for the cast analysis as specified in table 1 by the values given in table 2.

Table 2. Permissible deviations in the results of the product analysis from specified values applicable to the cast analysis (see table 1)

Element	Specified value in the cast analysis according to table 1 % by mass	Permissible deviations ¹⁾ of the product analysis from the specified values listed in table 1 for the cast analysis % by mass
C	≤ 0,22	± 0,02
Si	≤ 0,35 > 0,35 to ≤ 0,60	+ 0,05 + 0,06
Mn	≤ 1,00 > 1,00 to ≤ 1,70	± 0,05 ± 0,10
P	≤ 0,030	+ 0,005
S	≤ 0,025	+ 0,005
Al	≥ 0,020	- 0,005
Cr	≤ 1,00 > 1,00 to ≤ 2,50	± 0,05 ± 0,10
Mo	≤ 0,35 > 0,35 to ≤ 1,10	± 0,03 ± 0,04
Cu	≤ 0,30	+ 0,05
Nb	≤ 0,010	+ 0,005
Ni	≤ 0,30	+ 0,05
Ti	≤ 0,03	+ 0,01
V	≤ 0,02	+ 0,01

¹⁾ If several product analyses are carried out for one cast and if, in this case, values for an individual element are established which fall outside the permitted range for the chemical composition, then it is only permissible that the values either exceed the maximum permitted value or fall short of the minimum permitted value. It is not acceptable for both to apply for one cast.

8.3.3 . . A maximum value for the carbon equivalent may be agreed upon at the time of ordering for steel grades P235GH, P265GH, P295GH and P355GH.

8.4 Mechanical properties

The values given in tables 3 and 4 (see also EN 10028-1) shall apply.

Annex A gives preliminary data for the purchaser about creep and stress rupture properties.

8.5 Surface condition

See EN 10028-1.

8.6 Internal soundness

See EN 10028-1.

9 Testing

See EN 10028-1.

9.1 Type and content of inspection documents

See EN 10028-1.

9.2 Tests to be carried out

See EN 10028-1.

9.3 Number of tests

See EN 10028-1.

9.4 Sampling and sample preparation

See EN 10028-1.

9.5 Test procedures

See EN 10028-1.

9.6 Re-tests

See EN 10028-1.

10 Marking

See EN 10028-1.

Table 3. Mechanical properties (applicable to transverse test pieces)

Steel grade		Usual delivery condition ¹⁾	Product thickness		Yield point ²⁾ R_{eH}	Tensile strength R_m	Elongation after fracture ($L_0 = 5.65\sqrt{S_0}$) A	Impact energy (quenched test pieces) KV	
Name	Material number		mm over	up to				N/mm ² min.	N/mm ²
								°C	min.
P235GH	1.0345	N ³⁾		16	235	360 to 480	25 ⁵⁾	0	27
			16	40	225				
			40	60	215				
			60	100	200	350 to 480	24		
			100	150	185				
			150		4)	4)	4)	4)	
P265GH	1.0425	N ³⁾		16	265	410 to 530	23 ⁶⁾	0	27
			16	40	255				
			40	60	245				
			60	100	215	400 to 530	22		
			100	150	200				
			150		4)	4)	4)	4)	
P295GH	1.0481	N ³⁾		16	295	460 to 580	22	0	27
			16	40	290				
			40	60	285				
			60	100	260	440 to 570	21		
			100	150	235				
			150		4)	4)	4)	4)	
P355GH	1.0473	N ³⁾		16	355	510 to 650	21	0	27
			16	40	345				
			40	60	335				
			60	100	315	490 to 630	20		
			100	150	295				
			150		4)	4)	4)	4)	
16 Mo 3	1.5415	N ⁷⁾		16	275	440 to 590	24	+20	31 ⁸⁾
			16	40	270				
			40	60	260				
			60	100	240	430 to 560	22		
			100	150	220				
			150		4)	4)	4)	27 ⁸⁾	
					4)	4)	4)	4)	

Table 3. Mechanical properties (applicable to transverse test pieces)													
Steel grade		Usual delivery condition ¹⁾	Product thickness		Yield point ²⁾ R_{eH}	Tensile strength R_m	Elongation after fracture ($L_0 = 5.65\sqrt{S_0}$) A	Impact energy (quenched test pieces) KV					
Name	Material number		mm over	up to				N/mm ² min.	N/mm ²	% min.	Test temperature °C	Mean value from three test pieces min.	
13 CrMo 4-5	1.7335	N + T		16	300	450 to 600	20	+20	31 ⁹⁾				
			16	60	295								
			N + T or QA or QL	60	100					275	440 to 590	19	27 ⁸⁾
			QL	100	150					255	430 to 580		4)
			150		4)	4)		4)					
10 CrMo 9-10	1.7380	N + T		16	310	480 to 630	18	+20	31				
			16	40	300								
			N + T or QA or QL	60	100					270	470 to 620	17	27
			QL	100	150					250	460 to 610		4)
			150		4)	4)		4)					
11 CrMo 9-10	1.7383	N + T or QA or QL		60	310	520 to 670	18	+20	31 ⁹⁾				
			QL	60						100		17	27 ⁸⁾

¹⁾ N = normalized; QA = air quenched; QL = liquid quenched; T = tempered.

²⁾ Until the yield point criteria are harmonized in the various national codes, determination of R_{eH} may be replaced by determination of $R_{p0.2}$. In this case, 10 N/mm² lower minimum values apply for $R_{p0.2}$.

³⁾ See 8.2.2.

⁴⁾ .. On agreement.

⁵⁾ If, for product thicknesses greater than 2 to less than 3 mm, the elongation after fracture has been determined on tensile test pieces with a gauge length $L_0 = 80$ mm and a width of 20 mm, a minimum value of 19 % applies for product thicknesses greater than 2 to 2.5 mm and a minimum value of 20 % for product thicknesses greater than 2.5 to less than 3 mm.

⁶⁾ If, for product thicknesses greater than 2 to less than 3 mm, the elongation after fracture has been determined on tensile test pieces with a gauge length $L_0 = 80$ mm and a width of 20 mm, a minimum value of 17 % applies for product thicknesses greater than 2 to 2,5 mm and a minimum value of 18 % for product thicknesses greater than 2.5 to less than 3 mm.

⁷⁾ This steel may also be supplied in the N + T condition at the discretion of the manufacturer.

⁸⁾ .. If a test at 0 °C has been agreed, a minimum value of 24 J applies.

⁹⁾ .. If a test at 0 °C has been agreed, a minimum value of 27 J applies.