



SLOVENSKI STANDARD
SIST EN 10222-4:2000
01-april-2000

>Y_`Yb]`n_cj_]nUhU bY'dcgcXY!' ("XY.'JUfjj UXfcVbcnf bUu`Y_`Un'j Y]_c
Xc[cj cfbc `bUdYfcgftc`hY Yb^U

Steel forgings for pressure purposes - Part 4: Weldable fine grain steels with high proof strength

Schmiedestücke aus Stahl für Druckbehälter - Teil 4: Schweißgeeignete Feinkornbaustähle mit hoher Dehngrenze

Pieces forgées en acier pour appareils a pression - Partie 4: Aciers soudables a grains fins avec limite d'élasticité élevée

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Ta slovenski standard je istoveten z: EN 10222-4:1998

ICS:

77.140.30	Jekla za uporabo pod tlakom	Steels for pressure purposes
77.140.85	Železni in jekleni kovani izdelki	Iron and steel forgings

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en

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EUROPEAN STANDARD

EN 10222-4

NORME EUROPÉENNE

EUROPÄISCHE NORM

November 1998

ICS

Descriptors: iron and steel products, forgings, steels, weldable fine grain steels, pressure equipment, grades: quality, chemical composition, mechanical properties, heat treatment

English version

Steel forgings for pressure purposes - Part 4: Weldable fine grain steels with high proof strength

Pièces forgées en acier pour appareils à pression - Partie
4: Aciers soudables à grains fins avec limite d'élasticité
élevée

Schmiedestücke aus Stahl für Druckbehälter - Teil 4:
Schweißgeeignete Feinkornbaustähle mit hoher
Dehngrenze

This European Standard was approved by CEN on 8 November 1998.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. 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.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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

Page 2
EN 10222-4:1998

Contents	Page
Foreword.....	3
1 Scope	4
2 Normative references.....	4
3 Chemical composition	4
4 Heat treatment and mechanical properties.....	4
Annex Z (informative) Clauses of this European Standard addressing essential requirements or other provisions of EU Directives.	8

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SIST EN 10222-4:2000

<https://standards.iteh.ai/catalog/standards/sist/1006c8ff-b2f6-43af-835d-ebd7b318e724/sist-en-10222-4-2000>

Foreword

This European Standard has been prepared by Technical Committee ECISS/TC 28 "Steel forgings", the secretariat of which is held by BSI.

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 May 1999, and conflicting national standards shall be withdrawn at the latest by May 1999.

This European Standard 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(s).

For relationship with EU Directive(s), see informative Annex Z, which is an integral part of this standard.

The titles of the other Parts of this European Standard are:

Part 1: General requirements for open die forgings.

Part 2: Ferritic and martensitic steels with specified elevated temperature properties.

Part 3: Nickel steels with specified low temperature properties.

Part 5: Martensitic, austenitic and austenitic - ferritic stainless steels.

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

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1 Scope

This Part of this European Standard specifies the technical delivery conditions of the types of forgings for pressure purposes made of weldable fine grain steels with high proof strength.

General information on technical delivery conditions is given in EN 10021.

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 10021	General technical delivery requirements for steel and iron products
EN 10022-1:1998	Steel forgings for pressure purposes - Part 1: General requirements for open die forgings.

3 Chemical composition

3.1 Cast analysis

The chemical composition (cast analysis), determined in accordance with EN 10222-1, shall conform to the requirements of table 1 (see 9.1 of EN 10222-1:1998).

3.2 Product analysis

The product analysis shall not deviate from the specified cast analysis (see table 1) by more than the values specified in table 2 (see 9.2 of EN 10222-1:1998).

4 Heat treatment and mechanical properties

When heat treated in accordance with table 4, the mechanical properties of the forgings, determined in accordance with EN 10022-1, shall conform to the requirements of table 1 and table 3.

Elevated temperature 0,2 % proof strength ($R_{p0,2}$) values shall conform to the requirements of table 4.

Table 1: Chemical composition, mechanical properties and heat treatment

Steel designation		Chemical composition (cast analysis) % ¹⁾											Mechanical properties at room temperature						Heat treatment				Carbon equivalent value	
Name	Number	C	Si	Mn	P	S	Al ²⁾ total	N	Ci	Cu	Mo	Nb	Ni	V	Nb+V	Thickness of the ruling section t _R ³⁾	Yield strength R _{0.2} ⁴⁾	Tensile strength R _m	Elongation after fracture A ⁵⁾	Symbol ⁶⁾	Austenizing or solution temperature	Cooling in ⁷⁾	Tempering	Carbon equivalent value
		max			max	max	min	max	max	max	max	max	max	max	max	mm	N/mm ²	N/mm ²	min	l	°C	°C	°C	max %
P285NH	1.0477	0.18	0.40	0.60	0.025	0.015	0.020	0.020	0.30	0.20	0.08	0.03	0.30	0.05	0.05	t _R ≤ 16	285	390	2.4	2.3	880 to 960	a	-	0.41
	16 < t _R ≤ 35															285	to 510	2.4	2.3					
P285QH	1.0478	0.18	0.40	0.60	0.025	0.015	0.020	0.020	0.30	0.20	0.08	0.03	0.30	0.05	0.05	70 < t _R ≤ 100	245	370	22	21	860 to 940	o, w	600 to 700	0.47
	100 < t _R ≤ 250															225	to 510	22	21					
P355NH	1.0565	0.20	0.10	0.90	0.025	0.015	0.020	0.020	0.30	0.20	0.08	0.05	0.30	0.10	0.12	t _R ≤ 16	355	490	23	21	880 to 960	a	-	0.47
	16 < t _R ≤ 35															355	to 630	23	21					
P355QHI	1.0571	0.20	0.10	0.90	0.025	0.015	0.020	0.020	0.30	0.20	0.08	0.05	0.30	0.10	0.12	35 < t _R ≤ 70	315	470	21	19	860 to 940	o, w	600 to 700	0.51
	70 < t _R ≤ 100															295	to 630	21	19					
P420NH	1.8932	0.20	0.10	1.00	0.025	0.015	0.020	0.30	0.20	0.10	0.020	0.05	1.00	0.20	0.22	t _R ≤ 16	420	530	20	19	880 to 960	a	-	0.51
	16 < t _R ≤ 35															410	to 680	20	19					
P420QH	1.8936	0.20	0.10	1.00	0.025	0.015	0.020	0.30	0.20	0.10	0.020	0.05	1.00	0.20	0.22	35 < t _R ≤ 70	385	680	18	17	860 to 940	o, w	600 to 700	0.51
	70 < t _R ≤ 100															365	to 670	18	17					

¹⁾ Elements not listed in this table shall not be intentionally added to the steel without the approval 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.

²⁾ Minimum Al level need not apply when Nb, V and Ti is used to control N content.

³⁾ The thickness ranges given in this column apply for the as heat treated thickness of forgings with the ruling section. This is characterized by rectangular shape, a width to thickness ratio of ≥ 4. For forgings with other sections the equivalent thickness shall be determined according to annex B of EN 10222-1:1998 or be agreed at the time of enquiry and order.

⁴⁾ Until the yield point criteria are harmonized in the various National Codes, determinations of R_{0.2} values are 10N/mm² lower for R_{0.2}, values up to 355 N/mm² and 15 N/mm² lower for R_m, values greater than 355 N/mm²

⁵⁾ l - longitudinal t - tangential tr - transverse

⁶⁾ N - normalized QT - quenched and tempered

⁷⁾ a - air o - oil w - water



Table 2: Permissible deviations of the product analysis from specified values of the cast analysis

Element	Specified value in the cast analysis according to table 1 %	Permissible deviations ¹⁾ of the product analysis %
C	≤ 0,20	+ 0,02
Si	≤ 0,60	+ 0,05
Mn	≤ 1,70	+ 0,10 - 0,05
P	≤ 0,025	+ 0,005
S	≤ 0,015	+ 0,003
Al	≤ 0,060	± 0,005
N	≤ 0,020	+ 0,002
Cr	≤ 0,30	+ 0,05
Cu	≤ 0,20	+ 0,05
Mo	< 0,10	+ 0,03
Nb	≤ 0,05	+ 0,01
Ni	≤ 1,00	+ 0,05
V	≤ 0,20	+ 0,02
<p>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.</p>		

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Table 3: Minimum impact properties

Steel designation		Heat treatment condition ¹⁾²⁾	Thickness of the ruling section t_R mm	Minimum KV notch impact energy in J at a test temperature of ³⁾ :							
Name	Number			Direction				Direction			
				Longitudinal				Transverse and tangential			
				20 °C	0 °C	- 20 °C	- 40 °C	20 °C	0 °C	- 20 °C	- 40 °C
P285NH P355NH P420NH	1.0477 1.0565 1.8932	N	≤ 100	55	47	40	28	40	34	-	-
P285QH P355QH P420QH	1.0478 1.0571 1.8936	QT	≤ 400	63	55	47	34	40	34	27	-

¹⁾ N = normalized QT = quenched and tempered

²⁾ For temperatures and cooling conditions, see table 1.

³⁾ Proof of the impact values shall be obtained at the lowest test temperature given in this table for the relevant steel grade.

Table 4: Minimum 0,2 % proof strength ($R_{p0,2}$) values at elevated temperatures

Steel designation		Thickness of the ruling section t_R mm	$R_{p0,2}$ min in N/mm ² at a temperature of:						
Name	Number		100 °C	150 °C	200 °C	250 °C	300 °C	350 °C	400 °C
P285 NH	1.0477	$t_R \leq 35$	255	235	-	-	-	-	-
P285 QH	1.0478	$35 < t_R \leq 70$	245	226	206	186	157	137	118
		$70 < t_R \leq 100$	226	206	186	167	137	118	98
		$100 < t_R \leq 250$	206	186	167	147	118	98	78
		$250 < t_R \leq 400$	186	167	147	128	98	78	59
P355 NH	1.0565	$t_R \leq 50$	304	284	-	-	-	-	-
P355 QH	1.0571	$50 < t_R \leq 100$	294	275	255	235	216	196	167
		$100 < t_R \leq 150$	275	255	235	216	196	177	147
		$150 < t_R \leq 375$	255	235	216	196	177	157	127
		$t_R > 375$	235	215	197	179	160	142	117
P420 NH	1.8932	$t_R \leq 50$	363	343	-	-	-	-	-
P420 QH	1.8936	$50 < t_R \leq 100$	353	335	314	284	265	235	206
		$100 < t_R \leq 150$	333	314	294	265	245	216	186
		$150 < t_R \leq 375$	314	294	275	245	226	196	167
		$t_R > 375$	294	275	255	226	206	176	147