

Steel forgings for pressure purposes —

Part 4: Weldable fine-grain steels with high proof strength

The European Standard EN 10222-4:1998, with the incorporation of amendment A1:2001, has the status of a British Standard

ICS 77.140.30; 77.140.85

National foreword

This British Standard is the English language version of EN 10222-4:1998, including amendment A1:2001. Together with EN 10222-1, EN 10222-2, EN 10222-3 and EN 10222-5, it supersedes BS 1503:1989, which will be withdrawn when the five parts of EN 10222 are published.

The UK participation in its preparation was entrusted to Technical Committee ISE/73, Steel for pressure purposes, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 7 and a back cover.

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Amendments issued since publication

Amd. No.	Date	Comments
13399	8 October 2001	Correction of Table 1

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ICS 77.140.30; 77.140.85

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

(includes amendment A1:2001)

Pièces forgées en acier pour appareils à
pression —
Partie 4: Aciers soudables à grains fins avec
limite d'élasticité élevée
(inclut l'amendement A1:2001)

Schmiedestücke aus Stahl für Druckbehälter —
Teil 4: Schweißgeeignete Feinkornbaustähle
mit hoher Dehngrenze
(enthält Änderung A1:2001)

This European Standard was approved by CEN on 8 November 1998.
Amendment A1:2000 was approved by CEN on 20 April 2001.

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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 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 ZA, 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.*

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Foreword to amendment A1

This amendment EN 10222-4:1998/A1:2001 to the EN 10222-4:1998 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 January 2002, and conflicting national standards shall be withdrawn at the latest by January 2002.

This amendment to the European Standard EN 10222-4:1998 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).

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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 EN 10222-1:1998, 9.1).

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 EN 10222-1:1998, 9.2).

4 Heat treatment and mechanical properties

When heat-treated in accordance with Table 1, 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) ^a %														Mechanical properties at room temperature				Heat treatment			Carbon equivalent value			
Name	Number	C max.	Si	Mn	P max.	S max.	Al ^b		N max.	Cr max.	Cu max.	Mo max.	Nb max.	Ni max.	V max.	Nb + V max.	Thickness of the ruling section t_R^c mm	Yield strength R_{eH}^d N/mm ² min.	Tensile strength R_m N/mm ²	Elongation after fracture A ^e min. %		Symbol ^f	Austenitizing or solution temperature °C	Cooling in ^g	Tempering °C	max. %
							min.	max.												1	t, tr					
P285NH/	1.0477/	0,18	0,40	0,60	0,025	0,015	0,020	0,060	0,020	0,30	0,20	0,08	0,03	0,30	0,05	0,05	$t_R \leq 16$	285	390	24	23	N	880 to 960	a	—	0,41
P285QH	1.0478																$16 < t_R \leq 35$	285	to							
																	$35 < t_R \leq 70$	265	510							
																	$70 < t_R \leq 100$	245	370							
																	$100 < t_R \leq 250$	225	to							
		$250 < t_R \leq 400$	205	510																						
P355NH/	1.0565/	0,20	0,10	0,90	0,025	0,015	0,020	0,060	0,020	0,30	0,20	0,08	0,05	0,30	0,10	0,12	$t_R \leq 16$	355	490	23	21	N	880 to 960	a	—	0,47
P355QH1	1.0571																$16 < t_R \leq 35$	355	to							
																	$35 < t_R \leq 70$	335	630							
																	$70 < t_R \leq 100$	315	470							
																	$100 < t_R \leq 250$	295	to							
		$250 < t_R \leq 400$	275	630																						
P420NH/	1.8932/	0,20	0,10	1,00	0,025	0,015	0,020	0,060	0,020	0,30	0,20	0,10	0,05	1,00	0,20	0,22	$t_R \leq 16$	420	530	20	19	N	880 to 960	a	—	0,51
P420QH	1.8936																$16 < t_R \leq 35$	410	to							
																	$35 < t_R \leq 70$	385	680							
																	$70 < t_R \leq 100$	365	510							
																	$100 < t_R \leq 250$	345	to							
		$250 < t_R \leq 400$	325	670																						

^a 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.

^b Minimum Al level need not apply when Nb, V and Ti are used to control N content.

^c 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 ≥ 2 and a length to thickness ratio of ≥ 4 . For forgings with other sections the equivalent thickness shall be determined according to Annex B of EN 10222-1 or be agreed at the time of enquiry and order.

^d 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, the $R_{p0,2}$ values are 10 N/mm² lower for R_{eH} values up to 355 N/mm² and 15 N/mm² lower for R_{eH} values greater than 355 N/mm².

^e l – longitudinal t – tangential tr – transverse

^f N – normalized QT – quenched and tempered

^g 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 ^a 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

^a 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.

Table 3 — Minimum impact properties

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

^a N: normalized. QT: quenched and tempered.

^b For temperatures and cooling conditions, see Table 1.

^c 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	$R_{p0,2}$ minimum at a temperature of:						
Name	Number		N/mm ²						
			100 °C	150 °C	200 °C	250 °C	300 °C	350 °C	400 °C
P285NH	1.0477	$t_R \leq 35$	255	235	—	—	—	—	—
P285QH	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
P355NH	1.0565	$t_R \leq 50$	304	284	—	—	—	—	—
P355QH	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
P420NH	1.8932	$t_R \leq 50$	363	343	—	—	—	—	—
P420QH	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

Annex ZA (informative)**Clauses of this European Standard addressing essential requirements or other provisions of EU Directives**

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

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

The clauses of this European Standard are likely to support the essential requirements of section 4 of Annex 1, *Essential safety requirements*, of the Pressure Equipment Directive 97/23/EC.

Compliance with this European Standard provides one means of conforming with the specific essential requirements of the Directive concerned.

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