

Steel forgings for pressure purposes —

Part 3: Nickel steels with specified low-temperature properties

压力用途用钢制锻件

第 3 部分：具有低温特性性的镍钢

The European Standard EN 10222-3:1998 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 10222-3:1998. Together with EN 10222-1, -2, -4 and -5, it supersedes BS 1503:1989, which will be withdrawn when the five parts of EN 10222 are published.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.

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Summary of pages

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

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ICS

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

English version

Steel forgings for pressure purposes — Part 3: Nickel steels with specified low-temperature properties

Pièces forgées en acier pour appareils à pression —
Partie 3: Aciers au nickel avec caractéristiques
spécifiées à basse température

Schmiedestücke aus Stahl für Druckbehälter —
Teil 3: Nickelstähle mit festgelegten Eigenschaften
bei tiefen Temperaturen

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

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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of an identical text or by endorsement, at the latest by May 1999, and conflicting national standards shall be withdrawn at the latest by May 1999.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 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 4: Weldable fine grain steels with high proof strength;*
- *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 forgings for pressure purposes, made of nickel steels, for use at low temperatures.

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 10222-1:1998, *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 10222-1, shall conform to the requirements of Table 1 and Table 3.

Table 1 — Chemical composition, mechanical properties and heat treatment

Steel designation		Chemical composition (cast analysis) ¹⁾ %								Mechanical properties at room temperature					Heat treatment					
Name	Number	C	Si	Mn	P	S	Al	Ni	V	Others	Thickness of the ruling section	Yield strength	Tensile strength	Elongation after fracture	Symbol ⁵⁾	Austenitizing or solution annealing		Tempering		
		max.	max.	max.	max.	max.	total min.				$t_R^{2)}$ mm	$R_{eH}^{3)}$ N/mm ² min.	R_m N/mm ²	$A^{4)}$ min. %		Temperature °C	Cooling in ⁶⁾	Temperature °C	Cooling in ⁶⁾	
13MnNi6-3	1.6217	0,16	0,50	0,85 to 1,70	0,025	0,015	0,020	0,30 to 0,85	≤ 0,05	Nb ≤ 0,05	$t_R \leq 35$ $35 < t_R \leq 50$ $50 < t_R \leq 70$	285	420 to 610	22	NT	880 to 940	a	580 to 640	a	
												275								
15NiMn6	1.6228	0,18	0,35	0,80 to 1,50	0,025	0,015	—	1,30 to 1,70 ⁷⁾	≤ 0,05		$t_R \leq 35$ $35 < t_R \leq 50$	355	470 to 640	20	N	850 to 900	a	—	—	
												345								
12Ni14	1.5637	0,15	0,35	0,30 to 0,80	0,020	0,010	—	3,25 to 3,75	≤ 0,05		$t_R \leq 35$ $35 < t_R \leq 50$ $50 < t_R \leq 70$	355	470 to 640	20	N	830 to 880	a	—	—	
												345								
X12Ni5	1.5680	0,15	0,35	0,30 to 0,80	0,020	0,010	—	4,75 to 5,25	≤ 0,05		$t_R \leq 35$	390	510 to 710	19	N	820 to 870	w, o	580 to 640	a, w	
												380								
X8Ni9	1.5662	0,10	0,35	0,30 to 0,80	0,020	0,010	—	8,50 to 10,00	≤ 0,05	Mo ≤ 0,10	$t_R \leq 35$ $35 < t_R \leq 50$ $50 < t_R \leq 70$	490	640 to 840	18	N + NT	800 to 850	w, o	580 to 660	a, w	
												480								
												470			QT	880 to 930 + 680 to 800	a	540 to 600	a, o, w	
																	770 to 820	w, o		a, o, w

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. The following elements shall not exceed the limits stated:

chromium: 0,30 % maximum; copper: 0,30 % maximum; molybdenum: 0,08 % maximum.

The total of chromium + copper + molybdenum shall not exceed 0,50 %.

²⁾ 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 EN 10222-1:1998, annex B, or be agreed at the time of enquiry and order.

³⁾ Until the yield point criteria are harmonized in the various National Codes, determination of R_{eH} may be replaced by determination of $R_{p0,2}$.

⁴⁾ l: longitudinal t: tangential tr: transverse

⁵⁾ N: normalized NT: normalized and tempered

⁶⁾ a: air o: oil w: water

⁷⁾ The maximum nickel content for this steel may be increased to 2,00 % by agreement between the purchaser and supplier.

**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	≤ 0,18	±0,02
Si	≤ 0,50	+0,05
Mn	≤ 1,00 > 1,00 ≤ 1,70	±0,05 ±0,10
P	≤ 0,025	+0,005
S	≤ 0,015	+0,003
Al	≥ 0,020	−0,005
Mo	≤ 0,10	±0,03
Nb	≤ 0,05	±0,01
Ni	≤ 0,85 > 0,85 ≤ 3,75 > 3,75 ≤ 10,0	±0,05 ±0,07 ±0,10
V	≤ 0,05	+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.		

Table 3 — Minimum impact properties

Steel designation		Heat treatment condition ^{1) 2)}	Thickness of the ruling section mm	Direction of test piece	Minimum KV notch impact energy at a test temperature of: ³⁾ J										
Name	Number				20 °C	0 °C	−20 °C	−40 °C	−50 °C	−60 °C	−80 °C	−100 °C	−120 °C	−150 °C	−170 °C
13MnNi6-3	1.6217	NT	5 to 70	Longitudinal	70	60	55	50	45	40	—	—	—	—	—
				Transverse	45	40	40	35	30	27	—	—	—	—	—
15NiMn6 ⁴⁾	1.6228	Longitudinal		65	65	65	60	50	50	40	—	—	—	—	
		Transverse		45	45	45	40	35	35	27	—	—	—	—	
12Ni14	1.5637	Longitudinal		65	60	55	55	50	50	45	40	—	—	—	
		Transverse		45	40	40	35	35	35	30	27	—	—	—	
X12Ni5 ⁴⁾	1.5680	N		Longitudinal	70	70	70	65	65	65	60	50	40	—	—
		NT or QT		50	50	50	45	45	45	40	30	27	—	—	—
X8Ni9	1.5662	N + NT		Longitudinal	70	70	70	70	70	70	70	60	50	45	40
		or QT		50	50	50	50	50	50	50	40	35	30	27	

1) N: normalized.

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.

4) Maximum thickness of ruling section is 50 mm.

NT: normalized and tempered.

Annex Z (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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