BRITISH STANDARD

BS EN
10250-4:2000

Open die steel forgings for general engineering purposes —

Part 4: Stainless steels

The European Standard EN 10250-4:1999 has the status of a British Standard

ICS 77.140.85

National foreword

This British Standard is the official English language version of EN 10250-4:1999. This British Standard supersedes Table 11 of BS 970-1 which is currently under review.

The UK participation in its preparation was entrusted to Technical Committee ISE/31, Wrought steels, 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.

Cross-references

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Summary of pages

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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.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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Contents

	Page
Foreword	3
1 Scope	4
2 Normative references	4
3 Chemical composition	4
4 Heat treatment	9
5 Mechanical properties	9
Annex A (informative) Heat treatment details	13
Annex B (informative) Mechanical properties at low temperatures	16
Annex C (informative) Elevated temperature proof strength	17

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 April 2000, and conflicting national standards shall be withdrawn at the latest by April 2000.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association. This European Standard is considered to be a supporting standard to those application and product standards which in themselves support an essential safety requirement of a New Approach Directive and which make reference to this European Standard.

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

Part 1: General requirements

Part 2: Non-alloy quality and special steels

Part 3: Alloy special 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.

1 Scope

This part of this European Standard specifies the technical delivery requirements for open die forgings, forged bars and products pre-forged and finished in ring rolling mills, manufactured from stainless steels with ferritic, martensitic, austenitic and austenitic-ferritic structures.

NOTE: The majority of steels listed in this part of EN 10250 are identical to steels specified EN 10088-3 and more extensive information on properties is given in that European Standard.

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 iron and steel products

EN 10088-3 Stainless steels – Part 3: Technical delivery conditions for semi-finished products, bars, rods and sections for general purposes.

EN 10250-1 Open steel die forgings for general engineering purposes – Part 1: General requirments

3 Chemical composition

3.1 Cast analysis

The chemical composition of the steel shall be determined by cast analysis and shall conform to the analysis given in Tables 1, 2 and 3 (see A.7, A.8, and A.11 of EN 10250-1).

Elements not quoted in Tables 1, 2, and 3 shall not be added intentionally to the steel without the agreement of the purchaser, except for the purpose of finishing the heat. All reasonable measures should also be taken to prevent the addition from the scrap, or other material used in the manufacture of the steel, of such elements which affect the corrosion resistance, mechanical properties and applicability of the steel.

3.2 Product analysis

The product analysis shall not deviate from the specified cast analysis (see Tables 1, 2 and 3) by more than the values specified in Table 4 (see 9.2 of EN 10250-1).

Table 1: Steel grades and chemical composition - ferritic and martensitic grades

Steel designation		C	Si max	Mn max	P max	S max	Cr	Mo	Ni	Others
Name	Number	%	%	%	%	%	%	%	%	%
X6CrAl13	1.4002	≤ 0,08	1,00	1,00	0,040	0,030[1)]	12,00 to 14,00	–	–	Al 0,10 to 0,30
X6Cr17	1.4016	≤ 0,08	1,00	1,00	0,040	0,030[1)]	16,00 to 18,00	–	–	–
X12Cr13	1.4006	0,08 to 0,15	1,00	1,50	0,040	0,030[1)]	11,50 to 13,50	–	≤ 0,75	–
X20Cr13	1.4021	0,16 to 0,25	1,00	1,50	0,040	0,030[1)]	12,00 to 14,00	–	–	–
X30Cr13	1.4028	0,26 to 0,35	1,00	1,50	0,040	0,030[1)]	12,00 to 14,00	–	–	–
X17CrNi16-2	1.4057	0,12 to 0,22	1,00	1,50	0,040	0,030[1)]	15,00 to 17,00	–	1,50 to 2,50	–
X3CrNiMo13-4	1.4313	≤ 0,05	0,70	1,50	0,040	0,015	12,00 to 14,00	0,30 to 0,70	3,50 to 4,50	N ≥ 0,020
X4CrNiMo16-5-1	1.4418	≤ 0,06	0,70	1,50	0,040	0,030[1)]	15,00 to 17,00	0,80 to 1,50	4,00 to 6,00	N ≥ 0,020
X5CrNiCuNb16-4	1.4542	≤ 0,07	0,70	1,50	0,040	0,030[1)]	15,00 to 17,00	≤ 0,60	3,00 to 5,00	Nb=5 × C to 0,45 Cu=3,00 to 5,00

[1)] For products to be machined a controlled sulfur content of 0,015 to 0,030 % is recommended.

Table 2: Steel grades and chemical composition - austenitic grades

Steel designation		C max	Si max	Mn max	P max	S max	N	Cr	Mo	Ni	Nb	Ti	Others
Name	Number	%	%	%	%	%	%	%	%	%	%	%	%
X2CrNi18-9	1.4307	0,030	1,00	2,00	0,045	≤ 0,030[1)]	≤ 0,11	17,50 to 19,50	–	8,00 to 10,00	–	–	–
X2CrNi19-11	1.4306	0,030	1,00	2,00	0,045	0,030[1)]	≤ 0,11	18,00 to 20,00	_	10,00 to 12,00[2)]	-	-	-
X2CrNiN18-10	1.4311	0,030	1,00	2,00	0,045	0,030[1)]	0,12 to 0,22	17,00 to 19,50	_	8,50 to 11,50	_	_	_
X5CrNi18-10	1.4301	0,07	1,00	2,00	0,045	0,030[1)]	≤ 0,11	17,00 to 19,50	_	8,00 to 10,50	_	_	_
X6CrNiTi18-10	1.4541	0,08	1,00	2,00	0,045	0,030[1)]	_	17,00 to 19,00	_	9,00 to 12,00[2)]	_	5 x C to 0,70	_
X2CrNiMo17-12-2	1.4404	0,030	1,00	2,00	0,045	0,030[1)]	≤ 0,11	16,50 to 18,50	2,00 to 2,50	10,00 to 13,00[2)]	_	_	_
X2CrNiMoN17-11-2	1.4406	0,030	1,00	2,00	0,045	0,030[1)]	0,12 to 0,22	16,50 to 18,50	2,00 to 2,50	10,00 to 12,00	_	_	_
X5CrNiMo17-12-2	1.4401	0,07	1,00	2,00	0,045	0,030[1)]	≤ 0,11	16,50 to 18,50	2,00 to 2,50	10,00 to 13,00	-	-	-
X6CrNiMoTi17-12-2	1.4571	0,08	1,00	2,00	0,045	0,030[1)]	_	16,50 to 18,50	2,00 to 2,50	10,50 to 13,50[2)]	_	5 x C to 0,70	_
X2CrNiMoN17-13-3	1.4429	0,030	1,00	2,00	0,045	0,015	0,12 to 0,22	16,50 to 18,50	2,50 to 3,00	11,00 to 14,00[2)]	-	-	-
X3CrNiMo17-13-3	1.4436	0,05	1,00	2,00	0,045	0,030[1)]	≤ 0,11	16,50 to 18,50	2,50 to 3,00	10,50 to 13,00[2)]	-	-	-
X2CrNiMo18-14-3	1.4435	0,030	1,00	2,00	0,045	0,030[1)]	≤ 0,11	17,00 to 19,00	2,50 to 3,00	12,50 to 15,00	-	-	-
X1NiCrMoCu25-20-5	1.4539	0,020	0,70	2,00	0,030	0,010	≤ 0,15	19,00 to 21,00	4,00 to 5,00	24,00 to 26,00	-	-	Cu 1,20 to 2,00
X6CrNiNb18-10	1.4550	0,08	1,00	2,00	0,045	0,015	_	17,00 to 19,00	_	9,00 to 12,00[2)]	10 x C to 1,00	_	_
X1NiCrMoCu31-27-4	1.4563	0,020	0,70	2,00	0,030	≤ 0,010	-≤ 0,11	26,00 to 28,00	3,00 to 4,00	30,00 to 32,00	-	-	Cu 0,70 to 1,50
X1CrNiMoCuN20-18-7[3)]	1.4547[3)]	0,020	0,70	1,00	0,030	0,010	0,18 to 0,25	19,50 to 20,50	6,00 to 7,00	17,500 to 18,50	-	-	Cu 0,50 to 1,00
X1NiMoCuN25-20-7	1.4529	0,020	0,50	1,00	0,030	0,010	0,15 to 0,25	19,00 to2 1,00	6,00 to 7,00	24,00 to 26,00	-	–	–

[1)] For products to be machined a controlled sulfur content of 0,015 to 0,030 % is recommended.

[2)] Where for special reasons, e.g. hot workability for fabrication where it is necessary to minimize the delta ferrite content, or with the aim of low permeability, the maximum Ni content may be increased by the following amounts:

0,50 % : 1.4571 – 1,00 % : 1.4306, 1.4429, 1.4436, 1.4541, 1.4550 – 1,50 % : 1.4404

[3)] Patented steel

Table 3: Steel grades and chemical composition - austenitic-ferritic grades

Steel designation		C max	Si max	Mn max	P max	S max	N	Cr	Mo	Ni	Others
Name	Number	%	%	%	%	%	%	%	%	%	%
X2CrNiN23-4[2)]	1.4362[2)]	0,030	1,00	2,00	0,035	0,015	0,05 to 0,20	22,00 to 24,00	0,10 to 0,60	3,50 to 5,50	Cu 0,10 to 0,60
X3CrNiMoN27-5-2	1.4460	0,05	1,00	2,00	0,035	0,030[1)]	0,05 to 0,20	25,00 to 28,00	1,30 to 2,00	4,50 to 6,50	–
X2CrNiMoN22-5-3	1.4462	0,030	1,00	2,00	0,035	0,015	0,10 to 0,22	21,00 to 23,00	2,50 to 3,50	4,50 to 6,50	–
X2CrNiMoCuN25-6-3	1.4507	0,030	0,70	2,00	0,035	0,015	0,15 to 0,30	24,00 to 26,00	2,70 to 4,00	5,50 to 7,50	Cu 1,00 to 2,50
X2CrNiMoN25-7-4[2)]	1.4410[2)]	0,030	1,00	2,00	0,035	0,015	0,20 to 0,35	24,00 to 26,00	3,00 to 4,50	6,00 to 8,00	–
X2CrNiMoCuWN25-7-4	1.4501	0,030	1,00	1,00	0,035	0,015	0,20 to 0,30	24,00 to 26,00	3,00 to 4,00	6,00 to 8,00	W 0,50 to 1,00 Cu 0,50 to 1,00

[1)] For products to be machined a controlled sulfur content of 0,015 to 0,030 % is recommended.

[2)] Patented steel

Table 4: Permissible deviations between the product analysis and the limiting values given in Tables 1, 2 and 3 for the cast analysis

Element	Permissible maximum content in the cast analysis %		Permissible deviation %
Carbon		≤ 0,030	+ 0,005
	> 0,030	≤ 0,20	± 0,01
	> 0,20	≤ 0,35	± 0,02
Silicon		≤ 1,00	+ 0,05
Manganese		≤ 1,0	+ 0,03
	> 1,0	≤ 2,0	± 0,04
Phosphorus		≤ 0,045	+ 0,005
Sulfur		≤ 0,015	+ 0,003
	> 0,015	≤ 0,030	+ 0,005
Nitrogen		≤ 0,35	± 0,01
Aluminium	> 0,10	≤ 0,30	± 0,05
Chromium	> 11,50	≤ 15,00	± 0,15
	> 15,00	≤ 20,00	± 0,20
	> 20,00	≤ 28,00	± 0,25
Copper		≤ 1,00	± 0,07
	> 1,00	≤ 5,00	± 0,10
Molybdenum		≤ 0,60	± 0,03
	> 0,60	≤ 1,75	± 0,05
	> 1,75	≤ 7,00	± 0,10
Nickel		≤ 1,00	+ 0,03
	> 1,00	≤ 5,00	± 0,07
	> 5,00	≤ 10,00	± 0,10
	> 10,00	≤ 20,00	± 0,15
	> 20,00	≤ 32,00	± 0,20
Titanium		≤ 0,70	± 0,05
Niobium		≤ 1,00	± 0,05
Tungsten		≤ 1,00	± 0,05

4 Heat treatment

4.1 Heat treatment conditions are given in Tables A.1, A.2 and A.3 for guidance.

4.2 The grain size of the forgings shall be left to the discretion of the manufacturer.

4.3 If any straightening operation is carried out after the final heat treatment the procedure shall be such that the forgings will be free from harmful residual stress. If with the agreement of the purchaser, this procedure includes a thermal stress relief this treatment shall also be applied to the test specimens either when still attached to the forging or after removal.

5 Mechanical properties

5.1 Room temperature properties

The mechanical properties determined on test pieces selected, prepared and tested in accordance with clauses 11 and 12 of EN 10250-1 shall conform to the property requirements given in Tables 8, 9 and 10.

5.2 Low temperature properties

Low temperature properties of certain steels are shown in Table B.1 for information.

5.3 Elevated temperature properties

Elevated temperature proof strength values are given in Tables C1, C2 and C3 for information.

Table 5: Mechanical properties at room temperature - ferritic and martensitic grades

Steel designation		Heat treatment condition[1]	Thickness of ruling section t_R mm max.	Hardness HB max[2]	Proof strength $R_{p0.2}$ min	Tensile strength R_m	Elongation A min %		Energy impact KV – J min	
Name	Number				N/mm²	N/mm²	l[3]	tr[3]	l[3]	tr[3]
X6CrA113	1.4002	A	25	–	230	400 to 600	–	–	–	–
X6Cr17	1.4016	A	100	200	240	400 to 630	–	–	–	–
X12Cr13	1.4006	A	–	220	–	730 max	–	–	–	–
		QT 650	160	–	450	650 to 850	15	–	25	–
X20Cr13	1.4021	A	–	230	–	760 max	–	–	–	–
		QT 700	160	–	500	700 to 850	13	–	25	–
		QT 800	160	–	600	800 to 950	12	–	20	–
X30Cr13	1.4028	A	–	245	–	800 max	–	–	–	–
		QT 850	160	–	650	850 to 1 000	10	–	–	–
X17CrNi16–2	1.4057	A	250	295	–	1 000 max	–	–	–	–
		QT 800	250	–	600	800 to 950	10	8	20	15
		QT 900	250	–	700	900 to 1 050	10	8	15	10
X3CrNiMo13–4	1.4313	A	–	320	–	1 100 max	–	–	–	–
		QT 650	450	–	520	650 to 830	15	12	70	50
		QT 780	450	–	620	780 to 980	15	12	70	50
		QT 900	450	–	800	900 to 1 100	12	10	50	40
X4CrNiMo16–5–1	1.4418	A	–	320	–	1 100 max	–	–	–	–
		QT 760	450	–	550	760 to 960	16	14	90	70
		QT 900	450	–	700	900 to 1 100	16	14	80	60
X5CrNiCuNb16–4	1.4542	A	–	360	–	1 200 max	–	–	–	–
		P 930	250	–	720	930 min	15	12	40	30
		P 1070	250	–	1 000	1 070 min	12	10	20	15
		P 1300	250	–	1 150	1 300 min	8	6	–	–

[1] A = annealed - QT = quenched and tempered - P = precipitation hardened

[2] For information only

[3] l = longitudinal tr = transverse

Table 6: Mechanical properties at room temperature in the solution annealed conditions - Austenitic grades

Steel designation		Thickness of ruling section	Proof strength		Tensile strength	Elongation	Impact energy	
		t_R	$R_{p0.2}$ min	$R_{p1.0}$ min	R_m	A min	KV min	
Name	Number	mm	N/mm^2	N/mm^2	N/mm^2	%	J	
		max				tr[1)]	l[1)]	tr[1)]
X2CrNi18-9	1.4307	250	175	210	450 to 680	35	100	60
X2CrNi19-11	1.4306	250	180	215	460 to 680	35	100	60
X2CrNiN18-10	1.4311	250	270	305	550 to 760	30	100	60
X4CrNi18-10	1.4301	250	190	225	500 to 700	35	100	60
X6CrNiTi18-10	1.4541	450	190	225	500 to 700	30	100	60
X2CrNiMo17-12-2	1.4404	250	200	235	500 to 700	30	100	60
X2CrNiMoN17-12-2	1.4406	250	280	315	580 to 800	30	100	60
X4CrNiMo17-12-2	1.4401	250	200	235	500 to 700	30	100	60
X6CrNiMoTi17-12-2	1.4571	450	200	235	500 to 700	30	100	60
X2CrNiMoN17-13-3	1.4429	400	280	315	580 to 800	30	100	60
X4CrNiMo17-13-3	1.4436	250	200	235	500 to 700	30	100	60
X2CrNiMo18-14-3	1.4435	250	200	235	500 to 700	30	100	60
X1NiCrMoCu20-20-5	1.4539	250	230	260	530 to 730	30	100	60
X6CrNiNb18-10	1.4550	450	205	240	510 to 740	30	100	60
X1NiCrMoCu31-27-4	1.4563	250	220	250	500 to 750	30	100	60
X1CrNiMoCuN20-18-7	1.4547	250	300	340	650 to 850	30	100	60
X1NiCrMoCuN25-20-7	1.4529	250	300	340	650 to 850	35	100	60

[1)] l = longitudinal tr = transverse

Table 7: Mechanical properties at room temperature in the solution annealed condition - Austenitic-ferritic grades

Steel designation		Thickness of ruling section	Proof strength	Tensile strength	Elongation		Inpact energy	
		t_R	$R_{p\,0.2}$ min	R_m	A min		KV min	
		mm	N/mm^2	N/mm^2	%		J	
Name	Number	max			l[1)]	tr[1)]	l[1)]	tr[1)]
X3CrNiMoN27-5-2	1.4460	160	460	620 to 880	20	15	85	50
X2CrNiMoN22-5-3	1.4462	350	450	650 to 880	25	20	100	60
X2CrNiN23-4	1.4362	160	400	600 to 830	25	20	100	60
X2CrNiMoCuN25-6-3	1.4507	160	500	700 to 900	25	20	100	60
X2CrNiMoN25-7-4	1.4410	160	530	730 to 930	25	20	100	60
X2CrNiMoCuWN25-7-4	1.4501	160	530	730 to 930	25	20	100	60

[1)] l = longitudinal tr = transverse

Annex A (informative)

Heat treatment details

Heat treatment conditions are given in Tables A.1, A.2 and A.3.

Table A.1: Heat treatment conditions - ferritic and martensitic grades

Steel designation		Heat treatment condition[1)]	Annealing temperature °C	Quenching temperature °C	Type of cooling	Tempering temperature °C
Name	Number					
X6CrA113	1.4002	A	750 to 850	–	Air	–
X6Cr17	1.4016	A	750 to 850	–	Air	–
X12Cr13	1.4006	A	750 to 850	–	Oil or air	680 to 780
		QT 650	–	950 to 1 000	–	–
X20Cr13	1.4021	A	750 to 850	–	–	–
		QT 700	–	950 to 1 050	Oil or air	650 to 750
		QT 800	–	950 to 1 050	Oil or air	600 to 700
X30Cr13	1.4028	A	750 to 850	–	–	–
		QT 850	–	950 to 1 050	Oil or air	625 to 675
X17CrNi16-2	1.4057	A	600 to 800	–	Furnace or air	–
		QT 800	–	1 020 to 1 080	Oil	(580 to 630) + (550 to 650)
		QT 900	–	1 020 to 1 080	Oil	(540 to 600) + (520 to 640)
X3CrNiMo13-4	1.4313	A	600 to 650	–	–	–
		QT 650	–	950 to 1 050	Oil or air	(650 to 700) + (600 to 620)
		QT 780	–	950 to1 050	Oil or air	550 to 620
		QT 900	–	950 to 1 050	Oil or air	520 to 580
X4CrNiMo 16-5-1	1.4418	A	600 to 650	–	–	–
		QT 760	–	950 to 1 050	Oil	590 to 640
		QT 900	–	950 to 1 050	Oil	550 to 620
X5CrNiCuNb16-4	1.4542	A	600 to 750	–	Furnace or air	–
		P 930	–	1 020 to 1 080	Oil	620
		P 1070	–	1 020 to 1 080	Oil	550
		P 1300	–	1 020 to 1 080	Oil	480

[1)] A - annealed QT = quenched and tempered. P = precipitation hardened

Table A.2: Heat treatment conditions - austenitic grades

Steel designation		Solution annealing temperature °C	Cooling medium
Name	Number		
X2CrNi18-9	1.4307	1 000 to 1 100	Water or air
X2CrNi19-11	1.4306	1 000 to 1 100	Water or air
X2CrNiN18-10	1.4311	1 000 to 1 100	Water or air
X4CrNi18-10	1.4301	1 000 to 1 100	Water or air
X6CrNiTi18-10	1.4541	1 020 to 1 120	Water or air
X6CrNiNb18-10	1.4550	1 020 to 1 120	Water or air
X2CrNiMo17-12-2	1.4404	1 020 to 1 120	Water or air
X2CrNiMoN17-11-2	1.4406	1 020 to 1 120	Water or air
X6CrNiMoTi17-12-2	1.4571	1 020 to1 120	Water or air
X5CrNiMo17-12-2	1.4401	1 020 to 1 120	Water or air
X3CrNiMo17-13-2	1.4436	1 020 to 1 120	Water or air
X2CrNiMoN17-13-3	1.4429	1 020 to 1 120	Water or air
X2CrNiMo18-14-3	1.4435	1 020 to 1 120	Water or air
X1NiCrMoCu25-20-5	1.4539	1 050 to 1 150	Water or air
X1CrNiMoCuN20-18-7	1.4547	1 140 to 1 200	Water or air
X1NiCrMoCuN25-20-7	1.4529	1 120 to 1 180	Water or air
X1NiCrMoCu31-27-4	1.4563	1 050 to 1 150	Water

Table A.3: Heat treatment conditions - austenitic-ferritic grades

Steel designation		Solution annealing °C temperature	Cooling medium
Name	Number		
X3CrNiMoN27-5-2	1.4460	1 020 to 1 100	Water or air
X2CrNiMoN22-5-3	1.4462	1 020 to 1 100	Water or air
X2CrNiN23-4	1.4362	950 to 1 050	Water or air
X2CrNiMoCuN25-6-3	1.4507	1 040 to 1 120	Water or air
X2CrNiMoN25-7-4	1.4410	1 040 to 1 120	Water or air
X2CrNiMoCuWN25 -7-5	1.4501	1 040 to 1 120	Water or air

Annex B (informative)

Mechanical properties at low temperatures

Properties of certain steels at low temperatures are given in Table B.1.

Table B.1: Mechanical properties at low temperatures (typical values)

Steel designation		- 150 °C				- 196 °C			
Name	Number	R_{po2} N/mm^2	R_m N/mm^2	A %	KV J	R_{po2} N/mm^2	R_m N/mm^2	A %	KV J
X2CrNi 19-11	1.4306	230	1 200	45	60	240	1 350	40	60
X5CrNi 18-10	1.4301	370	1 400	40	60	400	1 500	35	60
X6CrNi Ti 18-10	1.4541	360	1 200	40	60	400	1 350	35	60
X6CrNiNb 18-10	1.4550	360	1 200	40	40	400	1 350	35	40
X2CrNiN18-10	1.4311	450	1 050	35	60	550	1 250	35	60
X2CrNiMoN17-13-3	1.4429	500	1 000	30	60	600	1 150	30	60

Annex C (informative)

Elevated temperature proof strength

Elevated temperature proof strength values are given in Tables C.1, C.2 and C.3 for information.

Table C.1: Minimum values for the 0,2 % proof strength of ferritic and martensitic grades at elevated temperatures

Steel designation		Heat-treatment	Minimum 0,2 % proof strength in N/mm^2 at a temperature of:						
Name	Number	condition [1)]	100 °C	150 °C	200 °C	250 °C	300 °C	350°C	400 °C
X6Cr17	1.4016	A	220	215	210	205	200	195	190
X12Cr13	1.4006	QT 650	420	410	400	385	365	335	305
X20Cr13	1.4021	QT 700	460	445	430	415	395	365	330
		QT 800	515	495	475	460	440	405	355
X3CrNiMo13-4	1.4313	QT 650	500	490	480	470	460	450	–
		QT 780	590	575	560	545	530	515	–
		QT 900	720	690	665	640	620	–	–
X4CrNiMo16-5-1	1.4418	QT 760	520	510	500	490	480	–	–
		QT 900	660	640	620	600	580	–	–

[1)] A = annealed QT = quenched and tempered

Table C.2: Minimum values for the 0,2 % and 1 % proof strength of austenitic steels at elevated temperatures in the solution annealed condition

Steel designation		Minimum 0,2 % proof strength (N/mm^2) at a temperature (in °C) of											Minimum 0,1 % proof strength (N/mm^2) at a temperature (in °C) of										
Name	Number	100	150	200	250	300	350	400	450	500	550	600	100	150	200	250	300	350	400	450	500	550	600
X2CrNiN18-10	1.4311	205	175	157	145	136	130	125	121	119	118	-	240	210	187	175	167	161	156	152	149	147	--
X4CrNi18-10	1.4301	157	142	127	118	110	104	98	95	92	90	-	191	172	157	145	135	129	125	122	120	120	-
X6CrNiTi18-10	1.4541	176	167	157	147	136	130	125	121	119	118	-	208	196	186	177	167	161	156	152	149	147	-
X6CrNiNb18-10	1.4550	177	167	157	147	136	130	125	121	119	118	-	211	196	186	177	167	161	156	152	149	147	-
X2CrNiMoN17-12-2	1.4406	211	185	167	155	145	140	135	131	128	127	-	246	218	198	183	175	169	164	160	158	157	-
X2CrNiMo17-12-2	1.4404	166	152	137	127	118	113	108	103	100	98	-	199	181	167	157	145	139	135	130	128	127	-
X6CrNiMoTi17-12-2	1.4571	185	177	167	157	145	140	135	131	129	127	-	218	206	196	186	175	169	164	160	158	157	-
X2CrNi19-11	1.4306	147	132	118	108	100	94	89	85	81	80	-	181	162	147	137	127	121	116	112	109	108	-
X5CrNiMo17-12-2	1.4401	177	162	147	137	127	120	115	112	110	108	-	211	191	177	167	156	150	144	141	139	137	-
X3CrNiMo17-13-3	1.4436	177	162	147	137	127	120	115	112	110	108	-	211	191	177	167	156	150	144	141	139	137	-
X2CrNiMoN17-13-3	1.4429	211	185	167	155	145	140	135	131	129	127	-	246	218	198	183	175	169	164	160	158	157	-
X2CrNiMo18-14-3	1.4435	165	150	137	127	119	113	108	103	100	98	-	200	180	165	153	145	139	135	130	128	127	-
X1NiCrMoCu25-20-5	1.4539	205	190	175	160	145	135	125	115	110	105	-	235	220	205	190	175	165	155	145	140	135	-
X1CrNiMoCuN20-18-7	1.4547	230	205	190	180	170	165	160	153	148	-	-	270	245	225	212	200	195	190	184	180	-	-
X1CrNiMoCuN25-20-7	1.4529	230	210	190	180	170	165	160	130	120	105	-	270	245	225	215	205	195	190	160	150	135	-
X2CrNi18-9	1.4307	145	130	118	108	100	94	89	85	81	80	-	180	160	145	135	127	121	116	112	109	108	-
X1NiCrMoCu31-27-4	1.4563	190	175	160	155	150	145	135	125	120	115	-	220	205	190	185	180	175	165	155	150	145	-

Table C.3: Minimum values for the 0,2 % proof strength of austenitic-ferritic steels at elevated temperatures in the solution annealed condition

Steel designation		Minimum 0,2 % proof strength (N/mm^2) at a temperature (in °C) of			
Name	Number	100	150	200	250
X3CrNiMoN27-5-2	1.4460	360	335	310	295
X2CrNiMoN22-5-3	1.4462	360	335	315	300
X2CrNiN23-4	1.4362	330	300	280	265
X2CrNiMoCuN25-6-3	1.4507	450	420	400	380
X2CrNiMoN25-7-4	1.4410	450	420	400	380
X2CrNiMoCuWN25-7-4	1.4501	450	420	400	380

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