DIN EN 10088-1

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ICS 77.140.20

Supersedes
August 1995 edition.

Stainless steels

Part 1: List of stainless steels

English version of DIN EN 10088-1

Nichtrostende Stähle – Teil 1: Verzeichnis der nichtrostenden Stähle

National foreword

This standard has been prepared by Subcommittee TC 23/SC 1 'Stainless steels' (Secretariat: Germany) of ECISS.

The responsible German body involved in its preparation was the *Normenausschuss Eisen und Stahl* (Steel and Iron Standards Committee), Subcommittee 06/1 *Nichtrostende Stähle*. This standard provides an overview of

- the chemical composition of all stainless steels covered in ECISS standards or designated for inclusion in European standards, classified as corrosion resisting, heat resisting, or creep resisting steels (see tables 2 to 9),
- the physical properties of stainless steels (see Annex A),
- the classification of grades (see Annex B),
- classification by microstructure (see Annex C),
- which stainless steels are included in which ECISS standards (see Annex D),
- the chemical composition of nickel and cobalt alloys included in DIN EN 10095, DIN EN 10269 and DIN EN 10302 (see Annex E).

Amendments

This standard differs from the August 1995 edition as follows.

a) 'Stainless steel' is now the overall term for corrosion resisting, heat resisting and creep resisting steels.

b) Heat resisting and creep resisting steels have been included (see tables 6 to 9). The definition of corrosion resisting steels has been adopted from the previous definition of stainless steels.

c) A table has been included listing the ECISS standards covering the use of steels to this standard for particular products.

d) The following new steel grades have been included:

- 2 ferritic corrosion resisting steels,
- 11 martensitic and precipitation hardening corrosion resisting steels,
- 13 austenitic corrosion resisting steels,
- 3 austenitic-ferritic corrosion resisting steels,
- 6 ferritic heat resisting steels,
- 14 austenitic heat resisting steels,
- 1 austenitic-ferritic heat resisting steel,
- 8 martensitic creep resisting steels,
- 21 austenitic creep resisting steels.

Continued overleaf.

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e) Ferritic corrosion resisting steel X2CrAlTi18-2 (1.4605) and precipitation hardening corrosion resisting steel X8CrNiMoAl15-7-2 (1.4532) have been omitted.

f) Guidance data have been included in Annex A for ferritic heat resisting, austenitic heat resisting, austenitic-ferritic heat resisting, martensitic creep resisting and austenitic creep resisting steels.

g) Annex B has been reworked to reflect the new classification of stainless steels by their working properties (corrosion resisting steels, heat resisting steels and creep resisting steels), classification by microstructure (ferritic, martensitic, precipitation hardening, austenitic and austenitic-ferritic steels), and classification by significant alloying elements.

h) Annex C has been included, giving empirical formulae for steel grade classification by microstructure.

i) Annex D has been included, with a matrix showing which steels are included in which standards.

j) Annex E has been included, with a table giving the chemical composition of nickel and cobalt alloys listed in DIN EN 10095, DIN EN 10269 and DIN EN 10302.

k) The standard has been editorially revised.

Previous edition

DIN EN 10088-1: 1995-08

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 10088-1

June 2005

ICS 77.140.20

Supersedes EN 10088-1:1995.

English version

Stainless steels

Part 1: List of stainless steels

Aciers inoxydables – Partie 1: Liste des aciers inoxydables

Nichtrostende Stähle – Teil 1: Verzeichnis der nichtrostenden Stähle

This European Standard was approved by CEN on 2005-04-14.

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Foreword

This European Standard (EN 10088-1:2005) has been prepared by Technical Committee ECISS/TC 23 “Steels for heat treatment, alloy steels and free-cutting steels - Qualities and dimensions”, the secretariat of which is held by DIN.

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 December 2005, and conflicting national standards shall be withdrawn at the latest by December 2005.

This document supersedes EN 10088-1:1995.

EN 10088, under the general title "Stainless steels", consists of the following parts:

— Part 1: List of stainless steels (including a table of European Standards, in which these stainless steels are further specified, see Annex D),

— Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes,

— Part 3: Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes.

The European Organisation for Standardisation (CEN) draws attention to the fact that it is claimed that compliance with this document may involve the use of patents applied to five steels grades

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1 Scope

This European Standard lists the chemical composition of stainless steels, which are subdivided in accordance with their main properties into corrosion resisting steels, heat resisting steels and creep resisting steels and specified in the European Standards given in Table 1.

Table 1 — Overview of material standards for stainless steels

Stainless steels		
Corrosion resisting steels	**Heat resisting steels**	**Creep resisting steels**
EN 10028-7		EN 10028-7
EN 10088-2		
EN 10088-3		
	EN 10095	
EN 10151		
EN 10216-5		EN 10216-5
EN 10217-7		
EN 10222-5		EN 10222-5
EN 10250-4		
EN 10263-5		
EN 10264-4	EN 10264-4	
EN 10269		EN 10269
EN 10270-3		
EN 10272		
EN 10296-2		
EN 10297-2		
		EN 10302
EN 10312		

Reference data on some physical properties are given in Tables A.1 to A.8.

NOTE 1 A matrix that shows which steels are included in which standard is given in Annex D.

NOTE 2 Valve steels are specified in EN 10090.

NOTE 3 Steel castings are specified in various European Standards (see Bibliography).

NOTE 4 Tool steels are specified in EN ISO 4957.

NOTE 5 Welding consumables are specified in various European Standards (see Bibliography).

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 10079:1992, *Definition of steel products*

EN 10020:2000, *Definition and classification of grades of steel*

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions for the product forms given in EN 10079:1992 and the following apply.

3.1
stainless steels
stainless steels are steels with at least 10,5 % of chromium and maximum 1,2 % of carbon
[see EN 10020:2000, definition 3.2.2]
They are further subdivided in accordance with their main property into corrosion resisting steels, heat resisting steels and creep resisting steels

NOTE One steel in Table 6 and five in Table 8 contain less Chromium than the minimum defined for stainless steels, but are included in the heat-resisting and creep-resisting steels standards respectively, because they form a part of these two families of steels.

4 Chemical composition

The chemical composition of stainless steels is given

— in Table 2 for ferritic corrosion resisting steels;

— in Table 3 for martensitic and precipitation hardening corrosion resisting steels;

— in Table 4 for austenitic corrosion resisting steels;

— in Table 5 for austenitic-ferritic corrosion resisting steels;

— in Table 6 for ferritic heat resisting steels;

— in Table 7 for austenitic and austenitic-ferritic heat resisting steels;

— in Table 8 for martensitic creep resisting steels;

— in Table 9 for austenitic creep resisting steels.

NOTE The chemical composition of nickel and cobalt alloys listed in EN 10095, EN 10269 and EN 10302 is given in Tables E.1 and E.2.

Table 2 — Chemical composition (cast analysis) [a] of ferritic corrosion resisting steels

Steel designation		% by mass											
Name	Number	C max.	Si max.	Mn max.	P max.	S	N max.	Cr	Mo	Nb	Ni	Ti	Others
X2CrNi12	1.4003	0,030	1,00	1,50	0,040	≤ 0,015 [b]	0,030	10,5 to 12,5	-	-	0,30 to 1,00	-	-
X2CrTi12	1.4512	0,030	1,00	1,00	0,040	≤ 0,015	-	10,5 to 12,5	-	-	-	[6 x (C+N)] to 0,65	-
X6CrNiTi12	1.4516	0,08	0,70	1,50	0,040	≤ 0,015	-	10,5 to 12,5	-	-	0,50 to 1,50	0,05 to 0,35	-
X6Cr13	1.4000	0,08	1,00	1,00	0,040	≤ 0,015 [b]	-	12,0 to 14,0	-	-	-	-	-
X6CrAl13	1.4002	0,08	1,00	1,00	0,040	≤ 0,015 [b]	-	12,0 to 14,0	-	-	-	-	Al : 0,10 to 0,30
X2CrTi17	1.4520	0,025	0,50	0,50	0,040	≤ 0,015	0,015	16,0 to 18,0	-	-	-	0,30 to 0,60	-
X6Cr17	1.4016	0,08	1,00	1,00	0,040	≤ 0,015 [b]	-	16,0 to 18,0	-	-	-	-	-
X3CrTi17	1.4510	0,05	1,00	1,00	0,040	≤ 0,015 [b]	-	16,0 to 18,0	-	-	-	[4 x (C+N) + 0,15] to 0,80 [c]	-
X1CrNb15	1.4595	0,020	1,00	1,00	0,025	≤ 0,015	0,020	14,0 to 16,0	-	0,20 to 0,60	-	-	-
X3CrNb17	1.4511	0,05	1,00	1,00	0,040	≤ 0,015 [b]	-	16,0 to 18,0	-	12 x C to 1,00	-	-	-
X6CrMo17-1	1.4113	0,08	1,00	1,00	0,040	≤ 0,015 [b]	-	16,0 to 18,0	0,90 to 1,40	-	-	-	-
X6CrMoS17	1.4105	0,08	1,50	1,50	0,040	0,15 to 0,35	-	16,0 to 18,0	0,20 to 0,60		-	-	-
X2CrMoTi17-1	1.4513	0,025	1,00	1,00	0,040	≤ 0,015	0,020	16,0 to 18,0	0,80 to 1,40	-	-	0,30 to 0,60	-
X2CrMoTi18-2	1.4521	0,025	1,00	1,00	0,040	≤ 0,015	0,030	17,0 to 20,0	1,80 to 2,50	-	-	[4 x (C+N) + 0,15] to 0,80 [c]	-
X2CrMoTiS18-2	1.4523	0,030	1,00	0,50	0,040	0,15 to 0,35	-	17,5 to 19,0	2,00 to 2,50	-	-	0,30 to 0,80	(C+N) ≤ 0,040
X6CrNi17-1	1.4017	0,08	1,00	1,00	0,040	≤ 0,015	-	16,0 to 18,0	-	-	1,20 to 1,60	-	-
X5CrNiMoTi15-2	1.4589	0,08	1,00	1,00	0,040	≤ 0,015	-	13,5 to 15,5	0,20 to 1,20	-	1,00 to 2,50	0,30 to 0,50	-
X6CrMoNb17-1	1.4526	0,08	1,00	1,00	0,040	≤ 0,015	0,040	16,0 to 18,0	0,80 to 1,40	[7x(C+N)+0,10] to 1,00	-	-	-
X2CrNbZr17	1.4590	0,030	1,00	1,00	0,040	≤ 0,015	-	16,0 to 17,5	-	0,35 to 0,55	-	-	Zr ≥ 7x(C+N)+0,15
X2CrTiNb18	1.4509	0,030	1,00	1,00	0,040	≤ 0,015	-	17,5 to 18,5	-	[3 x C + 0,30] to 1,00	-	0,10 to 0,60	-
X2CrMoTi29-4	1.4592	0,025	1,00	1,00	0,030	≤ 0,010	0,045	28,0 to 30,0	3,50 to 4,50	-	-	[4 x (C+N) + 0,15] to 0,80 [c]	-

[a] 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 precautions are to be taken to avoid the addition of such elements from scrap and other materials used in production which would impair mechanical properties and the suitability of the steel.

[b] For bars, rods, wire, sections, bright products and the relevant semi-finished products, a maximum content of 0,030 % S applies. Particular ranges of sulphur content may provide improvement of particular properties. For machinability a controlled sulphur content of 0,015 % to 0,030 % is recommended and permitted. For weldability, a controlled sulphur content of 0,008 % to 0,030 % is recommended and permitted. For polishability, a controlled sulphur content of 0,015 % max. is recommended.

[c] The stabilisation may be made by use of titanium or niobium or zirconium. According to the atomic mass of these elements and the content of carbon and nitrogen, the equivalence shall be the following: *Nb* (% by mass) ≡ *Zr* (% by mass) ≡ 7/4 *Ti* (% by mass).

Table 3 — Chemical composition (cast analysis) [a] of martensitic and precipitation hardening corrosion resisting steels

Steel designation		% by mass										
Name	Number	C[c]	Si max.	Mn	P max.	S	Cr	Cu	Mo	Nb	Ni	Others
X12Cr13	1.4006	0,08 to 0,15	1,00	≤ 1,50	0,040	≤ 0,015 [b]	11,5 to 13,5	-	-	-	≤ 0,75	-
X12CrS13	1.4005	0,08 to 0,15	1,00	≤ 1,50	0,040	0,15 to 0,35	12,0 to 14,0	-	≤0,60	-	-	-
X15Cr13	1.4024	0,12 to 0,17	1,00	≤ 1,00	0,040	≤ 0,015 [b]	12,0 to 14,0	-	-	-	-	-
X20Cr13	1.4021	0,16 to 0,25	1,00	≤ 1,50	0,040	≤ 0,015 [b]	12,0 to 14,0	-	-	-	-	-
X30Cr13	1.4028	0,26 to 0,35	1,00	≤ 1,50	0,040	≤ 0,015 [b]	12,0 to 14,0	-	-	-	-	-
X29CrS13	1.4029	0,25 to 0,32	1,00	≤ 1,50	0,040	0,15 to 0,25	12,0 to 13,5	-	≤ 0,60	-	-	-
X39Cr13	1.4031	0,36 to 0,42	1,00	≤ 1,00	0,040	≤ 0,015 [b]	12,5 to 14,5	-	-	-	-	-
X46Cr13	1.4034	0,43 to 0,50	1,00	≤ 1,00	0,040	≤ 0,015 [b]	12,5 to 14,5	-	-	-	-	-
X46CrS13	1.4035	0,43 to 0,50	1,00	≤ 2,00	0,040	0,15 to 0,35	12,5 to 14,0	-	-	-	-	-
X38CrMo14	1.4419	0,36 to 0,42	1,00	≤ 1,00	0,040	≤ 0,015	13,0 to 14,5	-	0,60 to 1,00	-	-	-
X55CrMo14	1.4110	0,48 to 0,60	1,00	≤ 1,00	0,040	≤ 0,015 [b]	13,0 to 15,0	-	0,50 to 0,80	-	-	V: ≤ 0,15
X50CrMoV15	1.4116	0,45 to 0,55	1,00	≤ 1,00	0,040	≤ 0,015 [b]	14,0 to 15,0	-	0,50 to 0,80	-	-	V: 0,10 to 0,20
X70CrMo15	1.4109	0,60 to 0,75	0,70	≤ 1,00	0,040	≤ 0,015 [b]	14,0 to 16,0	-	0,40 to 0,80	-	-	-
X40CrMoVN16-2	1.4123	0,35 to 0,50	1,00	≤ 1,00	0,040	≤ 0,015	14,0 to 16,0	-	1,00 to 2,50	-	≤ 0,50	V ≤ 1,50 N: 0,10 to 0,30
X14CrMoS17	1.4104	0,10 to 0,17	1,00	≤ 1,50	0,040	0,15 to 0,35	15,5 to 17,5	-	0,20 to 0,60	-	-	-
X39CrMo17-1	1.4122	0,33 to 0,45	1,00	≤ 1,50	0,040	≤ 0,015 [b]	15,5 to 17,5	-	0,80 to 1,30	-	≤ 1,00	-
X105CrMo17	1.4125	0,95 to 1,20	1,00	≤ 1,00	0,040	≤ 0,015 [b]	16,0 to 18,0	-	0,40 to 0,80	-	-	-
X90CrMoV18	1.4112	0,85 to 0,95	1,00	≤ 1,00	0,040	≤ 0,015 [b]	17,0 to 19,0	-	0,90 to 1,30	-	-	V: 0,07 to 0,12
X17CrNi16-2	1.4057	0,12 to 0,22	1,00	≤ 1,50	0,040	≤ 0,015 [b]	15,0 to 17,0	-	-	-	1,50 to 2,50	-
X1CrNiMoCu12-5-2	1.4422	≤ 0,020	0,50	≤ 2,00	0,040	≤ 0,003	11,0 to 13,0	0,20 to 0,80	1,30 to 1,80	-	4,0 to 5, 0	N: ≤ 0,020
X1CrNiMoCu12-7-3	1.4423	≤ 0,020	0,50	≤ 2,00	0,040	≤ 0,003	11,0 to 13,0	0,20 to 0,80	2,30 to 2,80	-	6,0 to 7, 0	N: ≤ 0,020
X2CrNiMoV13-5-2	1.4415	≤ 0,030	0,50	≤ 0,50	0,040	≤ 0,015	11,5 to 13,5	-	1,50 to 2,50	-	4,5 to 6,5	Ti: ≤ 0,010 V: 0,10 to 0,50
X3CrNiMo13-4	1.4313	≤ 0,05	0,70	≤ 1,50	0,040	≤ 0,015	12,0 to 14,0	-	0,30 to 0,70	-	3,5 to 4,5	N: ≥ 0,020
X4CrNiMo16-5-1	1.4418	≤ 0,06	0,70	≤ 1,50	0,040	≤ 0,015 [b]	15,0 to 17,0	-	0,80 to 1,50	-	4,0 to 6,0	N: ≥ 0,020
X1CrNiMoAlTi12-9-2	1.4530	≤ 0,015	0,10	≤ 0,10	0,010	≤ 0,005	11,5 to 12,5	-	1,85 to 2,15	-	8,5 to 9,5	Al: 0,60 to 0,80 Ti: 0,28 to 0,37 N: ≤ 0,010
X1CrNiMoAlTi12-10-2	1.4596	≤ 0,015	0,10	≤ 0,10	0,010	≤ 0,005	11,5 to 12,5	-	1,85 to 2,15	-	9,2 to 10,2	Al: 0,80 to 1,10 Ti: 0,28 to 0,40 N: ≤ 0,020
X5CrNiCuNb16-4	1.4542	≤ 0,07	0,70	≤ 1,50	0,040	≤ 0,015 [b]	15,0 to 17,0	3,0 to 5,0	≤ 0,60	5xC to 0,45	3,0 to 5,0	-

Table 3 (*concluded*)

Steel designation		% by mass										
Name	**Number**	**C** [c]	**Si** max.	**Mn**	**P** max.	**S**	**Cr**	**Cu**	**Mo**	**Nb**	**Ni**	**Others**
X7CrNiAl17-7	1.4568	≤ 0,09	0,70	≤ 1,00	0,040	≤ 0,015	16,0 to 18,0	-	-	-	6,5 to 7,8[d]	Al: 0,70 to 1,50
X5CrNiMoCuNb14-5	1.4594	≤ 0,07	0,70	≤ 1,00	0,040	≤ 0,015	13,0 to 15,0	1,20 to 2,00	1,20 to 2,00	0,15 to 0,60	5,0 to 6,0	-
X5NiCrTiMoVB25-15-2	1.4606	≤ 0,08	1,00	1,00 to 2,00	0,025	≤ 0,015	13,0 to 16,0	-	1,00 to 1,50	-	24,0 to 27,0	B: 0,001 0 to 0,010 Al: ≤ 0,35 Ti: 1,90 to 2,30 V: 0,10 to 0,50

[a] Elements not quoted in this table shall not be intentionally added to the steel without the agreement of the purchaser except for finishing the cast. All appropriate precautions are to be taken to avoid the addition of such elements from scrap and other materials used in production which would impair mechanical properties and the suitability of the steel.

[b] For bars, rods, wire, sections, bright products and the relevant semi-finished products, a maximum content of 0,030 % S applies. Particular ranges of sulphur content may provide improvement of particular properties. For machinability a controlled sulphur content of 0,015 % to 0,030 % is recommended and permitted. For weldability, a controlled sulphur content of 0,008 % to 0,030 % is recommended and permitted. For polishability, a controlled sulphur content of 0,015 % max. is recommended.

[c] Tighter carbon ranges may be agreed at the time of enquiry and order.

[d] For better cold deformability, the upper limit may be increased to 8,3 %.

Table 4 — Chemical composition (cast analysis) [a] of austenitic corrosion resisting steels

Steel designation		% by mass											
Name	Number	C	Si	Mn	P max.	S	N	Cr	Cu [c]	Mo	Nb	Ni	Others
X5CrNi17-7	1.4319	≤ 0,07	≤ 1,00	≤ 2,00	0,045	≤ 0,030	≤ 0,11	16,0 to 18,0	-	-	-	6,0 to 8,0	-
X10CrNi18-8	1.4310	0,05 to 0,15	≤ 2,00	≤ 2,00	0,045	≤ 0,015	≤ 0,11	16,0 to 19,0	-	≤ 0,80	-	6,0 to 9,5	-
X9CrNi18-9	1.4325	0,03 to 0,15	≤ 1,00	≤ 2,00	0,045	≤ 0,030	≤ 0,11	17,0 to 19,0	-	-	-	8,0 to 10,0	-
X2CrNiN18-7	1.4318	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015	0,10 to 0,20	16,5 to 18,5	-	-	-	6,0 to 8,0	-
X2CrNi18-9	1.4307	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015 [b]	≤ 0,11	17,5 to 19,5	-	-	-	8,0 to 10,5	-
X2CrNi19-11	1.4306	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015 [b]	≤ 0,11	18,0 to 20,0	-	-	-	10,0 to 12,0 [d]	-
X5CrNiN19-9	1.4315	≤ 0,06	≤ 1,00	≤ 2,00	0,045	≤ 0,015	0,12 to 0,22	18,0 to 20,0	-	-	-	8,0 to 11,0	-
X2CrNiN18-10	1.4311	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015 [b]	0,12 to 0,22	17,5 to 19,5	-	-	-	8,5 to 11,5	-
X5CrNi18-10	1.4301	≤ 0,07	≤ 1,00	≤ 2,00	0,045	≤ 0,015 [b]	≤ 0,11	17,5 to 19,5	-	-	-	8,0 to 10,5	-
X8CrNiS18-9 [e]	1.4305 [e]	≤ 0,10	≤ 1,00	≤ 2,00	0,045	0,15 to 0,35	≤ 0,11	17,0 to 19,0	≤ 1,00	-	-	8,0 to 10,0	-
X6CrNiTi18-10	1.4541	≤ 0,08	≤ 1,00	≤ 2,00	0,045	≤ 0,015 [b]	-	17,0 to 19,0	-		-	9,0 to 12,0 [d]	Ti:5xC to 0,70
X6CrNiNb18-10	1.4550	≤ 0,08	≤ 1,00	≤ 2,00	0,045	≤ 0,015	-	17,0 to 19,0	-	-	10xC to 1,00	9,0 to 12,0 [d]	-
X4CrNi18-12	1.4303	≤ 0,06	≤ 1,00	≤ 2,00	0,045	≤ 0,015 [b]	≤ 0,11	17,0 to 19,0	-	-	-	11,0 to 13,0	-
X1CrNi25-21	1.4335	≤ 0,020	≤ 0,25	≤ 2,00	0,025	≤ 0,010	≤ 0,11	24,0 to 26,0	-	≤ 0,20	-	20,0 to 22,0	-
X2CrNiMo17-12-2	1.4404	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015 [b]	≤ 0,11	16,5 to 18,5	-	2,00 to 2,50	-	10,0 to 13,0 [d]	-
X2CrNiMoN17-11-2	1.4406	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015 [b]	0,12 to 0,22	16,5 to 18,5	-	2,00 to 2,50	-	10,0 to 12,5 [d]	-
X5CrNiMo17-12-2	1.4401	≤ 0,07	≤ 1,00	≤ 2,00	0,045	≤ 0,015 [b]	≤ 0,11	16,5 to 18,5	-	2,00 to 2,50	-	10,0 to 13,0	-
X1CrNiMoN25-22-2	1.4466	≤ 0,020	≤ 0,70	≤ 2,00	0,025	≤ 0,010	0,10 to 0,16	24,0 to 26,0	-	2,00 to 2,50	-	21,0 to 23,0	-
X6CrNiMoTi17-12-2	1.4571	≤ 0,08	≤ 1,00	≤ 2,00	0,045	≤ 0,015 [b]	-	16,5 to 18,5	-	2,00 to 2,50	-	10,5 to 13,5 [d]	Ti:5xC to 0,70
X6CrNiMoNb17-12-2	1.4580	≤ 0,08	≤ 1,00	≤ 2,00	0,045	≤ 0,015	-	16,5 to 18,5	-	2,00 to 2,50	10xC to 1,00	10,5 to 13,5	-
X2CrNiMo17-12-3	1.4432	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015 [b]	≤ 0,11	16,5 to 18,5	-	2,50 to 3,00	-	10,5 to 13,0	-
X2CrNiMoN17-13-3	1.4429	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015	0,12 to 0,22	16,5 to 18,5	-	2,50 to 3,00	-	11,0 to 14,0 [d]	-
X3CrNiMo17-13-3	1.4436	≤ 0,05	≤ 1,00	≤ 2,00	0,045	≤ 0,015 [b]	≤ 0,11	16,5 to 18,5	-	2,50 to 3,00	-	10,5 to 13,0 [d]	-
X3CrNiMo18-12-3	1.4449	≤ 0,035	≤ 1,00	≤ 2,00	0,045	≤ 0,015	≤ 0,08	17,0 to 18,2	≤ 1,00	2,25 to 2,75	-	11,5 to 12,5	-
X2CrNiMo18-14-3	1.4435	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015 [b]	≤ 0,11	17,0 to 19,0	-	2,50 to 3,00	-	12,5 to 15,0	-
X2CrNiMoN18-12-4	1.4434	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015	0,10 to 0,20	16,5 to 19,5	-	3,0 to 4,0	-	10,5 to 14,0 [d]	-
X2CrNiMo18-15-4	1.4438	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015 [b]	≤ 0,11	17,5 to 19,5	-	3,0 to 4,0	-	13,0 to 16,0 [d]	-
X2CrNiMoN17-13-5	1.4439	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015	0,12 to 0,22	16,5 to 18,5	-	4,0 to 5,0	-	12,5 to 14,5	-
X1CrNiMoCuN24-22-8 [*)]	1.4652 [*)]	≤ 0,020	≤ 0,50	2,00 to 4,0	0,030	≤ 0,005	0,45 to 0,55	23,0 to 25,0	0,30 to 0,60	7,0 to 8,0	-	21,0 to 23,0	-
X1CrNiSi18-15-4	1.4361	≤ 0,015	3,7 to 4,5	≤ 2,00	0,025	≤ 0,010	≤ 0,11	16,5 to 18,5	-	≤ 0,20	-	14,0 to 16,0	-
X11CrNiMnN19-8-6	1.4369	0,07 to 0,15	0,50 to 1,00	5,0 to 7,5	0,030	≤ 0,015	0,20 to 0,30	17,5 to 19,5	-	-	-	6,5 to 8,5	-
X12CrMnNiN17-7-5	1.4372	≤ 0,15	≤ 1,00	5,5 to 7,5	0,045	≤ 0,015	0,05 to 0,25	16,0 to 18,0	-	-	-	3,5 to 5,5	-
X2CrMnNiN17-7-5	1.4371	≤ 0,030	≤ 1,00	6,0 to 8,0	0,045	≤ 0,015	0,15 to 0,20	16,0 to 17,0	-	-	-	3,5 to 5,5	-
X12CrMnNiN18-9-5	1.4373	≤ 0,15	≤ 1,00	7,5 to 10,5	0,045	≤ 0,015	0,05 to 0,25	17,0 to 19,0	-	-	-	4,0 to 6,0	-
X8CrMnNiN18-9-5	1.4374	0,05 to 0,10	0,30 to 0,60	9,0 to 10,0	0,035	≤ 0,030	0,25 to 0,32	17,5 to 18,5	≤ 0,40	≤ 0,50	-	5,0 to 6,0	-
X8CrMnCuNB17-8-3	1.4597	≤ 0,10	≤ 2,00	6,5 to 8,5	0,040	≤ 0,030	0,15 to 0,30	16,0 to 18,0	2,00 to 3,5	≤ 1,00	-	≤ 2,00	B: 0,000 5 to 0,005 0
X3CrNiCu19-9-2	1.4560	≤ 0,035	≤ 1,00	1,50 to 2,00	0,045	≤ 0,015	≤ 0,11	18,0 to 19,0	1,50 to 2,00	-	-	8,0 to 9,0	-
X2CrNiCu19-10	1.4650	≤ 0,030	≤1,00	≤ 2,00	0,045	≤ 0,015	≤ 0,08	18,5 to 20,0	≤ 1,00	-	-	9,0 to 10,0	-
X6CrNiCuS18-9-2 [e]	1.4570 [e]	≤ 0,08	≤1,00	≤ 2,00	0,045	0,15 to 0,35	≤ 0,11	17,0 to 19,0	1,40 to 1,80	≤ 0,60	-	8,0 to 10,0	-

Table 4 (*concluded*)

Steel designation		% by mass											
Name	Number	C	Si	Mn	P max.	S	N	Cr	Cu [c]	Mo	Nb	Ni	Others
X3CrNiCu18-9-4	1.4567	≤ 0,04	≤ 1,00	≤ 2,00	0,045	≤ 0,015 [b]	≤ 0,11	17,0 to 19,0	3,0 to 4,0	-	-	8,5 to 10,5	-
X3CrNiCuMo17-11-3-2	1.4578	≤ 0,04	≤ 1,00	≤ 2,00	0,045	≤ 0,015	≤ 0,11	16,5 to 17,5	3,0 to 3,5	2,00 to 2,50	-	10,0 to 11,0	-
X1NiCrMoCu31-27-4	1.4563	≤ 0,020	≤ 0,70	≤ 2,00	0,030	≤ 0,010	≤ 0,11	26,0 to 28,0	0,70 to 1,50	3,0 to 4,0	-	30,0 to 32,0	-
X1NiCrMoCu25-20-5	1.4539	≤ 0,020	≤ 0,70	≤ 2,00	0,030	≤ 0,010	≤ 0,15	19,0 to 21,0	1,20 to 2,00	4,0 to 5,0	-	24,0 to 26,0	-
X1CrNiMoCuN25-25-5	1.4537	≤ 0,020	≤ 0,70	≤ 2,00	0,030	≤ 0,010	0,17 to 0,25	24,0 to 26,0	1,00 to 2,00	4,7 to 5,7	-	24,0 to 27,0	-
X1CrNiMoCuN20-18-7	1.4547	≤ 0,020	≤ 0,70	≤ 1,00	0,030	≤ 0,010	0,18 to 0,25	19,5 to 20,5	0,50 to 1,00	6,0 to 7,0	-	17,5 to 18,5	-
X2CrNiMoCuS17-10-2 [e]	1.4598 [e]	≤ 0,03	≤ 1,00	≤ 2,00	0,045	0,10 to 0,25	≤ 0,11	16,5 to 18,5	1,30 to 1,80	2,00 to 2,50	-	10,0 to 13,0	-
X1CrNiMoCuNW24-22-6	1.4659	≤ 0,020	≤ 0,70	2,00 to 4,0	0,030	≤ 0,010	0,35 to 0,50	23,0 to 25,0	1,00 to 2,00	5,5 to 6,5	-	21,0 to 23,0	W:1,50 to 2,50
X1NiCrMoCuN25-20-7	1.4529	≤ 0,020	≤ 0,50	≤ 1,00	0,030	≤ 0,010	0,15 to 0,25	19,0 to 21,0	0,50 to 1,50	6,0 to 7,0	-	24,0 to 26,0	-
X2NiCrAlTi32-20	1.4558	≤ 0,030	≤ 0,70	≤ 1,00	0,020	≤ 0,015	-	20,0 to 23,0	-	-	-	32,0 to 35,0	Al:0,15 to 0,45 Ti:[8x(C+N)] to 0,60
X2CrNiMnMoN25-18-6-5	1.4565	≤ 0,030	≤ 1,00	5,0 to 7,0	0,030	≤ 0,015	0,30 to 0,60	24,0 to 26,0	-	4,0 to 5,0	≤ 0,15	16,0 to 19,0	-

[a] Elements not quoted in this table shall not be intentionally added to the steel without the agreement of the purchaser except for finishing the cast. All appropriate precautions are to be taken to avoid the addition of such elements from scrap and other materials used in production which would impair mechanical properties and the suitability of the steel.

[b] For bars, rods, wire, sections, bright products and the relevant semi-finished products, a maximum content of 0,030 % S applies. Particular ranges of sulphur content may provide improvement of particular properties. For machinability a controlled sulphur content of 0,015 % to 0,030 % is recommended and permitted. For weldability, a controlled sulphur content of 0,008 % to 0,030 % is recommended and permitted. For polishability, a controlled sulphur content of 0,015 % max. is recommended.

[c] For austenitic steel grades intended for cold heading and cold extruding, a Cu-content of max. 1,0 % is permitted.

[d] Where for special reasons, e. g. hot workability for the fabrication of seamless tubes where it is necessary to minimize the deltaferrite content, or with the aim of low magnetic permeability, the maximum Ni content may be increased by the following amounts:
0,50 % (m/m): 1.4571.
1,00 % (m/m): 1.4306, 1.4406, 1.4429, 1.4434, 1.4436, 1.4438, 1.4541, 1.4550.
1,50 % (m/m): 1.4404

[e] Parts made of high sulphur free cutting austenitic steels may not comply with European Directive 94/27 regarding articles in contact with human skin.

[*)] Patented steel grade.

Table 5 — Chemical composition (cast analysis) [a] of austenitic-ferritic corrosion resisting steels

Steel designation		% by mass										
Name	Number	C max.	Si	Mn	P max.	S max.	N	Cr	Cu	Mo	Ni	W
X2CrNiN23-4[*)]	1.4362[*)]	0,030	≤ 1,00	≤ 2,00	0,035	0,015	0,05 to 0,20	22,0 to 24,0	0,10 to 0,60	0,10 to 0,60	3,5 to 5,5	-
X2CrNiCuN23-4	1.4655	0,030	≤ 1,00	≤ 2,00	0,035	0,015	0,05 to 0,20	22,0 to 24,0	1,00 to 3,00	0,10 to 0,60	3,5 to 5,5	-
X3CrNiMoN27-5-2	1.4460	0,05	≤ 1,00	≤ 2,00	0,035	0,015 [b]	0,05 to 0,20	25,0 to 28,0	-	1,30 to 2,00	4,5 to 6,5	-
X2CrNiMoN29-7-2[*)]	1.4477[*)]	0,030	≤ 0,50	0,80 to 1,50	0,030	0,015	0,30 to 0,40	28,0 to 30,0	≤ 0,80	1,50 to 2,60	5,8 to 7,5	-
X2CrNiMoN22-5-3 [c]	1.4462[c]	0,030	≤ 1,00	≤ 2,00	0,035	0,015	0,10 to 0,22	21,0 to 23,0	-	2,50 to 3,5	4,5 to 6,5	-
X2CrNiMoCuN25-6-3	1.4507	0,030	≤ 0,70	≤ 2,00	0,035	0,015	0,20 to 0,30	24,0 to 26,0	1,00 to 2,50	3,0 to 4,0	6,0 to 8,0	-
X2CrNiMoN25-7-4[*)]	1.4410[*)]	0,030	≤ 1,00	≤ 2,00	0,035	0,015	0,24 to 0,35	24,0 to 26,0	-	3,0 to 4,5	6,0 to 8,0	-
X2CrNiMoCuWN25-7-4	1.4501	0,030	≤ 1,00	≤ 1,00	0,035	0,015	0,20 to 0,30	24,0 to 26,0	0,50 to 1,00	3,0 to 4,0	6,0 to 8,0	0,50 to 1,00
X2CrNiMoSi18-5-3	1.4424	0,030	1,40 to 2,00	1,20 to 2,00	0,035	0,015	0,05 to 0,10	18,0 to 19,0	-	2,50 to 3,0	4,5 to 5,2	-

[a] 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 precautions are to be taken to avoid the addition of such elements from scrap and other materials used in production which would impair mechanical properties and the suitability of the steel.

[b] For bars, rods, wire, sections, bright products and the relevant semi-finished products, a maximum content of 0,030 % S applies. Particular ranges of sulphur content may provide improvement of particular properties. For machinability a controlled sulphur content of 0,015 % to 0,030 % is recommended and permitted. For weldability, a controlled sulphur content of 0,008 % to 0,030 % is recommended and permitted. For polishability, a controlled sulphur content of 0,015 % max. is recommended.

[c] By agreement, this grade can be delivered with a Pitting Resistance Equivalent Number (PRE = Cr + 3,3 Mo + 16 N, compare Table C.1) greater than 34.

[*)] Patented steel grade.

Table 6 — Chemical composition (cast analysis) [a] of ferritic heat-resisting steels

Steel designation		% by mass							
Name	Number	C	Si	Mn max.	P max.	S max.	Cr	Al	Others
X10CrAlSi7	1.4713	max. 0,12	0,50 to 1,00	1,00	0,040	0,015	6,0 to 8,0	0,50 to 1,00	-
X10CrAlSi13	1.4724	max. 0,12	0,70 to 1,40	1,00	0,040	0,015	12,0 to 14,0	0,70 to 1,20	-
X10CrAlSi18	1.4742	max. 0,12	0,70 to 1,40	1,00	0,040	0,015	17,0 to 19,0	0,70 to 1,20	-
X10CrAlSi25	1.4762	max. 0,12	0,70 to 1,40	1,00	0,040	0,015	23,0 to 26,0	1,20 to 1,70	-
X18CrN28	1.4749	0,15 to 0,20	max. 1,00	1,00	0,040	0,015	26,0 to 29,0	-	N: 0,15 to 0,25
X3CrAlTi18-2	1.4736	max. 0,04	max. 1,00	1,00	0,040	0,015	17,0 to 18,0	1,70 to 2,10	Ti: [4(C+N)+0,2] to 0,80

[a] Elements not listed in the table shall not be intentionally added to the steel without the agreement of the purchaser except for finishing the cast. All appropriate precautions are to be taken to avoid addition of such elements from scrap and other materials used in production which would impair mechanical properties and the suitability of the steel.

Table 7 — Chemical composition (cast analysis) [a] of austenitic and austenitic-ferritic heat-resisting steels

Steel designation		% by mass								
Name	Number	C	Si	Mn	P max.	S max.	Cr	Ni	N	Others
austenitic heat-resisting steels										
X8CrNiTi18-10	1.4878	≤ 0,10	≤ 1,00	≤ 2,00	0,045	0,015	17,0 to 19,0	9,0 to 12,0	-	Ti: 5xC to 0,80
X15CrNiSi20-12	1.4828	≤ 0,20	1,50 to 2,50	≤ 2,00	0,045	0,015	19,0 to 21,0	11,0 to 13,0	≤ 0,11	-
X9CrNiSiNCe21-11-2	1.4835	0,05 to 0,12	1,40 to 2,50	≤ 1,00	0,045	0,015	20,0 to 22,0	10,0 to 12,0	0,12 to 0,20	Ce : 0,03 to 0,08
X12CrNi23-13	1.4833	≤ 0,15	≤ 1,00	≤ 2,00	0,045	0,015	22,0 to 24,0	12,0 to 14,0	≤ 0,11	-
X8CrNi25-21	1.4845	≤ 0,10	≤ 1,50	≤ 2,00	0,045	0,015	24,0 to 26,0	19,0 to 22,0	≤ 0,11	-
X15CrNiSi25-21	1.4841	≤ 0,20	1,50 to 2,50	≤ 2,00	0,045	0,015	24,0 to 26,0	19,0 to 22,0	≤ 0,11	-
X12NiCrSi35-16	1.4864	≤ 0,15	1,00 to 2,00	≤ 2,00	0,045	0,015	15,0 to 17,0	33,0 to 37,0	≤ 0,11	-
X10NiCrAlTi32-21	1.4876	≤ 0,12	≤ 1,00	≤ 2,00	0,030	0,015	19,0 to 23,0	30,0 to 34,0	-	Al : 0,15 to 0,60 Ti : 0,15 to 0,60
X6NiCrNbCe32-27	1.4877	0,04 to 0,08	≤ 0,30	≤ 1,00	0,020	0,010	26,0 to 28,0	31,0 to 33,0	≤ 0,11	Al : ≤ 0,025 Ce : 0,05 to 0,10 Nb : 0,60 to 1,00
X25CrMnNiN25-9-7	1.4872	0,20 to 0,30	≤ 1,00	8,0 to 10,0	0,045	0,015	24,0 to 26,0	6,0 to 8,0	0,20 to 0,40	-
X6CrNiSiNCe19-10	1.4818	0,04 to 0,08	1,00 to 2,00	≤ 1,00	0,045	0,015	18,0 to 20,0	9,0 to 11,0	0,12 to 0,20	Ce : 0,03 to 0,08
X6NiCrSiNCe35-25*)	1.4854*)	0,04 to 0,08	1,20 to 2,00	≤ 2,00	0,040	0,015	24,0 to 26,0	34,0 to 36,0	0,12 to 0,20	Ce : 0,03 to 0,08
X10NiCrSi35-19	1.4886	≤ 0,15	1,00 to 2,00	≤ 2,00	0,030	0,015	17,0 to 20,0	33,0 to 37,0	≤ 0,11	-
X10NiCrSiNb35-22	1.4887	≤ 0,15	1,00 to 2,00	≤ 2,00	0,030	0,015	20,0 to 23,0	33,0 to 37,0	≤ 0,11	Nb: 1,00 to 1,50
austenitic-ferritic heat-resisting steel										
X15CrNiSi25-4	1.4821	0,10 to 0,20	0,8 to 1,50	≤ 2,00	0,040	0,015	24,5 to 26,5	3,5 to 5,5	≤ 0,11	-

[a] Elements not listed in the table shall not be intentionally added to the steel without the agreement of the purchaser except for finishing the cast. All appropriate precautions are to be taken to avoid addition of such elements from scrap and other materials used in production which would impair mechanical properties and the suitability of the steel.

*) Patented steel grade.

Table 8 — Chemical composition (cast analysis) [a] of martensitic creep-resisting steels

Steel designation		% by mass													
Name	Number	C	Si	Mn	P max.	S max.	N	Al	Cr	Mo	Nb	Ni	V	W	Others
X10CrMoVNb9-1	1.4903	0,08 to 0,12	≤ 0,50	0,30 to 0,60	0,025	0,015	0,030 to 0,070	≤ 0,040	8,0 to 9,5	0,85 to 1,05	0,060 to 0,10	≤ 0,40	0,18 to 0,25	-	-
X11CrMoWVNb9-1-1	1.4905	0,09 to 0,13	0,10 to 0,50	0,30 to 0,60	0,020	0,010	0,050 to 0,090	≤ 0,040	8,5 to 9,5	0,90 to 1,10	0,060 to 0,10	0,10 to 0,40	0,18 to 0,25	0,90 to 1,10	B: 0,000 5 to 0,005 0
X8CrCoNiMo10-6	1.4911	0,05 to 0,12	0,10 to 0,80	0,30 to 1,30	0,025	0,015	≤ 0,035	-	9,8 to 11,2	0,50 to 1,00	0,20 to 0,50	0,20 to 1,20	0,10 to 0,40	≤ 0,70	B: 0,005 to 0,015 Co: 5,0 to 7,0
X19CrMoNbVN11-1	1.4913	0,17 to 0,23	≤ 0,50	0,40 to 0,90	0,025	0,015	0,050 to 0,10	≤ 0,020	10,0 to 11,5	0,50 to 0,80	0,25 to 0,55	0,20 to 0,60	0,10 to 0,30	-	B: ≤ 0,0015
X20CrMoV11-1	1.4922	0,17 to 0,23	≤ 0,40	0,30 to 1,00	0,025	0,015	-	-	10,0 to 12,5	0,80 to 1,20	-	0,30 to 0,80	0,20 to 0,35	-	-
X22CrMoV12-1	1.4923	0,18 to 0,24	≤ 0,50	0,40 to 0,90	0,025	0,015	-	-	11,0 to 12,5	0,80 to 1,20	-	0,30 to 0,80	0,25 to 0,35	-	-
X20CrMoWV12-1	1.4935	0,17 to 0,24	0,10 to 0,50	0,30 to 0,80	0,025	0,015	-	-	11,0 to 12,5	0,80 to 1,20	-	0,30 to 0,80	0,20 to 0,35	0,40 to 0,60	-
X12CrNiMoV12-3	1.4938	0,08 to 0,15	≤ 0,50	0,40 to 0,90	0,025	0,015	0,020 to 0,040	-	11,0 to 12,5	1,50 to 2,00	-	2,00 to 3,00	0,25 to 0,40	-	-

[a] 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 precautions are to be taken to avoid the addition of such elements from scrap and other materials used in production which would impair mechanical properties and the suitability of the steel.

Table 9 — Chemical composition (cast analysis) [a] of austenitic creep-resisting steels

Steel designation		% by mass														
Name	Number	C	Si	Mn	P max.	S max.	N	Al	Cr	Mo	Nb	Ni	Ti	V	W	Others
X3CrNiMoBN17-13-3	1.4910	≤ 0,04	≤ 0,75	≤ 2,00	0,035	0,015	0,10 to 0,18	-	16,0 to 18,0	2,00 to 3,00	-	12,0 to 14,0	-	-	-	B: 0,001 5 to 0,005 0
X7CrNiNb18-10	1.4912	0,04 to 0,10	≤ 1,00	≤ 2,00	0,045	0,015	-	-	17,0 to 19,0	-	10xC to 1,20	9,0 to 12,0	-	-	-	-
X6CrNiMoB17-12-2	1.4919	0,04 to 0,08	≤ 1,00	≤ 2,00	0,035	0,015	≤ 0,11	-	16,5 to 18,5	2,00 to 2,50	-	10,0 to 13,0	-	-	-	B: 0,001 5 to 0,005 0
X6CrNiTiB18-10	1.4941	0,04 to 0,08	≤ 1,00	≤ 2,00	0,035	0,015	-	-	17,0 to 19,0		-	9,0 to 12,0	5xC to 0,80	-	-	B: 0,001 5 to 0,005 0
X6CrNiWNbN16-16	1.4945	0,04 to 0,10	0,30 to 0,60	≤ 1,50	0,035	0,015	0,06 to 0,14	-	15,5 to 17,5	-	10xC to 1,20	15,5 to 17,5	-	-	2,50 to 3,50	-
X6CrNi18-10	1.4948	0,04 to 0,08	≤ 1,00	≤ 2,00	0,035	0,015	≤ 0,11	-	17,0 to 19,0	-	-	8,0 to 11,0	-	-	-	-
X6CrNi23-13	1.4950	0,04 to 0,08	≤ 0,70	≤ 2,00	0,035	0,015	≤ 0,11	-	22,0 to 24,0	-	-	12,0 to 15,0	-	-	-	-
X6CrNi25-20	1.4951	0,04 to 0,08	≤ 0,70	≤ 2,00	0,035	0,015	≤ 0,11	-	24,0 to 26,0	-	-	19,0 to 22,0	-	-	-	-
X5NiCrAlTi31-20	1.4958	0,03 to 0,08	≤ 0,70	≤ 1,50	0,015	0,010	≤ 0,030	0,20 to 0,50	19,0 to 22,0	-	≤ 0,10	30,0 to 32,5	0,20 to 0,50	-	-	Co: ≤ 0,50 Cu: ≤ 0,50
X8NiCrAlTi32-21	1.4959	0,05 to 0,10	≤ 0,70	≤ 1,50	0,015	0,010	≤ 0,030	0,25 to 0,65	19,0 to 22,0	-	-	30,0 to 34,0	0,25 to 0,65	-	-	Co: ≤ 0,50 Cu: ≤ 0,50
X8CrNiNb16-13	1.4961	0,04 to 0,10	0,30 to 0,60	≤ 1,50	0,035	0,015	-	-	15,0 to 17,0	-	10xC to 1,20	12,0 to 14,0	-	-	-	-
X12CrNiWTiB16-13	1.4962	0,07 to 0,15	≤ 0,50	≤ 1,50	0,035	0,015	-	-	15,5 to 17,5	-	-	12,5 to 14,5	0,40 to 0,70	-	2,50 to 3,00	B: 0,001 5 to 0,006 0
X12CrCoNi21-20	1.4971	0,08 to 0,16	≤ 1,00	≤ 2,00	0,035	0,015	0,10 to 0,20	-	20,0 to 22,5	2,50 to 3,5	0,75 to 1,25	19,0 to 21,0	-	-	2,00 to 3,00	Co: 18,5 to 21,0
X6NiCrTiMoVB25-15-2	1.4980	0,03 to 0,08	≤ 1,00	1,00 to 2,00	0,025	0,015	-	≤ 0,35	13,5 to 16,0	1,00 to 1,50	-	24,0 to 27,0	1,90 to 2,30	0,10 to 0,50	-	B: 0,003 0 to 0,010
X8CrNiMoNb16-16	1.4981	0,04 to 0,10	0,30 to 0,60	≤ 1,50	0,035	0,015	-	-	15,5 to 17,5	1,60 to 2,00	10xC to 1,20	15,5 to 17,5	-	-	-	-
X10CrNiMoMnNbVB15-10-1	1.4982	0,07 to 0,13	≤ 1,00	5,5 to 7,0	0,040	0,030	≤ 0,11	-	14,0 to 16,0	0,80 to 1,20	0,75 to 1,25	9,0 to 11,0	-	0,15 to 0,40	-	B:0,003 to 0,009

Table 9 (*concluded*)

Steel designation		% by mass														
Name	Number	C	Si	Mn	P max.	S max.	N	Al	Cr	Mo	Nb	Ni	Ti	V	W	Others
X6CrNiMoTiB17-13	1.4983	0,04 to 0,08	≤ 0,75	≤ 2,00	0,035	0,015	-	-	16,0 to 18,0	2,00 to 2,50	-	12,0 to 14,0	5xC to 0,80	-	-	B: 0,0015 to 0,0060
X7CrNiMoBNb16-16	1.4986	0,04 to 0,10	0,30 to 0,60	≤ 1,50	0,045	0,030	-	-	15,5 to 17,5	1,60 to 2,00	Nb + Ta: 10xC to 1,20	15,5 to 17,5	-	-	-	B: 0,05 to 0,10
X8CrNiMoVNb16-13	1.4988	0,04 to 0,10	0,30 to 0,60	≤ 1,50	0,035	0,015	0,06 to 0,14	-	15,5 to 17,5	1,10 to 1,50	10xC to 1,20	12,5 to 14,5	-	0,60 to 0,85	-	-
X7CrNiTi18-10	1.4940	0,04 to 0,08	≤ 1,00	≤ 2,00	0,040	0,015	≤ 0,11	-	17,0 to 19,0	-	-	9,0 to 13,0	5x(C+N) to 0,80	-	-	-
X6CrNiMo17-13-2	1.4918	0,04 to 0,08	≤ 0,75	≤ 2,00	0,035	0,015	≤ 0,11	-	16,0 to 18,0	2,00 to 2,50	-	12,0 to 14,0	-	-	-	-

[a] 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 precautions are to be taken to avoid the addition of such elements from scrap and other materials used in production which would impair mechanical properties and the suitability of the steel.

Annex A
(informative)

Guidance data on some physical properties

Tables A.1 to A.8 give guidance data on some physical properties for stainless steels.

Table A.1 — Guidance data on some physical properties of ferritic corrosion resisting steels

Steel designation		Density	Modulus of elasticity at						Mean coefficient of thermal expansion between 20 °C and					Thermal conductivity at 20 °C	Specific thermal capacity at 20 °C	Electrical resistivity at 20 °C	Magnetizable
			20 °C	100 °C	200 °C	300 °C	400 °C	500 °C	100 °C	200 °C	300 °C	400 °C	500 °C	$\frac{W}{m \cdot K}$	$\frac{J}{kg \cdot K}$	$\frac{\Omega \cdot mm^2}{m}$	
Name	Number	kg/dm³	GPa						$10^{-6} \times K^{-1}$								
X2CrNi12	1.4003	7,7	220	215	210	205	195	-	10,4	10,8	11,2	11,6	11,9	25	430	0,60	yes
X2CrTi12	1.4512								10,5	11,0	11,5	12,0	12,0	25	460	0,60	
X6CrNiTi12	1.4516								10,5	-	11,5	-	-	30	460	0,60	
X6Cr13	1.4000								10,5	11,0	11,5	12,0	12,0	30	460	0,60	
X6CrAl13	1.4002								10,5	11,0	11,5	12,0	12,0	30	460	0,60	
X2CrTi17	1.4520								10,4	10,8	11,2	11,6	11,9	20	430	0,70	
X6Cr17	1.4016								10,0	10,0	10,5	10,5	11,0	25	460	0,60	
X3CrTi17	1.4510								10,0	10,0	10,5	10,5	11,0	25	460	0,60	
X1CrNb15	1.4595								10,4	10,8	11,2	11,6	11,9	30	460	0,60	
X3CrNb17	1.4511								10,0	10,0	10,5	10,5	11,0	25	460	0,60	
X6CrMo17-1	1.4113								10,0	10,5	10,5	10,5	11,0	25	460	0,70	
X6CrMoS17	1.4105								10,0	10,5	10,5	10,5	11,0	25	460	0,70	
X2CrMoTi17-1	1.4513								10,0	10,5	10,5	10,5	11,0	25	460	0,70	
X2CrMoTi18-2	1.4521								10,4	10,8	11,2	11,6	11,9	23	430	0,80	
X2CrMoTiS18-2	1.4523								10,4	10,8	11,2	11,6	11,9	23	430	0,80	
X6CrNi17-1	1.4017								10,2	-	10,8	-	-	30	460	0,70	
X5CrNiMoTi15-2	1.4589								10,5	11,0	11,5	12,0	12,0	25	460	0,60	
X6CrMoNb17-1	1.4526								11,7	-	12,1	-	-	30	440	0,70	
X2CrNbZr17	1.4590								11	-	11,5	-	-	26	460	0,60	
X2CrTiNb18	1.4509								10,0	10,0	10,5	10,5	-	25	460	0,60	
X2CrMoTi29-4	1.4592								11,5	-	12	-	-	17	440	0,67	

Table A.2 — Guidance data on some physical properties of martensitic and precipitation hardening corrosion resisting steels

Steel designation		Density	Modulus of elasticity at					Mean coefficient of thermal expansion between 20 °C and				Thermal conductivity at 20 °C $\frac{W}{m \cdot K}$	Specific thermal capacity at 20 °C $\frac{J}{kg \cdot K}$	Electrical resistivity at 20 °C $\frac{\Omega \cdot mm^2}{m}$	Magnetizable
			20 °C	100 °C	200 °C	300 °C	400 °C	100 °C	200 °C	300 °C	400 °C				
Name	Number	kg/dm³	GPa					$10^{-6} \times K^{-1}$							
X12Cr13	1.4006	7,7	215	212	205	200	190	10,5	11,0	11,5	12,0	30	460	0,60	
X12CrS13	1.4005	7,7	215	212	205	200	190	10,5	11,0	11,5	12,0	30	460	0,60	
X15Cr13	1.4024	7,7	216	213	207	200	192	10,5	11,0	11,5	12,0	30	460	0,60	
X20Cr13	1.4021	7,7	215	212	205	200	190	10,5	11,0	11,5	12,0	30	460	0,60	
X30Cr13	1.4028	7,7	215	212	205	200	190	10,5	11,0	11,5	12,0	30	460	0,65	
X29CrS13	1.4029	7,7	215	212	205	200	190	10,5	-	11,5	-	30	460	0,55	
X39Cr13	1.4031	7,7	215	212	205	200	190	10,5	11,0	11,5	12,0	30	460	0,55	
X46Cr13	1.4034	7,7	215	212	205	200	190	10,5	11,0	11,5	12,0	30	460	0,55	
X46CrS13	1.4035	7,7	215	212	205	200	190	10,5	11,0	11,5	12,0	30	460	0,55	
X38CrMo14	1.4419	7,7	215	212	205	200	190	10,5	11,0	11,5	12,0	30	460	0,62	
X55CrMo14	1.4110	7,7	215	212	205	200	190	10,5	11,0	11,5	12,0	30	460	0,62	
X50CrMoV15	1.4116	7,7	215	212	205	200	190	10,5	11,0	11,0	11,5	30	460	0,65	
X70CrMo15	1.4109	7,7	215	212	205	200	190	10,5	11,0	11,0	11,5	30	460	0,65	
X40CrMoVN16-2	1.4123	7,7	195	188	182	177	-	10,4	10,6	10,8	11,1	24	430	0,80	
X14CrMoS17	1.4104	7,7	215	212	205	200	190	10,0	10,5	10,5	10,5	25	460	0,70	yes
X39CrMo17-1	1.4122	7,7	215	212	205	200	190	10,4	10,8	11,2	11,6	15	430	0,80	
X105CrMo17	1.4125	7,7	215	212	205	200	190	10,4	10,8	11,2	11,6	15	430	0,80	
X90CrMoV18	1.4112	7,7	215	212	205	200	190	10,4	10,8	11,2	11,6	15	430	0,80	
X17CrNi16-2	1.4057	7,7	215	212	205	200	190	10,0	10,5	10,5	10,5	25	460	0,70	
X1CrNiMoCu12-5-2	1.4422	7,7	200	195	185	175	170	10,4	10,8	11,2	11,6	16	450	0,75	
X1CrNiMoCu12-7-3	1.4423	7,7	200	195	185	175	170	10,4	10,8	11,2	11,6	16	450	0,75	
X2CrNiMoV13-5-2	1.4415	7,8	200	195	185	175	170	10,9	-	11,1	-	16	500	0,71	
X3CrNiMo13-4	1.4313	7,7	200	195	185	175	170	10,5	10,9	11,3	11,6	25	430	0,60	
X4CrNiMo16-5-1	1.4418	7,7	200	195	185	175	170	10,3	10,8	11,2	11,6	15	430	0,80	
X1CrNiMoAlTi12-9-2	1.4530	7,7	195	187	178	171	-	10,0	10,3	10,7	11,2	16	500	0,71	
X1CrNiMoAlTi12-10-2	1.4596	7,7	195	187	178	171	-	10,0	10,3	10,7	11,2	16	500	0,71	
X5CrNiCuNb16-4	1.4542	7,8	200	195	185	175	170	10,9	-	11,1	-	16	500	0,71	
X7CrNiAl17-7	1.4568	7,8	200	195	185	175	170	13,0	13,5	14,0	-	16	500	0,80	
X5CrNiMoCuNb14-5	1.4594	7,8	200	195	185	175	170	10,9	-	11,1	-	16	500	0,71	
X5NiCrTiMoVB25-15-2	1.4606	7,9	211	206	200	192	183	16,5	16,8	18,0	17,5	14	460	0,91	no

Table A.3 — Guidance data on some physical properties of austenitic corrosion resisting steels

Steel designation		Density	Modulus of elasticity at						Mean coefficient of thermal expansion between 20 °C and					Thermal conductivity at 20 °C $\frac{W}{m \cdot K}$	Specific thermal capacity at 20 °C $\frac{J}{kg \cdot K}$	Electrical resistivity at 20 °C $\frac{\Omega \cdot mm^2}{m}$	Magnetizable
			20 °C	100 °C	200 °C	300 °C	400 °C	500 °C	100 °C	200 °C	300 °C	400 °C	500 °C				
Name	Number	kg/dm³	GPa						$10^{-6} \times K^{-1}$								
X5CrNi17-7	1.4319	7,9	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,73	
X10CrNi18-8	1.4310	7,9	200	194	186	179	172	165	16,0	17,0	17,0	18,0	18,0	15	500	0,73	
X9CrNi18-9	1.4325	7,9	200	194	186	179	172	165	16,0	17,0	17,0	18,0	18,0	15	500	0,73	
X2CrNiN18-7	1.4318	7,9	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,73	
X2CrNi18-9	1.4307	7,9	200	194	186	179	172	165	16,0	16,5	17,0	18,0	18,0	15	500	0,73	
X2CrNi19-11	1.4306	7,9	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,73	
X5CrNiN19-9	1.4315	7,9	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,73	
X2CrNiN18-10	1.4311	7,9	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,73	
X5CrNi18-10	1.4301	7,9	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,73	
X8CrNiS18-9	1.4305	7,9	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,73	
X6CrNiTi18-10	1.4541	7,9	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,73	
X6CrNiNb18-10	1.4550	7,9	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,73	
X4CrNi18-12	1.4303	7,9	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,73	
X1CrNi25-21	1.4335	7,9	195	190	182	174	166	158	15,8	16,1	16,5	16,9	17,3	14	450	0,85	
X2CrNiMo17-12-2	1.4404	8,0	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,75	
X2CrNiMoN17-11-2	1.4406	8,0	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,75	
X5CrNiMo17-12-2	1.4401	8,0	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,75	
X1CrNiMoN25-22-2	1.4466	8,0	195	190	182	174	166	158	15,7	-	17,0	-	-	14	500	0,80	
X6CrNiMoTi17-12-2	1.4571	8,0	200	194	186	179	172	165	16,5	17,5	18,0	18,5	19,0	15	500	0,75	
X6CrNiMoNb17-12-2	1.4580	8,0	200	194	186	179	172	165	16,5	17,5	18,0	18,5	19,0	15	500	0,75	
X2CrNiMo17-12-3	1.4432	8,0	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,75	
X2CrNiMoN17-13-3	1.4429	8,0	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,75	
X3CrNiMo17-13-3	1.4436	8,0	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,75	
X2CrNiMo18-12-3	1.4449	8,0	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,75	
X2CrNiMo18-14-3	1.4435	8,0	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,75	no [a]
X2CrNiMoN18-12-4	1.4434	8,0	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,75	
X2CrNiMo18-15-4	1.4438	8,0	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	14	500	0,85	
X2CrNiMoN17-13-5	1.4439	8,0	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	14	500	0,85	
X1CrNiMoCuN24-22-8	1.4652	8,0	190	184	177	170	164	158	15,0	15,4	15,8	16,2	16,4	8,6	500	0,78	
X1CrNiSi18-15-4	1.4361	7,7	200	194	186	179	172	165	16,5	-	-	-	-	14	-	-	
X11CrNiMnN19-8-6	1.4369	7,9	190	186	179	172	165	158	16,5	17,0	18,0	18,5	19,0	15	500	0,70	
X12CrMnNiN17-7-5	1.4372	7,8	200	194	186	179	172	165	-	-	-	-	-	15	-	0,70	
X2CrMnNiN17-7-5	1.4371	7,8	200	194	186	179	172	165	17,0	17,5	18,0	18,5	-	15	500	0,70	
X12CrMnNiN18-9-5	1.4373	7,8	200	194	186	179	172	165	-	-	-	-	-	15	-	0,70	
X8CrMnNiN18-9-5	1.4374	7,8	199	192	185	170	165	158	16,7	17,3	18,2	18,4	18,6	12	500	0,73	
X8CrMnCuNB17-8-3	1.4597	7,8	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,73	

Table A.3 *(concluded)*

Steel designation		Density	Modulus of elasticity at						Mean coefficient of thermal expansion between 20 °C and					Thermal conductivity at 20 °C $\frac{W}{m \cdot K}$	Specific thermal capacity at 20 °C $\frac{J}{kg \cdot K}$	Electrical resistivity at 20 °C $\frac{\Omega \cdot mm^2}{m}$	Magnetizable
			20 °C	100 °C	200 °C	300 °C	400 °C	500 °C	100 °C	200 °C	300 °C	400 °C	500 °C	-	-	-	
Name	Number	kg/dm³	GPa						$10^{-6} \times K^{-1}$					-	-	-	
X3CrNiCu19-9-2	1.4560	7,9	200	194	186	179	172	165	-	-	-	-	-	-	-	-	
X2CrNiCu19-10	1.4650	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
X6CrNiCuS18-9-2	1.4570	7,9	200	194	186	179	172	165	-	-	-	-	-	-	-	-	
X3CrNiCu18-9-4	1.4567	7,9	200	194	186	179	172	165	16,7	17,2	17,7	18,1	18,4	-	-	-	
X3CrNiCuMo17-11-3-2	1.4578	8,0	200	194	186	179	172	165	-	-	-	-	-	-	-	-	no [a]
X1NiCrMoCu31-27-4	1.4563	8,0	195	190	182	174	166	158	15,8	16,1	16,5	16,9	17,3	12	450	1,00	
X1NiCrMoCu25-20-5	1.4539	8,0	195	190	182	174	166	158	15,8	16,1	16,5	16,9	17,3	12	450	1,00	
X1CrNiMoCuN25-25-5	1.4537	8,1	195	190	182	174	166	158	15,0	-	16,5	-	-	14	500	0,85	
X1CrNiMoCuN20-18-7	1.4547	8,0	195	190	182	174	166	158	16,5	17	17,5	18	18	14	500	0,85	
X2CrNiMoCuS17-10-2	1.4598	8,0	200	194	186	179	172	165	16,5	17,3	17,7	18,1	18,4	14,5	500	0,75	
X1CrNiMoCuNW24-22-6	1.4659	8,2	190	185	179	174	166	158	15,0	15,5	16,0	16,3	16,5	12	450	1,00	
X1NiCrMoCuN25-20-7	1.4529	8,1	195	190	182	174	166	158	15,8	16,1	16,5	16,9	17,3	12	450	1,00	
X2NiCrAlTi32-20	1.4558	8,0	200	195	188	182	175	168	16	16	16	16,5	16,5	12	475	0,99	
X2CrNiMnMoN25-18-6-5	1.4565	8,0	190	186	177	170	165	158	14,5	15,5	16,3	16,8	17,2	12	450	0,92	

[a] Small amounts of ferrite and/or martensite caused by cold deformation will increase the magnetizability.

Table A.4 — Guidance data on some physical properties of austenitic-ferritic corrosion resisting steels

Steel designation		Density	Modulus of elasticity at				Mean coefficient of thermal expansion between 20 °C and			Thermal conductivity at 20 °C $\frac{W}{m \cdot K}$	Specific thermal capacity at 20 °C $\frac{J}{kg \cdot K}$	Electrical resistivity at 20 °C $\frac{\Omega \cdot mm^2}{m}$	Magnetizable
			20 °C	100 °C	200 °C	300 °C	100 °C	200 °C	300 °C				
Name	Number	kg/dm³	GPa				$10^{-6} \times K^{-1}$						
X2CrNiN23-4	1.4362	7,8	200	194	186	180	13,0	13,5	14,0	15	500	0,8	
X2CrNiCuN23-4	1.4655	7,8	200	194	186	180	13,0	13,5	14,0	15	500	0,8	
X3CrNiMoN27-5-2	1.4460	7,8	200	194	186	180	13,0	13,5	14,0	15	500	0,8	
X2CrNiMoN29-7-2	1.4477	7,7	200	194	186	180	11,5	12,0	12,5	13	470	0,8	
X2CrNiMoN22-5-3	1.4462	7,8	200	194	186	180	13,0	13,5	14,0	15	500	0,8	yes
X2CrNiMoCuN25-6-3	1.4507	7,8	200	194	186	180	13,0	13,5	14,0	15	500	0,8	
X2CrNiMoN25-7-4	1.4410	7,8	200	194	186	180	13,0	13,5	14,0	15	500	0,8	
X2CrNiMoCuWN25-7-4	1.4501	7,8	200	194	186	180	13,0	13,5	14,0	15	500	0,8	
X2CrNiMoSi18-5-3	1.4424	7,8	200	194	186	180	13,0	13,5	14,0	13	475	0,8	

Table A.5 — Guidance data on some physical properties of ferritic heat-resisting steels

Steel designation		Density	Mean coefficient of thermal expansion between 20 °C and					Thermal conductivity at 20 °C	Specific thermal capacity at 20 °C	Electrical resistivity at 20 °C	Magnetizable
			200 °C	400 °C	600 °C	800 °C	1 000 °C	$\frac{W}{m \cdot K}$	$\frac{J}{kg \cdot K}$	$\frac{\Omega \cdot mm^2}{m}$	
Name	Number	kg/dm³	$10^{-6} \times K^{-1}$								
X10CrAlSi7	1.4713	7,7	11,5	12,0	12,5	13,0	-	23	450	0,70	yes
X10CrAlSi13	1.4724		10,5	11,5	12,0	12,5	-	21	500	0,75	
X10CrAlSi18	1.4742		10,5	11,5	12,0	12,5	13,5	19	500	0,93	
X10CrAlSi25	1.4762		10,5	11,5	12,0	12,0	13,5	17	500	1,1	
X18CrN28	1.4749		10,0	11,0	11,5	12,0	13,0	17	500	0,70	
X3CrAlTi18-2	1.4736		10,5	10,8	12,0	12,5	13,0	21	500	0,60	

Table A.6 — Guidance data on some physical properties of austenitic and austenitic-ferritic heat-resisting steels

Steel designation		Density	Mean coefficient of thermal expansion between 20 °C and					Thermal conductivity at 20 °C	Specific thermal capacity at 20 °C	Electrical resistivity at 20 °C	Magnetizable
			200 °C	400 °C	600 °C	800 °C	1 000 °C	$\frac{W}{m \cdot K}$	$\frac{J}{kg \cdot K}$	$\frac{\Omega \cdot mm^2}{m}$	
Name	Number	kg/dm³	$10^{-6} \times K^{-1}$								
austenitic heat-resisting steels											
X8CrNiTi18-10	1.4878	7,9	17,0	18,0	18,5	19,0	-	15	500	0,73	no [a]
X15CrNiSi20-12	1.4828	7,9	16,5	17,5	18,0	18,5	19,5	15	500	0,85	
X9CrNiSiNCe21-11-2	1.4835	7,8	17,0	18,0	18,5	19,0	19,5	15	500	0,85	
X12CrNi23-13	1.4833	7,9	16,0	17,5	18,0	18,5	19,5	15	500	0,78	
X8CrNi25-21	1.4845	7,9	15,5	17,0	17,5	18,5	19,0	15	500	0,85	
X15CrNiSi25-21	1.4841	7,9	15,5	17,0	17,5	18,0	19,0	15	500	0,90	
X12NiCrSi35-16	1.4864	8,0	15,0	16,0	17,0	17,5	18,5	12,5	550	1,0	
X10NiCrAlTi32-21	1.4876	8,0	15,0	16,0	17,0	17,5	18,5	12	550	1,0	
X6NiCrNbCe32-27	1.4877	8,0	15,5	16,5	16,5	17,7	18,4	12	450	0,96	
X25CrMnNiN25-9-7	1.4872	7,8	16,5	18,0	18,5	19,0	19,5	14,5	500	0,75	
X6CrNiSiNCe19-10	1.4818	7,8	16,5	18,0	18,5	19,0	20,0	15	500	0,85	
X6NiCrSiNCe35-25	1.4854	7,9	15,5	16,5	17,0	17,5	18,0	11	450	1,0	
X10NiCrSi35-19	1.4886	8,0	15,5	16,0	17,0	17,7	18,0	12	460	1,0	
X10NiCrSiNb35-22	1.4887	8,0	15,5	16,0	17,0	17,7	18,0	12	460	1,0	
austenitic-ferritic heat-resisting steel											
X15CrNiSi25-4	1.4821	7,7	13,0	13,5	14,0	14,5	15,0	17	500	0,90	yes

[a] Slightly magnetic when cold worked.

Table A.7 — Guidance data on some physical properties of martensitic creep-resisting steels

Steel Designation		Density	Modulus of elasticity at							Mean coefficient of thermal expansion between 20 °C and						Thermal conductivity at 20 °C	Specific thermal capacity at 20 °C	Electrical resistivity at 20 °C
			20 °C	100 °C	200 °C	300 °C	400 °C	500 °C	600 °C	100 °C	200 °C	300 °C	400 °C	500 °C	600°C	$\frac{W}{m \cdot K}$	$\frac{J}{kg \cdot K}$	$\frac{\Omega \cdot mm^2}{m}$
Name	Number	kg/dm³	GPa							$10^{-6} \times K^{-1}$								
X10CrMoVNb9-1	1.4903	7,7	218	213	206	198	190	180	167	10,9	11,3	11,7	12,0	12,3	12,6	26	-	0,50
X11CrMoWVNb9-1-1	1.4905	7,8	218	213	206	198	190	180	167	10,7	11,1	11,5	11,9	12,3	12,6	26	450	0,47
X8CrCoNiMo10-6	1.4911	7,8	215	-	211	206	196	186	-	10,6	11,2	11,4	11,6	11,8	12,0	20	460	0,65
X19CrMoNbVN11-1	1.4913	7,7	216	209	200	290	179	167	127	10,5	11	11,5	12	12,3	12,5	24	460	-
X20CrMoV11-1	1.4922	7,7	216	209	200	290	179	167	127	10,5	10,9	11,3	11,6	12,0	12,2	24	460	0,60
X22CrMoV12-1	1.4923	7,7	216	209	200	290	179	167	127	10,5	11	11,5	12	12,3	12,5	24	460	-
X20CrMoWV12-1	1.4935	7,7	216	209	200	290	179	167	127	10,5	11	11,5	12	12,3	12,5	24	460	-
X12CrNiMoV12-3	1.4938	7,8	216	209	200	290	179	167	127	10,8	11	11,3	11,6	11,9	12,1	30	460	0,60

Table A.8 — Guidance data on some physical properties of austenitic creep-resisting steels

Steel Designation		Density	Modulus of elasticity at											Mean coefficient of thermal expansion between 20 °C and										Thermal conductivity at 20 °C	Specific thermal capacity at 20 °C	Electrical resistivity at 20 °C
			20 °C	100 °C	200 °C	300 °C	400 °C	500 °C	600 °C	700 °C	800 °C	900 °C	1000 °C	100 °C	200 °C	300 °C	400 °C	500 °C	600° C	700 °C	800 °C	900 °C	1000 °C	$\frac{W}{m \times K}$	$\frac{J}{kg \times K}$	$\frac{\Omega \times mm^2}{m}$
Name	Number	kg/dm³	GPa											$10^{-6} \times K^{-1}$												
X3CrNiMoBN17-13-3	1.4910	8,0	200	190	185	175	170	160	155	145	140	135	125	16,3	16,9	17,3	17,8	18,2	18,5	18,7	-	-	-	16	450	0,77
X7CrNiNb18-10	1.4912	7,9	200	194	186	179	172	165	155	-	-	-	-	16,0	16,5	17,0	17,5	18,0	18,5	-	-	-	-	15	500	0,73
X6CrNiMoB17-12-2	1.4919	8,0	196	192	186	181	174	165	157	-	-	-	-	16,3	16,9	17,3	-	18,2	18,5	-	-	-	-	16	450	0,77
X6CrNiTiB18-10	1.4941	7,9	200	190	185	175	170	160	155	145	140	135	125	16,3	16,9	17,3	17,8	18,2	18,5	18,7	-	-	-	17	450	0,71
X6CrNiWNbN16-16	1.4945	8,0	196	192	186	181	174	165	157	-	-	-	-	10,5	10,9	11,3	11,6	12,0	12,2	-	-	-	-	14	440	0,60
X6CrNi18-10	1.4948	7,9	200	190	185	175	170	160	155	145	140	135	125	16,3	16,9	17,3	17,8	18,2	18,5	18,7	-	-	-	17	450	0,71
X6CrNi23-13	1.4950	7,9	200	190	185	175	170	160	155	145	140	135	125	-	16,0	16,8	17,5	17,8	18,0	18,3	18,5	19,0	19,5	15	500	0,78
X6CrNi25-20	1.4951	7,9	200	190	185	175	170	160	155	145	140	135	125	-	15,5	16,3	17,0	17,3	17,5	18,0	18,5	18,8	19,0	15	500	0,85
X5NiCrAlTi31-20	1.4958	8,0	200	190	185	175	170	160	155	145	140	135	125	15,4	16,0	16,5	16,8	17,2	17,5	17,9	18,3	18,6	19,0	12	460	0,99
X8NiCrAlTi32-21	1.4959	8,0	200	190	185	175	170	160	155	145	140	135	125	15,4	16,0	16,5	16,8	17,2	17,5	17,9	18,3	18,6	19,0	12	460	0,99
X8CrNiNb16-13	1.4961	7,9	200	190	185	175	170	160	155	145	140	135	125	16,3	16,9	17,3	17,8	18,2	18,5	18,7	-	-	-	16	450	0,78
X12CrNiWTiB16-13	1.4962	8,0	196	191	182	175	167	159	151	-	-	-	-	15,6	16,8	17,5	18,0	18,3	18,6	-	-	-	-	14	500	0,74
X12CrCoNi21-20	1.4971	8,3	200	195	190	185	178	170	160	-	-	-	-	14,2	14,6	15,0	15,5	15,9	16,4	-	-	-	-	11,6	-	-
X6NiCrTiMoVB25-15-2	1.4980	8,0	196	192	186	180	172	167	157	-	-	-	-	17,0	17,5	18,7	18,0	18,2	18,5	-	-	-	-	-	-	-
X8CrNiMoNb16-16	1.4981	8,0	198	192	183	175	167	159	150	-	-	-	-	16,3	16,9	17,3	17,8	18,2	18,5	-	-	-	-	16	450	0,77
X10CrNiMoMnNbVB15 -10-1	1.4982	8,0	207	201	193	184	175	165	158	-	-	-	-	15,7	16,8	17,7	18,3	18,6	19,0	-	-	-	-	12,5	480	0,74
X6CrNiMoTiB17-13	1.4983	8,0	200	190	185	175	170	160	155	-	-	-	-	-	17,0	-	18,0	-	-	-	-	-	-	15	500	0,74
X7CrNiMoBNb16-16	1.4986	7,9	196	192	186	181	174	165	157	-	-	-	-	16,6	17,7	17,9	17,9	17,9	18,1	-	-	-	-	15	460	-
X8CrNiMoVNb16-13	1.4988	8,0	198	192	183	175	167	159	150	-	-	-	-	16,3	16,9	17,3	17,8	18,2	18,5	-	-	-	-	15	450	0,79
X7CrNiTi18-10	1.4940	7,9	200	194	186	179	172	165	155	-	-	-	-	16,0	16,5	17,0	17,5	18,0	18,5	-	-	-	-	15	500	0,73
X6CrNiMo17-13-2	1.4918	8,0	200	194	186	179	172	165	155	-	-	-	-	16,0	16,5	17,0	17,5	18,0	18,5	-	-	-	-	15	500	0,75

Annex B
(informative)

Classification of stainless steel grades

B.1 General

Stainless steels are classified according to 3 principles:

- use properties, to produce material standards;
- microstructure, to produce tables in the standards;
- significant alloying elements, to sort grades in the tables.

They may be further classified according to availability into standard grades and special grades. Special grades are intended for a particular use and with limited availability. Some alloy steels within the stainless steel definition are classified according to their use function as tool or valve steels.

B.2 Classification by use properties

B.2.1 Corrosion resisting

A corrosion resisting steel is a steel with a good resistance to uniform or local attack from the environment. The protection is provided by a minimum content of 10,5 % Cr through a spontaneously formed chromium oxide film. The environment may be atmospheric at ambient temperature (indoor, rural, urban, industrial, marine) or a solution giving electrochemical conditions.

EN grades are given steel numbers (EN 10027-2) in the groups:

1.40xx for grades with < 2,5% Ni, without Mo, without special additions;

1.41xx for grades with < 2,5% Ni, with Mo, without special additions;

1.43xx for grades with ≥ 2,5% Ni, without Mo, without special additions;

1.44xx for grades with ≥ 2,5% Ni, with Mo, without special additions;

1.45xx and 1.46xx for grades with special additions, such as Ti, Nb or Cu.

B.2.2 Heat resisting

A heat resisting steel is a steel, mainly ferritic or austenitic, with a good resistance to oxidation and the effects of hot gases and combustion products at temperatures higher than 550 ºC. In oxidizing atmospheres a protective oxide layer is formed by chromium, silicon and aluminium on the steel surface. This oxide also reduces the attack from sulphur. In a reducing atmosphere, where no oxide is formed, an increased nickel content will reduce carbon and nitrogen pickup, but increases the susceptibility to sulphur attack.

EN grades are given steel numbers in the groups:

1.47xx for grades with < 2,5% Ni;

1.48xx for grades with ≥ 2,5% Ni.

B.2.3 Creep resisting

A creep resisting steel is a steel, mainly martensitic and austenitic, with good resistance to deformation under mechanical long-time stressing at temperatures above 500 ºC. Several austenitic grades are variants of grades in B.2.1 and B.2.2 with specified minimum carbon content.

EN grades are given steel numbers in the group 1.49xx.

B.3 Classification by microstructure

B.3.1 Ferritic

Ferrite (alpha-iron, α-Fe) has a body centred cubic (bcc) atomic packing. It is magnetic, and is brittle below a characteristic transition temperature. Delta-ferrite (δ) is a residual bcc structure from the solidification process and has similar characteristics.

Ferritic steels are annealed at temperatures 750 - 950 °C, to avoid the formation of austenite. Heat treatments at higher temperatures (typical example: heat affected zones in welds) may result in the formation of austenite, which transforms to martensite on cooling, and may also cause embrittlement due to grain coarsening. These effects are reduced by stabilisation of the C and N contents with Ti, Nb or Zr.

As a rule, ferritic steels have a poor weldability due to their sensitivity to intergranular corrosion and embrittlement in the heat affected zone.

In the ASTM standards, the ferritic grades are classified in the 400 series.

B.3.2 Martensitic

Martensite is formed from austenite during heat treatment or by cold working. It has a high strength and is magnetic.

Above 900 °C to 1 000 °C these steels have an austenitic structure with high solubility for carbon. Upon cooling the austenite transforms to a supersaturated solution of carbon in a quadratic body centred α'-matrix, i.e. martensite, which is stable down to ambient temperature.

If the structure contains a high amount of ferrite the steels are called "*martensitic-ferritic*" or "*semi-ferritic*". Steel grade examples are grades 1.4005 and 1.4006.

Traditional martensitic steels have high carbon contents in the range 0,08 % to 1 %. They are air hardening on cooling, but their mechanical strength may be increased by a quenching heat treatment. The type of cooling (in air, oil or water) is adapted for each grade. The ductility is improved by a tempering treatment before use. With carbon contents > 0,20 %, they are difficult to weld.

Martensitic steels are also made with a low carbon content (max. 0,06 %) and 3 % to 6 % Ni. These steels have a balanced composition that promotes stable austenite after hardening and tempering and are called "*martensitic-austenitic*" or "*nickel martensitic*". These steels have a relatively good weldability. Examples are grades 1.4313 and 1.4418.

The low carbon type has been further developed to "*supermartensitic*" steels. Typical compositions are 11 % to 13 % Cr, 2 % to 6 % Ni, 0 to 3 % Mo and max. 0,030 % C and N. Their high strength is combined with good impact strength and good weldability. An example is 1.4415 (X2CrNiMoV13-5-2).

In the ASTM standards, the martensitic grades are classified in the 400 series.

B.3.3 Precipitation hardening

After solution annealing and quenching, the precipitation of intermetallic compounds, carbides, nitrides or copper phase from the martensitic structure gives an increased strength.

The specific heat treatment conditions shall be adjusted depending on the desired level of mechanical properties and the data provided by the manufacturers.

Examples are grades 1.4568, 1.4542 and 1.4594.

B.3.4 Austenitic

Austenite (gamma-iron, γ Fe) has a face centered cubic (fcc) atomic packing. It is not magnetic, and is ductile over a wide temperature range, from cryogenic to creep temperatures. It does not display brittle fracture. The tensile strength is high at low temperatures. By coldforming it may be workhardened to high strength levels.

Austenitic grades are solution annealed within the range 1 000 °C to 1 200 °C. Austenite does not harden from heat treatment. Austenite formers like Ni, C and N promote the austenitic structure, whereas ferrite formers like Cr, Mo and Si promote a ferritic structure. Conventional austenitic grades may contain traces of delta ferrite, for improved weldability. Alloying with interstitial elements, particularly N, will increase the strength.

The stability of the austenitic structure depends on the amount of alloying elements. Grades with alloy content on the low side may transform to martensite during plastic deformation and/or by cooling to low temperature. They are called "*metastable austenitic*"**.** Typical examples are grades 1.4310 and 1.4318.

Ferrite traces and high chromium and molybdenum contents may promote precipitation of sigma phase (σ) which is brittle. The critical temperature range for precipitation of this and other intermetallic phases is 600 °C to 900 °C.

Stable austenitic grades without any ferrite are called "*fully austenitic*" and may require special care in hot forming and welding. Typical examples are grades 1.4466 and 1.4539.

Grades with excellent corrosion resistance in aggressive environments due to high chromium, molybdenum and nitrogen contents may be called "*superaustenitic*". Typical examples are grades 1.4547 and 1.4652

The metallic materials grouping system in CR ISO 15608 defines a separate austenitic steel group 8.2, with typical chromium contents over 19 %. This group contains all superaustenitic and most fully austenitic grades.

In the ASTM standards, the austenitic grades with manganese contents equal to or lower than 2 % are classified in the 300 series.

B.3.5 Austenitic-ferritic (Duplex)

These steels have a well-balanced two-phase structure, with ferrite content between 30 % and 50 %. Strength properties are higher than for austenitic steels hence high power is required for cold deformation. These steels have a good resistance to stress corrosion cracking.

Sigma phase, and other phases that may reduce toughness and corrosion resistance, can be formed rapidly in the range 600 °C to 900 °C, primarily from the ferrite. Hot forming is therefore be performed well above these temperatures and followed by rapid cooling. Welds should be cooled rapidly through this range.

The metallic materials grouping system in CR ISO 15608 defines a separate austenitic-ferritic steel group 10.2, with typical chromium contents over 24 %. This group will contain "*superduplex*" grades with high chromium, molybdenum and nitrogen contents. Typical examples are grades 1.4410, 1.4507 or 1.4501.

In the ASTM standards, the austenitic-ferritic grades are classified in the 300 series.

B.4 Classification by significant alloying elements

B.4.1 Chromium and Nickel

Chromium and Nickel are the main alloying elements in stainless steel, and give the basic sorting order in EN standards. "*Cr-steel*" is a traditional term for ferritic grades, whereas "*CrNi-steel*" may be used for austenitic grades.

B.4.2 Molybdenum

Molybdenum improves the corrosion resistance, especially against chloride induced pitting. It is detrimental in oxidizing acids, like nitric acid, and in oxidizing atmospheres at high temperature.

Austenitic grades with over 2 % Mo may be called "*CrNiMo-steel*". They were earlier called "*acid resisting*", due to their resistance in the acid sulphite pulping process.

B.4.3 Manganese

Manganese is added as a substitute for nickel as an austenite former and to increase the solubility of nitrogen. The metallic materials grouping system in CR ISO 15608 defines a separate austenitic steel group 8.3, with manganese contents 2 % to 9 %.

In the ASTM standards, the austenitic grades with manganese contents higher than 2 % are classified in the 200 series.

B.4.4 Low carbon

Chromium carbides may precipitate in the grain boundaries during slow cooling after heat treatment or welding, and cause intergranular attack in contact with corrosive environments. The critical temperature range is 600 °C to 800 °C. The modern method to avoid intergranular corrosion is to make steels with ≤ 0,030 % carbon, so called LC-steels (Low Carbon), in which case all of the carbon remains in solid solution and does not combine with chromium to form chromium-carbide precipitates. The traditional method is described in B.4.6.

B.4.5 Nitrogen

Nitrogen, being a strong austenite stabilizing element, is added as a substitute for nickel as an austenite former and to increase strength as well as the resistance to pitting corrosion.

B.4.6 Stabilization

Addition of titanium, niobium and/or zirconium prevents the precipitation of chromium carbides following heat treatment and/or welding processes. Stabilization was the preferred method up to the 1960's, when technological advances enabled low carbon grades to be made cheap and reliable. Stabilized grades display good strength properties up to about 600 °C.

B.4.7 Sulphur

Sulphur promotes chip breaking in machining operations and improves machinability considerably. Free cutting grades with 0,15 % to 0,35% S are thus available with ferritic, martensitic and austenitic microstructure. The addition of sulphur is however detrimental to impact strength and corrosion resistance.

Annex C
(informative)

Empirical formulae for steel grade classification by microstructure

The formulae given in Table C.1 are used for characterisation of grades and classification into groups. They may be updated and harmonised with other formulae in use. The traditional groups for Ferrite, Martensite and Austenite are complemented with transition groups marked in bold. The basis is the average chemical composition for the grade, i.e. (min+max/2). The steel groups are similar to the grouping of metallic materials in CR ISO 15608.

The formulae may also be used in steel manufacturing for statistical process control, and for optimisation of properties within composition limits.

Table C.1 — Empirical formulae for steel grade classification by microstructure

Microstructure characteristics	Formulae and parameters	Range of application	
FM Ferrite - Martensite- region in Schaeffler/de Long diagram	FM = (A - 1,2)/(F – 8) for F = min 8 where: F = 1,5Si + Cr + Mo + 2Ti + 0,5Nb A = 30C + 0,5Mn + 30N + Ni + 0,5Cu + 0,5Co	Fer	Ferritic when: FM = 0, 00 - 0,30
		Martensitic	**Ferritic-Martensitic** when: FM = 0,30 - 1,0
			Martensitic when: FM = 1,0 - 4
MS Ferrite - Martensite transform (1)	MS = 540 - 497C - 6,3Mn - 10,8Cr - 36,3Ni - 46,6Mo		Martensitic when: MS = 100 - 300
MNA Martensite Number based on Md30 (2)	MNA = 551 - 462(C+N) – 9,2Si – 8,1Mn – 13,7Cr – 29(Ni+Cu) - 18,5Mo - 68Nb		**Austenitic-Martensitic** when: MNA = 100 - 300
MNK Martensite Number based on WRC-1992 diagram (4)	MNK = 25 – F – 0,90A for Mn = max 2,4 % MNK = 21 – 0,90F – A for Mn = 2,5 – 6,9 % MNK = 13 – 0,42F – 1,3A for Mn = min 7,0 % where: F = Cr + Mo + 2Ti + 0,7Nb A = 35C + 20N + Ni + 0,25Cu	Austenitic	**Metastable austenitic** when: MNA = 0 - 100 or MNK = (-2) - 0
MS Austenite - Martensite transform (3)	MS = 502 – 810C - 13Mn - 1230N - 12Cr - 30Ni – 46Mo - 54Cu		Austenitic when: MS = (-1000) - (-10)
SM Solidification Mode based on WRC-1992 diagram (4)	SM = F – 1,3A – 2,0 where: F = Cr + Mo + 2Ti + 0,7Nb A = 35C + 20N + Ni + 0,25Cu		Fully austenitic when: SM = (-30) - (-4)
FNA Ferrite Number based on complemented Schaeffler/de Long diagram (5)	FNA = 3,34F – 2,46A – 28,6 for FNA = max 5,9 FNA = 4,44F – 3,39A – 38,4 for FNA = 6,0 – 11,9 FNA = 4,06F – 3,23A – 32,2 for FNA = min 12 where: F = 1,5Si + Cr + Mo + 2Ti + 0,5Nb A = 30C + 0,5Mn + 30N + Ni + 0,5Cu + 0,5Co		Austenitic when: FNA = (-40) - 20
		Duplex	**Austenitic-Ferritic (Duplex)** when: FNA = 30 – 50 or SM = 8 - 15
IMP Intermetallic phases based on FNA equivalents and (3)	IMP = F - 0,23A - 20,2 for A = min 8,7 IMP = F + 1,25A - 32,8 for A = max 8,6	Sensitive to formation of IMP when: IMP = 4 - 10	
PRE Pitting Resistance Equivalent (6)	PRE = Cr + 3,3Mo + 16N most common formula for Super-austenitic/duplex/ferritic PRE = Cr + 3,3Mo + 30N also for austenitic steels with Mo > 3%	Resistant when: PRE = 40 - 60	

(1) Walker, Gooch. 1986
(2) Angel 1954. Nohara 1977
(3) SINTEF Welding handbook. 1997
(4) Kotecki, Siewert. WRC 1992. Kotecki 2000
(5) ASME Sect III Div 1 NB-2433. 1992
(6) Herbsleb (30N) 1982. Truman (16N) 1987

Annex D
(informative)

Matrix to show which steels are included in which standards

Table D.1 — Matrix to show which steels are included in which standards (current at June 2004)

Steel designation		Steels listed in EN 10088-1 and specified in																	
Name	Number	EN 10028-7	EN 10088-2	EN 10088-3	EN 10095	EN 10151	EN 10216-5	EN 10217-7	EN 10222-5	EN 10250-4	EN 10263-5	EN 10264-4	EN 10269	EN 10270-3	EN 10272	EN 10296-2	EN 10297-2	EN 10302	EN 10312
ferritic corrosion resisting steels																			
X2CrNi12	1.4003	x	x	x											x	x			
X2CrTi12	1.4512		x		x											x	x		
X6CrNiTi12	1.4516	x	x																
X6Cr13	1.4000		x	x	x														
X6CrAl13	1.4002		x							x							x		
X2CrTi17	1.4520	x	x	x															
X6Cr17	1.4016		x	x	x	x				x	x					x	x		
X3CrTi17	1.4510	x	x		x											x	x		x
X1CrNb15	1.4595		x																
X3CrNb17	1.4511		x	x															x
X6CrMo17-1	1.4113		x	x							x								
X6CrMoS17	1.4105			x															
X2CrMoTi17-1	1.4513		x																
X2CrMoTi18-2	1.4521	x	x													x			x
X2CrMoTiS18-2	1.4523			x															
X6CrNi17-1	1.4017		x																
X5CrNiMoTi15-2	1.4589		x																
X6CrMoNb17-1	1.4526		x	x												x			
X2CrNbZr17	1.4590		x		x														
X2CrTiNb18	1.4509	x	x	x	x											x			
X2CrMoTi29-4	1.4592		x																
martensitic and precipitation hardening corrosion resisting steels																			
X12Cr13	1.4006		x	x	x					x	x				x		x		
X12CrS13	1.4005			x															
X15Cr13	1.4024		x	x															
X20Cr13	1.4021		x	x		x				x									
X30Cr13	1.4028		x	x		x				x									
X29CrS13	1.4029			x															
X39Cr13	1.4031		x	x		x													
X46Cr13	1.4034		x	x															
X46CrS13	1.4035			x															
X38CrMo14	1.4419		x	x															
X55CrMo14	1.4110		x	x															
X50CrMoV15	1.4116		x	x															

Table D.1 (*continued*)

Steel designation		steels listed in EN 10088-1 and specified in																	
Name	Number	EN 10028-7	EN 10088-2	EN 10088-3	EN 10095	EN 10151	EN 10216-5	EN 10217-7	EN 10222-5	EN 10250-4	EN 10263-5	EN 10264-4	EN 10269	EN 10270-3	EN 10272	EN 10296-2	EN 10297-2	EN 10302	EN 10312
X70CrMo15	1.4109			x															
X40CrMoVN16-2	1.4123			x															
X14CrMoS17	1.4104			x															
X39CrMo17-1	1.4122		x	x															
X105CrMo17	1.4125			x															
X90CrMoV18	1.4112			x															
X17CrNi16-2	1.4057			x						x					x				
X1CrNiMoCu12-5-2	1.4422		x																
X1CrNiMoCu12-7-3	1.4423		x																
X2CrNiMoV13-5-2	1.4415			x															
X3CrNiMo13-4	1.4313	x	x	x					x	x					x				
X4CrNiMo16-5-1	1.4418	x	x	x						x					x				
X1CrNiMoAlTi12-9-2	1.4530			x															
X1CrNiMoAlTi12-10-2	1.4596			x															
X5CrNiCuNb16-4	1.4542		x	x						x									
X7CrNiAl17-7	1.4568		x	x		x								x					
X5CrNiMoCuNb14-5	1.4594			x															
X5NiCrTiMoVB25-15-2	1.4606			x															
austenitic corrosion resisting steels																			
X5CrNi17-7	1.4319		x	x															
X10CrNi18-8	1.4310		x	x		x					x	x		x					
X9CrNi18-9	1.4325			x															
X2CrNiN18-7	1.4318	x	x													x			
X2CrNi18-9	1.4307	x	x	x			x	x	x	x	x		x		x	x	x		
X2CrNi19-11	1.4306	x	x	x			x	x		x	x				x	x	x		
X5CrNi19-9	1.4315	x	x	x															
X2CrNiN18-10	1.4311	x	x	x			x	x	x	x					x	x	x		
X5CrNi18-10	1.4301	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x		x
X8CrNiS18-9	1.4305		x	x													x		
X6CrNiTi18-10	1.4541	x	x	x	x		x	x	x	x	x				x	x	x		x
X6CrNiNb18-10	1.4550	x	x	x			x	x	x	x					x	x	x		
X4CrNi18-12	1.4303		x	x							x	x	x						
X1CrNi25-21	1.4335	x	x				x										x		
X2CrNiMo17-12-2	1.4404	x	x	x			x	x	x	x	x		x		x	x	x		x
X2CrNiMoN17-11-2	1.4406	x	x	x					x	x					x				x
X5CrNiMo17-12-2	1.4401	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x		x
X1CrNiMoN25-22-2	1.4466	x	x	x			x										x		
X6CrNiMoTi17-12-2	1.4571	x	x	x			x	x	x	x	x				x	x	x		x
X6CrNiMoNb17-12-2	1.4580	x	x	x			x								x		x		
X2CrNiMo17-12-3	1.4432	x	x	x				x	x		x				x	x			
X2CrNiMoN17-13-3	1.4429	x	x	x			x	x	x	x	x		x		x	x	x		
X3CrNiMo17-13-3	1.4436	x	x	x			x	x	x	x	x				x	x	x		x
X3CrNiMo18-12-3	1.4449								x										
X2CrNiMo18-14-3	1.4435	x	x	x			x	x	x	x					x	x	x		x
X2CrNiMoN18-12-4	1.4434	x	x																
X2CrNiMo18-15-4	1.4438	x	x	x				x											

Table D.1 (*continued*)

Steel designation		steels listed in EN 10088-1 and specified in																	
Name	Number	EN 10028-7	EN 10088-2	EN 10088-3	EN 10095	EN 10151	EN 10216-5	EN 10217-7	EN 10222-5	EN 10250-4	EN 10263-5	EN 10264-4	EN 10269	EN 10270-3	EN 10272	EN 10296-2	EN 10297-2	EN 10302	EN 10312
X2CrNiMoN17-13-5	1.4439	x	x	x			x	x							x	x	x		x
X1CrNiMoCuN24-22-8[*)]	1.4652[*)]		x	x															
X1CrNiSi18-15-4	1.4361		x	x															
X11CrNiMnN19-8-6	1.4369		x	x		x													
X12CrMnNiN17-7-5	1.4372		x	x		x													
X2CrMnNiN17-7-5	1.4371		x																
X12CrMnNiN18-9-5	1.4373		x																
X8CrMnNiN18-9-5	1.4374			x															
X8CrMnCuNB17-8-3	1.4597		x	x															
X3CrNiCu19-9-2	1.4560			x							x								
X2CrNiCu19-10	1.4650								x										
X6CrNiCuS18-9-2	1.4570			x															
X3CrNiCu18-9-4	1.4567			x							x		x						
X3CrNiCuMo17-11-3-2	1.4578			x							x								
X1NiCrMoCu31-27-4	1.4563	x	x	x			x	x							x		x		
X1NiCrMoCu25-20-5	1.4539	x	x	x			x	x		x					x	x	x		x
X1CrNiMoCuN25-25-5	1.4537	x	x	x															
X1CrNiMoCuN20-18-7	1.4547	x	x	x			x	x		x					x		x		
X2CrNiMoCuS17-10-2	1.4598			x															
X1CrNiMoCuNW24-22-6	1.4659		x	x															
X1NiCrMoCuN25-20-7	1.4529	x	x	x			x	x		x					x		x		x
X2NiCrAlTi32-20	1.4558						x										x		
X2CrNiMnMoN25-18-6-5	1.4565		x	x															
austenitic-ferritic corrosion resisting steels																			
X2CrNiN23-4[*)]	1.4362[*)]	x	x	x	x		x	x		x					x	x	x		
X2CrNiCuN23-4	1.4655		x																
X3CrNiMoN27-5-2	1.4460			x						x							x		
X2CrNiMoN29-7-2[*)]	1.4477[*)]		x	x															
X2CrNiMoN22-5-3	1.4462	x	x	x			x	x	x	x	x				x	x	x		x
X2CrNiMoCuN25-6-3	1.4507	x	x	x			x			x					x		x		
X2CrNiMoN25-7-4[*)]	1.4410[*)]	x	x	x			x	x	x	x					x	x	x		
X2CrNiMoCuWN25-7-4	1.4501	x	x	x			x	x		x					x		x		
X2CrNiMoSi18-5-3	1.4424		x	x			x										x		
ferritic heat-resisting steels																			
X10CrAlSi7	1.4713				x														
X10CrAlSi13	1.4724				x														
X10CrAlSi18	1.4742				x														
X10CrAlSi25	1.4762				x														
X18CrN28	1.4749				x														
X3CrAlTi18-2	1.4736				x														
austenitic heat-resisting steels																			
X8CrNiTi18-10	1.4878				x														
X15CrNiSi20-12	1.4828				x														
X9CrNiSiNCe21-11-2	1.4835				x														
X12CrNi23-13	1.4833				x														
X8CrNi25-21	1.4845				x														

Table D.1 (*concluded*)

Steel designation		steels listed in EN 10088-1 and specified in																	
Name	Number	EN 10028-7	EN 10088-2	EN 10088-3	EN 10095	EN 10151	EN 10216-5	EN 10217-7	EN 10222-5	EN 10250-4	EN 10263-5	EN 10264-4	EN 10269	EN 10270-3	EN 10272	EN 10296-2	EN 10297-2	EN 10302	EN 10312
X15CrNiSi25-21	1.4841				x							x							
X12NiCrSi35-16	1.4864				x														
X10NiCrAlTi32-21	1.4876				x														
X6NiCrNbCe32-27	1.4877				x														
X25CrMnNiN25-9-7	1.4872				x														
X6CrNiSiNCe19-10	1.4818				x														
X6NiCrSiNCe35-25[*)]	1.4854[*)]				x														
X10NiCrSi35-19	1.4886				x														
X10NiCrSiNb35-22	1.4887				x														
austenitic-ferritic heat-resisting steel																			
X15CrNiSi25-4	1.4821				x														
martensitic creep-resisting steels																			
X10CrMoVNb9-1	1.4903																	x	
X11CrMoWVNb9-1-1	1.4905																	x	
X8CrCoNiMo10-6	1.4911																	x	
X19CrMoNbVN11-1	1.4913												x					x	
X20CrMoV11-1	1.4922																	x	
X22CrMoV12-1	1.4923												x					x	
X20CrMoWV12-1	1.4935																	x	
X12CrNiMoV12-3	1.4938												x					x	
austenitic creep-resisting steels																			
X3CrNiMoBN17-13-3	1.4910	x					x		x				x					x	
X7CrNiNb18-10	1.4912						x		x										
X6CrNiMoB17-12-2	1.4919												x					x	
X6CrNiTiB18-10	1.4941	x			x		x		x				x					x	
X6CrNiWNbN16-16	1.4945																	x	
X6CrNi18-10	1.4948	x			x		x		x				x						
X6CrNi23-13	1.4950	x			x														
X6CrNi25-20	1.4951	x			x														
X5NiCrAlTi31-20	1.4958	x					x											x	
X8NiCrAlTi32-21	1.4959	x					x											x	
X8CrNiNb16-13	1.4961	x					x											x	
X12CrNiWTiB16-13	1.4962																	x	
X12CrCoNi21-20	1.4971																	x	
X6NiCrTiMoVB25-15-2	1.4980												x					x	
X8CrNiMoNb16-16	1.4981						x											x	
X10CrNiMoMnNbVB15-10-1	1.4982						x						x						
X6CrNiMoTiB17-13	1.4983																	x	
X7CrNiMoBNb16-16	1.4986												x						
X8CrNiMoVNb16-13	1.4988						x											x	
X7CrNiTi18-10	1.4940						x												
X6CrNiMo17-13-2	1.4918						x												

[*)] Patented steel grade.

Annex E
(informative)

Chemical composition of nickel and cobalt alloys listed in EN 10095, EN 10269 and EN 10302

The chemical composition of nickel and cobalt alloys listed in EN 10095, EN 10269 and EN 10302 are given in Tables E.1 and E.2.

Table E.1 — Chemical composition (cast analysis) [a] of nickel alloys listed in EN 10095

Alloy designation		% by mass															
Name	Number	C	Mn max.	Si	P max.	S max.	Ni	Cr	Co	Fe	Mo	Al	Ti	Cu max.	Nb+Ta	B max.	Ce
NiCr15Fe	2.4816	0,05 to 0,10	1,00	≤ 0,50	0,020	0,015	≥ 72,0	14,0 to 17,0	[b]	6,0 to 10,0	-	≤ 0,30	≤ 0,30	0,50	-	-	-
NiCr20Ti	2.4951	0,08 to 0,15	1,00	≤ 1,00	0,020	0,015	Rem.	18,0 to 21,0	≤ 5,0	≤ 5,0	-	≤ 0,30	0,20 to 0,60	0,50	-	-	-
NiCr22Mo9Nb	2.4856	0,03 to 0,10	0,50	≤ 0,50	0,020	0,015	≥ 58,0	20,0 to 23,0	≤ 1,00	≤ 5,0	8,0 to 10,0	≤ 0,40	≤ 0,40	0,50	3,15 to 4,15	-	-
NiCr23Fe	2.4851	0,03 to 0,10	1,00	≤ 0,50	0,020	0,015	58,0 to 63,0	21,0 to 25,0	[b]	≤ 18,0	-	1,00 to 1,70	≤ 0,50	0,50	-	0,006	-
NiCr28FeSiCe	2.4889	0,05 to 0,12	1,00	2,50 to 3,0	0,020	0,010	≥ 45,0	26,0 to 29,0	[b]	21,0 to 25,0	-	-	-	0,30	-	-	0,03 to 0,09

[a] Elements not listed in the table may not be intentionally added to the alloy without the agreement of the purchaser except for finishing the cast. All appropriate precautions are to be taken to avoid addition of such elements from scrap and other materials used in production which would impair mechanical properties and the suitability of the alloy.

[b] A maximum of 1,5 % Co is allowed and counted as nickel. Reporting of cobalt is not required.

Table E.2 — Chemical composition (cast analysis) [a] of nickel and cobalt alloys listed in EN 10269 [b] and/or EN 10302

Alloy designation		% by mass														
Name	Number	C	Si	Mn max.	P max.	S max.	Al	Cr	Co	Cu max.	Fe	Mo	Ni	Nb + Ta	Ti	Others
nickel alloys																
NiCr26MoW	2.4608	0,03 to 0,08	0,70 to 1,50	2,00	0,030	0,015	-	24,0 to 26,0	2,50 to 4,0		Rem.	2,5 to 4,0	44,0 to 47,0	-	-	W: 2,50 to 4,0
NiCr20Co18Ti	2.4632	≤ 0,13	≤ 1,00	1,00	0,020	0,015	1,00 to 2,00	18,0 to 21,0	15,0 to 21,0	0,20	≤ 1,50	-	Rem.	-	2,00 to 3,0	B: ≤ 0,020 Zr: ≤ 0,15
NiCr25FeAlY	2.4633	0,15 to 0,25	≤ 0,50	0,50	0,020	0,010	1,80 to 2,40	24,0 to 26,0	-	0,10	8,0 to 11,0	-	Rem.	-	0,10 to 0,20	Y: 0,05 to 0,12 Zr: 0,01 to 0,10
NiCr29Fe	2.4642	≤ 0,05	≤ 0,50	0,50	0,020	0,015	≤ 0,50	27,0 to 31,0	-	0,50	7,0 to 11,0	-	Rem.	-	-	-
NiCo20Cr20MoTi	2.4650	0,04 to 0,08	≤ 0,40	0,60	0,020	0,007	0,30 to 0,60	19,0 to 21,0	19,0 to 21,0	0,20	≤ 0,70	5,6 to 6,1	Rem.	-	1,90 to 2,40	B: ≤ 0,005 Ti+Al: 2,40 to 2,80
NiCr20Co13Mo4Ti3Al	2.4654	0,02 to 0,10	≤ 0,15	1,00	0,015	0,015	1,20 to 1,60	18,0 to 21,0	12,0 to 15,0	0,10	≤ 2,00	3,5 to 5,0	Rem.	-	2,80 to 3,3	B: 0,003 to 0,010 Zr: 0,02 to 0,08
NiCr23Co12Mo	2.4663	0,05 to 0,10	≤ 0,20	0,20	0,010	0,010	0,70 to 1,40	20,0 to 23,0	11,0 to 14,0	0,50	≤ 2,00	8,5 to 10,0	Rem.	-	0,20 to 0,60	B: ≤ 0,006
NiCr22Fe18Mo	2.4665	0,05 to 0,15	≤ 1,00	1,00	0,020	0,015	≤ 0,50	20,5 to 23,0	0,50 to 2,50	0,50	17,0 to 20,0	8,0 to 10,0	Rem.	-	-	B: ≤ 0,010 W: 0,20 to 1,00
NiCr19Fe19Nb5Mo3	2.4668	0,02 to 0,08	≤ 0,35	0,35	0,015	0,015	0,30 to 0,70	17,0 to 21,0	≤ 1,00	0,30	Rem.	2,80 to 3,3	50,0 to 55,0	4,7 to 5,5	0,60 to 1,20	B: 0,002 to 0,006
NiCr15Fe7TiAl	2.4669[b]	≤ 0,08	≤ 0,50	1,00	0,020	0,015	0,40 to 1,00	14,0 to 17,0	≤ 1,00	0,50	5,0 to 9,0	-	≥ 70,0	0,70 to 1,20	2,25 to 2,75	-
NiCr25Co20TiMo	2.4878	0,03 to 0,07	≤ 0,50	0,50	0,010	0,007	1,20 to 1,60	23,0 to 25,0	19,0 to 21,0	0,20	≤ 1,00	1,00 to 2,00	Rem.	0,70 to 1,20	2,80 to 3,2	B: 0,010 to 0,015 Ta: ≤ 0,05 Zr: 0,03 to 0,07
NiCr20TiAl	2.4952[b]	0,04 to 0,10	≤ 1,00	1,00	0,020	0,015	1,00 to 1,80	18,0 to 21,0	≤ 1,00	0,20	≤ 1,50	-	> 65,0	-	1,80 to 2,70	B: ≤ 0,008
cobalt alloy																
CoCr20W15Ni	2.4964	0,05 to 0,15	≤ 0,40	2,00	0,020	0,015	-	19,0 to 21,0	Rem.	-	≤ 3,00	-	9,0 to 11,0	-	-	W: 14,0 to 16,0

[a] Elements not listed in this table may not be intentionally added to the alloy without the agreement of the purchaser except for finishing the cast. All appropriate precautions are to be taken to avoid the addition of such elements from scrap and other materials used in production which would impair mechanical properties and the suitability of the alloy.

[b] EN 10269 includes only grades NiCr15Fe7TiAl (2.4669) and NiCr20TiAl (2.4952) from this table.

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[3] EN 10028-7, *Flat products made of steels for pressure purposes – Part 7: Stainless steels*

[4] EN 10088-2, *Stainless steels – Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes*

[5] EN 10088-3, *Stainless steels – Part 3: Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes*

[6] EN 10090, *Valve steels and alloys for internal combustion engines*

[7] EN 10095, *Heat resisting steels and nickel alloys*

[8] EN 10151, *Stainless steel strip for springs – Technical delivery conditions*

[9] EN 10213-2, *Technical delivery conditions for steel castings for pressure purposes – Part 2: Steel grades for use at room temperature and elevated temperatures*

[10] EN 10213-3, *Technical delivery conditions for steel castings for pressure purposes – Part 3: Steel grades for use at low temperatures*

[11] EN 10213-4, *Technical delivery conditions for steel castings for pressure purposes – Part 4: Austenitic and austenitic-ferritic steel grades*

[12] EN 10216-5, *Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 5: Stainless steel tubes*

[13] EN 10217-7, *Welded steel tubes for pressure purposes – Technical delivery conditions – Part 7: Stainless steel tubes*

[14] EN 10222-5, *Steel forgings for pressure purposes – Part 5: Martensitic, austenitic and austenitic-ferritic stainless steels*

[15] EN 10250-4, *Open die steel forgings for general engineering purposes – Part 4: Stainless steels*

[16] EN 10263-5, *Steel rod, bars and wire for cold heading and cold extrusion – Part 5: Technical delivery conditions for stainless steels*

[17] EN 10264-4, *Steel wire and wire products, steel wire for ropes – Part 4: Stainless steel wire*

[18] EN 10269, *Steels and nickel alloys for fasteners with specific elevated and/or low temperature properties*

[19] EN 10270-3, *Steel wire for mechanical springs – Part 3: Stainless spring steel wire*

[20] EN 10272, *Stainless steel bars for pressure purposes*

[21] EN 10283, *Corrosion resistant steel castings*

[22] EN 10295, *Heat resistant steel castings*

[23] EN 10296-2, *Welded circular steel tubes for mechanical and general engineering purposes – Technical delivery conditions – Part 2: Stainless steel tubes*

[24] EN 10297-2, *Seamless steel tubes for mechanical and general engineering purposes – Technical delivery conditions – Part 2: Stainless steel tubes*

[25] EN 10302, *Creep resisting steels, nickel and cobalt alloys*

[26] EN 10312, Welded *stainless steel tubes and fittings for the conveyance of aqueous liquids including water for human consumption – Technical delivery conditions*

[27] EN 12072, *Welding consumables – Wire electrodes, wires and rods for arc welding of stainless and heat-resisting steels - Classification*

[28] EN 12073, *Welding consumables – Tubular cored electrodes for metal arc welding with or without a gas shield of stainless and heat resisting steels - Classification*

[29] EN ISO 4957, *Tool steels (ISO 4957:1999)*

[30] ENV 1993-1-4, *Eurocode 3: Design of steel structures – Part 1-4: General rules – Supplementary rules for stainless steels*

[31] CR ISO 15608, *Welding – Guidelines for a metallic material grouping system (ISO/TR 15608:2000)*