TECHNICAL SPECIFICATION

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Stainless steels — Chemical composition

Aciers inoxydables — Composition chimique

不锈钢——化学成分

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of normative document:

— an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;

— an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/TS 15510 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 4, *Heat treatable and alloy steels*.

Introduction

In its meeting held on 6th June 2000, ISO/TC 17/SC 4 decided to issue the revised version of ISO/TR 15510:1997 as a Technical Specification. It was nevertheless also stated that future discussions on ISO/TS 15510 should lead to a full ISO Standard.

Stainless steels — Chemical composition

1 Scope

This ISO Technical Specification lists the chemical compositions of stainless steels agreed by ISO/TC 17/SC 4 mainly on the basis of a composition of the specifications in existing ISO, ASTM, EN and JIS standards. They apply to all product forms including ingots and semi-finished material.

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.

ISO 6929:1987, *Steel products — Definitions and classification*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6929 as well as the following apply.

3.1
stainless steel
steel with at least 10,5 % mass fraction Cr and a maximum of 1,2 % mass fraction C

NOTE For the classification of stainless steels according to their structure, composition and application see Annex A.

4 Chemical composition

The chemical composition of stainless steels approved by ISO/TC 17/SC 4 is given in Table 1.

NOTE If, in special cases, e.g. an ISO committee charged with establishing or revising a standard for a specific product or application of stainless steels, sees the necessity of deviating from the specifications in Table 1 it should inform ISO/TC 17/SC 4 (Secretariat's address: DIN, Postfach 10 51 45, 40042 Düsseldorf, Germany) of the reasons for this and try, before such deviations are considered, to achieve consensus for a corresponding modification to Table 1.

5 Designation of comparable steels

In Table 2 are given the designations of stainless steels which are listed in other international, regional or national standards or designation systems and are comparable to the grades in Table 1.

NOTE To compare similar grades, it is necessary to check each element before making a substitution.

Table 1 — Internationally agreed specifications for the composition of stainless steels (applicable for cast analysis); (mass %)

Line	Steel designation	C		Si		Mn		P	S		N		Cr		Mo		Ni		Others		
		min.	max.	min.	max.	min.	max.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	Element	min.	max.
a) Austenitic steels																					
1	X2CrNi18-9		0,030		1,00		2,00	0,045		0,030[a]		0,11	17,5	19,5			8,0	10,0[b]			
2	X2CrNi19-11		0,030		1,00		2,00	0,045		0,030[a]		0,11	18,0	20,0			10,0	12,0[b]			
3	X2CrNiN18-9		0,030		1,00		2,00	0,045		0,030[a]	0,12	0,22	17,5	19,5			8,0	10,0			
4	X2CrNiN18-7		0,030		1,00		2,00	0,045		0,015	0,10	0,20	16,5	18,5			6,0	8,0			
5	X5CrNi17-7		0,07		1,00		2,00	0,045		0,030[a]		0,11	16,0	18,0			6,0	8,0			
6	X5CrNi18-9		0,07		1,00		2,00	0,045		0,030[a]		0,11	17,5	19,5			8,0	10,5			
7	X7CrNi18-9	0,04	0,08		1,00		2,00	0,045		0,030[a]		0,11	18,0	20,0			8,0	10,5			
8	X6CrNi18-12		0,08		1,00		2,00	0,045		0,030[a]		0,11	17,0	19,0			10,5	13,0			
9	X3NiCr18-16		0,04		1,00		2,00	0,045		0,030[a]			15,0	17,0			17,0	19,0			
10	X5CrNiN18-8		0,07		1,00		2,50	0,045		0,030	0,10	0,16	18,0	20,0			8,0	11,0			
11	X10CrNi18-8	0,05	0,15		2,00		2,00	0,045		0,030[a]		0,11	16,0	19,0		0,80	6,0	9,5			
12	X1CrNi25-21		0,02		0,25		2,00	0,025		0,010		0,11	24,0	26,0		0,20	20,0	22,0			
13	X12CrMnNiN17-7-5		0,15		1,00	5,5	7,5	0,045		0,030[a]	0,05	0,25	16,0	18,0			3,5	5,5			
14	X10CrNiS18-9		0,12		1,00		2,00	0,060	0,15			0,11	17,0	19,0			8,0	10,0	Cu		[c]
15	X3CrNiCu18-9-4		0,04		1,00		2,00	0,045		0,030[a]		0,11	17,0	19,0			8,0	10,5	Cu	3,0	4,0
16	X6CrNiTi18-10		0,08		1,00		2,00	0,045		0,030[a]			17,0	19,0			9,0	12,0[b]	Ti	5 × C	0,70
17	X7CrNiTi18-10	0,04	0,08		1,00		2,00	0,045		0,030[a]			17,0	19,0			9,0	12,0[b]	Ti	5 × C	0,70
18	X6CrNiTiB18-10	0,04	0,08		1,00		2,00	0,035		0,015			17,0	19,0			9,0	12,0	Ti	5 × C	0,70
																			B	0,001 5	0,005 0
19	X8CrNiNb18-10		0,08		1,00		2,00	0,045		0,030[a]			17,0	19,0			9,0	12,0[b]	Nb	10 × C	1,00
20	X7CrNiNb18-10	0,04	0,08		1,00		2,00	0,045		0,030[a]			17,0	19,0			9,0	12,0[b]	Nb	10 × C	1,00
21	X2CrNiMo17-12-2		0,030		1,00		2,00	0,045		0,030[a]		0,11	16,5	18,5	2,00	3,00	10,0	13,0[b]			
22	X2CrNiMo17-12-3		0,030		1,00		2,00	0,045		0,030[a]		0,11	16,5	18,5	2,50	3,00	10,5	13,0[b]			
23	X2CrNiMo18-14-3		0,030		1,00		2,00	0,045		0,015		0,11	17,0	19,0	2,50	3,00	12,5	15,0			
24	X2CrNiMo19-14-4		0,030		1,00		2,00	0,045		0,030[a]		0,11	17,5	20,0	3,0	4,0	12,0	16,0			
25	X2CrNiMoN17-11-2		0,030		1,00		2,00	0,045		0,030[a]	0,12	0,22	16,5	18,5	2,00	3,00	10,0	12,5[b]			

Table 1 (*continued*)

Line	Steel designation	C		Si		Mn		P	S		N		Cr		Mo		Ni		Others		
		min.	max.	min.	max.	min.	max.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	Element	min.	max.
a) Austenitic steels																					
26	X2CrNiMoN17-12-3		0,030		1,00		2,00	0,045		0,030[a]	0,12	0,22	16,5	18,5	2,50	3,00	10,5	13,0[b]			
27	X2CrNiMoN18-12-4		0,030		1,00		2,00	0,045		0,030[a]	0,10	0,20	16,5	19,5	3,00	4,00	10,5	14,0[b]			
28	X2CrNiMoN18-15-5		0,030		1,00		2,00	0,045		0,030[a]	0,12	0,22	17,0	20,0	4,0	5,0	13,0	17,0			
29	X1CrNiMoN25-22-2		0,020		0,70		2,00	0,025		0,010	0,10	0,16	24,0	26,0	2,00	2,50	21,0	23,0			
30	X5CrNiMo17-12-2		0,07		1,00		2,00	0,045		0,030[a]		0,11	16,5	18,5	2,00	3,00	10,0	13,0			
31	X3CrNiMo17-12-3		0,05		1,00		2,00	0,045		0,030[a]		0,11	16,5	18,5	2,50	3,00	10,5	13,0[b]			
32	X6CrNiMoTi17-12-2		0,08		1,00		2,00	0,045		0,030[a]			16,5	18,5	2,00	2,50	10,5	13,5[b]	Ti	5 × C	0,70
33	X6CrNiMoNb17-12-2		0,08		1,00		2,00	0,045		0,030[a]			16,5	18,5	2,00	2,50	10,5	13,5	Nb	10 × C	1,00
34	X1CrNiMoCuN20-18-7[d]		0,020		0,70		1,00	0,035		0,015	0,18	0,25	19,5	20,5	6,0	7,0	17,5	18,5	Cu	0,50	1,00
35	X1NiCrMoCu25-20-5		0,020		0,75		2,00	0,035		0,015		0,15	19,0	22,0	4,0	5,0	23,5	26,0	Cu	1,20	2,00
36	X1NiCrMoCu31-27-4		0,020		0,70		2,00	0,030		0,010		0,11	26,0	28,0	3,0	4,0	30,0	32,0	Cu	0,70	1,50
37	X1NiCrMoCuN25-20-7		0,020		0,75		2,00	0,035		0,015	0,15	0,25	19,0	21,0	6,0	7,0	24,0	26,0	Cu	0,50	1,50
38	X1CrNiMoCuN24-22-8		0,020		0,50	2,0	4,0	0,030		0,005	0,45	0,55	23,0	25,0	7,0	8,0	21,0	23,0	Cu	0,30	0,60
39	X8CrMnNiN18-9-5	0,05	0,10	0,30	0,60	9,0	10,0	0,035		0,030	0,25	0,32	17,5	18,5		0,50	5,0	6,0	Cu		0,40
40	X8CrMnCuN17-8-3		0,10		2,00	6,5	8,5	0,040		0,030	0,15	0,30	16,0	18,0		1,00		2,00	Cu	2,00	3,50
41	X1CrNiMoCuNW24-22-6		0,020		0,70	2,0	4,0	0,030		0,010	0,35	0,50	23,0	25,0	5,5	6,5	21,0	23,0	Cu W	1,00 1,50	2,00 2,50
42	X2CrNiMnMoN25-18-6-5		0,030		1,00	5,0	7,0	0,030		0,015	0,30	0,60	24,0	26,0	4,0	5,0	16,0	19,0	Nb		0,15
43	X11CrNiMnN19-8-6	0,07	0,15	0,50	1,00	5,0	7,5	0,030		0,015	0,20	0,30	17,5	19,5			6,5	8,5			
44	X6CrNiCuS18-9-2		0,08		1,00		2,00	0,045	0,15			0,11	17,0	19,0		0,60	8,0	10,0	Cu	1,4	1,8
45	X8CrNiCu17-8-2		0,08		1,70		3,00	0,045		0,030			15,0	18,0			6,0	9,0	Cu	1,0	3,0
46	X12CrNiSi18-9-3		0,15	2,00	3,00		2,00	0,045		0,030			17,0	19,0			8,0	10,0			

Table 1 (*continued*)

Line	Steel designation	C		Si		Mn		P	S		N		Cr		Mo		Ni		Others		
		min.	max.	min.	max.	min.	max.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	Element	min.	max.
b) Austenitic-ferritic (duplex) steels																					
51	X2CrNiN23-4[d]		0,030		1,00		2,00	0,035		0,015	0,05	0,20	22,0	24,0	0,10	0,60	3,5	5,5	Cu	0,10	0,60
52	X2CrNiMoN22-5-3[e]		0,030		1,00		2,00	0,035		0,015	0,10	0,22	21,0	23,0	2,5	3,5	4,5	6,5			
53	X2CrNiMoCuN25-6-3		0,030		0,70		2,00	0,035		0,015	0,15	0,30	24,0	26,0	2,5	4,0	5,0	7,5	Cu	1,00	2,50
54	X2CrNiMoN25-7-4[d]		0,030		1,00		2,00	0,035		0,015	0,24	0,35	24,0	26,0	3,0	4,5	6,0	8,0			
55	X3CrNiMoN27-5-2		0,050		1,00		2,00	0,035		0,015	0,05	0,20	25,0	28,0	1,30	2,00	4,5	6,5			
56	X2CrNiMoCuWN25-7-4		0,030		1,00		1,00	0,035		0,015	0,20	0,30	24,0	26,0	3,0	4,0	6,0	8,0	Cu W	0,50 0,50	1,00 1,00
c) Ferritic steels																					
61	X2CrNi12		0,030		1,00		1,50	0,040		0,015		0,030	10,5	12,5			0,30	1,10			
62	X2CrTi12		0,030		1,00		1,00	0,040		0,030[a]			10,5	12,5				0,50	Ti	6 × (C+N)	0,65
63	X6CrTi12		0,08		1,00		1,00	0,040		0,030[f]			10,5	12,5				0,50	Ti	6 × (C+N)	0,65
64	X6CrNiTi12		0,08		1,00		1,00	0,040		0,015			10,5	12,5			0,50	1,50	Ti	0,05	0,35
65	X6Cr13		0,08		1,00		1,00	0,040		0,030[a]			11,5	14,0				0,75			
66	X6CrAl13		0,08		1,00		1,00	0,040		0,030[a]			11,5	14,0					Al	0,10	0,30
67	X6Cr17		0,08[g]		1,00		1,00	0,040		0,030[a]			16,0	18,0							
68	X7CrS17		0,09		1,50		1,50	0,040	0,15				16,0	18,0		0,60					
69	X6CrMo17-1		0,08		1,00		1,00	0,040		0,030[a]			16,0	18,0	0,90	1,40					
70	X3CrTi17		0,05		1,00		1,00	0,040		0,030[a]			16,0	19,0					Ti	4 × (C + N) + 0,20	0,75
71	X6CrMoNb17-1		0,08		1,00		1,00	0,040		0,015		0,040	16,0	18,0	0,80	1,40			Nb	5 × C	1,00
72	X2CrMoTi18-2		0,025		1,00		1,00	0,040		0,015		0,025	17,0	20,0	1,80	2,50			Ti+Nb	4 × (C + N) + 0,20	0,80
73	X3CrNb17		0,05		1,00		1,00	0,040		0,015			16,0	18,0					Nb	12 × C	1,00
74	X2CrMoTiS18-2		0,03		1,00		0,50	0,040	0,15				17,5	19,0	2,00	2,50			Ti (C + N)	0,30	0,80 0,040

Table 1 (*continued*)

Line	Steel designation	C		Si		Mn		P	S		N		Cr		Mo		Ni		Others		
		min.	max.	min.	max.	min.	max.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	Element	min.	max.
d) Martensitic steels																					
81	X3CrNiMo13-4		0,05		0,70	0,50	1,00	0,040		0,015			12,0	14,0	0,30	1,00	3,5	4,5			
82	X12Cr13	0,08	0,15		1,00		1,50	0,040		0,030[a]			11,5	13,5				0,75			
83	X12CrS13	0,08	0,15		1,00		1,50	0,040	0,15				12,0	14,0		0,60					
84	X20Cr13	0,16	0,25		1,00		1,50	0,040		0,030[a]			12,0	14,0							
85	X30Cr13	0,26	0,35		1,00		1,50	0,040		0,030[a]			12,0	14,0							
86	X39Cr13	0,36	0,42		1,00		1,00	0,040		0,030[a]			12,5	14,5							
87	X46Cr13	0,43	0,50		1,00		1,00	0,040		0,030[a]			12,5	14,5							
88	X52Cr13	0,48	0,55		1,00		1,00	0,040		0,030[a]			12,5	14,5							
89	X60Cr13	0,56	0,65		1,00		1,00	0,040		0,030[a]			12,5	14,5							
90	X14CrS17	0,10	0,17		1,00		1,50	0,040	0,15				16,0	18,0		0,60					
91	X17CrNi16-2	0,12	0,22		1,00		1,50	0,040		0,030			15,0	17,0			1,50	2,50			
92	X39CrMo17-1	0,33	0,45		1,00		1,50	0,040		0,015			15,5	17,5	0,80	1,30		1,00			
93	X105CrMo17	0,95	1,20		1,00		1,00	0,040		0,015			16,0	18,0	0,40	0,80					

Table 1 (*continued*)

Line	Steel designation	C		Si		Mn		P	S		N		Cr		Mo		Ni		Others		
		min.	max.	min.	max.	min.	max.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	Element	min.	max.
e) Precipitation hardening steels																					
101	X5CrNiCuNb16-4		0,07		0,70		1,50	0,040		0,030[a]			15,0	17,0		0,60	3,0	5,0	Cu	3,0	5,0
																			Nb	5 × C	0,45
102	X7CrNiAl17-7		0,09		0,70		1,00	0,040		0,015			16,0	18,0			6,5	7,8[h]	Al	0,70	1,50
103	X8CrNiMoAl15-7-2		0,10		0,70		1,20	0,040		0,015			14,0	16,0	2,00	3,00	6,5	7,8	Al	0,75	1,50

[a] Particular ranges of sulfur content may provide improvement of particular properties. For machinability, a controlled sulfur content of 0,015 % to 0,030 % is recommended. For weldability, a controlled sulfur content of 0,008 % to 0,020 % may be beneficial. For polishability, a controlled sulfur content of 0,015 % maximum is recommended.

[b] Where, for special reasons (e.g. hot workability or low magnetic permeability), it is necessary to minimize the ferrite content, the maximum nickel content may be increased by the following amounts:

by 0,50 % for steels in lines 1 and 32;
by 1,00 % for steels in lines 2, 16, 17, 19, 20, 25, 26, 27 and 31;
by 1,50 % for steels in lines 21 and 22.

[c] Copper may be added up to 1,00 %. If added, it must be reported in the inspection document, provided such a document has been ordered.

[d] Patented grade.

[e] For special applications, the lower limits of N, Cr and Mo can be limited to 0,14 %, 22,0 % and 3,0 % respectively.

[f] Where machinability is of special importance increased sulfur contents of up to 0,045 % are recommended and permitted.

[g] For certain applications, e.g. weldability or high strength wire, a maximum of 0,12 % C may be agreed.

[h] By special agreement, the steel when intended for cold deformation may also be ordered with 7,00 % to 8,30 % Ni.

Table 2 — Designations of the steels given in Table 1 and of comparable grades covered in various international, regional or national standards or designation systems

Line	Table 1	Steel designations according to[a]											
		ASTM A 959/UNS[b]	EN 10088-1:1995		JIS[d]	CSN[e]	ISO 683-13: 1986	ISO 683-16: 1976	ISO 4954:1993	ISO 4955:1994	ISO 6931-1:1994	ISO 6931-2:1989	ISO 9328-5:1991
			Name[c]	Number[c]									
a) Austenitic steels													
1	X2CrNi18-9	S30403	X2CrNi18-9	1.4307	SUS304L	—	10	—	X2CrNi18 10E	—	—	—	X2CrNi18-10
2	X2CrNi19-11	S30403	X2CrNi19-11	1.4306	SUS304L	17249	—	—	—	—	—	—	—
3	X2CrNiN18-9	S30453	X2CrNiN18-10	1.4311	SUS304LN	—	10N	—	—	—	—	—	X2CrNiN18-10
4	X2CrNiN18-7	S30153	X2CrNiN18-7	1.4318	SUS301L	—	—	—	—	—	—	—	—
5	X5CrNi17-7	S30100	(X3CrNiN17-8)	(1.4319)	SUS301	—	—	—	—	—	—	—	—
6	X5CrNi18-9	S30400	X5CrNi18-10	1.4301	SUS304	17240	11	—	X5CrNi18 9E	—	—	X5CrNi18 10	X5CrNi18-9
7	X7CrNi18-9	S30409	(X6CrNi18-10)	(1.4948)	SUS304H	—	—	—	—	X7CrNi18 9	—	—	X7CrNi18-9
8	X6CrNi18-12	S30500	X4CrNi18-12	1.4303	SUS305	—	13	—	X5CrNi18 12E	—	—	—	—
9	X3NiCr18-16	S38400	—	—	SUS384	—	—	—	X6NiCr18 16E	—	—	—	—
10	X5CrNiN18-8	S30451	(X5CrNiN19-9)	(1.4315)	SUS304N1	—	—	—	—	—	—	—	—
11	X10CrNi18-8	S30100	X10CrNi18-8	1.4310	—	—	14	—	—	—	X9CrNi18-8	X12CrNi17 7	—
12	X1CrNi25-21	S31002	X1CrNi25-21	1.4335	—	—	—	—	—	—	—	—	—
13	X12CrMnNiN17-7-5	S20100	X12CrMnNiN17-7-5	1.4372	SUS201	—	A-2	—	—	—	—	—	—
14	X10CrNiS18-9	S30300	X8CrNiS18-9	1.4305	SUS303	—	17	—	—	—	—	—	—
15	X3CrNiCu18-9-4	S30430	X3CrNiCu18-9-4	1.4567	SUSXM7	—	—	—	X3CrNiCu18 9 3E	—	—	—	—
16	X6CrNiTi18-10	S32100	X6CrNiTi18-10	1.4541	SUS321	17247	15	—	X6CrNiTi18 10E	—	—	—	X6CrNiTi18-10
17	X7CrNiTi18-10	S32109	X6CrNiTi18-10	1.4541	SUS321H	—	—	—	—	X7CrNiTi18 10	—	—	X7CrNiTi18-10
18	X6CrNiTiB18-10	—	(X6CrNiTiB18-10)	(1.4941)	—	—	—	—	—	—	—	—	—
19	X6CrNiNb18-10	S34700	X6CrNiNb18-10	1.4550	SUS347	—	16	—	—	X7CrNiNb18 10	—	—	X6CrNiNb18-10
20	X7CrNiNb18-10	S34709	(X7CrNiNb18-10)	(1.4912)	SUS347H	—	—	—	—	—	—	—	X7CrNiNb18-10
21	X2CrNiMo17-12-2	S31603	X2CrNiMo17-12-2	1.4404	SUS316L	17349	19	—	—	—	—	—	X2CrNiMo17-12
22	X2CrNiMo17-12-3	S31603	X2CrNiMo17-12-3	1.4432	SUS316L	17350	19a	—	X2CrNiMo17 13 3E	—	—	—	X2CrNiMo17-13
23	X2CrNiMo18-14-3	S31603	X2CrNiMo18-14-3	1.4435	—	—	—	—	—	—	—	—	—
24	X2CrNiMo19-14-4	S31703	X2CrNiMo18-15-4	1.4438	SUS317L	—	24	—	—	—	—	—	X3CrNiMo18-16-4

Table 2 (*continued*)

Line	Table 1	ASTM A 959/UNS[b]	Steel designations according to[a] EN 10088-1:1995 Name[c]	EN 10088-1:1995 Number[c]	JIS[d]	CSN[e]	ISO 683-13: 1986	ISO 683-16: 1978	ISO 4954:1993	ISO 4955:1994	ISO 6931-1:1994	ISO 6931-2:1989	ISO 9326-5:1991
a) Austenitic steels													
25	X2CrNiMoN17-11-2	S31653	X2CrNiMoN17-12-2	1.4406	SUS316LN	—	19N	—	—	—	—	—	X2CrNiMoN17-12
26	X2CrNiMoN17-12-3	S31653	X2CrNiMoN17-13-3	1.4429	SUS316LN	—	19aN	—	X2CrNiMoN17 13 3E	—	—	—	X2CrNiMoN17-13
27	X2CrNiMoN18-12-4	S31753	X2CrNiMoN18-12-4	1.4434	SUS317LN	—	—	—	—	—	—	—	—
28	X2CrNiMoN18-15-5	S31726	X2CrNiMoN17-13-5	1.4439	—	—	—	—	—	—	—	—	X2CrNiMoN17-13-5
29	X1CrNiMoN25-22-2	S31050	X1CrNiMoN25-22-2	1.4466	—	—	—	—	—	—	—	—	—
30	X5CrNiMo17-12-2	S31600	X5CrNiMo17-12-2	1.4401	SUS316	17346	20	—	X5CrNiMo17 12 2E	—	X5CrNiMo17-12-2	X6CrNiMo17 12 2	X5CrNiMo17-12
31	X3CrNiMo17-12-3	S31600	X3CrNiMo17-13-3	1.4436	SUS316	17352	20a	—	—	—	—	—	X5CrNiMo17-13
32	X6CrNiMoTi17-12-2	S31635	X6CrNiMoTi17-12-2	1.4571	SUS316Ti	17348	21	—	X6CrNiMoTi17 12 2E	—	—	—	X6CrNiMoTi17-12
33	X6CrNiMoNb17-12-2	S31640	X6CrNiMoNb17-12-2	1.4580	—	—	23	—	—	—	—	—	X6CrNiMoNb17-12
34	X1CrNiMoCuN20-18-7	S31254	X1CrNiMoCuN20-18-7	1.4547	—	—	—	—	—	—	—	—	—
35	X1NiCrMoCu25-20-5	N08904	X1NiCrMoCu25-20-5	1.4539	SUS890L	—	A-4	—	—	—	—	—	X2NiCrMoCu25-20-5
36	X1NiCrMoCu31-27-4	N08028	X1NiCrMoCu31-27-4	1.4563	—	—	—	—	—	—	—	—	—
37	X1NiCrMoCuN25-20-7	N08926	X1NiCrMoCuN25-20-7	1.4529	—	—	—	—	—	—	—	—	—
38	X1CrNiMoCuN24-22-8	S32654	(X1CrNiMoCuN24-22-8)	(1.4652)	—	—	—	—	—	—	—	—	—
39	X8CrMnNiN18-9-5	—	(X8CrMnNiN18-9-5)	—	—	—	—	—	—	—	—	—	—
40	X8CrMnCuN17-8-3	—	(X8CrMnCuNB17-8-3)	—	—	—	—	—	—	—	—	—	—
41	X1CrNiMoCuNW24-22-6	—	(X1CrNiMoCuNW24-22-6)	—	—	—	—	—	—	—	—	—	—
42	X2CrNiMnMoN25-18-6-5	S34565	(X2CrNiMnMoN25-18-6-5)	(1.4565)	—	—	—	—	—	—	—	—	—
43	X11CrNiMnN19-8-6	—	(X11CrNiMnN19-8-6)	(1.4369)	—	—	—	—	—	—	—	—	—
44	X6CrNiCuS18-9-2	—	(X6CrNiCuS18-9-2)	(1.4570)	—	—	—	—	—	—	—	—	—
45	X6CrNiCu17-8-2	—	—	—	SUS304J1	—	—	—	—	—	—	—	—
46	X12CrNiSi18-9-3	S30215	—	—	SUS302B	—	—	—	—	—	—	—	—

Table 2 (*continued*)

Line	Table 1	ASTM A 959/UNS[b]	Steel designations according to[a] EN 10088-1:1995 Name[c]	EN 10088-1:1995 Number[c]	JIS[d]	CSN[e]	ISO 683-13: 1986	ISO 683-16: 1978	ISO 4954:1993	ISO 4955:1994	ISO 6931-1:1994	ISO 6931-2:1989	ISO 9328-5:1991
b) Austenitic-ferritic (duplex) steels													
51	X2CrNiN23-4	S32304	X2CrNiN23-4	1.4362	—	—	—	—	—	—	—	—	—
52	X2CrNiMoN22-5-3	S31803	X2CrNiMoN22-5-3	1.4462	SUS329J3L	—	—	—	—	—	—	—	—
53	X2CrNiMoCuN25-6-3	S32550	X2CrNiMoCuN25-6-3	1.4507	SUS329J4L	—	—	—	—	—	—	—	—
54	X2CrNiMoN25-7-4	S32750	X2CrNiMoN25-7-4	1.4410	—	—	—	—	—	—	—	—	—
55	X3CrNiMoN27-5-2	S31200	X3CrNiMoN27-5-2	1.4460	—	—	—	—	—	—	—	—	—
56	X2CrNiMoCuWN25-7-4	S32760	X2CrNiMoCuWN25-7-4	1.4501	—	—	—	—	—	—	—	—	—
c) Ferritic steels													
61	X2CrNi12	S41003	X2CrNi12	1.4003	—	—	—	—	—	—	—	—	—
62	X2CrTi12	S40900	X2CrTi12	1.4512	SUH409L	—	—	—	—	—	—	—	—
63	X6CrTi12	S40900	—	—	SUH409	—	1Ti	—	X6CrTi12E	X6CrTi12	—	—	—
64	X6CrNiTi12	S40975	X6CrNiTi12	1.4516	—	—	—	—	—	—	—	—	—
65	X6Cr13	S41008	X6Cr13	1.4000	SUS410S	17020	1	—	—	X6Cr13	—	—	—
66	X6CrAl13	S40500	X6CrAl13	1.4002	SUS405	—	—	—	—	—	—	—	—
67	X6Cr17	S43000	X6Cr17	1.4016	SUS430	17040	8	—	X6Cr17E	X6Cr17	—	—	—
68	X7CrS17	S43020	X6CrMoS17	1.4105	SUS430F	—	8a	—	—	—	—	—	—
69	X6CrMo17-1	S43400	X6CrMo17-1	1.4113	SUS434	—	9c	—	X6CrMo17 1E	—	—	—	—
70	X3CrTi17	S43035	X3CrTi17	1.4510	SUS430LX	—	8b	—	—	—	—	—	—
71	X6CrMoNb17-1	S43600	X6CrMoNb17-1	1.4526	—	—	—	—	—	—	—	—	—
72	X2CrMoTi18-2	S44400	X2CrMoTi18-2	1.4521	SUS444	—	—	—	—	—	—	—	—
73	X3CrNb17	—	X3CrNb17	1.4511	—	—	—	—	—	—	—	—	—
74	X2CrMoTiS18-2	—	(X2CrMoTiS18-2)	(1.4523)	—	—	—	—	—	—	—	—	—

Table 2 (*continued*)

Line	Table 1	Steel designations according to[a]											
		ASTM A 959/UNS[b]	EN 10088-1:1995		JIS[d]	CSN[e]	ISO 683-13: 1986	ISO 683-16: 1976	ISO 4954:1993	ISO 4955:1994	ISO 6931-1:1994	ISO 6931-2:1989	ISO 9328-5:1991
			Name[c]	Number[c]									
d) Martensitic steels													
81	X3CrNiMo13-4	S41500	X3CrNiMo13-4	1.4313	SUSF6NM	—	—	—	—	—	—	—	—
82	X12Cr13	S41000	X12Cr13	1.4006	SUS410	17021	3	—	X12Cr13E	—	—	—	—
83	X12CrS13	S41600	X12CrS13	1.4005	SUS416	—	7	—	—	—	—	—	—
84	X20Cr13	S42000	X20Cr13	1.4021	SUS420J1	17022	4	—	—	—	—	—	—
85	X30Cr13	S42000	X30Cr13	1.4028	SUS420J2	17023	5	—	—	—	—	—	—
86	X39Cr13	S42000	X39Cr13	1.4031	—	17024	—	—	—	—	—	—	—
87	X46Cr13	S42000	X46Cr13	1.4034	—	—	—	—	—	—	—	—	—
88	X52Cr13	S42000	—	—	—	—	—	—	—	—	—	—	—
89	X60Cr13	S42000	—	—	—	17030	—	—	—	—	—	—	—
90	X14CrS17	S43020	X14CrMoS17	1.4104	—	—	9a	—	—	—	—	—	—
91	X17CrNi16-2	S43100	X17CrNi16-2	1.4057	SUS431	—	—	—	X19CrNi16 2E	—	—	—	—
92	X39CrMo17-1	—	X39CrMo17-1	1.4122	—	—	—	—	—	—	—	—	—
93	X105CrMo17	—	X105CrMo17	1.4125	—	—	—	—	—	—	—	—	—
e) Precipitation hardening steels													
101	X5CrNiCuNb16-4	S17400	X5CrNiCuNb16-4	1.4542	SUS630	—	—	1	—	—	—	—	—
102	X7CrNiAl17-7	S17700	X7CrNiAl17-7	1.4568	SUS631	—	—	2	—	—	X7CrNiAl17-7	X7CrNiAl17 7	—
103	X8CrNiMoAl15-7-2	S15700	X8CrNiMoAl15-7-2	1.4532		—	—	3	—	—	—	—	—

NOTE The grades given in this table are comparable to those given in Table 1. However, it should be noted that their chemical compositions may vary.

[a] See sources in Bibliography.

[b] Letters or question marks within the UNS-number mean that for the relevant grade a specific UNS-number was not yet known when the work on this ISO Technical Specification was finalized.

[c] Steel grades given in brackets mean that the steel is not covered in EN 10088-1 but in EN 10028-7, EN 10088-1:2001, EN 10222-5 and/or in the "Stahleisenliste".

[d] Japanese Industrial Standards.

[e] Czech Office for Standards.

Annex A
(informative)

Classification of grades

A.1 Stainless steels

Chromium is the main alloying element and the chromium not bound to carbon determines the corrosion resistance.

A.2 Ferritic steels

Ferritic steels have a carbon content limit of 0,08 %. They are annealed at temperatures below that at which austenite is formed. This limit is generally 850 °C to 950 °C, depending on chemistry. Heat treatments at higher temperatures give rise to austenite in the heat-affected zones of welds, which transforms to martensite on cooling. The extent of this effect depends upon the unstabilized C and N contents and the content of chromium and other alloying elements. The steels most liable to martensite transformation are called semi-ferritic.

The metallurgical structure is ferrite (alpha ferrite or delta ferrite), a body-centered cubic phase that is magnetic.

This structure is ductile in specific manufacturing conditions, especially in thin cross sections.

The ferritic free-cutting grades most commonly used for bars include a sulfur addition greater than 0,15 % to facilitate machining. This sulfur addition causes some reduction of corrosion resistance.

Ferritic steels have a relatively good weldability. A European Standard covering the conditions for welding these materials is in preparation by CEN/TC 121. In general, a low heat-input is advisable to avoid embrittlement due to excessive grain growth.

A.3 Martensitic steels

Martensitic steels have the highest carbon contents, typically 0,08 % to 1,00 %. Their mechanical strength is developed by heat treatment consisting of quenching and tempering. These steels are magnetic.

Some grades include sulfur additions greater than 0,15 % for improved machinability although such a sulfur content may impair corrosion resistance.

In addition to the grades defined in this Technical Specification, there are grades intended for specific applications; e.g. some of the steels specified for bearings are of compositions within the range of stainless steels.

A.4 Precipitation hardening steels

Precipitation hardening steels can have high strength while retaining good corrosion resistance.

The high strength of these steels results from the precipitation of intermetallic compounds in the structure by a final heat treatment at a relatively low temperature.

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

A.5 Austenitic steels

Austenitic steels are alloyed with a combination of nickel, manganese, copper, nitrogen and carbon to produce the austenitic structure.

The metallurgical structure of these steels is austenite (gamma phase), a face-centered cubic crystal structure that is non-magnetic.

Some austenitic steels may become faintly magnetic as a result of the formation of martensite within the structure during deformation, or the formation of delta ferrite during solidification.

NOTE Martensitic structures may only be removed by solution annealing or could be significantly reduced by adjustment of elements like C, Mn, N and Ni.

Austenitic steels possess good general corrosion resistance. Austenitic steels are not hardenable by heat treatment. Their strength can be increased by nitrogen addition or by cold working.

If the steels cool slowly after heat treatment or welding (e.g. in thick sections), chromium carbides precipitate in the grain boundaries in a critical temperature range of approximately 600 °C to 800 °C. This causes intergranular corrosion in contact with acids and other corrosive media. There are two principal ways of avoiding this problem, by alteration to the chemical analysis given in c) and d) below.

Austenitic steels have a good weldability.

Austenitic steels have excellent toughness. Some grades of austenitic steels are stable and tough at cryogenic temperatures.

According to the carbon content and the alloying elements, austenitic steels may be classified into the following:

a) Austenitic steels without molybdenum

These steels are typically more difficult to machine than ferritic or martensitic stainless steels. There are free machining variants of the austenitic stainless steels ($S \geqslant 0{,}15$ %), but the sulfur causes some loss of corrosion resistance.

b) Austenitic molybdenum steels

The addition of molybdenum in general improves the corrosion resistance, especially against chloride induced pitting.

Molybdenum-containing stainless steels are not recommended for nitric acid and nitrous gas environments.

c) Extra low carbon austenitic steels

One method of avoiding intergranular corrosion as a result of welding is to make steels with low carbon ($\leqslant 0{,}030$ %), so that the precipitation of chromium carbide is delayed beyond the period of exposure associated with welding, and with stress relief when applied.

d) Stabilized austenitic steels

The addition of titanium and/or niobium will prevent the formation of chromium carbides in heat treatment, welding or extended thermal exposure applications.

e) Super austenitic steels

These steels are enriched in chromium and molybdenum contents and have a completely austenitic structure due to higher nickel and nitrogen contents. They have an excellent corrosion resistance in aggressive environments.

f) Comparison of methods of avoiding intergranular corrosion

Up to the 1960s the stabilized steel "solution" to this problem was preferred, as it was difficult, expensive and unreliable to refine extra low carbon steels in the electric arc furnace. However, the technological advances in stainless steelmaking since then have enabled extra low carbon steels to be made more cheaply, quickly and reliably than stabilized grades.

Further advice on steel selection is available from manufacturers. Whichever "solution" is chosen, the steel will be melted and processed to be free from the risk of intergranular corrosion in the delivery condition, and there should be no need to specify intergranular corrosion testing in most purchase specifications.

A.6 Austenitic-ferritic (duplex) steels

Duplex stainless steels typically have a higher chromium content (20 % to 26 %) with or without molybdenum additions of up to 4 %, and a nickel content intermediate to that of ferritic and austenitic stainless steels. The metallurgical structure is typically 40 % to 60 % austenitic in a ferritic matrix. Nitrogen additions are essential for retaining toughness and corrosion resistance when these grades are welded without subsequent full annealing.

Their strength properties are higher than those of austenitic steels.

These steels have an especially good resistance to stress corrosion.

Sigma phase, and other phases that may seriously reduce toughness and corrosion resistance, are formed rapidly at 600 °C to 900 °C in these steels. Welds should be cooled rapidly through this range. A re-solution anneal and quench would be needed to remove these deleterious phases.

A.7 Creep resisting steels

Variants of the steels described by Clauses A.1 to A.6, often with an increased carbon content, are used as creep resisting steels.

A.8 Heat resisting steels

These ferritic or austenitic types of steels are used in part for their excellent resistance to oxidation and to corrosion by high temperature gases and also for retaining their mechanical properties over a wide range of temperatures.

Annex B
(informative)

Density values for stainless steels

Table B.1 lists density values for the steels given in Tables 1 and 2.

Table B.1 — Density values

Line	Steel designation	Density kg/dm³
a) Austenitic steels		
1	X2CrNi18-9	7,9
2	X2CrNi19-11	7,9
3	X2CrNiN18-9	7,9
4	X2CrNiN18-7	7,9
5	X5CrNi17-7	7,9
6	X5CrNi18-9	7,9
7	X7CrNi18-9	7,9
8	X6CrNi18-12	7,9
9	X3NiCr18-16	7,9
10	X5CrNiN18-8	7,9
11	X10CrNi18-8	7,9
12	X1CrNi25-21	7,9
13	X12CrMnNiN17-7-5	7,8
14	X10CrNiS18-9	7,9
15	X3CrNiCu18-9-4	7,9
16	X6CrNiTi18-10	7,9
17	X7CrNiTi18-10	7,9
18	X6CrNiTiB18-10	7,9
19	X6CrNiNb18-10	7,9
20	X7CrNiNb18-10	7,9
21	X2CrNiMo17-12-2	8,0
22	X2CrNiMo17-12-3	8,0
23	X2CrNiMo18-14-3	8,0
24	X2CrNiMo19-14-4	8,0
25	X2CrNiMoN17-11-2	8,0
26	X2CrNiMoN17-12-3	8,0
27	X2CrNiMoN18-12-4	8,0
28	X2CrNiMoN18-15-5	8,0
29	X1CrNiMoN25-22-2	8,0
30	X5CrNiMo17-12-2	8,0
31	X5CrNiMo17-12-3	8,0
32	X6CrNiMoTi17-12-2	8,0
33	X6CrNiMoNb17-12-2	8,0
34	X1CrNiMoCuN20-18-7	8,0
35	X1NiCrMoCu25-20-5	8,0
36	X1NiCrMoCu31-27-4	8,0
37	X1NiCrMoCuN25-20-7	8,1
38	X1CrNiMoCuN24-22-8	8,0
39	X8CrMnNiN18-9-5	7,8
40	X8CrMnCuN17-8-3	7,8
41	X1CrNiMoCuNW24-22-6	8,2
42	X2CrNiMnMoN25-18-6-5	8,0
43	X11CrNiMnN19-8-6	7,9
44	X6CrNiCuS18-9-2	7,9
45	X6CrNiCu17-8-2	7,9
46	X12CrNiSi18-9-3	7,9

Line	Steel designation	Density kg/dm³
b) Austenitic-ferritic steels		
51	X2CrNiN23-4	7,8
52	X2CrNiMoN22-5-3	7,8
53	X2CrNiMoCuN25-6-3	7,8
54	X2CrNiMoN25-7-4	7,8
55	X3CrNiMoN27-5-2	7,8
56	X2CrNiMoCuWN25-7-4	7,8
c) Ferritic steels		
61	X2CrNi12	7,7
62	X2CrTi12	7,7
63	X6CrTi12	7,7
64	X6CrNiTi12	7,7
65	X6Cr13	7,7
66	X6CrAl13	7,7
67	X6Cr17	7,7
68	X7CrS17	7,7
69	X6CrMo17-1	7,7
70	X3CrTi17	7,7
71	X6CrMoNb17-1	7,7
72	X2CrMoTi18-2	7,7
73	X3CrNb17	7,7
74	X2CrMoTiS18-2	7,7
d) Martensitic steels		
81	X3CrNiMo13-4	7,7
82	X12Cr13	7,7
83	X12CrS13	7,7
84	X20Cr13	7,7
85	X30Cr13	7,7
86	X39Cr13	7,7
87	X46Cr13	7,7
88	X52Cr13	7,7
89	X60Cr13	7,7
90	X14CrS17	7,7
91	X17CrNi16-2	7,7
e) Precipitation hardening steels		
101	X5CrNiCuNb16-4	7,8
102	X7CrNiAl17-7	7,8
103	X8CrNiMoAl15-7-2	7,8

Bibliography

[1] ISO 683-13, *Heat-treatable steels, alloy steels and free-cutting steels — Part 13: Wrought stainless steels*[1)]

[2] ISO 683-16, *Heat-treatable steels, alloy steels and free-cutting steels — Part 16: Precipitation hardening stainless steels*[1)]

[3] ISO 4954:1993, *Steels for cold heading and cold extruding*

[4] ISO 4955:1994, *Heat-resisting steels and alloys*

[5] ISO 6931-1:1994, *Stainless steels for springs — Part 1: Wire*

[6] ISO 6931-2:1989, *Stainless steels for springs — Part 2: Strip*

[7] ISO 9328-5:1991, *Steel plates and strips for pressure purposes — Technical delivery conditions — Part 5: Austenitic steels*

[8] EN 10088-1:1995, *Stainless steels — Part 1: List of stainless steels*

[9] EN 10028-7:2000, *Flat products made of steels for pressure purposes — Part 7: Stainless steels*

[10] EN 10222-5:1999, *Steel forgings for pressure purposes — Part 5: Martensitic, austenitic and austenitic-ferritic stainless steels*

[11] *Stahl-Eisen-Liste*, Published by Verlag Stahleisen GmbH, Düsseldorf

[12] ASTM E 527, *Standard Practice for Numbering Metals and Alloys (UNS)*[2)]

[13] ASTM A 959, *Standard Guide for Specifying Harmonized Standard Grade Compositions for Wrought Stainless Steels*

1) Withdrawn in 1997.

2) Joint publication of the Society of Automotive Engineers and the American Society for Testing and Materials.

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