
**Steel flat products for pressure
purposes — Technical delivery
conditions —**

**Part 7:
Stainless steels**

iTeh STANDARD PREVIEW

*Produits plats en acier pour service sous pression — Conditions
techniques de livraison —*
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Partie 7: Aciers inoxydables

ISO 9328-7:2004

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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.

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 9328-7 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 10, *Steel for pressure purposes*.

This first edition of ISO 9328-7 cancels and replaces ISO 9328-5:1991 (first edition) of which it constitutes a technical revision.

ISO 9328 consists of the following parts, under the general title *Steel flat products for pressure purposes — Technical delivery conditions*:

- Part 1: *General requirements*
- Part 2: *Non-alloy and alloy steels with specified elevated temperature properties*
- Part 3: *Weldable fine grain steels, normalized*
- Part 4: *Nickel-alloy steels with specified low temperature properties*
- Part 5: *Weldable fine grain steels, thermomechanically rolled*
- Part 6: *Weldable fine grain steels, quenched and tempered*
- Part 7: *Stainless steels*

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Introduction

ISO 9328-7 has been newly elaborated on the basis of European Standard EN 10028-7:2000. However, chemical compositions and steel names have been taken from ISO/TS 15510:2003 as far as possible.

Parts 1, 2, 4, and 7 of ISO 9328 are intended to cancel and replace the first editions of ISO 9328-1:1991, ISO 9328-2:1991, ISO 9328-3:1991 and ISO 9328-5:1991, respectively; parts 3 and 6 replace the first edition of ISO 9328-4:1991 of which they constitute a technical revision. ISO 9328-5 has been newly elaborated as an additional part of the series.

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Steel flat products for pressure purposes — Technical delivery conditions —

Part 7: Stainless steels

1 Scope

This part of ISO 9328 specifies the technical delivery conditions for flat products for pressure purposes made of stainless steels, including austenitic creep resisting steels, in thicknesses as indicated in Tables 7 to 10.

Additionally the requirements of ISO 9328-1 also apply.

NOTE Two points (••) relate to agreements that may be made at the time of enquiry and order.

2 Normative references

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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 643:2003, *Steels — Micrographic determination of the apparent grain size*

ISO 3651-2:1998, *Determination of resistance to intergranular corrosion of stainless steels — Part 2: Ferritic, austenitic and ferritic-austenitic (duplex) stainless steels — Corrosion test in media containing sulfuric acid*

ISO 9328-1:2003, *Steel flat products for pressure purposes — Technical delivery conditions — Part 1: General requirements*

ISO 10474:1991, *Steel and steel products — Inspection documents*

ISO 18286:—¹⁾, *Hot-rolled stainless steel plates — Tolerances on dimensions and shape*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 9328-1 apply.

NOTE Under the term “standard grades”, grades are understood to have relatively good availability and a wider range of application. Under the term “special grades”, grades are understood to be for special use and/or have limited availability.

1) To be published.

4 Classification and designation

See ISO 9328-1.

5 Information to be supplied by the purchaser

5.1 Mandatory information

See ISO 9328-1.

5.2 Options

A number of options are specified in this part of ISO 9328 and are listed in a) and b). Additionally the relevant options of ISO 9328-1 apply. If the purchaser does not indicate a wish to implement any of these options at the time of enquiry and order, products shall be supplied in accordance with the basic specification (see ISO 9328-1).

- a) Mechanical properties for increased product thicknesses (see Table 7, Footnote e).
- b) Higher $R_{p0,2}$ and $R_{p1,0}$ values for continuously hot rolled products (see Table 9, Footnote d and Table 10, footnote b).

5.3 Example for ordering iTeh STANDARD PREVIEW

For 10 plates made of a steel grade with the designation X5CrNi18-10 as specified in ISO 9328-7 with nominal dimensions, thickness = 8 mm, width = 2 000 mm, length = 5 000 mm; tolerances on dimensions, shape and mass as specified in ISO 18286 with "normal" flatness tolerance in process route 1D (see Table 6), inspection document 3.1.B as specified in ISO 10474:1991, the order is as follows:

10 plates ISO 18286–8x2000x5000 N

Steel ISO 9328-7–X5CrNi18-10+1D

Inspection document ISO 10474–3.1.B

6 Requirements

6.1 Steelmaking process

See ISO 9328-1.

6.2 Delivery condition

The products shall be supplied in the delivery condition specified in the order by reference to the process route given in Table 6 and, where alternatives exist, to the treatment conditions given in Tables 7 to 10. Guidelines for further treatment including heat treatment are given in Annex A.

6.3 Chemical composition and chemical corrosion properties

6.3.1 The chemical composition requirements given in Tables 1 to 4 apply in respect of the chemical composition according to the cast analysis.

6.3.2 The product analysis may deviate from the limiting values for the cast analysis given in Tables 1 to 4 by the values listed in Table 5.

6.3.3 Referring to resistance to intergranular corrosion as defined in ISO 3651-2, for ferritic, austenitic and austenitic-ferritic steels, the specifications in Tables 7, 9 and 10 apply.

NOTE 1 ISO 3651-2 is not applicable for testing martensitic steels.

NOTE 2 The corrosion resistance of stainless steels is very dependent on environment and can therefore not always be clearly ascertained through laboratory tests. It is therefore advisable to draw on available experience concerning the steels' end use.

6.4 Mechanical properties

6.4.1 The tensile properties at room temperature and the impact energy at room and at low temperatures as specified in Tables 7 to 10 apply for the relevant specified heat treatment condition.

NOTE Austenitic steels are insensitive to brittle fracture in the solution annealed condition. Because they do not have a pronounced transition temperature, which is characteristic of other steels, they are also useful for application at cryogenic temperatures.

6.4.2 The values in Tables 11 to 14 apply for the 0,2 % and 1,0 % proof strength at elevated temperatures. Additionally, the values in Table 15 apply for the tensile strength at elevated temperatures of austenitic steels.

Tensile strength values at elevated temperatures for austenitic-ferritic steels are given for guidance in Annex B.

6.4.3 Annex C gives mean values for the purchaser, as preliminary data about creep strength and creep rupture. These data apply for the solution annealed condition only.

6.4.4 Annex D lists preliminary data on mechanical properties at low temperatures of austenitic steels.

6.5 Surface condition

See ISO 9328-1 and Table 6.

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6.6 Internal soundness

See ISO 9328-1.

6.7 Post-weld heat treatment

Guidelines for purchaser on post-weld heat treatment are given in Annex E.

6.8 Dimensions and tolerances

See ISO 9328-1.

6.9 Calculation of mass

For density of steels, see Annex F.

6.10 Physical properties

Reference data on some physical properties are given in Annex F.

7 Inspection

7.1 Types of inspection and inspection documents

See ISO 9328-1.

7.2 Tests to be carried out

See Table 16 and ISO 9328-1.

7.3 Re-tests

See ISO 9328-1.

8 Sampling

8.1 Frequency of testing

See Table 16 and ISO 9328-1.

8.2 Selection and preparation of samples and test pieces

See ISO 9328-1.

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9 Test methods

See ISO 9328-1.

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10 Marking

See ISO 9328-1.

Table 1 — Chemical composition (cast analysis)^a of ferritic steels

Steel grade	Line ^b	% by mass										
		C max.	Si max.	Mn max.	P max.	S max.	N max.	Cr	Mo	Nb	Ni	Ti
Standard grades												
X2CrNi12	61	0,030	1,00	1,50	0,040	0,015	0,030	10,5 to 12,5	—	—	0,30 to 1,10	—
X6CrNiTi12	64	0,08	1,00	1,00	0,040	0,015	—	10,5 to 12,5	—	—	0,50 to 1,50	0,05 to 0,35
X3CrTi17	(70)	0,05	1,00	1,00	0,040	0,015	—	16,0 to 19,0	—	—	—	[4 × (C + N) + 0,15] to 0,75 ^c
X2CrMoTi18-2	(72)	0,025	1,00	1,00	0,040	0,015	0,030	17,0 to 20,0	1,80 to 2,50	—	—	[4 × (C + N) + 0,15] to 0,80 ^c
Special grades												
X2CrTi17	—	0,025	0,50	0,50	0,040	0,015	0,015	16,0 to 18,0	—	—	—	0,30 to 0,60
X2CrTiNb18	—	0,030	1,00	1,00	0,040	0,015	—	17,5 to 18,5	—	[(3 × C) + 0,30] to 1,00	—	0,10 to 0,60

^a Elements not listed in this table may not be intentionally added to the steel without the agreement of the purchaser, except for finishing of the cast. All appropriate precautions shall 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 In ISO/TS 15510:2003, Table 1 (line numbers in parentheses indicate differences to the compositions specified in ISO/TS 15510).

^c Stabilization may be made by use of titanium or niobium or zirconium. According to the atomic number of these elements and the content of carbon and nitrogen, the equivalence shall, if additional stabilizing with niobium or zirconium is used, be the following:

$$\text{Ti} \triangleq \frac{7}{4} \text{Nb} \triangleq \frac{7}{4} \text{Zr}$$

Table 2 — Chemical composition (cast analysis)^a of martensitic steels

Steel grade	Line ^b	% by mass									
		C max.	Si max.	Mn max.	P max.	S max.	N min.	Cr	Mo	Ni	
X3CrNiMo13-4	81	0,05	0,70	0,50 to 1,00	0,040	0,015	—	12,0 to 14,0	0,30 to 1,00	3,5 to 4,5	
X4CrNiMo16-5-1	—	0,06	0,70	1,50	0,040	0,015	0,020	15,0 to 17,0	0,80 to 1,50	4,0 to 6,0	

^a Elements not listed in this table may not be intentionally added to the steel without the agreement of the purchaser, except for finishing of the cast. All appropriate precautions shall 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 In ISO/TS 15510:2003, Table 1.

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Table 3 — Chemical composition (cast analysis)^a of austenitic steels

Steel grade	Line ^c	% by mass											Ti	Others
		C	Si	Mn max.	P max.	S max.	N	Cr	Cu	Mo	Nb	Ni		
Standard grades														
X2CrNi18-7	4	≤ 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	≤ 0,030	≤ 1,00	2,00	0,045	0,015	≤ 0,11	17,5 to 19,5	—	—	—	8,0 to 10,0 ^c	—	—
X2CrNi19-11	2	≤ 0,030	≤ 1,00	2,00	0,045	0,015	≤ 0,11	18,0 to 20,0	—	—	—	10,0 to 12,0	—	—
X2CrNi18-10	(3)	≤ 0,030	≤ 1,00	2,00	0,045	0,015	0,12 to 0,22	17,5 to 19,5	—	—	—	8,0 to 11,5	—	—
X5CrNi18-9	6	≤ 0,07	≤ 1,00	2,00	0,045	0,015	≤ 0,11	17,5 to 19,5	—	—	—	8,0 to 10,5	—	—
X5CrNi18-8	10	≤ 0,07	≤ 1,00	2,50	0,045	0,015	0,10 to 0,16	18,0 to 20,0	—	—	—	8,0 to 11,0	—	—
X6CrNi18-10	(7)	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	—	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	—	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	—	—
X6CrNiTi18-10	16	≤ 0,08	≤ 1,00	2,00	0,045	0,015	—	17,0 to 19,0	—	—	—	9,0 to 12,0	5 × C to 0,70	—
X6CrNiTiB18-10	18	0,04 to 0,08	≤ 1,00	2,00	0,035	0,015	—	17,0 to 19,0	—	—	—	9,0 to 12,0	5 × C to 0,70	0,001 5 to 0,005 0 B
X2CrNiMo17-12-2	21	≤ 0,030	≤ 1,00	2,00	0,045	0,015	≤ 0,11	16,5 to 18,5	—	2,00 to 3,00	—	10,0 to 13,0	—	—
X2CrNiMo17-11-2	25	≤ 0,030	≤ 1,00	2,00	0,045	0,015	0,12 to 0,22	16,5 to 18,5	—	2,00 to 3,00	—	10,0 to 12,5	—	—
X5CrNiMo17-12-2	30	≤ 0,07	≤ 1,00	2,00	0,045	0,015	≤ 0,11	16,5 to 18,5	—	2,00 to 3,00	—	10,0 to 13,0	—	—
X6CrNiMoTi17-12-2	32	≤ 0,08	≤ 1,00	2,00	0,045	0,015	—	16,5 to 18,5	—	2,00 to 2,50	—	10,5 to 13,5	5 × C to 0,70	—
X2CrNiMo17-12-3	22	≤ 0,030	≤ 1,00	2,00	0,045	0,015	≤ 0,11	16,5 to 18,5	—	2,50 to 3,00	—	10,5 to 13,0	—	—
X2CrNiMo18-14-3	23	≤ 0,030	≤ 1,00	2,00	0,045	0,015	≤ 0,11	17,0 to 19,0	—	2,50 to 3,00	—	12,5 to 15,0	—	—
X2CrNiMoN17-13-5	—	≤ 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	—	—
X1NiCrMoCu25-20-5	(35)	≤ 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	—	—
X5NiCrAlTi31-20 (+ RA) ^d	—	0,03 to 0,08	≤ 0,70	1,50	0,015	0,010	≤ 0,11	19,0 to 22,0	≤ 0,50	—	≤ 0,10	30,0 to 32,5	0,20 to 0,50	0,20 to 0,50 Al Al + Ti: ≤ 0,70 ≤ 1,00 Co Ni + Co: 30,0 to 32,5
X8NiCrAlTi32-21	—	0,05 to 0,10	≤ 0,70	1,50	0,015	0,010	≤ 0,11	19,0 to 22,0	≤ 0,50	—	—	30,0 to 34,0	0,25 to 0,65	0,25 to 0,65 Al ≤ 1,00 Co Ni + Co: 30,0 to 34,0
X3CrNiMoBN17-13-3	—	≤ 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	—	0,001 5 to 0,005 0 B

Table 3 (continued)

Steel grade	Line ^d	% by mass												
		C	Si	Mn	P	S	N	Cr	Cu	Mo	Nb	Ni	Ti	Others
Special grades														
X1CrNi25-21	12	≤ 0,020	≤ 0,25	2,00	0,025	0,010	≤ 0,11	24,0 to 26,0	—	≤ 0,20	—	20,0 to 22,0	—	—
X6CrNiNb18-10	19	≤ 0,08	≤ 1,00	2,00	0,045	0,015	—	17,0 to 19,0	—	—	10 × C to 1,00	9,0 to 12,0	—	—
X8CrNiNb16-13	—	0,04 to 0,10	0,30 to 0,60	1,50	0,035	0,015	—	15,0 to 17,0	—	—	≥ 10 × C to 1,20	12,0 to 14,0	—	—
X1CrNiMoN25-22-2	29	≤ 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	—	—
X6CrNiMoNb17-12-2	33	≤ 0,08	≤ 1,00	2,00	0,045	0,015	—	16,5 to 18,5	—	2,00 to 2,50	10 × C to 1,00	10,5 to 13,5	—	—
X2CrNiMoN17-13-3	(26)	≤ 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 13,0 ^c	—	—
X3CrNiMo17-12-3	31	≤ 0,05	≤ 1,00	2,00	0,045	0,015	≤ 0,11	16,5 to 18,5	—	2,50 to 3,00	—	10,5 to 13,0	—	—
X2CrNiMoN18-12-4	27	≤ 0,030	≤ 1,00	2,00	0,045	0,015	0,10 to 0,20	16,5 to 19,5	—	3,00 to 4,0	—	10,5 to 14,0	—	—
X2CrNiMo18-15-4	—	≤ 0,030	≤ 1,00	2,00	0,045	0,015	≤ 0,11	17,5 to 19,5	—	3,00 to 4,0	—	13,0 to 16,0	—	—
X1NiCrMoCu31-27-4	36	≤ 0,020	≤ 0,70	2,00	0,030	0,010	≤ 0,11	26,0 to 28,0	0,70 to 1,50	3,00 to 4,0	—	30,0 to 32,0	—	—
X1CrNiMoCuN25-25-5	—	≤ 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 ^e	34	≤ 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	—	—
X1NiCrMoCuN25-20-7	37	≤ 0,020	≤ 0,75	2,00	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	—	—

a Elements not listed in this table may not be intentionally added to the steel without the agreement of the purchaser, except for finishing of the cast. All appropriate precautions shall 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 In ISO/TS 15510:2003, Table 1 (line numbers in parentheses indicate differences to the compositions specified in ISO/TS 15510).

c Where, for special reasons (e.g. workability or low magnetic permeability), it is necessary to minimize the ferrite content, the maximum nickel content may be increased by 0,50 % in the case of grade X2CrNi18-9 and 1,00 % in the case of grade X2CrNiMoN17-13-3.

d +Ra = recrystallizing annealed condition.

e Patented steel grade.

Table 4 — Chemical composition (cast analysis)^a of austenitic-ferritic steels

Steel grade	Line ^b	% by mass										
		C max.	Si max.	Mn max.	P max.	S max.	N	Cr	Cu	Mo	Ni	W
Standard grades												
X2CrNiN23-4	51	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	—
X2CrNiMoN22-5-3	52	0,030	1,00	2,00	0,035	0,015	0,10 to 0,22	21,0 to 23,0	—	2,5 to 3,5	4,5 to 6,5	—
Special grades												
X2CrNiMoCuN25-6-3	53	0,030	0,70	2,00	0,035	0,015	0,15 to 0,30	24,0 to 26,0	1,00 to 2,50	2,5 to 4,0	5,0 to 7,5	—
X2CrNiMoN25-7-4	54	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	56	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

^a Elements not listed in this table may not be intentionally added to the steel without the agreement of the purchaser, except for finishing of the cast. All appropriate precautions shall 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 In ISO/TS 15510:2003, Table 1.