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

**Part 7:
Stainless steels**

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

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Published in Switzerland

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html. (standards.iteh.ai)

This document was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 10, *Steel for pressure purposes*.
ISO 9328-7:2018

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This third edition cancels and replaces the second edition (ISO 9328-7:2011), which has been technically revised. The following changes have been made:

- the term “product thickness” has been replaced with “nominal thickness”;
- new steel grades X1CrNiSI18-5-4, X2CrCuNbTiV22-1, X2CrNiMoN21-9-1, X2CrMnNiN21-5-1 and X2CrNiMnMoCuN24-4-3-2 and all their technical data have been added;
- the technical data in [Table 5](#) have been revised;
- the technical data in [Table 9](#) have been aligned with EN 10028-7.

A list of all the parts in the ISO 9328 series can be found on the ISO website.

Introduction

The International Organization for Standardization (ISO) draws attention to the fact that it is claimed that compliance with this document may involve the use of patents concerning eight steel grades.

ISO takes no position concerning the evidence, validity and scope of this patent right. The holder of this patent right has assured ISO that he/she is willing to negotiate licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holder of this patent right is registered with ISO. Information may be obtained from the following sources.

For steel grades 1.4162 (but also consider footnote ^c in [Table 4](#)) and 1.4662 from:

Outokumpu Stainless AB

SE-77480 AVESTA, Sweden

For steel grades 1.4420 and 1.4622 from:

Outokumpu Oyj

FI-02200 Espoo, Finland

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

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Steel flat products for pressure purposes — Technical delivery conditions —

Part 7: Stainless steels

1 Scope

This document specifies requirements for flat products for pressure purposes made of stainless steels, including austenitic creep-resisting steels, in thicknesses as specified in [Tables 7](#) to [10](#).

The requirements and definitions of ISO 9328-1 also apply to this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 3651-2, *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 9328-1:2018, *Steel flat products for pressure purposes — Technical delivery conditions — Part 1: General requirements*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1

cryogenic temperature

temperature lower than -75 °C used in the liquefaction of gases

4 Classification and designation

Shall be in accordance with ISO 9328-1.

NOTE 1 Information on the designation of comparable steel grades in national or regional standards is given in [Annex A](#).

NOTE 2 Information on numbering of steel grades is in accordance with ISO 15510.

5 Information to be supplied by the purchaser

5.1 Mandatory information

Shall be in accordance with ISO 9328-1.

5.2 Options

The relevant options of ISO 9328-1 apply.

5.3 Example for ordering

An order of 10 plates made of a steel grade with the name X5CrNi18-10 as specified in this document with nominal dimensions thickness = 8 mm, width = 2 000 mm, length = 5 000 mm and tolerances on dimensions, shape and mass as specified in ISO 18286, with “normal” flatness tolerance in process route 1D (see [Table 6](#)), and with inspection certificate 3.1 as specified in ISO 10474 is designated as follows:

10 plates ISO 18286 – 8 × 2 000 × 5 000 N – Steel ISO 9328-7 – X5 CrNi18-10 + 1D – Inspection certificate 3.1

6 Requirements

6.1 Steelmaking process

Shall be in accordance with ISO 9328-1.

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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 B](#).

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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 the type of environment and can therefore not always be clearly ascertained through laboratory tests. It is therefore advisable to draw on the available experience of the use of the steels.

6.4 Mechanical properties

6.4.1 The tensile properties at room temperature and the impact energy at room temperature and at low temperature, 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 D](#).

6.4.3 [Annex E](#) provides for the purchaser mean values as preliminary data on the strength for 1 % (plastic) creep strain and creep rupture. These data apply for the solution annealed condition only.

6.4.4 In [Annex F](#), preliminary data on mechanical properties at low temperatures of austenitic steels are listed.

6.5 Surface condition

Shall be in accordance with ISO 9328-1 and [Table 6](#).

6.6 Internal soundness

Shall be in accordance with ISO 9328-1.

6.7 Post-weld heat treatment

Guidelines for the purchaser on post-weld heat treatment are given in [Annex C](#).

6.8 Dimensions and tolerances

Shall be in accordance with ISO 9328-1.

6.9 Calculation of mass

For density of steels, see [Annex G](#).

6.10 Physical properties

Reference data on some physical properties are given in [Annex G](#).

7 Inspection

7.1 Types of inspection and inspection documents

Shall be in accordance with ISO 9328-1.

7.2 Tests to be carried out

Shall be in accordance with [Table 16](#) and ISO 9328-1.

7.3 Re-tests

Shall be in accordance with ISO 9328-1.

8 Sampling

8.1 Frequency of testing

Shall be in accordance with [Table 16](#) and ISO 9328-1.

8.2 Selection and preparation of samples and test pieces

Shall be in accordance with ISO 9328-1.

9 Test methods

Shall be in accordance with ISO 9328-1.

10 Marking

Shall be in accordance with ISO 9328-1.

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

Steel grade ^b	mass fraction, %										
	C max.	Si max.	Mn max.	P max.	S max.	N max.	Cr	Mo	Nb	Ni	Ti
X2CrNi12	0,030	1,00	1,50	0,040	0,015	0,030	10,5 to 12,5	—	—	0,30 to 1,10	—
X6CrNiTi12	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
X2CrTi17	0,025	0,50	0,50	0,040	0,015	0,015	16,0 to 18,0	—	—	—	0,30 to 0,60
X3CrTi17	0,05	1,00	1,00	0,040	0,015	—	16,0 to 18,0	—	—	—	[4 × (C + N) + 0,15] to 0,80 ^c
X2CrMoTi17-1	0,025	1,00	1,00	0,040	0,015	0,030	16,0 to 18,0	0,80 to 1,40	—	—	0,30 to 0,60
X2CrMoTi18-2	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
X6CrMoNb17-1	0,08	1,00	1,00	0,040	0,015	0,040	16,0 to 18,0	0,80 to 1,40	[7 × (C + N) + 0,10] to 1,00	—	—
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
X2CrCuNbTiV22-1 _{d,e}	0,030	1,00	0,80	0,040	0,015	0,030	20,0 to 24,0	—	0,10 to 0,70	—	0,10 to 0,70

^a Elements not listed in this table may not be intentionally added to the steel without agreement of the purchaser, except for finishing of 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 Information concerning ISO steel numbers and designations according to other regional or national standards is given in [Annex A](#).

^c The stabilization may be made by use of titanium and/or niobium and/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:

$$\text{Nb} = \text{Zr} = \frac{7}{4} \text{Ti}.$$

^d Patented steel.

^e Other elements: V: 0,03 to 0,50 %; Cu: 0,30 to 0,80 %; Ti + Nb: 8x(C+N) to 0,80 %.

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

Steel grade ^b	mass fraction, %									
	C	Si	Mn	P	S	N	Cr	Mo	Ni	
X3CrNiMo13-4	max. 0,05	max. 0,70	max. 0,50 to 1,00	max. 0,040	max. 0,015	min. 0,020	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 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 Information concerning ISO steel numbers and designations according to other regional or national standards is given in [Annex A](#).

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

Steel grade ^b	mass fraction, %											Ti	Others	
	C	Si	Mn	P	S	N	Cr	Cu	Mo	Nb	Ni			
Austenitic corrosion-resisting grades														
X2CrNi18-7	≤ 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	≤ 0,030	≤ 1,00	2,00	0,045	0,015	0,10	17,5 to 19,5	—	—	—	8,0 to 10,5	—	—	
X2CrNi19-11	≤ 0,030	≤ 1,00	2,00	0,045	0,015	0,10	18,0 to 20,0	—	—	—	10,0 to 12,0	—	—	
X5CrNi19-9	≤ 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	—	—	
X2CrNi18-10	≤ 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	—	—	
X5CrNi18-10	≤ 0,07	≤ 1,00	2,00	0,045	0,015	≤ 0,10	17,5 to 19,5	—	—	—	8,0 to 10,5	—	—	
X6CrNiTi18-10	≤ 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	—	
X6CrNiNb18-10	≤ 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	—	—	
X1CrNi25-21	≤ 0,020	≤ 0,25	2,00	0,025	0,010	≤ 0,10	24,0 to 26,0	—	—	≤ 0,20	20,0 to 22,0	—	—	
X2CrNiMo17-12-2	≤ 0,030	≤ 1,00	2,00	0,045	0,015	≤ 0,10	16,5 to 18,5	—	—	2,00 to 2,50	10,0 to 13,0	—	—	
X2CrNiMoN17-11-2	≤ 0,030	≤ 1,00	2,00	0,045	0,015	0,12 to 0,22	16,5 to 18,5	—	—	2,00 to 2,50	10,0 to 12,5	—	—	
X5CrNiMo17-12-2	≤ 0,07	≤ 1,00	2,00	0,045	0,015	≤ 0,10	16,5 to 18,5	—	—	2,00 to 2,50	10,0 to 13,0	—	—	
X1CrNiMoN25-22-2	≤ 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	≤ 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	—	

^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 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 Information concerning ISO steel numbers and designations according to other regional or national standards is given in [Annex A](#).

^c Patented steel.

Table 3 (continued)

Steel grade ^b	mass fraction, %												
	C	Si	Mn	P	S	N	Cr	Cu	Mo	Nb	Ni	Ti	Others
X6CrNiMoNb17-12-2	≤ 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	—	—
X2CrNiMo17-12-3	≤ 0,030	≤ 1,00	2,00	0,045	0,015	≤ 0,10	16,5 to 18,5	—	2,50 to 3,00	—	10,5 to 13,0	—	—
X2CrNiMoN17-13-3	≤ 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	—	—
X3CrNiMo17-12-3	≤ 0,05	≤ 1,00	2,00	0,045	0,015	≤ 0,10	16,5 to 18,5	—	2,50 to 3,00	—	10,5 to 13,0	—	—
X2CrNiMo18-14-3	≤ 0,030	≤ 1,00	2,00	0,045	0,015	≤ 0,10	17,0 to 19,0	—	2,50 to 3,00	—	12,5 to 15,0	—	—
X2CrNiMoN18-12-4	≤ 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	—	—
X2CrNiMo18-15-4	≤ 0,030	≤ 1,00	2,00	0,045	0,015	≤ 0,10	17,5 to 19,5	—	3,0 to 4,0	—	13,0 to 16,0	—	—
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	—	—
X1NiCrMoCu31-27-4	≤ 0,020	≤ 0,70	2,00	0,030	0,010	≤ 0,10	26,0 to 28,0	0,70 to 1,50	3,0 to 4,0	—	30,0 to 32,0	—	—
X1NiCrMoCu25-20-5	≤ 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	—	—
X1CrNiSi18-15-4	≤ 0,015	3,7 to 4,5	≤ 2,00	0,025	0,010	≤ 0,10	16,5 to 18,5	—	≤ 0,20	—	14,0 to 16,0	—	—
X2CrNiMoN21-9-1 ^c	≤ 0,03	≤ 1,00	≤ 2,00	0,045	0,015	0,14 to 0,25	19,5 to 21,5	≤ 1,00	0,50 to 1,50	—	8,0 to 9,5	—	—
Austenitic corrosion-resisting grades													
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	≤ 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	—	—

^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 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 Information concerning ISO steel numbers and designations according to other regional or national standards is given in Annex A.

^c Patented steel.

Table 3 (continued)

Steel grade ^b	mass fraction, %											Ti	Others
	C	Si	Mn	P	S	N	Cr	Cu	Mo	Nb	Ni		
X1NiCrMoCuN25-20-7	≤ 0,020	≤ 0,50	2,00	max. 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	—	—
X2CrMnNiN17-7-5	< 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	—	—
X9CrMnNiCu17-8-5-2	≤ 0,10	≤ 1,00	5,5 to 9,5	0,070	0,010	≤ 0,15	16,5 to 18,5	1,00 to 2,50	—	—	4,5 to 5,5	—	—
Austenitic creep-resisting grades													
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
X6CrNiTiB18-10	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
X6CrNi18-10	0,04 to 0,08	≤ 1,00	2,00	0,035	0,015	≤ 0,10	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	≤ 0,10	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	≤ 0,10	24,0 to 26,0	—	—	—	19,0 to 22,0	—	—

^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 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 Information concerning ISO steel numbers and designations according to other regional or national standards is given in [Annex A](#).

^c Patented steel.