



SLOVENSKI STANDARD SIST EN 10028-7:2016

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Nadomešča:
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Ploščati jekleni izdelki za tlačne posode - 7. del: Nerjavna jekla

Flat products made of steels for pressure purposes - Part 7: Stainless steels

Flacherzeugnisse aus Druckbehälterstählen - Teil 7: Nichtrostende Stähle

Produits plats en aciers pour appareils à pression - Partie 7: Aciers inoxydables
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Ta slovenski standard je istoveten z: EN 10028-7:2016

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ICS:

77.140.20	Visokokakovostna jekla	Stainless steels
77.140.30	Jekla za uporabo pod tlakom	Steels for pressure purposes
77.140.50	Ploščati jekleni izdelki in polizdelki	Flat steel products and semi-products

SIST EN 10028-7:2016

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EUROPEAN STANDARD

EN 10028-7

NORME EUROPÉENNE

EUROPÄISCHE NORM

July 2016

ICS 77.140.30; 77.140.50

Supersedes EN 10028-7:2007

English Version

Flat products made of steels for pressure purposes - Part 7: Stainless steels

Produits plats en aciers pour appareils à pression -
Partie 7: Aciers inoxydables

Flacherzeugnisse aus Druckbehälterstählen - Teil 7:
Nichtrostende Stähle

This European Standard was approved by CEN on 15 April 2016.

This European Standard was corrected and reissued by the CEN-CENELEC Management Centre on 2016-07-27.

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EN 10028-7:2016 (E)**European foreword**

This document (EN 10028-7:2016) has been prepared by Technical Committee ECISS/TC 107 “Steels for pressure purposes”, 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of an identical text or by endorsement, at the latest by January 2017, and conflicting national standards shall be withdrawn at the latest by January 2017.

This document supersedes EN 10028-7:2007.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive, see informative Annex ZA, which is an integral part of this document.

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Introduction

The European Committee for Standardization (CEN) draws attention to the fact that it is claimed that compliance with this document may involve the use of patents concerning eight steel grades given in Clause 12, Annex A, Annex B, Annex C and Annex E.

CEN takes no position concerning the evidence, validity and scope of this patent right.

The holder of this patent right has assured CEN that he/she is willing to negotiate licences either free of charge or 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 CEN. Information may be obtained from:

Outokumpu Oyj

FI-02200 Espoo, Finland

for steel grades 1.4420, 1.4622, 1.4162 (but also consider footnote c in Table 4) and 1.4662

Industeel

F-71200 Creusot,

56 Rue Clemenceau, France

for steel grade 1.4062

Acciai Speciali Terni S.p.A.

I-05100 Terni, Italy

for steel grades 1.4646, 1.4611 and 1.4613

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. CEN shall not be held responsible for identifying any or all such patent rights.

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EN 10028-7:2016 (E)**1 Scope**

This European Standard specifies requirements for flat products for pressure purposes made of stainless steels, including austenitic creep resisting steels, in thicknesses as indicated in Tables 7 to 10.

The requirements of EN 10028-1 also apply.

NOTE 1 The steel grades covered by this European Standard have been selected from EN 10088-1.

NOTE 2 Once this European Standard is published in the Official Journal of the European Union (OJEU) under Directive 2014/68/EU, presumption of conformity to the Essential Safety Requirements (ESRs) of Directive 2014/68/EU is limited to technical data of materials in this European Standard (Part 1 and Part 7) and does not presume adequacy of the material to a specific item of equipment. Consequently, the assessment of the technical data stated in this material standard against the design requirements of this specific item of equipment to verify that the ESRs of the Pressure Equipment Directive are satisfied, needs to be done.

2 Normative references

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

EN 10028-1, *Flat products made of steels for pressure purposes — Part 1: General requirements*

EN 10088-1:2014, *Stainless steels — Part 1: List of stainless steels*

EN 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 3651-2)*

EN ISO 9444-2, *Continuously hot-rolled stainless steel — Tolerances on dimensions and form — Part 2: Wide strip and sheet/plate (ISO 9444-2)*

EN ISO 9445-2, *Continuously cold-rolled stainless steel — Tolerances on dimensions and form — Part 2: Wide strip and plate/sheet (ISO 9445-2)*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 10028-1 and the following apply.

3.1**cryogenic temperature**

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

4 Tolerances on dimensions

Shall be according to the following standards:

- EN ISO 9445-2 for product form C;
- EN ISO 9444-2 for product form H;
- EN ISO 18286 for product form P.

5 Calculation of mass

For density values, shall be according to EN 10088-1:2014, Annex E.

6 Classification and designation

Shall be according to EN 10028-1.

7 Information to be supplied by the purchaser

7.1 Mandatory information

Shall be according to EN 10028-1.

7.2 Options

The relevant options of EN 10028-1 apply. If the purchaser does not indicate a wish to implement any of these options at the time of enquiry and order, the products shall be supplied in accordance with the basic specification (see EN 10028-1).

7.3 Example for ordering

10 plates made of a steel grade with the name X5CrNi18-10 and the number 1.4301 as specified in EN 10028-7 with nominal dimensions, thickness = 8 mm, width = 2 000 mm, length = 5 000 mm; tolerances on dimensions, shape and mass as specified in EN ISO 18286 with thickness tolerance class B and "normal" flatness tolerance according to process route 1D. (see Table 6), inspection document 3.1 as specified in EN 10204:

10 plates- EN ISO 18286:—, 8x2000x5000 B-steel EN 10028-7-X5CrNi18-10+1D-inspection document

<https://standards.iteh.ai/catalog/standards/sist/045065f2-f3c4-46dc-a8de-c662493db1e7/sist-en-10028-7-2016>
or

10 plates- EN ISO 18286:—, 8x2000x5000 B-steel EN 10028-7-1+1D-inspection document 3.1

8 Requirements

8.1 Steelmaking process

Shall be according to EN 10028-1.

8.2 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.

8.3 Chemical composition and chemical corrosion properties

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

8.3.2 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.

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8.3.3 The specifications in Tables 7, 9 and 10 shall apply in respect to resistance to intergranular corrosion as defined in EN ISO 3651-2, for ferritic, austenitic and austenitic-ferritic steels.

NOTE 1 EN 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.

8.4 Mechanical properties

8.4.1 The tensile properties at room temperature and the impact energy at 20 °C and at low temperatures as specified in Tables 7 to 10 apply for the relevant specified heat treatment condition.

NOTE Austenitic stainless steels are insensitive to brittle fracture in the solution annealed condition. As they have a good resistance to shock loads, due to their high impact energy, also at very low (cryogenic) temperatures, they are useful for applications at such temperatures (see also the NOTE to Tables 9 and 10).

8.4.2 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 for austenitic steels.

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

8.4.4 Annex D gives mean values as preliminary data for the purchaser about strength for 1 % (plastic) creep strain and creep rupture. These data apply for the solution annealed condition only (see Table A.3).

8.4.5 In Annex E preliminary data on mechanical properties at low temperatures of austenitic steels are listed.

8.5 Surface condition

Shall be according to EN 10028-1 and Table 6.

8.6 Internal soundness

Shall be according to EN 10028-1.

8.7 Physical properties

For reference data on physical properties, see EN 10088-1:2014, Annex E.

8.8 Weldability**8.8.1 General**

The choice of the appropriate welding method and welding parameters is under the responsibility of the equipment manufacturer.

8.8.2 Post weld heat treatment

Guidelines for the purchaser on post weld heat treatment are given in Annex B.

9 Inspection

9.1 Types of inspection and inspection documents

Shall be according to EN 10028-1.

9.2 Tests to be carried out

Shall be according to Table 16 and EN 10028-1.

9.3 Re-tests, sorting and reprocessing

Shall be according to EN 10028-1.

10 Sampling

10.1 Frequency of testing

Shall be according to Table 16 and EN 10028-1.

10.2 Selection and preparation of samples and test pieces

Shall be according to EN 10028-1.

11 Test methods

Shall be according to EN 10028-1.

12 Marking

Shall be according to EN 10028-1.

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

Steel grade		% by mass										
Steel name	Steel number	C max.	Si max.	Mn max.	P max.	S max.	N max.	Cr	Mo	Nb	Ni	Ti
X2CrNi12	1.4003	0,030	1,00	1,50	0,040	0,015	0,030	10,5 to 12,5	-	-	0,30 to 1,00	-
X2CrTiNb18	1.4509	0,030	1,00	1,00	0,040	0,015	-	17,5 to 18,5	-	[(3xC)+ 0,30] to 1,00	-	0,10 to 0,60
X3CrTi17	1.4510	0,050	1,00	1,00	0,040	0,015	-	16,0 to 18,0	-	-	-	[(4 x(C+N) + 0,15) to 0,80] ^b
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	-	-	[(4 x(C+N) + 0,15) to 0,60] ^b
X6CrNiTi12	1.4516	0,080	0,70	1,50	0,040	0,015	-	10,5 to 12,5	-	-	0,50 to 1,50	0,05 to 0,35
X2CrTi17	1.4520	0,025	0,50	0,50	0,040	0,015	0,015	16,0 to 18,0	-	-	-	[(4 x(C+N) + 0,15) to 0,60] ^b
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] ^b
X6CrMoNb17-1	1.4526	0,080	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	-	-
X2CrTi21 ^{c,d}	1.4611	0,030	1,00	1,00	0,050	0,05	-	19,0 to 22,0	≤ 0,50	≤ 1,00 ^b	≤ 0,50	≤ 1,00 ^b
X2CrTi24 ^{c,d}	1.4613	0,030	1,00	1,00	0,050	0,05	-	22,0 to 25,0	≤ 0,50	≤ 1,00 ^b	≤ 0,50	≤ 1,00 ^b
X2CrCuNbTiV22-1 ^{d,e}	1.4622	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 shall 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 The stabilization may be made by use of titanium and/or niobium and/or zirconium. According to the atomic mass of these elements and the content of carbon and nitrogen, the equivalence shall be the following, in % by mass:

$$Nb \approx Zr \approx \frac{7}{4} Ti$$

^c Other elements: Cu < 0,5 % and Al < 0,05 %.

^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		% by mass								N min.
Steel name	Steel number	C max.	Si max.	Mn max.	P max.	S max.	Cr	Mo	Ni	
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	0,020
X4CrNiMo16-5-1	1.4418	0,06	0,70	1,50	0,040	0,015	15,0 to 17,0	0,80 to 1,50	4,0 to 6,0	0,020

^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.

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

Steel grade		% by mass												
Steel name	Steel number	C	Si	Mn	P max.	S max.	N	Cr	Cu	Mo	Nb	Ni	Ti	Others
Austenitic corrosion resisting grades														
X5CrNi18-10	1.4301	≤ 0,07	≤ 1,00	≤ 2,00	0,045	0,015	≤ 0,10	17,5 to 19,5	-	-	-	8,0 to 10,5	-	-
X2CrNi19-11	1.4306	≤ 0,03	≤ 1,00	≤ 2,00	0,045	0,015	≤ 0,10	18,0 to 20,0	-	-	-	10,0 to 12,0	-	-
X2CrNi18-9	1.4307	≤ 0,03	≤ 1,00	≤ 2,00	0,045	0,015	≤ 0,10	17,5 to 19,5	-	-	-	8,0 to 10,5	-	-
X2CrNi18-10	1.4311	≤ 0,03	≤ 1,00	≤ 2,00	0,045	0,015	0,12 to 0,22	17,5 to 19,5	-	-	-	8,5 to 11,5	-	-
X5CrNi19-9	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	-	-
X2CrNi18-7	1.4318	≤ 0,03	≤ 1,00	≤ 2,00	0,045	0,015	0,10 to 0,20	16,5 to 18,5	-	-	-	6,0 to 8,0	-	-
X1CrNi25-21	1.4335	≤ 0,02	≤ 0,25	≤ 2,00	0,025	0,010	≤ 0,10	24,0 to 26,0	-	≤ 0,20	-	20,0 to 22,0	-	-
X1CrNiSi18-15-4	1.4361	≤ 0,01 5	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	-	-
X2CrMnNi17-7-5	1.4371	≤ 0,03	≤ 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	-	-
X12CrMnNi17-7-5	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	-	-
X5CrNiMo17-12-2	1.4401	≤ 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	-	-
X2CrNiMo17-12-2	1.4404	≤ 0,03	≤ 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	-	-
X2CrNiMo17-11-2	1.4406	≤ 0,03	≤ 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	-	-
X2CrNiMoN21-9-1 ^b	1.4420	≤ 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	-	-
X2CrNiMoN17-13-3	1.4429	≤ 0,03	≤ 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	-	-
X2CrNiMo17-12-3	1.4432	≤ 0,03	≤ 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	-	-
X2CrNiMoN18-12-4	1.4434	≤ 0,03	≤ 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	-	-
X2CrNiMo18-14-3	1.4435	≤ 0,03	≤ 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	-	-
X3CrNiMo17-13-3	1.4436	≤ 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	-	-
X2CrNiMo18-15-4	1.4438	≤ 0,03	≤ 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	1.4439	≤ 0,03	≤ 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	-	-
X1CrNiMoN25-22-2	1.4466	≤ 0,02	≤ 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	-	-
X1NiCrMoCuN25-20-7	1.4529	≤ 0,02	≤ 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	-	-
X1CrNiMoCuN25-25-5	1.4537	≤ 0,02	≤ 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	-	-
X1NiCrMoCu25-20-5	1.4539	≤ 0,02	≤ 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	-	-
X6CrNiTi18-10	1.4541	≤ 0,08	≤ 1,00	≤ 2,00	0,045	0,015	-	17,0 to 19,0	-	-	-	9,0 to 12,0	5 x C to 0,70	-
X1CrNiMoCuN20-18-7	1.4547	≤ 0,02	≤ 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	-	-
X6CrNiNb18-10	1.4550	≤ 0,08	≤ 1,00	≤ 2,00	0,045	0,015	-	17,0 to 19,0	-	-	10 x C to 1,00	9,0 to 12,0	-	-
X1NiCrMoCu31-27-4	1.4563	≤ 0,02	≤ 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	-	-

(to be continued)

Steel grade		% by mass												
Steel name	Steel number	C	Si	Mn	P max.	S max.	N	Cr	Cu	Mo	Nb	Ni	Ti	Others
X6CrNiMoTi17-12-2	1.4571	≤ 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 x C 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	10 x C to 1,00	10,5 to 13,5	-	-
X9CrMnNiCu17-8-5-2	1.4618	≤ 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	-	-
X6CrMnNiCuN18-2-4-2 ^b	1.4646	0,02 to 0,10	1,0	10,5 to 12,5	0,05	0,015	0,2 to 0,3	17 to 19	1,5 to 3,0	< 0,5	-	3,5 to 4,5	-	Al < 0,05
Austenitic creep resisting grades														
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
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	5 x C to 0,80	B: 0,001 5 to 0,005 0
X6CrNi18-10	1.4948	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	1.4950	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	1.4951	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	-	-
X5NiCrAlTi31-20 (+RA)	1.4958 (+RA)	0,03 to 0,08	≤ 0,70	≤ 1,50	0,015	0,010	≤ 0,030	19,0 to 22,0	≤ 0,50	-	≤ 0,10	30,0 to 32,5	0,20 to 0,50	Al: 0,20 to 0,50 Al+Ti: ≤ 0,70 Co ≤ 0,50 Ni+Co: 30,0 to 32,5
X8NiCrAlTi32-21	1.4959	0,05 to 0,10	≤ 0,70	≤ 1,50	0,015	0,010	≤ 0,030	19,0 to 22,0	≤ 0,50	-	-	30,0 to 34,0	0,25 to 0,65	Al: 0,25 to 0,65 Co ≤ 0,50 Ni+Co: 30,0 to 34,0
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	-	-	10 x C to 1,20	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 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 Patented steel