



SLOVENSKI STANDARD
SIST EN 10028-7:2008
01-februar-2008

BUXca Yý U.
SIST EN 10028-7:2000
SIST EN 10028-7:2000/AC:2005

D`cý Uĥ`Ÿ`Yb]`nXY`_]`nUĥU bY`dcgcXY`Ë`+"XY.`BYf`Uj`bU`Ÿ``U

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

Flacherzeugnisse aus Druckbehälterstählen - Teil 7: Nichtrostende Stähle

iTeh STANDARD PREVIEW

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

(standards.itech.ai)

Ta slovenski standard je istoveten z: EN 10028-7:2007
<https://standards.itech.ai/catalog/standards/sist/10116346-5a61-4449-93e9-bfe795ec688d/sist-en-10028-7-2008>

ICS:

- | | | |
|-----------|---|---------------------------------------|
| 77.140.30 | Jekla za uporabo pod tlakom | Steels for pressure purposes |
| 77.140.50 | Ú[[z aak \ ^ } as a ^ \ as] [ã á ^ \ ã | Flat steel products and semi-products |

SIST EN 10028-7:2008 **en,de**

iTeh STANDARD PREVIEW
(standards.iteh.ai)

SIST EN 10028-7:2008

<https://standards.iteh.ai/catalog/standards/sist/f0116346-5a61-4449-93e9-bfe795ec688d/sist-en-10028-7-2008>

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 21 October 2007.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

iTeh STANDARD PREVIEW
(standards.iteh.ai)
<https://standards.iteh.ai/catalog/standards/sist/f0116346-5a61-4449-93e9-bfe795ec688d/sist-en-10028-7-2008>



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

Contents

	page
Foreword.....	3
1 Scope	4
2 Normative references	4
3 Terms and definitions	4
4 Dimensions and tolerances on dimensions	5
5 Calculation of mass	5
6 Classification and designation.....	5
7 Information to be supplied by the purchaser	5
8 Requirements	5
9 Inspection	7
10 Sampling.....	7
11 Test methods.....	7
12 Marking	7
Annex A (informative) Guidelines for further treatment (including heat treatment in fabrication).....	29
Annex B (informative) Post weld heat treatment.....	32
Annex C (informative) Preliminary reference data for the tensile strength of austenitic-ferritic steels at elevated temperatures	34
Annex D (informative) Reference data of strength values for 1 % (plastic) creep strain and creep rupture	35
Annex E (informative) Reference data on mechanical properties of austenitic steels at room temperature and at low temperatures.....	44
Annex ZA (informative) Relationship between this European Standard and the Essential Requirements of EU Directive 97/23/EC	45
Bibliography	46

iTeh STANDARD PREVIEW
(standards.itech.ai)

SIST EN 10028-7:2008
<https://standards.itech.ai/catalog/standards/sist/0116346-5a61-4449-93e9-0c795cc680d/sist-en-10028-7-2008>

Foreword

This document (EN 10028-7:2007) has been prepared by Technical Committee ECISS/TC 22 "Steels for pressure purposes - Qualities", 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 June 2008, and conflicting national standards shall be withdrawn at the latest by June 2008.

This document supersedes EN 10028-7:2000.

This European Standard 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 97/23/EC.

For relationship with EU Directive 97/23/EC, see informative Annex ZA, which is an integral part of this document.

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

EN 10028 consists of the following parts under the general title *Flat products made of steels for pressure purposes*:

- iTeh STANDARD PREVIEW**
(standards.iteh.ai)
- 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*

NOTE The clauses marked by two points (••) contain information relating to agreements that may be made at the time of enquiry and order.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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 97/23/EC, presumption of conformity to the Essential Safety Requirements (ESRs) of Directive 97/23/EC 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 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 10028-1:2007, *Flat products made of steels for pressure purposes — Part 1: General requirements*

EN 10029, *Hot rolled plates 3 mm thick or above — Tolerances on dimensions, shape and mass*

EN 10088-1:2005, *Stainless steels — Part 1: List of stainless steels*

EN ISO 643, *Steels — Micrographic determination of the apparent grain size (ISO 643:2003)*

EN ISO 3651-2, *Determination of the 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 3651-2:1998)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 10028-1:2007 and the following apply.

3.1

cryogenic temperature

temperature lower than $-75\text{ }^{\circ}\text{C}$ used in the liquefaction of gases

4 Dimensions and tolerances on dimensions

Shall be according to EN 10028-1.

5 Calculation of mass

For density values, shall be according to EN 10088-1:2005, Annex A.

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

A number of options are specified in this document and listed below. Additionally, 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).

- 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).

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 10029 with thickness tolerance class A and "normal" flatness tolerance according to process route 1D (see Table 6), inspection document 3.1 as specified in EN 10204:

10 plates–EN 10029–8Ax2000x5000–steel EN 10028-7–X5CrNi18-10+1D–inspection document 3.1

or

10 plates– EN 10029–8Ax2000x5000–steel EN 10028-7–1.4301+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.

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 room 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.

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

8.4.3 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).

8.4.4 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 Annex A of EN 10088-1:2005.

8.8 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

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.

STANDARD PREVIEW
(standards.iteh.ai)

SIST EN 10028-7:2008

<https://standards.iteh.ai/catalog/standards/sist/0116346-5a61-4449-93e9-bfe795ec688d/sist-en-10028-7-2008>

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	–
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
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
X3CrTi17	1.4510	0,05	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	–	–	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 ^b
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	–	–
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

^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 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, in % by mass:

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

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

Steel grade		% by mass								
Steel name	Steel number	C max.	Si max.	Mn max.	P max.	S max.	Cr	Mo	Ni	N min.
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.

ITeH STANDARD PREVIEW
(standards.iteh.ai)

SIST EN 10028-7:2008

<https://standards.iteh.ai/catalog/standards/sist/f0116346-5a61-4449-93e9-bfe795ec688d/sist-en-10028-7-2008>

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

Steel grade		% by mass												
Steel name	Steel number	C	Si	Mn max.	P max.	S max.	N	Cr	Cu	Mo	Nb	Ni	Ti	Others
Austenitic corrosion resisting grades														
X2CrNi18-7	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	≤ 0,10	17,5 to 19,5	–	–	–	8,0 to 10,5	–	–
X2CrNi19-11	1.4306	≤ 0,030	≤ 1,00	2,00	0,045	0,015	≤ 0,10	18,0 to 20,0	–	–	–	10,0 to 12,0	–	–
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	–	–
X2CrNi18-10	1.4311	≤ 0,030	≤ 1,00	2,00	0,045	0,015	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	≤ 0,10	17,5 to 19,5	–	–	–	8,0 to 10,5	–	–
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	–
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	–	–
X1CrNi25-21	1.4335	≤ 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	1.4404	≤ 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	1.4406	≤ 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	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	–	–
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	–	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	–	–
X2CrNiMo17-12-3	1.4432	≤ 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	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	–	–
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	–	–
X2CrNiMo18-14-3	1.4435	≤ 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	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	–	–

(to be continued)

Table 3 (concluded)

Steel grade		% by mass												
Steel name	Steel number	C	Si	Mn max.	P max.	S max.	N	Cr	Cu	Mo	Nb	Ni	Ti	Others
X2CrNiMo18-15-4	1.4438	≤ 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	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	–	–
X1NiCrMoCu31-27-4	1.4563	≤ 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	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	–	–
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	–	–
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	–	0,001 5 to 0,005 0 B
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	0,001 5 to 0,005 0 B
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	0,20 to 0,50 Al Al+Ti: ≤ 0,70 ≤ 0,50 Co 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	0,25 to 0,65 Al ≤ 0,50 Co 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.