INTERNATIONAL STANDARD

ISO 9328-5

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Steel plates and strips for pressure purposes — Technical delivery conditions —

Part 5: Austenitic steels

Tôles et bandes en acier pour service sous pression — Conditions techniques de livraison —
Partie 5: Aciers austénitiques

Reference number
ISO 9328-5:1991(E)

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.

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.

International Standard ISO 9328-5 was prepared by Technical Committee ISO/TC 17, *Steel*, Sub-Committee SC 10, *Steel for pressure purposes*.

Parts 1 to 5 of ISO 9328 cancel and replace the first editions of ISO 2604-4:1975, ISO/TR 2604-7:1986 and ISO 2604-8:1985, of which they constitute a technical revision.

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

— *Part 1: General requirements*

— *Part 2: Unalloyed and low-alloyed steels with specified room temperature and elevated temperature properties*

— *Part 3: Nickel-alloyed steels with specified low temperature properties*

— *Part 4: Weldable fine grain steels with high proof stress supplied in the normalized or quenched and tempered condition*

— *Part 5: Austenitic steels*

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Steel plates and strips for pressure purposes — Technical delivery conditions —

Part 5:
Austenitic steels

1 Scope

1.1 This part of ISO 9328 applies to plates of 3 mm to 75 mm thickness and strip of thickness greater than or equal to 3 mm, manufactured of the austenitic steels covered in table 1 and to be delivered according to the specifications given in ISO 9328-1.

NOTE 1 Austenitic steels may by agreement be supplied thinner than 3 mm in accordance with the requirements of this part of ISO 9328.

1.2 This part of ISO 9328 covers the following data:

a) in table 1 the limits for

- the chemical composition according to the cast analysis,
- the tensile and impact properties at room temperature, and
- indications on the usual heat-treatment condition at the time of delivery;

b) in table 2 the permissible deviations of the results of the product analysis from the specified limits for the cast analysis;

c) in table 3 the minimum elevated temperature proof stress values;

d) in table 4 the estimated average stress rupture properties.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 9328. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 9328 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 148:1983, *Steel — Charpy impact test (V-notch).*

ISO 643:1983, *Steels — Micrographic determination of the ferritic or austenitic grain size.*

ISO 2605-2:1976, *Steel products for pressure purposes — Derivation and verification of elevated temperature properties — Part 2: Proof stress of austenitic steel products.*

ISO 9328-1:1991, *Steel plates and strips for pressure purposes — Technical delivery conditions — Part 1: General requirements.*

3 Definitions

See ISO 9328-1.

4 Ordering and designation

See ISO 9328-1.

5 Requirements

See ISO 9328-1 and tables 1 to 4.

6 Inspection, testing and conformity of products

See ISO 9328-1.

7 Marking

See ISO 9328-1.

Table 1 — Chemical composition (cast analysis), room temperature mechanical properties and heat-treatment conditions of austenitic steels

Line No.	Steel type designation[1]	Chemical composition [% (m/m)][2]								
		C	Si max.	Mn max.	P max.	S max.	Cr	Mo	Ni	Others
1	X 2 CrNi 18 10	≤ 0,030	1,00	2,00	0,045	0,030	17,00 to 19,00	—	9,00 to 12,00	—
2	X 2 CrNiN 18 10	≤ 0,030	1,00	2,00	0,045	0,030	17,00 to 19,00	—	8,50 to 11,50	N 0,12 to 0,22
3	X 5 CrNi 18 9	≤ 0,07	1,00	2,00	0,045	0,030	17,00 to 19,00	—	8,00 to 11,00	—
4	X 7 CrNi 18 9	0,04 to 0,10	1,00	2,00	0,045	0,030	17,00 to 19,00	—	8,00 to 11,00	—
5	X 6 CrNiNb 18 10	≤ 0,08	1,00	2,00	0,045	0,030	17,00 to 19,00	—	9,00 to 12,00	Nb ≥ 10 × % C ≤ 1,00[13]
6	X 6 CrNiTi 18 10	≤ 0,08	1,00	2,00	0,045	0,030	17,00 to 19,00	—	9,00 to 12,00	Ti ≥ 5 × % C ≤ 0,80
7	X 7 CrNiTi 18 10	0,04 to 0,10	1,00	2,00	0,045	0,030	17,00 to 19,00	—	9,00 to 12,00	Ti ≥ 5 × % C ≤ 0,80
8	X 7 CrNiNb 18 10	0,04 to 0,10	1,00	2,00	0,045	0,030	17,00 to 19,00	—	9,00 to 12,00	Nb ≥ 10 × % C ≤ 1,20[13]
9	X 2 CrNiMo 17 12	≤ 0,030	1,00	2,00	0,045	0,030	16,50 to 18,50	2,00 to 2,50	11,00 to 14,00	—
10	X 2 CrNiMoN 17 12	≤ 0,030	1,00	2,00	0,045	0,030	16,50 to 18,50	2,00 to 2,50	10,50 to 13,50	N 0,12 to 0,22
11	X 2 CrNiMo 17 13	≤ 0,030	1,00	2,00	0,045	0,030	16,50 to 18,50	2,50 to 3,00	11,50 to 14,50	—
12	X 2 CrNiMoN 17 13	≤ 0,030	1,00	2,00	0,045	0,030	16,50 to 18,50	2,50 to 3,00	11,50 to 14,50	N 0,12 to 0,22
13	X 2 CrNiMoN 17 13 5[17]	≤ 0,030	1,00	2,00	0,045	0,025	16,50 to 18,50	4,00 to 5,00	12,50 to 14,50	N 0,12 to 0,22
14	X 5 CrNiMo 17 12	≤ 0,07	1,00	2,00	0,045	0,030	16,50 to 18,50	2,00 to 2,50	10,50 to 13,50	—
15	X 5 CrNiMo 17 13	≤ 0,07	1,00	2,00	0,045	0,030	16,50 to 18,50	2,50 to 3,00	11,00 to 14,00	—
16	X 7 CrNiMo 17 12	0,04 to 0,10	1,00	2,00	0,045	0,030	16,50 to 18,50	2,00 to 2,50	10,50 to 13,50	—
17	X 7 CrNiMoB 17 12	0,04 to 0,10	1,00	2,00	0,045	0,030	16,50 to 18,50	2,00 to 2,50	10,50 to 13,50	B 0,001 to 0,005
18	X 6 CrNiMoTi 17 12	≤ 0,08	1,00	2,00	0,045	0,030	16,50 to 18,50	2,00 to 2,50	11,00 to 14,00	Ti ≥ 5 × % C ≤ 0,80
19	X 6 CrNiMoNb 17 12	≤ 0,08	1,00	2,00	0,045	0,030	16,50 to 18,50	2,00 to 2,50	11,00 to 14,00	Nb ≥ 10 × % C ≤ 1,00[13]
20	X 3 CrNiMo 18 16 4	≤ 0,030	1,00	2,00	0,045	0,030	17,50 to 19,50	3,00 to 4,00	14,00 to 17,00	—
21	X 2 NiCrMoCu 25 20 5[17]	≤ 0,025	1,00	2,00	0,035	0,025	19,00 to 22,00	4,00 to 5,00	24,00 to 27,00	Cu 1,00 to 2,00 N[14]
22	X 8 NiCrAlTi 32 21 TQ1	0,05 to 0,10	1,00	2,00	0,030	0,020	19,00 to 23,00	—	30,00 to 35,00	$Al_{met.}$ 0,15 to 0,60 Ti 0,15 to 0,60 Cu ≤ 0,75
23	X 8 NiCrAlTi 32 21 TQ2[16]									
24	X 7 NiCrAlTi 32 21 TQ1	≤ 0,10	1,00	2,00	0,030	0,020	19,00 to 23,00	—	30,00 to 35,00	$Al_{met.}$ 0,15 to 0,60 Ti 0,15 to 0,60 Cu ≤ 0,75
25	X 7 NiCrAlTi 32 21 TQ2[16]									

Mechanical properties at room temperature[3]					Elevated temperature properties		Heat treatment		
							Usual reference heat-treatment conditions		
$R_{p\,0,2}$ min.	$R_{p\,1,0}$ min.	R_m	A min.	KV[4] min. [5], [6]	R_p	Creep properties	Symbol [7]	Solution temperature [8], [9]	Cooling in [10]
N/mm²	N/mm²	N/mm²	%	J	See table	See table		°C	
180	215	480 to 680	40	55	3	—	Q	1 000 to 1 000[11]	w, a
270	305	550 to 750	35	55	3	—	Q	1 000 to 1 000[11]	w, a
195	230	500 to 700	40	55	3	—	Q	1 000 to 1 000[11]	w, a
195	230	490 to 690	40	55	3	4	Q	1 050 to 1 120[12]	w, a
205	240	510 to 710	30	55	3	—	Q	1 020 to 1 120[11]	w, a
200	235	510 to 710	35	55	3	—	Q	1 020 to 1 120[11]	w, a
175	210	490 to 690	35	55	3	4	Q	1 050 to 1 120[12]	w, a
205	240	510 to 710	30	55	3	4	Q	1 050 to 1 120[12]	w, a
190	225	490 to 690	40	55	3	—	Q	1 020 to 1 120[11]	w, a
280	315	580 to 780	35	55	3	—	Q	1 020 to 1 120[11]	w, a
190	225	490 to 690	40	55	3	—	Q	1 020 to 1 120[11]	w, a
280	315	580 to 780	35	55	3	—	Q	1 020 to 1 120[11]	w, a
285	320	580 to 800	35	55	3	—	Q	1 040 to 1 120[11]	w, a
205	240	510 to 710	40	55	3	—	Q	1 020 to 1 120[11]	w, a
205	240	510 to 710	40	55	3	—	Q	1 020 to 1 120[11]	w, a
205	240	510 to 710	40	55	3	4	Q	1 050 to 1 120[12]	w, a
205	240	510 to 710	40	55	3	4	Q	1 050 to 1 120[12]	w, a
210	245	510 to 710	35	55	3	—	Q	1 020 to 1 120[11]	w, a
215	250	510 to 710	30	55	3	—	Q	1 020 to 1 120[11]	w, a
195	230	490 to 690	35	55	3	—	Q	1 050 to 1 120[11]	w, a
220[14]	255[14]	520 to 720[14]	35	55	3	—	Q	1 050 to 1 150[11]	w, a
165	205	430 to 680	25[15]	55	3	4	Q1	1 050 to 1 150[12]	w, a
210	245	500 to 750	22	55	—	—	Q2	950 to 1 050[11]	w, a
165	205	430 to 680	25[15]	55	3	4	Q1	1 050 to 1 150[12]	w, a
210	245	500 to 750	22	55	—	—	Q2	950 to 1 050[11]	w, a

Footnotes to table 1

1) All data on designations in this part of ISO 9328 are to be regarded as preliminary and will be revised as soon as a general system for the designation of steels and steel products has been established.

2) See also ISO 9328-1, 5.2.1.1.

3) R_p: proof stress (see ISO 9328-1, table 3, footnote 4);

R_m: tensile strength;

A: percentage elongation after fracture on original gauge length $L_0 = 5{,}65\sqrt{S_0}$ (where S_0 is the original cross-sectional area);

KV: ISO V-notch impact strength.

4) Austenitic steels do not exhibit any transition range of impact values so that there is no important decrease of the impact values down to low temperatures.

5) Average of three tests. One of the three individual values may be below the specified minimum average value, provided it is not less than 70 % of this value.

6) The values apply to standard 10 mm × 10 mm Charpy V-notch impact test pieces (see ISO 148). For subsidiary test piece values see the note in 5.3.1 of ISO 9328-1.

7) Q: quenched.

8) The indications are for guidance only, except in cases where testing of reference test pieces is required.

9) In the case of heat treatment in continuous furnaces, the temperature of the furnace atmosphere should normally be the in upper part of the given temperature range or even exceed it.

10) w: water; a: air. Cooling sufficiently rapid.

11) In the case of heat treatment during processing after delivery, the lower part of the given solution temperature range is to be aimed for. If, during hot working, the temperature was not below the specified lower limit of the solution temperature, the following temperatures are sufficient for repeat heat treatments:

980 °C in the case of Mo-free steels;
1 000 °C in the case of steels with ⩽ 3 % (m/m) Mo;
1 020 °C in the case of steels with > 3 % (m/m) Mo.

12) For the steels for which stress rupture values are given in table 4, the treatment temperature may not be less than the minimum of the reference temperature range.

13) Niobium content including tantalum determined as niobium.

14) By agreement, nitrogen may be added up to a limit of 0,15 % (m/m). In this case, higher yield stress and tensile strength values may also be agreed upon.

15) A_{min} = 20 % for thicknesses ⩾ 40 mm.

16) Alternative heat treatment is to be agreed upon at the time of enquiry and order. The mechanical properties specified for the treatment condition Q2 apply for thicknesses less than or equal to 40 mm only.

17) Since this steel is at the stage of development, small deviations in chemical composition are permitted, provided the other requirements are fulfilled.

Table 2 — Permissible deviations of the product analysis from the specified limits for the cast analysis

Element	Maximum of specification range in the cast analysis % (*m*/*m*)	Permissible deviation[1)] % (*m*/*m*)
C	⩽ 0,030 > 0,030 ⩽ 0,10	+ 0,005 ± 0,01
Si	⩽ 1,00	+ 0,05
Mn	⩽ 2,00	+ 0,05
P	⩽ 0,030 > 0,030 ⩽ 0,045	+ 0,003 + 0,005
S	⩽ 0,030	+ 0,003
Al	⩽ 0,60	± 0,05
Cr	⩽ 23,0	± 0,20
Cu	⩽ 0,75 > 0,75 ⩽ 2,00	+ 0,05 ± 0,07
Mo	⩽ 3,00 > 3,00 ⩽ 5,00	± 0,08 ± 0,10
N	⩽ 0,22	± 0,01
Nb	⩽ 1,20	± 0,05
Ni	⩽ 20,00 > 20,00 ⩽ 35,00	± 0,15 ± 0,20
Ti	⩽ 0,80	± 0,05

1) The deviations, other than when maxima only are specified, apply either above or below the specified limits of the range but not both above and below for the same element from different sample products from the same cast. When maxima only are specified the deviations are positive only. The values are valid only if the samples were selected according to clause A.6 of ISO 9328-1.