

INTERNATIONAL STANDARD

ISO
9328-2

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

Part 2:

Unalloyed and low-alloyed steels with specified
room temperature and elevated temperature
properties

[ISO 9328-2:1991](#)

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Tôles et bandes en acier pour service sous pression — Conditions techniques de livraison —

Partie 2: Aciers non alliés et faiblement alliés à propriétés spécifiées à températures ambiante et élevée



Reference number
ISO 9328-2:1991(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 9328-2 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 2:

Unalloyed and low-alloyed steels with specified room temperature and elevated temperature properties

1 Scope

1.1 This part of ISO 9328 applies to plates of 3 mm to 150 mm thickness (partly up to 300 mm) and strip of thickness greater than or equal to 3 mm, manufactured of the steels covered in table 1 and to be delivered according to the specifications given in ISO 9328-1.

The unalloyed steels are classified into

- room temperature grades (P xxx-grades); and
- elevated temperature grades (PH xxx-grades).

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 properties at room temperature,
 - the impact properties at room temperature or at 0 °C,
 - indications on the usual heat-treatment conditions 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;

e) in table 5 the estimated average stresses for 1 % strain.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this part of ISO 9328. At the time of publication, the edition indicated was 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 edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

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 5.

6 Inspection, testing and conformity of products

See ISO 9328-1.

7 Marking

See ISO 9328-1.

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Table 1 — Chemical composition (cast analysis), room temperature mechanical properties and heat-treatment conditions of unalloyed and low-alloyed steels with specified room temperature and elevated temperature properties

Line No.	Steel type designation ¹⁾	Chemical composition [% (m/m)] ²⁾								
		C	Si	Mn	P max.	S max.	Al _{total}	Cr	Mo	Others
1	P 235 PH 235	<0,17	<0,35	0,40 to 1,20	0,035	0,030	>0,020	<0,30	<0,08	Cu <0,30 Ni <0,30 5)
2	P 265 PH 265	<0,20	<0,35	0,50 to 1,40	0,035	0,030	≥0,020	<0,30	≤0,08	Cu <0,30 Ni <0,30 5)
3	P 290	<0,20	<0,40	0,90 to 1,50	0,035	0,030	>0,020	<0,30	<0,08	Cu <0,30 Ni <0,30 5)
	PH 290	0,14 to 0,20								
4	P 315	<0,20	0,10 to 0,50	0,90 to 1,60	0,035	0,030	>0,020	<0,30	<0,08	Cu <0,30 Ni <0,30 5)
	PH 315	0,15 to 0,20								
5	P 355	<0,22	0,10 to 0,50	0,90 to 1,60	0,035	0,030	>0,020	<0,30	<0,08	Cu <0,30 Ni <0,30 5)
	PH 355	0,15 to 0,22								
6	16 Mo 3	0,12 to 0,20	<0,35	0,40 to 0,90	0,035	0,030	7)	<0,30	0,25 to 0,35	Cu <0,30
7	14 CrMo 4 5	0,08 to 0,18	<0,35	0,40 to 1,00	0,035	0,030	7)	0,70 to 1,15	0,40 to 0,60	Cu <0,30
8	13 CrMo 9 10 T1	0,08 to 0,15 6)	<0,50	0,40 to 0,70	0,035	0,030	7)	2,00 to 2,50	0,90 to 1,10	Cu <0,30

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Mechanical properties at room temperature ³⁾					Elevated temperature properties		Heat treatment					
Thickness mm	R_e min. N/mm ²	R_m N/mm ²	A min. %	KV min. at		R_p See table	Creep properties See table	Usual reference heat-treatment conditions				
				J	°C			Symbol ⁴⁾	Austenitizing or solution temperature °C	Cooling in	Tempering °C	Cooling in
> 3 < 16	235	360 to 480	25	27	0	3 ⁶⁾	4 + 5 ⁶⁾	N	890 to 950	Air	—	—
> 16 < 40	225		25									
> 40 < 60	215		25									
> 60 < 100	200		24									
> 100 < 150	185	350 to 480	24									
≥ 3 < 16	265	410 to 530	24	27	0	3 ⁶⁾	4 + 5 ⁶⁾	N	890 to 950	Air	—	—
> 16 < 40	255		24									
> 40 < 60	245		23									
> 60 < 100	215		22									
> 100 < 150	200	400 to 530	22									
> 3 < 16	290	460 to 580	22	27	0	3 ⁶⁾	4 + 5 ⁶⁾	N	890 to 950	Air	—	—
> 16 < 40	285		22									
> 40 < 60	280		22									
> 60 < 100	255		21									
> 100 < 150	230	440 to 570	21									
> 3 < 16	315	490 to 610	21	27	0	3 ⁶⁾	4 + 5 ⁶⁾	N	890 to 950	Air	—	—
> 16 < 40	310		21									
> 40 < 60	305		21									
> 60 < 100	280		20									
> 100 < 150	255	470 to 600	20									
> 3 < 16	355	510 to 650	21	27	0	3 ⁶⁾	4 + 5 ⁶⁾	N	890 to 950	Air	—	—
> 16 < 40	345		21									
> 40 < 60	335		21									
> 60 < 100	315		20									
> 100 < 150	295	490 to 640	20									
> 3 < 16	280	450 to 600	24	31	20	3	4 + 5	N(+T)	890 to 950	Air	(600 to 650)	(Air)
> 16 < 40	270		24									
> 40 < 60	260		23									
> 60 < 100	240		22									
> 100 < 150	220	430 to 580	22	27	20							
> 100 < 150	220	420 to 570	19									
≥ 3 < 16	300	450 to 600	20	31	20	3	4 + 5	N+T	890 to 950	Air	630 to 730	Air
> 16 < 40	300		20									
> 40 < 60	300		19									
> 60 < 100	275		18									
> 100 < 150	255	440 to 590	18	27	20							
> 100 < 150	255	430 to 580	18									
≥ 3 < 16	275	480 to 620	18	31	20	3	4 + 5	N+T	920 to 980	Air	680 to 750	Air
> 16 < 40	265		18									
> 40 < 60	265		18									
> 60 < 100	260		17									
> 100 < 150	250	470 to 620	17	27	20							
> 100 < 150	250	460 to 610	16									
> 150 < 300	240	450 to 600	16									
≥ 3 < 16	310	520 to 670	18	31	20	3	—	N+T	920 to 980	Air ⁹⁾	700 to 770	Air
> 16 < 40			18									
> 40 < 60			17									
> 60 < 100			17									
> 60 < 100	17		27	20								

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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_e : yield 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 : impact strength of ISO V-notch test pieces.
- 4) N: normalized,
N(+T): normalized and, if appropriate, tempered.
- 5) The sum of percentages of Cr + Cu + Mo + Ni shall not exceed 0,70 % (m/m).
- 6) Not applicable for the room temperature grades (P xxx).
- 7) Although the aluminium content is not specified it shall be given in the document.
- 8) For thicknesses under 6 mm the lower limit may by agreement be reduced to 0,06 % (m/m) C; for thicknesses over 150 mm the upper limit may by agreement be increased to 0,17 % (m/m) C.
- 9) Accelerated cooling is permitted.

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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	Permissible deviation ¹⁾
	% (m/m)	% (m/m)
C	≤ 0,22	± 0,03
Si	≤ 0,50	± 0,05
Mn	≤ 1,60	± 0,10
P	≤ 0,035	+ 0,005
S	≤ 0,030	+ 0,005
Al	≥ 0,020	− 0,005
Cr	≤ 2,50	± 0,10
Mo	≤ 0,35 > 0,35 ≤ 1,10	± 0,04 ± 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 element 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.

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