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

Part 3:  
**Weldable fine grain steels, normalized**

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**  
*Produits plats en acier pour service sous pression — Conditions  
techniques de livraison —  
Partie 3: Aciers soudables à grains fins, normalisés*

ISO 9328-3:2011

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# Contents

Page

Foreword .....	iv
<b>1</b> <b>Scope</b> .....	<b>1</b>
<b>2</b> <b>Normative references</b> .....	<b>1</b>
<b>3</b> <b>Terms and definitions</b> .....	<b>1</b>
<b>4</b> <b>Classification and designation</b> .....	<b>2</b>
4.1 <b>Classification</b> .....	2
4.2 <b>Designation</b> .....	2
<b>5</b> <b>Information to be supplied by the purchaser</b> .....	<b>2</b>
5.1 <b>Mandatory information</b> .....	2
5.2 <b>Options</b> .....	2
5.3 <b>Example for ordering</b> .....	3
<b>6</b> <b>Requirements</b> .....	<b>3</b>
6.1 <b>Steelmaking process</b> .....	3
6.2 <b>Delivery condition</b> .....	3
6.3 <b>Chemical composition</b> .....	4
6.4 <b>Mechanical properties</b> .....	5
6.5 <b>Surface condition</b> .....	5
6.6 <b>Internal soundness</b> .....	5
6.7 <b>Weldability</b> .....	5
6.8 <b>Dimensions and tolerances</b> .....	5
6.9 <b>Calculation of mass</b> .....	6
6.10 <b>Resistance to hydrogen-induced cracking</b> .....	6
<b>7</b> <b>Inspection</b> .....	<b>6</b>
7.1 <b>Types of inspection and inspection documents</b> .....	6
7.2 <b>Tests to be carried out</b> .....	6
7.3 <b>Retests</b> .....	6
<b>8</b> <b>Sampling</b> .....	<b>6</b>
<b>9</b> <b>Test methods</b> .....	<b>6</b>
<b>10</b> <b>Marking</b> .....	<b>6</b>
<b>Annex A</b> (normative) <b>Chemical composition and mechanical properties of products delivered in accordance with European design codes</b> .....	<b>7</b>
<b>Annex B</b> (normative) <b>Chemical composition and mechanical properties of products delivered in accordance with ASME-type design codes</b> .....	<b>12</b>
<b>Annex C</b> (informative) <b>Steel designations in accordance with this part of ISO 9328 and designation of comparable steel grades in national or regional standards</b> .....	<b>16</b>
<b>Annex D</b> (normative) <b>Evaluation of resistance to hydrogen-induced cracking</b> .....	<b>17</b>
<b>Bibliography</b> .....	<b>18</b>

## 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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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.

ISO 9328-3 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 10, *Steel for pressure purposes*.

This third edition cancels and replaces the second edition (ISO 9328-3:2004), of which it constitutes a minor revision.

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

- iTeh STANDARD PREVIEW**  
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- <https://standards.iteh.ai/catalog/standards/sist/253f03bd-6b1e-4b0a-982b-d77de00e4170/iso-9328-3-2011>
- *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*

The clauses marked with a point (●) contain information relating to agreements that shall be made at the time of enquiry and order. Clauses and paragraphs marked by two points (●●) contain information relating to agreements that may be made at the time of enquiry and order.

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

## Part 3: Weldable fine grain steels, normalized

### 1 Scope

This part of ISO 9328 specifies the requirements for flat products for pressure equipment made of weldable fine grain steels as specified in Tables A.1 and B.1. The requirements and definitions of ISO 9328-1 also apply to this part of ISO 9328.

NOTE 1 Fine grain steels are understood as steels with a ferritic grain size of 6 or finer when tested in accordance with ISO 643.

NOTE 2 This part of ISO 9328 offers the possibility to specifying products in accordance with European design codes and ASME-type design codes.

### 2 Normative references

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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.

ISO 4948-1:1982, *Steels — Classification — Part 1: Classification of steels into unalloyed and alloy steels based on chemical composition*

ISO 4948-2:1981, *Steels — Classification — Part 2: Classification of unalloyed and alloy steels according to main quality classes and main property or application characteristics*

ISO 9328-1:2011, *Steel flat products for pressure purposes — Technical delivery conditions — Part 1: General requirements*

ISO 10474:1991, *Steel and steel products — Inspection documents*

EN 10229:1998, *Evaluation of resistance of steel products to hydrogen induced cracking (HIC)*

EN 10314, *Method for the derivation of minimum values of proof strength of steel at elevated temperatures*

### 3 Terms and definitions

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

## 4 Classification and designation

### 4.1 Classification

4.1.1 The steel grades covered by this part of ISO 9328 are given in four qualities:

- a) the room temperature quality (P...N; PT...N);
- b) the elevated temperature quality (P...NH; PT...NH);
- c) the low temperature quality (P...NL1; PT...NL1);
- d) the special low temperature quality (P...NL2).

4.1.2 In accordance with ISO 4948-1 and ISO 4948-2, the grades P275NH, P275NL1, P355N, P355NH, P355NL1, PT400N, PT400NH, PT400NL1, PT440N, PT440NH, PT440NL1, PT490N and PT490NH are alloy-quality steels, the grades P275NL2 and P355NL2 are non-alloy special steels and the grades P460NH, P460NL1, P460NL2, PT520N and PT520NH are alloyed special steels.

### 4.2 Designation

See ISO 9328-1.

NOTE 1 Steel grades in Annex A are classified according to their yield strength; steel grades in Annex B are classified according to their tensile strength.

NOTE 2 Information on the designation of comparable steel grades in national or regional standards is given in Annex C.

## 5 Information to be supplied by the purchaser

### 5.1 Mandatory information

See ISO 9328-1.

Additionally, for steel grades in accordance with Annex B, the test direction for the impact test shall be agreed upon (see 9.2 and Table B.4, footnote b).

### 5.2 Options

A number of options are specified in this part of ISO 9328. These are listed below under a) to q). Additionally, the relevant options of ISO 9328-1 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 ISO 9328-1):

- a) delivery condition other than specified in Tables A.3 and B.3 (see 6.2.1);
- b) tests in the simulated normalized condition (see 6.2.2);
- c) delivery of products in the untreated condition (see 6.2.3);
- d) maximum carbon-equivalent value (see 6.3.3);
- e) specification of an impact energy value of 40 J (see Note to 6.4.1 and Table A.3);
- f) application of the  $R_{p0,2}$  values of Table A.4 for the corresponding P...NL1 and P...NL2 grades (see 6.4.2);

- g) test on simulated heat-treated samples (see 6.7.2);
- h) hydrogen-induced cracking (HIC) test in accordance with Annex D (see 6.10);
- i) mid-thickness test pieces for the impact test and/or tensile test (see Clause 8);
- j) verification of impact energy for longitudinal test pieces (see 9.3);
- k) tensile properties for increased product thicknesses (see Table A.3, footnote d);
- l)  $R_{p0,2}$  values at elevated temperatures for increased product thicknesses (see Table A.4, footnote c);
- m) modified values for  $R_{eH}$  and  $R_m$  for grades P460NH and P460NL1 (see Table A.3, footnote f);
- n) altered maximum value for Cr, Cu, Mo, Nb, Ni, Ti and V (see Table B.1, footnote b);
- o)  $Al_{total}$  content < 0,020 % (see Table B.1, footnote c);
- p) increased maximum carbon contents for grades PT...NH (see Table B.1, footnote d)
- q) other test requirements for the impact test (see Table B.4, footnote c).

### 5.3 Example for ordering

10 plates with nominal dimensions thickness = 50 mm, width = 2 000 mm, length = 10 000 mm, made of a steel grade with the name P275NL2 as specified in ISO 9328-3, to be delivered with inspection certificate 3.1.B as specified in ISO 10474:1991 is designated as follows:

**10 plates — 50 × 2 000 × 10 000 — ISO 9328-3 P275NL2 — Inspection certificate 3.1.B**

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## 6 Requirements

### 6.1 Steelmaking process

See ISO 9328-1.

### 6.2 Delivery condition

**6.2.1** •• Unless otherwise agreed at the time of enquiry and order (see 6.2.3), the products covered by this part of ISO 9328 shall be supplied in the normalized condition.

For steels with a minimum yield strength  $\geq 460$  MPa, delayed cooling or additional tempering may be necessary for small product thicknesses and in special cases. If such a treatment is performed, this shall be noted in the inspection document.

**6.2.2** •• At the discretion of the manufacturer, normalizing may be replaced with normalizing rolling for the steel grades P275NH, P275NL1, P275NL2, P355N, P355NH, P355NL1 and P355NL2 (see Annex A and 3.1 in ISO 9328-1:2011). In this case, additional tests in the simulated normalized condition with an agreed frequency of testing may be agreed upon at the time of enquiry and order, to verify that the obtained properties also comply with the standard requirements.

**6.2.3** •• If so agreed at the time of enquiry and order, products covered by this part of ISO 9328 may be delivered in the untreated condition.

**6.2.4** For products delivered untreated, the specified tests shall be carried out on test pieces in the simulated normalized condition (but see 6.2.1).

NOTE Tests in a simulated heat-treated condition are carried out to verify the suitability of the final product in the usual delivery condition. However, they do not discharge the processor from the obligation of providing proof of the specified properties in the finished product when adequately heat treated.

**6.3 Chemical composition**

**6.3.1** The requirements of Tables A.1 and B.1 apply for the chemical composition according to the cast (heat) analysis.

**6.3.2** The product analysis may deviate from the specified values of the cast (heat) analysis given in Tables A.1 and B.1 by the values given in Table 1.

**6.3.3** •• For steel grades covered by this part of ISO 9328, a carbon-equivalent value according to Table A.2 (steel grades in Annex A) or Table B.2 (steel grades in Annex B) may be agreed upon at the time of enquiry and order.

**Table 1 — Permissible deviations of the product analysis from the specified limits given in Tables A.1 and B.1 for the cast (heat) analysis**

Element	Specified limit of the cast (heat) analysis according to Tables A.1 and B.1	Permissible deviation <sup>a</sup> of the product analysis
	% by mass	% by mass
C <sup>b</sup>	≤ 0,20	+0,02
Si	≤ 0,60	+0,06
Mn	≤ 1,00	±0,05
	> 1,00 to ≤ 1,70	±0,10
P <sup>b</sup>	≤ 0,030	+0,005
S <sup>b</sup>	≤ 0,010	+0,003
	> 0,010 to ≤ 0,030	+0,005
Al	≥ 0,020	-0,005
N	≤ 0,025	+0,002
Cr	≤ 0,30	+0,05
Mo	≤ 0,12	+0,03
Cu	≤ 0,30	+0,05
	> 0,30 to ≤ 0,70	+0,10
Nb	≤ 0,05	+0,01
Ni	≤ 0,80	+0,05
Ti	≤ 0,03	+0,01
V	≤ 0,20	+0,01

<sup>a</sup> If several product analyses are carried out on one cast, and the contents of an individual element, as determined, lie outside the permissible range of the chemical composition specified for the cast analysis, then it is only allowed to exceed the permissible maximum value or fall short of the permissible minimum value, but not both for one cast.

<sup>b</sup> In the case of the steel grades specified in Annex B, the maximum values listed in Table B.1 also apply for the product analysis.



## 6.4 Mechanical properties

**6.4.1** The values given in Tables A.3 to A.5 and Tables B.3 and B.4 (see also ISO 9328-1 and Clause 8) shall apply.

NOTE Optionally, a minimum impact energy value of 40 J can be specified for temperatures where lower minimum values are specified (see Table A.5, footnote d)

**6.4.2** ●● By agreement at the time of enquiry and order, the minimum proof strength  $R_{p0,2}$  values at elevated temperature specified in Table A.4 for the P...NH grades may also be applied to the P...NL1 and P...NL2 grades.

## 6.5 Surface condition

See ISO 9328-1.

## 6.6 Internal soundness

See ISO 9328-1.

## 6.7 Weldability

**6.7.1** The steel grades specified in this part of ISO 9328 shall be suitable for welding processes in current use (see the Note to 6.7.2).

**6.7.2** Information on welding can be found in appropriate documents, e.g. EN 1011-1 and EN 1011-2 or IIS/IIW 382-71.

NOTE Excessive post-weld heat treatment (PWHT) conditions can decrease the mechanical properties. When, on stress relieving, the intended time-temperature parameter

$$P = T_s(20 + \lg t) \times 10^{-3}$$

where

$T_s$  is the stress relieving temperature, in kelvins;

$t$  is the holding time in hours,

exceeds (for Annex A steel grades) the critical value  $P_{crit}$  of

- 17,3 for all steel grades except P460NH, P460NL1 and P460NL2,
- 16,7 in the case of steel grade P460NH, and
- 16,3 in the case of steel grades P460NL1 and P460NL2,

(for Annex B grades, other specific values may apply), the purchaser should, in his enquiry and order, inform the manufacturer accordingly.

●● Where appropriate, tests on simulated post-weld heat-treated samples may be agreed upon at the time of enquiry and order to check whether, after such a treatment, the properties specified in this part of ISO 9328 can still be regarded as valid.

## 6.8 Dimensions and tolerances

See ISO 9328-1.

## 6.9 Calculation of mass

See ISO 9328-1.

## 6.10 Resistance to hydrogen-induced cracking

Carbon and low-alloy steels may be susceptible to cracking when exposed to corrosive H<sub>2</sub>S-containing environments, usually referred to as “sour service”.

•• A test to evaluate the resistance to hydrogen-induced (HIC) cracking in accordance with Annex D or another agreed test method may be agreed upon at the time of enquiry and order.

## 7 Inspection

### 7.1 Types of inspection and inspection documents

See ISO 9328-1.

### 7.2 Tests to be carried out

See ISO 9328-1 and 6.10.

### 7.3 Retests

See ISO 9328-1.

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## 8 Sampling

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See ISO 9328-1.

•• For the impact test and/or tensile test, deviating from ISO 9328-1:2011, Table 3, footnote e, by preparing test pieces taken from the mid-thickness may be agreed upon at the time of enquiry and order. In this case, test temperatures and minimum impact energy values shall also be agreed upon.

## 9 Test methods

9.1 See ISO 9328-1 and Annex D.

9.2 • Impact tests for verification of impact energy values in Tables A.5 and B.4 shall be carried out on transverse test pieces (for steel grades in accordance with Annex A, but see 9.3) or on test pieces as specified in the order (for steel grades in accordance with Annex B; see Table B.4, footnote b).

9.3 •• For the impact test, verification of impact energy for longitudinal test pieces may be agreed upon at the time of enquiry and order for steel grades in accordance with Annex A.

## 10 Marking

See ISO 9328-1.

**Annex A**  
(normative)

**Chemical composition and mechanical properties of products delivered  
in accordance with European design codes**

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