INTERNATIONAL STANDARD

ISO 9328-3

Fourth edition
2018-02

Steel flat products for pressure purposes — Technical delivery conditions —

Part 3: Weldable fine grain steels, normalized

Produits plats en acier pour service sous pression — Conditions techniques de livraison —
Partie 3: Aciers soudables à grains fins, normalisés

Reference number
ISO 9328-3:2018(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Published in Switzerland

Contents

Page

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 10, *Steel for pressure purposes*.

This fourth edition cancels and replaces the third edition (ISO 9328-3:2011), which has been technically revised. The following changes have been made:

— the term “product thickness” has been replaced with “nominal thickness”;

— classification of the steels, examples of ordering and statements concerning weldability have been revised;

— the technical data in Annex A have been aligned with EN 10028-3.

— in Table B.1, “B ≤ 0,001 0” has been added and the specifications of “P” and “S” have been changed.

A list of all the parts in the ISO 9328 series can be found on the ISO website.

Steel flat products for pressure purposes — Technical delivery conditions —

Part 3: Weldable fine grain steels, normalized

1 Scope

This document 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 document.

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 document offers the possibility to specifying products in accordance with European design codes and ASME-type design codes.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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, *Steels — Classification — Part 1: Classification of steels into unalloyed and alloy steels based on chemical composition*

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

ISO 9328-1:2018, *Steel flat products for pressure purposes — Technical delivery conditions — Part 1: General requirements*

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.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

4 Classification and designation

4.1 Classification

4.1.1 The steel grades covered by this document 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, P355NL2, PT400N, PT400NH, PT400NL1, PT440N, PT440NH, PT440NL1, PT490N and PT490NH are alloy-quality steels, the grades P275NL2 and the grades P420NH, P420NL1, P420NL2, P460NH, P460NL1, P460NL2, PT520N and PT520NH are alloyed special steels.

4.2 Designation

Shall be in accordance with ISO 9328-1.

NOTE 1 Steel grades in Annex A are classified in accordance with their yield strength; steel grades in Annex B are classified in accordance with 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

Shall be in accordance with 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 document. These are listed below under a) to r). 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 nominal thicknesses (see Table A.3, footnote [d]);

l) $R_{p0,2}$ values at elevated temperatures for increased nominal 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]);

o) altered maximum value for Cr, Cu, Mo, Nb, Ni, Ti and V (see Table B.1, footnote [b]);

p) Al_{total} content < 0,020 % (see Table B.1, footnote [c]);

q) increased maximum carbon contents for grades PT...NH (see Table B.1, footnote [d]);

r) other test requirements for the impact test (see Table B.4, footnote [c]).

5.3 Example for ordering

An order of 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 this document, to be delivered with inspection certificate 3.1 as specified in ISO 10474, is designated as follows:

10 plates – 50 × 2 000 × 10 000 – ISO 9328-3 P275NL2 – Inspection certificate 3.1

6 Requirements

6.1 Steelmaking process

Shall be in accordance with 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 document shall be supplied in the normalized condition.

For steels with minimum yield strength ≥ 460 MPa, delayed cooling or additional tempering is permitted. 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 in Annex A (see ISO 9328-1:2018, 3.1). 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 (see 5.2, Option 2).

6.2.3 If so agreed at the time of enquiry and order, products covered by this document may be delivered in the untreated condition. The products delivered in untreated conditions shall be appropriately marked (+AR) to denote that heat treatment has not been performed.

6.2.4 For products delivered untreated, the specified tests shall be carried out by the manufacture 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 document, 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 % by mass	Permissible deviation[a] of the product analysis % by mass
C[b]	≤ 0,20	+0,02
Si	≤ 0,60	+0,06
Mn	≤ 1,00	±0,05
	> 1,00 to ≤ 1,70	±0,10
P[b]	≤ 0,030	+0,005
S[b]	≤ 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
B	≤ 0,001 0	+0,000 5
V	≤ 0,20	+0,01

[a] 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.

[b] 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).

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

Shall be in accordance with ISO 9328-1.

6.6 Internal soundness

Shall be in accordance with ISO 9328-1.

6.7 Weldability

6.7.1 The steel grades specified in this document 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.

Excessive post-weld heat treatment (PWHT) conditions can decrease the mechanical properties. When, on stress relieving, the intended time-temperature parameter shown by Formula (1):

$$P = T_S\left(20 + \lg t\right) \times 10^{-3} \tag{1}$$

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 P420NH, P420NL1, P420NL2, P460NH, P460NL1 and P460NL2,

— 16,7 in the case of steel grade P420NH, P460NH, and

— 16,3 in the case of steel grades P420NL1, P420NL2, 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 document can still be regarded as valid (see 5.2, Option 7).

6.8 Dimensions and tolerances

Shall be in accordance with ISO 9328-1.

6.9 Calculation of mass

Shall be in accordance with ISO 9328-1.

6.10 Resistance to hydrogen-induced cracking

Since carbon and low-alloy steels may be susceptible to cracking when exposed to corrosive H2S-containing environments, usually referred to as “sour service”, a test to evaluate the resistance to hydrogen-induced cracking in accordance with Annex D or another test method may be agreed at the time of enquiry and order.

7 Inspection

7.1 Types of inspection and inspection documents

Shall be in accordance with ISO 9328-1.

7.2 Tests to be carried out

Shall be in accordance with ISO 9328-1 and 6.10.

7.3 Retests, sorting and reprocessing

Shall be in accordance with ISO 9328-1.

8 Sampling

Shall be in accordance with ISO 9328-1.

For an impact test (and/or the tensile test), that deviates from ISO 9328-1:2018, Table 3, footnote [e], 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 Shall be in accordance with 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

Shall be in accordance with ISO 9328-1.

Annex A
(normative)

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