INTERNATIONAL STANDARD

ISO 9328-6

First edition
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Steel flat products for pressure purposes — Technical delivery conditions —

Part 6: Weldable fine grain steels, quenched and tempered

Produits plats en acier pour service sous pression — Conditions techniques de livraison —

Partie 6: Aciers soudables à grains fins, trempés et revenus

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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.

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 9328-6 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 10, *Steel for pressure purposes*.

This first edition, together with ISO 9328-3, cancels and replaces ISO 9328-4:1991, which has been technically revised and separated into two parts.

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

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

Introduction

In comparison with its first edition (ISO 9328-4:1991), this part of ISO 9328 takes into consideration partly deviating and additional requirements, thus offering the possibility to specify products in accordance with European design codes and ASME type design codes.

Main further alterations are: specification of additional grades, partly decreased maximum phosphorous and sulfur contents, partly increased minimum impact values, information on processing.

Steel flat products for pressure purposes — Technical delivery conditions —

Part 6:
Weldable fine grain steels, quenched and tempered

1 Scope

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

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

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.

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 9328-1:2003, *Steel plates and strips for pressure purposes — Technical delivery conditions — Part 1: General requirements*

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

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

In accordance with ISO 4948-1 and ISO 4948-2, all steel grades covered by this part of ISO 9328 are alloyed special steels.

4.2 Designation

See ISO 9328-1.

This part of ISO 9328 covers the steel grades specified in Annexes A and B in four series:

a) basic series (P...Q; PT…Q);

b) series with elevated temperature properties (P...QH, PT…QH);

c) series with low temperature properties down to – 40 °C (P...QL1);

d) series with low temperature properties down to – 60 °C (P...QL2, PT…QL2);

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 Clause 9 and Table B.3, footnote a).

5.2 Options

A number of options is specified in this part of ISO 9328. These are listed below under a) to h). 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) carbon equivalent value (see 6.3.3);

b) tensile properties at elevated temperatures for steel grades PT…QH (see 6.4);

c) lower copper content and maximum tin content (see Table A.1, footnote c);

d) mechanical properties for thicknesses > 150 mm (see Table A.2, footnote b);

e) applicability of elevated temperature values for QL grades (see Table A.4, footnote b);

f) increased maximum carbon content for the grade PT520Q (see Table B.1, footnote c);

g) increased maximum carbon content for the grade PT550QL2 (see Table B.1, footnote d);

h) other test requirements for the impact test (see Table B.3, footnote b).

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 P355QL2 as specified in ISO 9328-6, inspection document 3.1.B as specified in ISO 10474:1991 is designated as follows:

10 plates – 50 × 2 000 × 10 000 – ISO 9328-6 P355QL2 – Inspection document 3.1.B

6 Requirements

6.1 Steelmaking process

See ISO 9328-1.

6.2 Delivery condition

The products complying with this part of ISO 9328 are supplied in the quenched and tempered condition.

6.3 Chemical composition

6.3.1 The data in Tables A.1 and B.1 apply for the chemical composition according to the cast analysis.

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

6.3.3 •• For the steel grades covered by this part of ISO 9328, a carbon equivalent value (CEV) may be specified at the time of enquiry and order. This shall be based on the formula:

$$CEV = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

6.4 Mechanical properties

The values given in Tables A.2 to A.4 and B.2 to B.3 apply (see also ISO 9328-1).

•• Additionally, for PT…QH steels (see Annex B), tensile properties at elevated temperatures may be agreed upon at the time of enquiry and order.

6.5 Surface condition

See ISO 9328-1.

6.6 Internal soundness

See ISO 9328-1.

6.7 Weldability

6.7.1 The steels specified in this part of ISO 9328 shall be suitable for welding processes in current use (see NOTE to 6.7.2).

6.7.2 The manufacturer shall, if requested, provide the purchaser with data on suitable welding conditions determined on the basis of weld procedure tests.

With increasing product thickness and strength level, cold cracking can occur. Cold cracking is caused by the following factors in combination:

— the amount of diffusible hydrogen in the weld metal;

— brittle structure of the heat-affected zone;

— tensile stress concentrations in the welded joint.

When using recommendations as laid down in appropriate documents, e.g., EN 1011-1 and EN 1011-2 or IIS/IIW-382-71, the recommended welding conditions and the various welding ranges of the steel grades can be determined depending on the product thickness, the applied welding energy, the design requirements, the electrode efficiency, the welding process and the weld metal properties.

NOTE Excessive post-weld heat treatment (PWHT) conditions may decrease the mechanical properties. The purchaser should, in his enquiry and order, inform the manufacturer accordingly and, where appropriate, tests on simulated post-weld heat-treated samples may be agreed upon in order to check whether after such a treatment the properties specified in this part of ISO 9328 can still be regarded as valid.

Table 1 — Permissible deviations of the chemical composition in the results of the product analysis from the specified values applicable to the cast analysis

Element	Specified value in the cast analysis according to Tables A.1 and B.1 % by mass	Permissible deviation[a] of the product analysis % by mass
C	⩽ 0,24	+ 0,02
Si	⩽ 0,80	+ 0,05
Mn	⩽ 1,70	+ 0,10
P	⩽ 0,030	+ 0,005
S	⩽ 0,015	+ 0,003
	> 0,015 to ⩽ 0,030	+ 0,005
Al	⩽ 0,020	− 0,005
B	⩽ 0,005	+ 0,000 5
N	⩽ 0,020	+ 0,002
Cr	⩽ 1,50	+ 0,10
Cu	⩽ 0,40	+ 0,05
Mo	⩽ 0,70	+ 0,04
Nb	⩽ 0,06	+ 0,01
Ni	⩽ 2,50	+ 0,10
Ti	⩽ 0,05	+ 0,01
V	⩽ 0,12	+ 0,01
Zr	⩽ 0,15	+ 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 allowed either to exceed the permissible maximum value or to fall short of the permissible minimum value, but not both for one cast.

6.8 Dimensions and tolerances

See ISO 9328-1.

6.9 Calculation of mass

See ISO 9328-1.

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.

7.3 Retests

See ISO 9328-1.

8 Sampling

See ISO 9328-1.

•• For the impact test, deviating from ISO 9328-1:2003, Table 3, footnote c, the preparation of 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

See ISO 9328-1.

• Impact tests for verification of impact energy values in Tables A.4 and B.4 shall be carried out on transverse test pieces (steel grades in accordance with Annex A) or on test pieces specified in the order (steel grades in accordance with Annex B, see Table B.3 footnote b).

10 Marking

See ISO 9328-1.