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

**Part 1:  
General requirements**

**iTeh STANDARD PREVIEW**  
*Produits plats en acier pour service sous pression — Conditions  
techniques de livraison —  
Partie 1: Exigences générales*  
**(standards.iteh.ai)**

ISO 9328-1:2011

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## 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 9328-1 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 9328-1:2003), which has been technically revised.

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*

The clauses marked with a point (•) contain information relating to agreements which are to 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.

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

## Part 1: General requirements

### 1 Scope

This part of ISO 9328 specifies the general technical delivery conditions for steel flat products (plate/sheet and strip) used principally for the construction of pressure equipment.

The general technical delivery requirements in ISO 404 also apply to products supplied in accordance with this part of ISO 9328.

### 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 amendment) applies.

EN 10204:2004, *Metallic products — Types of inspection documents*

ISO 148-1:2009, *Metallic materials — Charpy pendulum impact test — Part 1: Test method*

ISO 377:1997 *Steel and steel products — Location and preparation of samples and test pieces for mechanical testing*

ISO 404:1992, *Steel and steel products — General technical delivery requirements*

ISO 2566-1:1984, *Steel — Conversion of elongation values — Part 1: Carbon and low alloy steels*

ISO 2566-2:1984, *Steel — Conversion of elongation values — Part 2: Austenitic steels*

ISO 3651-2:1998, *Determination of resistance to intergranular corrosion of stainless steels — Part 2: Ferritic, austenitic and ferritic-austenitic (duplex) stainless steels — Corrosion test in media containing sulfuric acid*

ISO 4885:1996, *Ferrous products — Heat treatments — Vocabulary*

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/TS 4949, *Steel names based on letter symbols*

ISO 6892-1:2009, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

ISO 6892-2:2011, *Metallic materials — Tensile testing — Part 2: Method of test at elevated temperature*

ISO 6929:1987, *Steel products — Definitions and classification*

ISO 7452:2002, *Hot-rolled structural steel plates — Tolerances on dimensions and shape*

ISO 7778:1983, *Steel plate with specified through-thickness characteristics*

ISO 7788:1985, *Steel — Surface finish of hot-rolled plates and wide flats — Delivery requirements*

ISO 9034:1987, *Hot-rolled structural steel wide flats — Tolerances on dimensions and shape*

ISO 9328-2, *Steel flat products for pressure purposes — Technical delivery conditions — Part 2: Non-alloy and alloy steels with specified elevated temperature properties*

ISO 9328-3, *Steel flat products for pressure purposes — Technical delivery conditions — Part 3: Weldable fine grain steels, normalized*

ISO 9328-4, *Steel flat products for pressure purposes — Technical delivery conditions — Part 4: Nickel-alloy steels with specified low temperature properties*

ISO 9328-5, *Steel flat products for pressure purposes — Technical delivery conditions — Part 5: Weldable fine grain steels, thermomechanically rolled*

ISO 9328-6, *Steel flat products for pressure purposes — Technical delivery conditions — Part 6: Weldable fine grain steels, quenched and tempered*

ISO 9328-7:2011, *Steel flat products for pressure purposes — Technical delivery conditions — Part 7: Stainless steels*

ISO 9444:2009 (all parts), *Continuously hot-rolled stainless steel — Tolerances on dimensions and form*

ISO 9445:2009 (all parts), *Continuously cold-rolled stainless steel — Tolerances on dimensions and form*

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

ISO 14284:1996, *Steel and iron — Sampling and preparation of samples for the determination of chemical composition*

ISO 15510:2010, *Stainless steels — Chemical composition*

ISO 18286, *Hot-rolled stainless steel plates — Tolerances on dimensions and shape*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4885, ISO 4948-1, ISO 4948-2 and ISO 6929, as well as the following, apply.

In addition to the definitions for thermomechanical treatment and quenching and tempering in ISO 4885, the following should be noted.

- a) Thermomechanical rolling (symbol M) may include processes of increased cooling rates with or without tempering, including self-tempering but definitively excluding direct quenching and tempering.
- b) Quenching and tempering (symbol QT) also includes direct quenching plus tempering.

NOTE In international publications, for both normalizing and thermomechanical rolling, the expression “controlled rolling” can be found. However, in view of the different applications of the products, it is necessary to make a distinction between the terms.

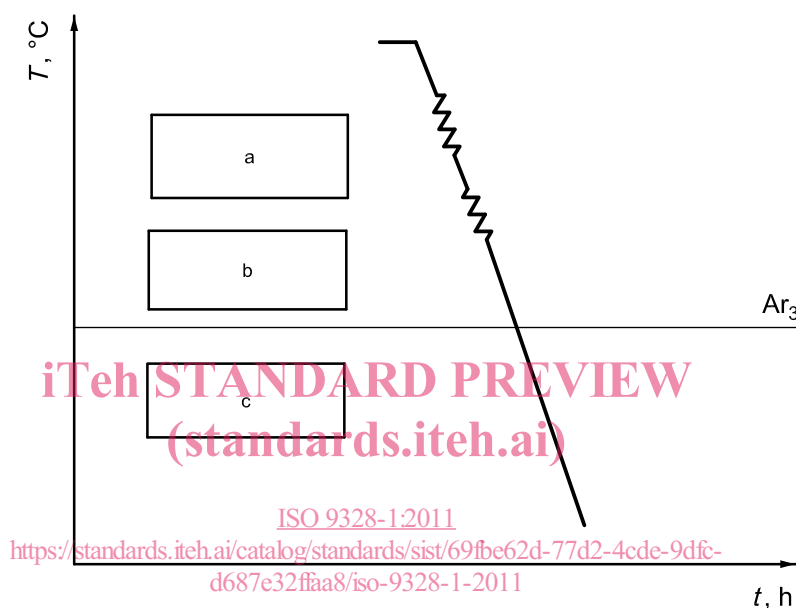
### 3.1

#### normalizing rolling

rolling process in which the final deformation process is carried out in a certain temperature range, leading to a material condition equivalent to that obtained after normalizing so that the specified values of the mechanical properties are retained even after normalizing

See Figure 1.

NOTE The symbol for this delivery condition and for the normalized condition is N.



#### Key

$T$  temperature, in degrees Celsius

$t$  time, in hours

$Ar_3$  temperature at which ferrite starts to form on cooling

a Recrystallized austenite region.

b Non-recrystallized austenite region.

c Austenite plus ferrite region.

**Figure 1 — Time-temperature scheme of normalizing rolling**

### 3.2

#### purchaser

person or organization that orders products in accordance with this document

NOTE The purchaser is not necessarily, but may be, a manufacturer of pressure equipment.

## 4 Classification and designation

### 4.1 Classification

**4.1.1** The classification of the steel grades in accordance with ISO 4948-1 and ISO 4948-2 is given in ISO 9328-2, ISO 9328-3, ISO 9328-4, ISO 9328-5, ISO 9328-6 and ISO 9328-7 depending on the steel grade's chemical composition and treatment condition.

**4.1.2** Steels covered in ISO 9328-7 are additionally classified according to their structure into

- ferritic steels,
- martensitic steels,
- austenitic steels, and
- austenitic-ferritic steels.

For more details, see ISO 15510:2010.

### 4.2 Designation

The steel grades specified in the applicable part of ISO 9328 are designated with steel names in accordance with ISO/TS 4949.

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## 5 Information to be supplied by the purchaser

### 5.1 Mandatory information

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The following information shall be supplied by the purchaser at the time of enquiry and order:

- a) the quantity required;
- b) the type of flat product;
- c) the International Standard specifying the tolerances on dimensions, shape and mass (see 6.7) and, if the relevant International Standard permits the purchaser certain options, e.g. regarding edge finishes or tolerance classes, specific information on these aspects;
- d) the nominal dimensions of the product;
- e) the number of the applicable part of ISO 9328, i.e. ISO 9328-2, ISO 9328-3, ISO 9328-4, ISO 9328-5, ISO 9328-6 or ISO 9328-7;
- f) the steel name;
- g) the delivery condition, if it differs from the usual condition specified in the applicable part of ISO 9328; for stainless steels, the process route selected from the relevant table of ISO 9328-7;
- h) whether impact testing is required, and the test direction, where applicable (see 6.4.3 and Table 1);
- i) the type of inspection document to be issued (see 7.1).



## 5.2 Options

A number of options are specified in this part of ISO 9328 and listed below. 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 5.1).

- a) specification of the steelmaking process (see 6.1.1);
- b) mechanical properties after additional heat treatment (see 6.4.1);
- c) specification of special classes for the reduction of area (see 6.4.2);
- d) impact energy values and the relevant testing temperature (see 6.4.3);
- e) surface conditions other than those specified in ISO 7788 (see 6.5);
- f) verification of internal soundness (see 6.6);
- g) one or several of the optional tests (see 7.2 and Table 1);
- h) deviating frequency of testing (see 8.1.1 and 8.1.3);
- i) deviating delivery condition (see 8.2.1.3);
- j) permission to use circular test pieces for product thicknesses > 20 mm (see 8.2.2.2.3 and Table 3);
- k) specification of an analytical method (see 9.1);
- l) temperature of the tensile test at elevated temperature (see 9.3);
- m) marking method (see 10.1);
- n) special marking (see 10.2 and 10.3);
- o) information to be given by marking (see Table 5).

## 6 Requirements

### 6.1 Steelmaking process

**6.1.1** •• Unless a special steelmaking process has been agreed at the time of enquiry and order, the steelmaking process shall be left at the discretion of the manufacturer. If a special steelmaking process has been specified, this shall be reported in the inspection document.

**6.1.2** Steels other than stainless steels shall be fully killed.

### 6.2 Delivery condition

See Clause 3 and 3.1 and the applicable part of ISO 9328.

### 6.3 Chemical composition

#### 6.3.1 Cast (heat) analysis

The cast (heat) analysis reported by the steel producer shall apply and comply with the requirements of the applicable part of ISO 9328 and shall be included in the relevant inspection document.

### 6.3.2 Product analysis

The permissible product analysis tolerances on the limiting values given for the cast analysis are specified in the applicable part of ISO 9328.

## 6.4 Mechanical properties

**6.4.1** •• The values given in the applicable part of ISO 9328 apply for test pieces taken and prepared in accordance with 8.2.2. The values relate to the nominal thicknesses (thicknesses on ordering) of the products and apply to the usual delivery conditions (see the applicable part of ISO 9328).

•• Agreement shall be reached, where appropriate, at the time of enquiry and order about the mechanical properties to be adhered to after additional heat treatment.

The minimum impact energy values, where specified in the relevant parts of ISO 9328, apply even if they are not to be verified in the case of product thicknesses < 6 mm (see 8.2.2.3).

**6.4.2** •• For products (except products made of stainless steels) of thickness 15 mm and above, it may be agreed at the time of enquiry and order to meet the requirements of one of the quality classes Z 15, Z 25, or Z 35, as specified in ISO 7778, characterized by minimum values for the reduction of area perpendicular to the product surface.

**6.4.3** •• Impact energy values and the relevant testing temperature may be agreed when another testing temperature and/or another minimum impact energy value is/are required by the purchaser or when no impact energy values are specified.

### 6.5 Surface condition

For plates, the requirements of surface quality specified in ISO 7788 shall apply. Other surface condition standards may be used if agreed upon at the time of enquiry and order.

### 6.6 Internal soundness

•• Ultrasonic test requirements, together with the conditions of their verification (see Table 1 and 9.5.3), may be agreed at the time of enquiry and order.

### 6.7 Dimensions and tolerances on dimensions

• The nominal dimensions and tolerances on dimensions for the products shall be agreed at the time of enquiry and order, with reference to the dimensional standards listed below.

**6.7.1** For hot-rolled (except stainless) flat products, see ISO 7452 for plates or ISO 9034 for wide flats. If agreed upon at the time of enquiry and order, EN 10029, ASTM A20/A20M, JIS G 3193, JIS G 3194 and other national standards may be used.

**6.7.2** For stainless hot-rolled flat products, see ISO 9444 or ISO 18286.

**6.7.3** For stainless cold-rolled sheet/plate and cut lengths, cold-rolled coil and slit coil, see ISO 9445.

NOTE ISO 9445 contains options providing a wider dimensional choice.

### 6.8 Calculation of mass

A density of 7,85 kg/dm<sup>3</sup> shall be used as the basis for the calculation of the nominal mass from the nominal dimensions of all steels in ISO 9328-2 to ISO 9328-6. Calculations for density of stainless steels shall be based on density values given in ISO 9328-7:2011, Annex G.

## 7 Inspection

### 7.1 Types of inspection and inspection documents

Compliance with the requirements of the order shall be verified for products in accordance with the ISO 9328 series by specific inspection.

- The purchaser shall state the required inspection document, either 3.1.A, 3.1.B, 3.1.C or 3.2 in accordance with ISO 10474:1991, or 3.1 or 3.2 in accordance with EN 10204:2004.

If an inspection document 3.1/3.1.A, 3.1.C or 3.2 is ordered, the purchaser shall notify the manufacturer of the name and address of the organization or person who is to carry out the inspection and produce the inspection document. In the case of the inspection report 3.2, the party to issue the certificate shall be agreed upon.

### 7.2 Tests to be carried out

The mandatory and optional tests to be carried out and the extent of testing are specified in Table 1.

**Table 1 — Summary of tests and extent of testing**

Type of inspection and test		Extent of testing	Refer to
Mandatory tests	Cast (heat) analysis	1 per cast	6.3.1
	Tensile test at room temperature	1 per test unit	8.1.2, 8.2.1, 8.2.2.2 and 9.2
	Impact test (except for austenitic steels of ISO 9328-7)	1 per test unit	8.1.2, 8.2.1, 8.2.2.3 and 9.4
	Dimensional inspection	each product	9.5.1
	Visual inspection	each product	9.5.2
Optional tests	Product analysis	1 per cast	8.1.1 and 9.1
	Tensile test at elevated temperature for verification of $R_{p0,2}$	for steels of ISO 9328-2, ISO 9328-3 and ISO 9328-6	1 per cast
		for steels of ISO 9328-7 (except austenitic steels)	a
	Tensile test for (simultaneous) verification of one, all, or any combination of $R_{p0,2}$ and $R_{p1,0}$ and $R_m$ at elevated temperature for austenitic steels of ISO 9328-7	a	8.1.3, 8.2.1, 8.2.2.2 and 9.3
	Tensile test perpendicular to the product surface for verification of corresponding minimum reduction of area (except for steels of ISO 9328-7)	1 per test unit	6.4.2 and 8.2.1.2
	Impact test for austenitic steels of ISO 9328-7 at room temperature	a	8.1.2, 8.2.1, 8.2.2.3 and 9.4
	Impact test for steels of ISO 9328-7 (except ferritic steels) at low temperature	a	
	Ultrasonic test for verification of internal soundness	each product	6.6 and 9.5.3
	Test for resistance to intergranular corrosion for steels of ISO 9328-7	a	9.5.4
$R_{p0,2}$ : 0,2 % proof strength. $R_{p1,0}$ : 1,0 % proof strength. $R_m$ : tensile strength.			
a See ISO 9328-7.			