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

**Part 1:  
General requirements**

**iTeh STANDARD PREVIEW**  
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*Produits plats en acier pour service sous pression — Conditions  
techniques de livraison —  
Partie 1: Exigences générales*

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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.

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](http://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](http://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](http://www.iso.org/iso/foreword.html). (standards.iteh.ai)

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ISO 9328-1:2018

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This fourth edition cancels and replaces the third edition (ISO 9328-1:2011), which has been technically revised. The following changes have been made:

- all designations concerning thickness have been changed to “nominal thickness”;
- the thickness for test pieces for impact testing has been increased to 12 mm throughout;
- some references have been moved to the Bibliography;
- the content of the document has been generally updated.

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 1: General requirements

### 1 Scope

This document 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 of ISO 404 also apply to products supplied in accordance with this document.

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

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

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

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

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

ISO 3651-2, *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, *Ferrous products — Heat treatments — Vocabulary*

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

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

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

ISO 6929, *Steel products — Vocabulary*

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

ISO 7778, *Through-thickness characteristics for steel products*

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

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

ISO 9328-2:2018, *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, *Steel flat products for pressure purposes — Technical delivery conditions — Part 7: Stainless steels*

ISO 9444-1, *Continuously hot-rolled stainless steel — Tolerances on dimensions and form — Part 1: Narrow strip and cut lengths*

ISO 9444-2, *Continuously hot-rolled stainless steel — Tolerances on dimensions and form — Part 2: Wide strip and sheet/plate*

ISO 9445-1, *Continuously cold-rolled stainless steel — Tolerances on dimensions and form — Part 1: Narrow strip and cut lengths*

ISO 9445-2, *Continuously cold-rolled stainless steel — Tolerances on dimensions and form — Part 2: Wide strip and plate/sheet*

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

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

ISO 17577, *Steel — Ultrasonic testing of steel flat products of thickness equal to or greater than 6 mm*

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 and the following 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>

NOTE 1 In addition to the definitions for thermomechanical treatment and quenching and tempering in ISO 4885, the following is noted:

- thermomechanical rolling (symbol M) can include processes of increased cooling rates with or without tempering, including self-tempering but definitively excluding direct quenching and tempering;
- quenching and tempering (symbol QT) also includes direct quenching plus tempering.

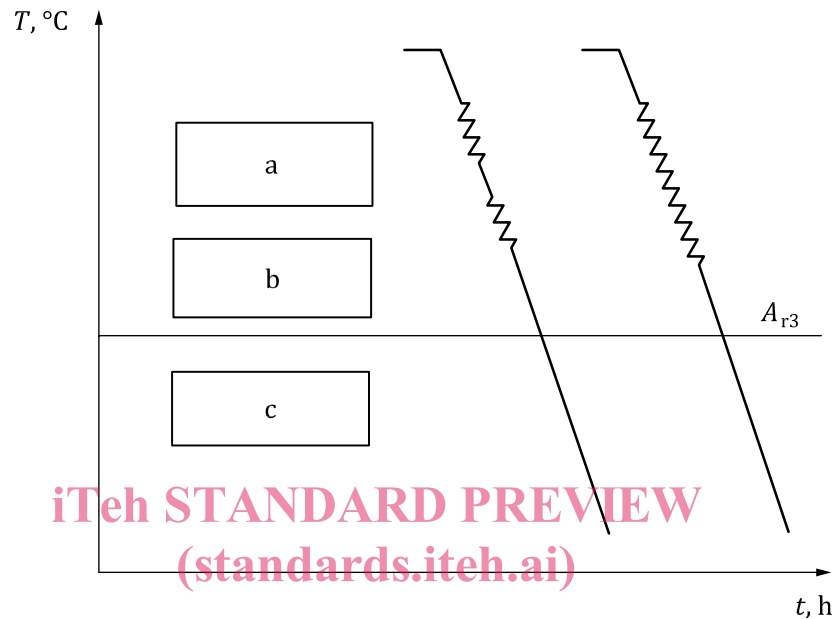
NOTE 2 In international publications, for normalizing rolling and thermomechanical rolling the expression “controlled rolling” can be found. However, in view of the different applications of the products, it is necessary to make a distinction between the terms.

### 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

Note 1 to entry: For explanation, see [Figure 1](#).

Note 2 to entry: The symbol for this delivery condition and for the normalized condition is N.



#### Key

$T$  temperature, in degrees Celsius

$t$  time, in hours

$A_{r3}$  temperature at which ferrite starts to form on cooling

a recrystallized austenite region

b non-recrystallized austenite region

c austenite plus ferrite region

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

### 3.2 purchaser

person or organization that orders products in accordance with this document

Note 1 to entry: 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.

## 4.2 Designation

The steel grades specified in the applicable documents of ISO 9328 (all parts) are designated with steel names in accordance with ISO/TS 4949.

## 5 Information to be supplied by the purchaser

### 5.1 Mandatory information

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 and shape (see 6.7) and whether 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 documents of ISO 9328 (all parts), 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 documents of ISO 9328 (all parts); for stainless steels, the process route selected from the relevant table of ISO 9328-7;
- h) the type of inspection document to be issued (see 7.1).

### 5.2 Options

A number of options are specified in this document 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, the relevant testing temperature and the test direction, where applicable (see 6.4.3 and Table 1);
- 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 nominal thicknesses > 20 mm (see [8.2.2.3](#) 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 documents of ISO 9328 (all parts).

### 6.3 Chemical composition

#### 6.3.1 Cast (heat) analysis

The cast (heat) analysis reported by the steel producer shall comply with the requirements of the applicable documents of ISO 9328 (all parts) 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 documents of ISO 9328 (all parts).

### 6.4 Mechanical properties

**6.4.1** The values given in the applicable documents of ISO 9328 (all parts) 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 documents of ISO 9328 (all parts)].

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 documents of ISO 9328 (all parts), apply even if they are not to be verified in the case of nominal 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 Z15, Z25, or Z35, 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 and, where appropriate, 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

**6.7.1** 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.

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

**6.7.3** For stainless hot-rolled flat products, in accordance with ISO 9444-1, ISO 9444-2 or ISO 18286.

**6.7.4** For stainless cold-rolled sheet/plate and cut lengths, cold-rolled coil and slit coil, in accordance with ISO 9445-1 or ISO 9445-2.

NOTE ISO 9445-1 and ISO 9445-2 contain 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.

# 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 ISO 9328 (all parts) by specific inspection.

The purchaser shall state the required inspection document, either inspection certificate 3.1 or 3.2, in accordance with ISO 10474.

If an inspection certificate 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.

**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](#).

**7.3 Retests, sorting and reprocessing**

Shall be in accordance with ISO 404.

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

Type of inspection and test		Extent of testing	Refer to	
<b>Mandatory tests</b>	Cast (heat) analysis	1 per cast	<a href="#">6.3.1</a>	
	Tensile test at room temperature	b	<a href="#">8.1.2</a> , <a href="#">8.2.1</a> , <a href="#">8.2.2.2</a> and <a href="#">9.2</a>	
	Impact test (except for austenitic steels of ISO 9328-7)	b	<a href="#">8.1.2</a> , <a href="#">8.2.1</a> , <a href="#">8.2.2.3</a> and <a href="#">9.4</a>	
	Dimensional inspection	each product	<a href="#">9.5.1</a>	
	Visual inspection	each product	<a href="#">9.5.2</a>	
<b>Optional tests</b>	Product analysis	1 per cast	<a href="#">8.1.1</a> and <a href="#">9.1</a>	
	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	<a href="#">8.1.3</a> , <a href="#">8.2.1</a> , <a href="#">8.2.2.2</a> and <a href="#">9.3</a>
		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		
	Tensile test perpendicular to the product surface for verification of corresponding minimum reduction of area (except for steels of ISO 9328-7)	c	<a href="#">6.4.2</a> and <a href="#">8.2.1.2</a>	
	Impact test for austenitic steels of ISO 9328-7 at room temperature	a	<a href="#">8.1.2</a> , <a href="#">8.2.1</a> , <a href="#">8.2.2.3</a> and <a href="#">9.4</a>	
	Impact test for steels of ISO 9328-7 (except ferritic steels) at low temperature	a		
	Ultrasonic test for verification of internal soundness	each product	<a href="#">6.6</a> and <a href="#">9.5.3</a>	
	Test for resistance to intergranular corrosion for steels of ISO 9328-7	a	<a href="#">9.5.4</a>	
	Step cooling test	1 per cast	<a href="#">9.5.5</a>	
<p>NOTE</p> <p><math>R_{p0,2}</math>: 0,2 % proof strength.</p> <p><math>R_{p1,0}</math>: 1,0 % proof strength.</p> <p><math>R_m</math>: tensile strength.</p> <p>a See ISO 9328-7.</p> <p>b For tensile and impact tests the sketches in <a href="#">Table 2</a> apply.</p> <p>c See ISO 7778.</p>				