

INTERNATIONAL STANDARD

ISO
9328-1

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Steel plates and strips for pressure purposes — Technical delivery conditions —

Part 1: General requirements

*Tôles et bandes en acier pour service sous pression — Conditions
techniques de livraison —*

Partie 1: Prescriptions générales



Reference number
ISO 9328-1:1991(E)

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.

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.

International Standard ISO 9328-1 was prepared by Technical Committee ISO/TC 17, *Steel*, Sub-Committee SC 10, *Steel for pressure purposes*.

Parts 1 to 5 of ISO 9328 cancel and replace the first editions of ISO 2604-4:1975, ISO/TR 2604-7:1986 and ISO 2604-8:1985 of which they constitute a technical revision.

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

- Part 1: *General requirements*
- Part 2: *Unalloyed and low-alloyed steels with specified room temperature and elevated temperature properties*
- Part 3: *Nickel-alloyed steels with specified low temperature properties*
- Part 4: *Weldable fine grain steels with high proof stress supplied in the normalized or quenched and tempered condition*
- Part 5: *Austenitic steels*

Annex A forms an integral part of this part of ISO 9328. Annexes B and C are for information only.

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Introduction

In addition to summarizing ISO 2604-4, ISO/TR 2604-7 and ISO 2604-8, parts 1 to 5 of ISO 9328 contain the following amendments, in particular:

- a) The general requirements for flat products for pressure purposes are covered in this part of ISO 9328 for all steel groups, so that incidental differences in the requirements for the various groups are avoided.
- b) The optional requirements other than the requirements concerning
 - the steel type,
 - the dimensions,
 - the type of document,
 - the testing temperature for the verification of the elevated temperature proof stress, as far as such verifications are mandatory,

are covered in annex A. The standard therefore becomes more flexible so that the part "Materials" of standards for the various types of pressure vessels and boilers can be restricted to the essential by references to the applicable part of ISO 9328 and to the special requirements appropriate to the specific type of vessel.

- c) The requirements for the chemical composition and the properties for the individual steel groups are covered in parts 2 to 5 of ISO 9328 so that further revisions will be less complicated.
- d) Parts 1 to 5 of ISO 9328 also cover strip.
- e) Only the aluminium-treated unalloyed steels were retained because of their higher yield strength at room temperature, their better impact properties and their better behaviour in the continuous casting process.

To the types with a minimum yield strength of 235 N/mm², 265 N/mm², 295 N/mm² (now 290 N/mm²), 315 N/mm², a type with 355 N/mm² was added.

- f) The low alloyed types P30 (1,2 % Mn, 0,5 % Mo) and P33 (0,5 % Cr, 0,6 % Mo, V) were deleted because of decreasing importance.
- g) In ISO 2604-4 the Al content for the CrMo-alloyed steels was restricted to $\leq 0,020$ % (m/m), because of the opinion that higher aluminium contents would have a negative effect on the creep ductility and the creep strength of the steel. An assessment showed, however, that the lowest creep ductility values were found for steels which are not Al-treated and that it is difficult to verify, within the temperature ranges and curves normally applied for these steels, a

negative effect of Al on the creep rupture strength. In addition, some countries reported that they had over 20 years experience with Al-treated steels. As Al additions are sometimes necessary in order to comply with the impact properties specified by the customers, the restriction of the Al-content was eliminated.

- h) The low temperature grade P41 was deleted. The low temperature grades 11 MnNi 53 and 13 MnNi 63 were inserted.
- i) It was not regarded as necessary to differentiate, in the case of austenitic steels, between low temperature and room temperature grades. The grades P49, P52 and P55 of ISO 2604-4 were consequently deleted and footnote 4 to table 1 of ISO 9328-5 added. Grade P67 was also not retained.

The following austenitic steels were inserted in ISO 9328-5:

- the nitrogen bearing steels X 2 CrNiN 18 10, X 2 CrNiMoN 17 12, X 2 CrNiMoN 17 13 and X 2 CrNiMoN 17 13 5,
 - the elevated temperature grades X 7 CrNiTi 18 10, X 7 CrNiNb 18 10 (as a substitute for the earlier type P56), X 7 CrNiMoB 17 12 and X 8 NiCrAlTi 32 21,
 - the types X 6 CrNiMoTi 17 12, X 6 CrNiMoNb 17 12, X 3 CrNiMo 18 16 4 and X 2 CrNiMoCu 25 20 5.
- j) The requirements for the chemical composition and the properties were partly amended, for example to take into more consideration the influence of the product thickness or to align the requirements with those in other International Standards, for example ISO 683-13.
 - k) Recommendations for the processing, in particular the welding of fine grain steels, were introduced by a reference to a Technical Report which is being prepared (see note to 5.4).
 - l) More specific requirements for surface quality were inserted by reference to ISO 7788.
 - m) When acceptance tests are ordered, no impact tests are to be carried out for austenitic steels (unless A.7 or A.8 are ordered).
 - n) Wherever impact tests are required these shall be carried out at the lowest temperature for which impact values are specified.
 - o) For steels with minimum elevated temperature proof stress values, except those austenitic steels for which no creep rupture properties are specified, verification of the elevated temperature proof stress values by specific testing is mandatory.
 - p) For austenitic steels the testing by batches, instead of the testing of each individual plate as rolled, is admitted under certain conditions (see table 2).

Steel plates and strips for pressure purposes — Technical delivery conditions —

Part 1: General requirements

1 Scope

1.1 This part of ISO 9328 covers the technical delivery conditions for plates and strip for pressure purposes manufactured from the following internationally used steels (see note 1):

- a) the unalloyed and low-alloyed steels with specified room temperature and elevated temperature properties covered in ISO 9328-2,
- b) the nickel-alloyed steels with specified low temperature properties covered in ISO 9328-3,
- c) the weldable normalized or quenched and tempered high strength fine grain steels (room temperature, elevated temperature and low temperature grades) covered in ISO 9328-4 (see note 3), and
- d) the austenitic steels (room temperature and elevated temperature grades) covered in ISO 9328-5.

NOTES

1 As well as the internationally used steels for pressure purposes covered in ISO 9328-2, ISO 9328-3, ISO 9328-4 and ISO 9328-5 there are other steels used regionally or nationally for the same application.

These other steels shall not be precluded by parts 2 to 5 of ISO 9328 provided that they comply with the concerned international or national standards for vessel constructions.

2 The following International Standards also apply for steel products for pressure purposes:

- ISO 2604-1, ISO 2604-2, ISO 2604-3, ISO 2604-5, ISO 2604-6, and ISO 4978.

3 In combination with the fine grain steels of ISO 9328-4 the term "quenched and tempered" also covers the precipitation-hardened fine grain steels.

4 It should be noted that not all steel types are available in the form of strip.

1.2 In special cases, variations of the requirements of parts 1 to 5 of ISO 9328 or additions to them may form the subject of an agreement at the time of enquiry and order. (See annex A.)

1.3 In addition to the requirements of parts 1 to 5 of ISO 9328 the general technical delivery requirements in ISO 404 apply, unless otherwise indicated in this part of ISO 9328.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 9328. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 9328 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 148:1983, *Steel — Charpy impact test (V-notch)*.

ISO 377-1:1989, *Selection and preparation of samples and test pieces of wrought steels — Part 1: Samples and test pieces for mechanical test*.

ISO 377-2:1989, *Selection and preparation of samples and test pieces of wrought steels — Part 2: Samples for the determination of the chemical composition*.

ISO 404:1981, *Steel and steel products — General technical delivery requirements.*

ISO 783:1989, *Metallic materials — Tensile testing at elevated temperature.*

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 3651-1:1976, *Austenitic stainless steels — Determination of resistance to intergranular corrosion — Part 1: Corrosion test in nitric acid medium by measurement of loss in mass (Huey test).*

ISO 3651-2:1976, *Austenitic stainless steels — Determination of resistance to intergranular corrosion — Part 2: Corrosion test in a sulphuric acid/copper sulphate medium in the presence of copper turnings (Monypenny Strauss test).*

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

ISO 4978:1983, *Flat rolled steel products for welded gas cylinders.*

ISO 4995:1991, *Hot-rolled steel sheet of structural quality.*

ISO 4996:1991, *Hot-rolled steel sheet of high yield stress structural quality.*

ISO 6892:1984, *Metallic materials — Tensile testing.*

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

ISO 7452:1984, *Hot-rolled structural steel plates — Tolerances on dimensions and shape.*

ISO/TR 7705:1991, *Guidelines for specifying Charpy V-notch impact prescriptions in steel specifications.*

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

ISO 9328-2:1991, *Steel plates and strips for pressure purposes — Technical delivery conditions — Part 2: Unalloyed and low-alloyed steels with specified room temperature and elevated temperature properties.*

ISO 9328-3:1991, *Steel plates and strips for pressure purposes — Technical delivery conditions — Part 3: Nickel-alloyed steels with specified low temperature properties.*

ISO 9328-4:1991, *Steel plates and strips for pressure purposes — Technical delivery conditions — Part 4:*

Weldable fine grain steels with high proof stress supplied in the normalized or quenched and tempered condition.

ISO 9328-5:1991, *Steel plates and strips for pressure purposes — Technical delivery conditions — Part 5: Austenitic steels.*

ISO 9444:1990, *Hot-rolled stainless steel wide strip and sheet — Tolerances on dimensions and form.*

3 Definitions

3.1 For the term "steel" the definition in ISO 4948-1 applies. Classification into "unalloyed steels" and "alloyed steels" is also given in this International Standard.

3.2 For the terms "plate" and "strip" the definitions in ISO 6929 apply.

4 Ordering and designation

4.1 The purchaser shall state on his enquiry and order the indications and requirements given below:

- a) indication of the product form ("plate" or "strip");
- b) number of the International Standard covering the requirements on dimensions, shape and tolerances of the product mentioned in item a) (see 5.8);
- c) nominal dimensions of the product;
- d) any necessary additional indications in cases where the International Standard mentioned in item b) contains alternatives (e.g. different tolerance classes, edge conditions, optional requirements etc.);
- e) the designation "steel" and the number of the applicable part of ISO 9328;
- f) designation of the steel type required (see table 1 of ISO 9328-2, ISO 9328-3, ISO 9328-4 and ISO 9328-5);

NOTE 5 The designations previously used in ISO 2604-4^[6], ISO/TR 2604-7^[9] and ISO 2604-8^[10] are given in annex B for comparison.

- g) in the case of the nickel-alloyed steels of ISO 9328-3, if for special reasons the choice between the heat-treatment conditions given in table 1 of ISO 9328-3 cannot be left to the discretion of the manufacturer, the preferred type of heat treatment (see A.2).

NOTE 6 Where the steels are further fabricated by welding, it may be appropriate to check whether the intended welding conditions are compatible with the heat-treatment conditions intended by the manufacturer.

- h) for the steels of table 3 of ISO 9328-2 and table 4 of ISO 9328-4 and for those steels of table 3 of ISO 9328-5 which are also included in table 4 of ISO 9328-5, the temperature selected from the relevant table for which the elevated temperature proof stress is to be verified (see table 3);
- i) the symbol for the document required (see 6.1 and table 1);
- j) where one or more of the supplementary requirements of annex A shall apply, the appropriate clause number of annex A (e.g. A.7) and eventually any necessary details.

Example: Plates according to ISO 7452 with nominal dimensions 30 mm × 2 500 mm × 6 000 mm and thickness tolerance class A (TCA), manufactured in accordance with ISO 9328-4, of steel type PLH 420 TN, with an inspection certificate of the qualified department of the manufacturer's work (symbol IC, see table 1).

The temperature for the verification of the elevated temperature proof stress shall be 350 °C.

An additional room temperature tensile test, an additional tensile test at 350 °C and three additional transverse Charpy-V-notch impact tests at -20 °C on test pieces from samples subjected to an additional heat treatment of 15 h at 600 °C shall be carried out. (See A.5.)

Designation:

Plate ISO 7452 - 30 × 2 500 × 6 000 - TCA

Steel ISO 9328-4 - PLH 420 TN

Document ISO 404 - IC

Additional agreements:

- a) Temperature for the verification of the elevated temperature proof stress: 350 °C.
- b) Applicable supplementary requirements of A.5 for 15 h at 600 °C.

4.2 The manufacturer shall indicate in his offer the following:

- a) in the case of fine grain steels according to tables 1A or 1B of ISO 9328-4, the chemical composition of his type of alloy (see 5.2.2.1);

- b) in the case of fine grain steels according to table 1B of ISO 9328-4, whether he will supply the steel in the quenched and tempered or in the precipitation-hardened condition (see 1.1, note 3).

5 Requirements

5.1 Manufacturing process

5.1.1 Steelmaking process

The steel shall be produced by one of the basic oxygen processes or by the electric or open hearth process or by a combination of these. The steelmaking process shall be decided by the steel manufacturer unless otherwise agreed.

Other processes may be used by agreement between the interested parties.

5.1.2 Type of deoxidation

All steels shall be fully killed.

5.1.3 Heat treatment condition

The products shall be supplied in the heat-treatment condition indicated in table 1 of ISO 9328-2, ISO 9328-3 and ISO 9328-5 and tables 1A and 1B of ISO 9328-4 for the particular steel type ordered. (See A.2.)

5.1.3.1 For products usually supplied in the normalized condition, in the case of small thicknesses and in special cases, an additional tempering treatment may be necessary for fine grain steel grades with $R_{e,min} \geq 420$ N/mm² to achieve the mechanical properties specified in ISO 9328-4.

5.1.3.2 For the unalloyed steels according to table 1 of ISO 9328-2, for steels 11 MnNi 5 3 and 13 MnNi 6 3 according to table 1 of ISO 9328-3 and for the normalized fine grain steels according to table 1A of ISO 9328-4, the application of controlled temperatures during and after rolling may take the place of normalizing, provided the specified properties are complied with and can also be obtained after a further normalizing treatment.

When hot forming flat products of these steels after delivery, these shall not be heated to more than 1 100 °C, and shall be cooled to a temperature below the transformation temperature, then normalized at the temperature given for guidance in table 1 of ISO 9328-2 and ISO 9328-3 or table 1A of ISO 9328-4.

However, the final normalizing may also be omitted after hot forming, provided that:

- a) the hot forming is carried out in one operation at the normalizing temperature;

or

if hot forming is carried out in more than one operation, the product is cooled below the transformation temperature before the last operation and this operation is then carried out at the normalizing temperature;

and

- b) the specified properties are complied with and can also be obtained after a further normalizing treatment.

5.1.3.3 In the case of coils, some of the ferritic steels are delivered in the heat-treatment conditions indicated in table 1 of ISO 9328-2 and ISO 9328-3, or table 1A of ISO 9328-4. However, for other ferritic steels the heat treatment is normally done after cutting the coils into sheets.

5.1.3.4 For the quenched and tempered fine grain steels see item b) of 4.2.

5.1.4 Surface treatment (finish)

5.1.4.1 The products shall be supplied without descaling with the exceptions given in 5.1.4.2 and 5.1.4.3.

5.1.4.2 Products of austenitic steels shall be supplied with a pickled surface. (See alternative in table A.1, last line, and in A.3.)

5.1.4.3 When an inspection of the surface by a special method is ordered (see A.11), the surface shall be descaled.

5.1.5 Cast separation

The products shall be delivered separated by casts.

5.2 Chemical composition

5.2.1 For the steels covered in ISO 9328-2, ISO 9328-3 and ISO 9328-5, the following applies.

5.2.1.1 The chemical composition determined by the cast analysis shall be within the limits given in table 1 of ISO 9328-2, ISO 9328-3 and ISO 9328-5. (See A.4.)

Elements not quoted in these tables shall not be intentionally added without the agreement of the purchaser, other than for the purpose of finishing the heat.

5.2.1.2 On samples taken and prepared in accordance with ISO 377-2 the results of a product analysis (see A.6) shall not deviate from the specified limits for the cast analysis by more than the values given in table 2 of ISO 9328-2, ISO 9328-3 and ISO 9328-5.

5.2.2 For the normalized and the quenched and tempered fine grain steels covered in ISO 9328-4 the following applies:

5.2.2.1 The chemical composition of the individual fine grain steel may be different, depending on the type of alloy additions selected by the manufacturer and on the thickness of the product. It shall, however, in each case comply with the requirements for the results of the cast analysis given for the relevant steel type in tables 1A and 1B of ISO 9328-4.

As the chemical composition influences the welding characteristics, the manufacturer shall describe in his offer the type of alloy which he will supply. For this purpose, he shall indicate the limiting values for the cast analysis for the carbon content and the content of the elements listed below if those were added to the steel.

— for steels of table 1A: Al, Cu, N, Nb, Ni, Ti, V;

— for steels of table 1B: Si, Mn, Al, B, Cr, Cu, Mo, N, Nb, Ni, Ti, V, Zr.

(See A.4.)

5.2.2.2 The results of a product analysis (see A.6), on samples taken and prepared in accordance with ISO 377-2, shall not deviate from the limiting values indicated by the manufacturer for the cast analysis of his type of alloy by more than the values given in table 2 of ISO 9328-4.

5.3 Mechanical properties

5.3.1 The products, when supplied in the heat treatment condition indicated in 5.1.3 and tested in accordance with 6.2.1 or A.7, A.8 or A.9, shall comply with the requirements for the tensile and impact properties given or referred to in table 1 of ISO 9328-2, ISO 9328-3 and ISO 9328-5 and tables 1A and 1B of ISO 9328-4 (see note).

NOTE 7 The impact values specified in table 1 of ISO 9328-2 and ISO 9328-5 and table 3 of ISO 9328-3 and ISO 9328-4 apply to the standard test piece 10 mm x 10 mm. When only the application of subsidiary test pieces is possible, the values shall be proportional to the thickness of the test piece.

5.3.2 Estimates of the average stress rupture properties are given in table 4 of ISO 9328-2 and ISO 9328-5.

5.4 Weldability

The steels covered by Parts 2 to 5 of ISO 9328 are generally regarded as being weldable. However, the general weldability of the steels cannot be guaranteed, as the behaviour of the steel during and after welding is dependent not only on the steel, but also on the welding conditions and the final use for which the steel is employed. Therefore, where appropriate, the welding procedure shall be agreed between the interested parties at the time of enquiry and order.

NOTE 8 A Technical Report giving guidelines for the fabrication and especially for welding of normalized or quenched and tempered fine grain steels is being prepared.

5.5 Physical properties

A Technical Report dealing with the physical properties of steels is being prepared. (See also 5.9.)

5.6 Internal soundness

The steel shall be free from internal defects likely to have an adverse effect. (See A.10.)

5.7 Surface quality

5.7.1 For plates, the requirements for the surface quality and for the repair of surface defects given in ISO 7788 apply.

5.7.2 For strip, the requirements for surface imperfections and for their removal given in ISO 404 apply.

5.8 Dimensions, shape and tolerances

5.8.1 The dimensions and shape of the products shall comply within the agreed tolerances (see 5.8.2) with the requirements of the order.

5.8.2 Requirements for the tolerances on dimensions and shape are covered by ISO 4995, ISO 4996, ISO 7452 and ISO 9444.

The agreements for tolerances at the time of enquiry and order shall, as far as possible, be based on one of these International Standards.

5.9 Calculation of nominal mass

Any calculation of the nominal mass of the products shall be based on the following density values:

- unalloyed and alloyed steels (see ISO 9328-2, ISO 9328-3 and ISO 9328-4): 7,85 kg/dm³
- austenitic stainless CrNi steels (see ISO 9328-5): 7,92 kg/dm³

- austenitic stainless CrNiMo steels (see ISO 9328-5): 7,98 kg/dm³

6 Inspection, testing and conformity of products

6.1 Inspection and testing procedures and types of documents

6.1.1 Table 1 gives a survey of the inspection procedures and the related documents according to ISO 404 which may be agreed upon at the time of enquiry and order for deliveries according to the applicable part of ISO 9328.

6.1.2 An inspection certificate IC shall be supplied, unless otherwise agreed.

6.1.3 The document shall contain the following.

- a) The number of the applicable part of ISO 9328 and the steel designation which shall be regarded as a claim by the manufacturer that the product has been manufactured in accordance with the appropriate requirements of the applicable part of ISO 9328. The accuracy of this claim is solely the manufacturer's responsibility.
- b) All symbols, letters or numbers which in addition to the information given in item a) are necessary to relate the order, the document, the test pieces, test results and products to each other and, if necessary, to the various sampling and testing conditions and deliveries.
- c) The steelmaking method.
- d) The results of the cast analysis for all elements specified for the steel type supplied.

In the case of normalized or quenched and tempered fine grain steels, the elements for which, in accordance with 5.2.2.1, limiting values are given in the offer shall be regarded as specified elements in addition to carbon, phosphorus and sulfur.

- e) The heat treatment with, in the case of tempered or quenched and tempered deliveries or reference test pieces, the heat-treatment temperatures and cooling conditions applied.
- f) The results of all the tests and inspections specified in table 3 and 6.2.2.
- g) The results of all the tests and inspections ordered in supplementary requirements (see annex A).

- h) The statement that the material complies with the requirements of the order.
- i) The identification of the inspector and/or, where appropriate, the inspection authority.

6.2 Specific inspection and testing

6.2.1 Mechanical testing

6.2.1.1 For the selection and preparation of the samples and test pieces the general requirements given in ISO 377-1 apply.

6.2.1.2 The test units and the number and position of samples to be taken are given in table 2. The type, the number, the position and direction of the test pieces to be taken per sample and the test methods to be applied are given in table 3.

6.2.2 Visual and dimensional inspection

Each product shall be inspected visually and appropriate checks shall be made for compliance with the dimensional tolerances. (See A.11.)

6.2.3 Retests

6.2.3.1 Where for one or more test units, one or more tests give unsatisfactory results, and if in such a case no indications for material confusion exist, the manufacturer has the choice between withdrawing the concerned test units (e.g. for retreatment or sorting in accordance with ISO 404) or retaining them. If they are retained, retests are to be carried out according to the following rules.

6.2.3.2 If, as in the case of the tensile tests or product analysis (see A.6), only one test of the concerned type was carried out on the concerned sample and gave the unsatisfactory result, two new tests of the same type shall be carried out.

In cases where the test unit consists of a parent plate or a coil the two new test pieces shall be taken from the sample concerned.

In cases where the test unit consists of a batch (see table 2) one of the two new test pieces shall be taken

from the concerned sample, the other from another item of the concerned batch.

The results of both retests must comply with the requirements. Otherwise the test unit is to be rejected.

6.2.3.3 If, in the case of impact tests, the average value of the three tests to be carried out on test pieces from one sample is lower than the specified value, or if the average value meets the specified requirement but two of the values are lower than the specified value, or if any one value is lower than 70 % of the specified value, three additional test pieces shall be taken from the same sample and tested.

The average value of the six tests shall be not less than the specified value. Not more than two of the individual values may be lower than the specified value and not more than one may be lower than 70 % of this value.

If the requirement is not complied with, the concerned parent plate or coil is to be rejected.

If the sample represented a batch from two further products of the batch, three further impact test pieces each are to be taken and to be tested. If the results of these two additional test series do not in every respect comply with the requirements, the batch is not accepted.


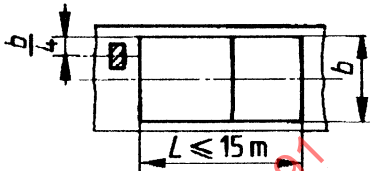
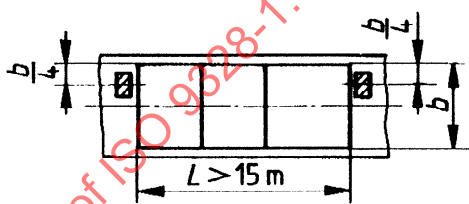
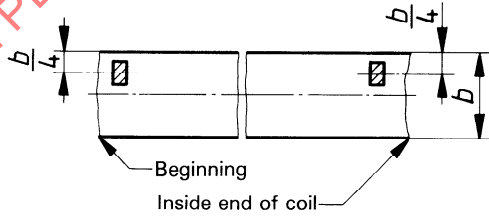
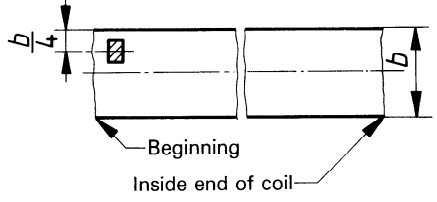
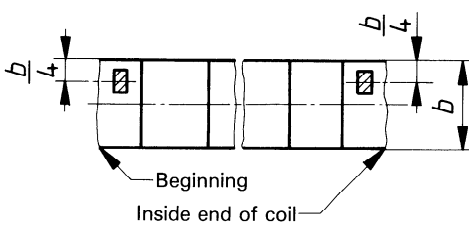
7 Marking

7.1 The products shall be marked legibly to show:

- a) the designation or material number¹⁾ for the type of steel, as given in the tables of parts 2 to 5 of ISO 9328;
- b) the brand mark, symbol or logo of the manufacturer of the products;
- c) symbols, letters or numbers which relate the test certificates, test pieces and products to each other.

7.2 The marking shall be carried out according to the specifications in table 4 unless otherwise agreed at the time of enquiry and order.

1) The material numbers will be inserted later.

Line No.	Product	Further conditions See table 2, line No.	Taking of test samples
			A test sample for making the test pieces listed in table 3 shall be taken from each sample product at points marked  1)
1	Plates (including plates cut from strip)	1a and 1c	
2		1b and 1d	
3		1e	
4	Strips (coils)	2a (ferritic steels)	
5		2b (austenitic steels)	

1) In relation to the width b the samples may be taken from either side of the centre line of the plate/sheet or strip.

Figure 1 — Position of test samples

Table 1 — Applicable inspection procedure and types of documents

Symbol ¹⁾	Inspection and testing procedure	Type of document designation
IC	Specific testing and inspection ²⁾ by the qualified department of the manufacturer's works	Inspection certificate issued by the representative of the qualified department of the manufacturer's works
ICP	Specific testing and inspection ²⁾ in the presence of the purchaser or a body designated by him	Inspection certificate issued by the purchaser or a body designated by him
IR		Inspection report signed by the manufacturer and purchaser or his representative
<div>1) The symbols are to be regarded as preliminary. During the revision of ISO 404 others may be agreed upon.</div> <div>2) "Specific inspection and testing" means the inspection and testing procedure carried out on the products to be supplied, in order to verify whether these products comply with the requirements of the order.</div>		

Table 2 — Test units and number and position of samples to be taken for specific testing

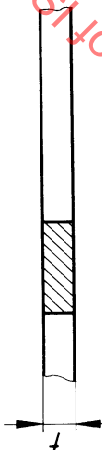
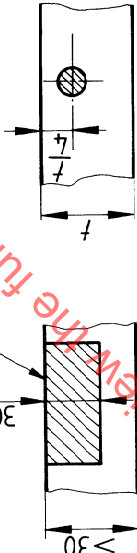
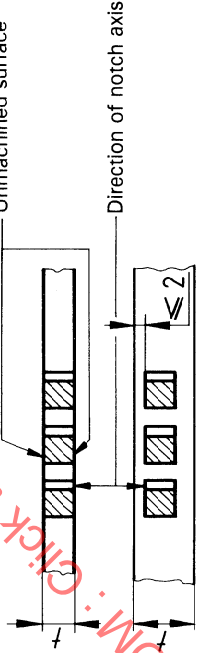
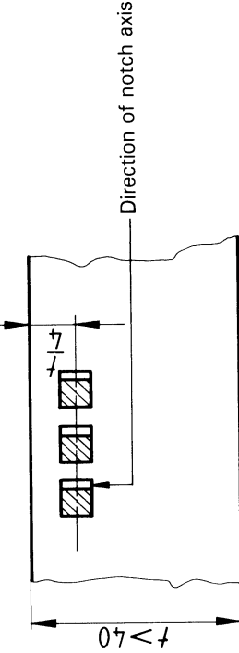
Col- umn	1	2		3	4	5	6	7
Line No.	The delivery or the part of the delivery to be tested consists of			The test unit shall consist of	The sample product shall consist of	Number and position of the samples to be taken per sample product for ¹⁾		See figure 1 line No.
1a	Plates ²⁾		≤ 3 000 kg	each part of a heat- treatment batch with a part batch mass of ≤ 5 000 kg or ≤ 20 plates ³⁾	one plate per test unit	$L \leq 15\text{ m}$	one from one end	1
1b						$L > 15\text{ m}$	two, one from each end	2
1c			> 3 000 kg	each heat-treated plate ³⁾		$L \leq 15\text{ m}$ and $m \leq 5\text{ t}$	one from one end	1
1d						$L > 15\text{ m}$ or $m > 5\text{ t}$	two, one from each end	2
1e		plate, finally heat-treated as strip and not further heat-treated as plate			each coil ³⁾		two, one from each end	3
2a	Strips (coils)			each heat-treated coil ³⁾			ferritic steels: one from the outer end of the coil	4
2b							austenitic steels: two, one from each end of the coil	5

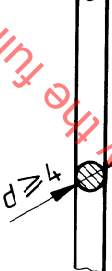
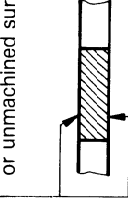
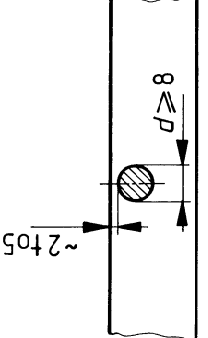
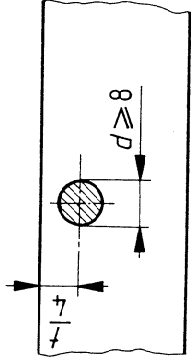
1) L = length, m = mass of the sample product.

2) The plates may consist of one parent plate or of plates cut from one parent plate or of plates cut from one strip (coil). The term "parent plate" refers to the unit plate from a slab, or piece of slab, or rolled directly from an ingot.

3) When the test unit has been satisfactorily tested at the specified frequency and the product(s) of which it consists is (are) subsequently cut into smaller products the original test results shall, without any additional testing, also apply to these smaller products.

Table 3 — Test pieces to be taken from the samples described in table 2 and test methods to be applied (see the footnotes on page 12)

Col- umn	1	2	3	4	5	6	7
Test	The following conditions apply	Number of test pieces to be taken per sample	Test piece orientation ¹⁾	Product thickness mm	Distance of the test pieces from the rolled surface of the product mm	Further requirements	The test shall be carried out according to
a) Room temperature tensile tests	to all steels covered in parts 2 to 5 of ISO 9328	One tensile test piece according to ISO 6892	Transverse	3 to 30	Rectangular test piece with both surfaces unmachined 	2)	ISO 6892 ⁴⁾
				> 30	a) unmachined surface or b) round test piece Unmachined surface 	3)	
b) Charpy V-notch impact tests	to products with a thickness > 5 mm of all steels except austenitic steels according to ISO 9328-5 (see A.7)	Three Charpy V-notch impact test pieces according to ISO 148	Transverse (unless otherwise agreed at the time of enquiry and order) (see A.8)	5 to 10 > 10 < 40 > 40	Unmachined surface Direction of notch axis  Unmachined surface Direction of notch axis 	5)	ISO 148 at the lowest temperature for which values are specified for the individual steel type

Column	1	2	3	4	5	6	7
Test	The following conditions apply	Number of test pieces to be taken per sample	Test piece orientation ¹⁾	Product thickness mm	Distance of the test pieces from the rolled surface of the product mm	Further requirements	The test shall be carried out according to
c) Verification of the elevated proof stress	to all steels of ISO 9328-2 and ISO 9328-4 and those steels of ISO 9328-5 for which creep properties are also specified	From one sample per each 30 t of a cast and heat-treatment batch from products falling within the same thickness range as specified in table 3 of ISO 9328-2 or table 4 of ISO 9328-4 or table 3 of ISO 9328-5. one tensile test piece according to ISO 783	Transverse (adjacent to the test piece for the room temperature tensile test)	3 to 10	 Round test piece or  rectangular test piece, machined or unmachined surface	3)	ISO 783 at the temperature agreed in the order [see 4.1, item h)]
				> 10 ≤ 30			
				> 30			

- 1) With reference to the direction of final rolling.
 - 2) Except in cases of arbitration, round tensile test pieces may be taken for product thicknesses > 15 mm.
 - 3) The width of the parallel portion of the rectangular tensile test pieces shall not exceed 40 mm and shall not be greater than $8a$ (a = thickness of the test piece), in accordance with ISO 6892.
 - 4) For the verification of the yield stress R_y of non-austenitic steels either the upper yield stress R_{yH} or the 0.5 % total elongation proof stress $R_{p0.5}$ or the 0.2 % proportional elongation proof stress $R_{p0.2}$ may be determined. However, in cases of dispute, the upper yield stress value R_{yH} or, if no yield phenomenon occurs, the proof stress $R_{p0.2}$ shall be the deciding factor.
- In the case of the austenitic steels the 1 % proportional elongation proof stress $R_{p1.0}$ shall be determined and shall be regarded as the deciding factor. The value given for the minimum yield stress is given for information only and corresponds to $R_{p0.2}$.
- The percentage elongation should be reported with reference to a $5.65\sqrt{S_0}$ gauge length (L_0) where S_0 is the original cross-sectional area of the parallel length. If other gauge lengths are used, the corresponding elongation on $5.65\sqrt{S_0}$ should be obtained by reference to ISO 2566-1 and ISO 2566-2. In cases of dispute, a gauge length of $5.65\sqrt{S_0}$ shall be used.
- 5) In cases of dispute, subsidiary test pieces with machined surfaces and a thickness of 7.5 mm or 5 mm (see ISO 148 and ISO/TR 7705) shall be applied.

NOTE The term "test piece thickness" applied in this part of ISO 9328 corresponds to the term "width" applied in ISO 148.

Table 4 — Standard types of marking

Product form	Type of package	Steel type	Thickness mm	Standard type of marking	
Plate	Not bundled or boxed	Austenitic steels	All	Painting	on a corner of each plate such that the symbols read in the direction of rolling ¹⁾
		Steels with R_e , min. > 360 N/mm ²			
		Steels with R_e , min. ≤ 360 N/mm ² except austenitic steels	≤ 5		
		> 5	Stamping		
	Boxed	All	All	Imprint on the box or as indicated below	
Bundled					
Coil	—	All	All	On a tag securely attached to the bundle, box or coil	
1) The marking shall be transverse to the major direction of rolling.					

Annex A (normative)

Supplementary or special requirements

A.1 General

As indicated in 1.2 and 4.1, item j) the individual supplementary or special requirements given in this annex, together with the necessary details, apply only if this was agreed upon at the time of enquiry and order.

A.2 (to 5.1.3 and 5.1.4) Heat-treatment and surface conditions for hot forming

The products shall not be delivered in the heat-treatment condition given in table 1 of ISO 9328-2, ISO 9328-3 and ISO 9328-5, and tables 1A and 1B of

ISO 9328-4, but in the condition usually applied when the products are to be further hot formed. These shall be, unless otherwise agreed, the conditions given in table A.1.

If this supplementary requirement is ordered, the requirements to be verified in accordance with 6.2.1 shall be determined on test pieces from samples which were subjected to a reference heat treatment complying with the requirements for the heat treatment in table 1 of ISO 9328-2, ISO 9328-3 and ISO 9328-5, and tables 1A and 1B of ISO 9328-4.

The actual heat treatment of the samples shall be indicated in the inspection certificate or inspection report.

Table A.1 — Condition usually applied for products to be hot formed

Steel type	See table	Usual heat treatment condition for products to be hot formed	Surface
14 CrMo 4 5	1 of ISO 9328-2	By agreement: — either tempered, — or normalized, — or, in particular cases, as-hot-rolled ¹⁾	Not descaled
13 CrMo 9 10 T1			
13 CrMo 9 10 T2			
X 8 Ni 9	1 of ISO 9328-3	Normalized	
Others	1 of ISO 9328-2 1 of ISO 9328-3 1A of ISO 9328-4 1B of ISO 9328-4 ²⁾ 1 of ISO 9328-5 ³⁾	As-hot-rolled	

1) In the as-hot-rolled condition the ductility may be too low for transportation.

2) When ordering the steels of table 1B of ISO 9328-4 for hot-forming operations with following heat treatment at the purchaser's plant, it should be observed that the properties specified for the quenched and tempered fine grain steels in ISO 9328-4 are not always obtained after the application of normal quenching procedures.

3) For the stainless steels, the as-hot-rolled condition is usually not readily available. In this condition, the steels are susceptible to corrosion.

A.3 (to 5.1.4.2) Mechanically descaled surface

The products shall not be pickled but shall be mechanically descaled (e.g. by shot blasting).

A.4 (to 5.2.1.1 and 5.2.2.1) Residual elements

If, in special cases, the purchaser considers that the level of residual elements is important in relation to the mechanical and technological properties of the steel in the intended application, the cast (ladle) analysis limits for such elements shall be agreed at the time of enquiry or order. The agreed elements shall then be analysed and the values reported.

A.5 (to 5.3.1 and 6.2.1) Mechanical tests on samples with additional heat treatment

NOTES

9 Additional heat treatments of the steel products during fabrication, as for example extended stress relieving treatments, may have an adverse effect on the properties of the steel. This supplementary requirement shall give the purchaser the possibility of estimating in advance the effects of the heat treatment which he has to carry out during the fabrication of the products.

10 If this supplementary requirement is ordered together with A.2, then the additional heat treatment shall be carried out after the reference heat treatment.

One additional sample shall be taken in accordance with the requirements of 6.2.1 per cast, heat treatment and product thickness. The postweld heat-treatment cycle shall be especially agreed upon between the parties concerned and be indicated in the order.

The sample shall be tested in the same way and, unless otherwise agreed, to the same extent as the sample specified in table 3. The test results to be obtained shall be agreed upon at the time of enquiry and order.

A.6 Product analysis (to 5.2.1.2 and 5.2.2.2)

One product analysis shall be carried out per cast for the determination of all elements for which values are specified for the steel type concerned.

The conditions for sampling shall be in accordance with ISO 377-2. In case of dispute the analysis shall be carried out, if possible, according to the appropriate internationally standardized method.

A.7 (to table 3, column 1) Impact tests at room temperature for austenitic steel

The requirements for the Charpy-V-notch impact energy at room temperature of the ordered austenitic steel (see table 1 of ISO 9328-5 and footnote 5 to table 3) shall be verified on transverse test pieces taken in accordance with table 2 and table 3.

A.8 (to table 3, column 3) Application of longitudinal impact test pieces

When this supplementary requirement is ordered for steel types, for which longitudinal ISO-V-notch impact energy values are also given (see table 3 of ISO 9328-3 and ISO 9328-4) the longitudinal instead of the transverse value shall be verified.

A.9 (to 5.3.1) Verification of the elevated temperature proof stress properties by specific tests

For all steels of table 3 of ISO 9328-2 and table 4 of ISO 9328-4 and for steels X 7 CrNi 18 9, X 7 CrNiTi 18 10, X 7 CrNiNb 18 10, X 7 CrNiMo 17 12, X 7 CrNiMoB 17 12, X 8 NiCrAlTi 32 21 TQ1, and X 7 NiCrAlTi 32 21 TQ1 of table 3 of ISO 9328-5, the verification of the elevated temperature proof stress by specific tests is not supplementary, but is a mandatory requirement.

When this special requirement is ordered for those steels of table 3 of ISO 9328-5 which are not cited above, one elevated temperature tensile test shall be made on each 30 t of a cast and heat-treatment batch, using a test sample prepared in accordance with 6.2.1 and with the test piece taken and tested in accordance with table 3.

The proof stress tests at elevated temperature shall be carried out in accordance with ISO 783 at a temperature selected from table 3 of ISO 9328-5 and agreed between the interested parties at the time of enquiry and order.

For retests, the requirements of ISO 404 shall apply.

NOTE 11 The results of all elevated temperature tensile tests on steels of ISO 9328-2, ISO 9328-4 and ISO 9328-5 should, together with information on the chemical composition of the material including residuals, the product thickness, the heat treatment temperatures and times, the position of the test piece in the product (if different from the standard position), the room temperature tensile properties, and the stress and/or strain rates used for the