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Second edition
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Heat treatable steels, alloy steels and free-cutting steels —

Part 5: Nitriding steels

Aciers pour traitement thermique, aciers alliés et aciers pour décolletage —
Partie 5: Aciers pour nitruration

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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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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

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

This document was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 4, *Heat treatable and alloy steels*.

This second edition cancels and replaces the first edition (ISO 683-5:2014), of which it constitutes a minor revision.

The main changes compared to the previous edition are as follows:

— in the Scope, "see 5.2" has been added as a cross reference;

— in 3.1, note 1 to entry has been revised;

— in 5.2, the ordering example has been moved into a new subclause, as 5.3;

— in 7.7.3, the surface class given has been changed from A to 1z2;

— in 9.2.3, the option for retesting has been revised;

— Figure 3 has been renamed as Table 9;

— in A.2.1, the cross references have been corrected to A.2.2 to A.2.4.

A list of all parts in the ISO 683 series can be found on the ISO website.

Heat treatable steels, alloy steels and free-cutting steels —

Part 5: Nitriding steels

1 Scope

This document gives the technical delivery requirements for

— semi-finished products, e.g. blooms, billets, slabs (see note 1),

— bars (see note 1),

— wire rod,

— hot-rolled plates (see note 2), and

— hammer or drop forgings (see note 1)

manufactured from the nitriding steels listed in Table 3 and supplied in one of the heat-treatment conditions given for the different types of products in Table 1, rows 2 to 5, and in one of the surface conditions given in Table 2.

The steels are generally intended for the fabrication of quenched and tempered and, subsequently, nitriding machine parts.

The requirements for mechanical properties given in this document are restricted to the sizes given in Table 6.

NOTE 1 Hammer-forged semi-finished products (blooms, billets, slabs, etc.), seamless rolled rings and hammer-forged bars are in the following covered under semi-finished products or bars and not under the term "hammer and drop forgings".

NOTE 2 The term "plate" includes in the following also wide flats unless otherwise stated.

In special cases, variations in these technical delivery requirements or additions to these requirements can form the subject of an agreement at the time of enquiry and order (see 5.2 and Annex B).

In addition to this document, the general technical delivery requirements of ISO 404 are applicable.

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 404:2013, *Steel and steel products — General technical delivery requirements*

ISO 643, *Steels — Micrographic determination of the apparent grain size*

ISO 3887, *Steels — Determination of depth of decarburization*

ISO 4885, *Ferrous materials — 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 4967, *Steel — Determination of content of non-metallic inclusions — Micrographic method using standard diagrams*

ISO 6506-1, *Metallic materials — Brinell hardness test — Part 1: Test method*

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

ISO 6929, *Steel products — Vocabulary*

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

ISO 9443, *Heat-treatable and alloy steels — Surface quality classes for hot-rolled round bars and wire rods — Technical delivery conditions*

ISO/TR 9769, *Steel and iron — Review of available methods of analysis*

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

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 377, ISO 4885, ISO 4948-1, ISO 4948-2, ISO 6929 and ISO 14284 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 http://www.iso.org/obp

3.1
ruling section
section for which the specified mechanical properties shall apply

Note 1 to entry: Independent of the actual shape and dimensions of the cross-section of the product, the size of its ruling section is always given by a diameter. This corresponds to the diameter of an "equivalent round bar". That is a round bar which will show the same cooling rate as the actual ruling section of the product concerned at its position for taking the test pieces when being cooled from austenitizing temperature.

3.2
nitriding steel
heat-treatable steel containing controlled amounts of the nitride forming elements, aluminium, chromium, molybdenum and/or vanadium and are particularly suited for nitriding

3.3
nitriding
heat treatment characterized by keeping a steel product for a sufficiently long time at temperatures below the transformation temperature AC1 in a nitrogen providing gaseous or liquid salt environment to achieve diffusion of the nitrogen into the steel surface

Note 1 to entry: An increase in surface hardness, wear resistance and fatigue properties is attained with this treatment.

4 Classification and designation

4.1 Classification

The classification of the relevant steel grades is allocated in accordance with ISO 4948-1 and ISO 4948-2. All steels covered by this document are classified as alloy special steels.

4.2 Designation

For the steel grades covered by this document, the steel names as given in the relevant tables are allocated in accordance with ISO/TS 4949.

The designation of steels given in this document and of comparable grades covered in various designation systems is given in Annex C.

5 Information to be supplied by the purchaser

5.1 Mandatory information

The manufacturer shall obtain the following information from the purchaser at the time of enquiry and order:

a) the quantity to be delivered;

b) the designation of the product form (e.g. slab, bloom, billet, round bar, wire rod);

c) either the designation of the dimensional standard and the dimensions and tolerances selected from this (see 7.9) or the designation of the drawing or any other document covering the dimensions and tolerances required for the product;

d) reference to this document, i.e. ISO 683-5;

e) the designation of the steel grade given in Table 3;

f) designation for a test report 2.2 or, if required, any other type of inspection document in accordance with ISO 10474.

5.2 Options/supplementary or special requirements

A number of options are specified in this document and listed below in this subclause. If the purchaser does not indicate the wish to implement any of these options, the products will be supplied in accordance with the basic specification of this document (see 5.1):

a) if a heat-treatment condition other than the untreated condition is required, the symbol for this other condition (see Table 1, column 2);

b) if another surface condition than hot worked or a special surface quality is required, the surface condition (see Table 2, column 2) and the surface quality (see 7.7);

c) any supplementary requirement that shall be complied with, the symbol and, where necessary, the details of this supplementary requirement (see Annex B);

d) any requirement relating to the removal of surface defects (see 7.7.4);

e) any requirement regarding the permissible depth of decarburization (see 7.8);

f) impact test at a temperature lower than room temperature (see 9.2.3).

5.3 Ordering example

EXAMPLE 2 t hot-rolled round bars according to ISO 1035-1 with a nominal diameter of 40 mm and a nominal length of 8 000 mm with diameter tolerance according to class S and with length tolerance according to class L2 made of steel grade ISO 683-5, 31CrMo12 (see Table 3) in heat-treatment condition +QT (see Table 1) with surface blast cleaned +BC (see Table 2) and with an inspection document 2.2.

Round bars ISO 1035 - 40,0S × 8 000L2

ISO 683-5 - 31CrMo12+QT

inspection document ISO 10474 2.2

6 Manufacturing process

6.1 General

The manufacturing process of the steel and of the products is with the restrictions given by the requirements in 6.2 and 6.4, left to the discretion of the manufacturer.

6.2 Deoxidization

All steels shall be deoxidized.

6.3 Heat treatment and surface condition at delivery

6.3.1 Normal condition at delivery

Unless otherwise agreed at the time of enquiry and order, the products shall be delivered in the untreated, i.e. hot-worked condition.

6.3.2 Particular heat-treatment condition

If so agreed at the time of enquiry and order, the products shall be delivered in one of the particular heat-treatment conditions given in Table 1, lines 3 to 5.

6.3.3 Particular surface conditions

If so agreed at the time of enquiry and order, the products shall be delivered in another particular surface condition as given in Table 2, lines 3 to 6.

6.4 Traceability of the cast

Each product shall be traceable to the cast (see Clause 10).

7 Requirements

7.1 Chemical composition, hardness and mechanical properties

7.1.1 General

Table 1 shows the combinations of usual heat-treatment conditions at delivery, product forms and requirements as specified in Tables 3 to 6.

7.1.2 Chemical composition

The chemical composition determined by cast analysis shall comply with the values in Table 3. Permissible deviations between the limiting values for cast analysis and the values for product analysis are given in Table 4.

The product analysis shall be carried out when specified at the time of enquiry and order (see B.5).

7.1.3 Mechanical properties

The requirements for the mechanical properties are for steels delivered in the "soft annealed condition" (+A) according to the maximum Brinell hardness (see Table 5) and for steels delivered in the "quenched and tempered condition" (+QT) according to the values cited in Table 6.

7.2 Machinability

All steels are in the condition: "soft annealed" (+A) machinable.

Where a further improved machinability is required, special heat treatments may be agreed at the time of enquiry and order.

7.3 Cold shearability

Under suitable shearing conditions (avoiding local stress peaks, preheating, application of blades with a profile adapted to that of the product, etc.), all steels are shearable in the "soft annealed" (+A) condition.

7.4 Grain size

Unless otherwise agreed at the time of enquiry and order, the steel shall show a fine grain structure with an austenitic grain size of 5 and finer when tested in accordance with ISO 643. For verification, see B.3.

The ferrite content in the core of the quenched and tempered product shall be determined on one microsection per cast, dimension and heat treatment batch, if agreed at the time of enquiry and order.

7.5 Non-metallic inclusions

7.5.1 Microscopic inclusions

The special steels shall have a certain degree of cleanness; however, verification of the non-metallic inclusion content requires a special agreement. If there is such an agreement at the time of enquiry and order, the microscopic non-metallic inclusion content shall be determined to an agreed procedure and within agreed limits in accordance with ISO 4967 or another standard, e.g. regional standards EN 10247 or JIS G 0555.

7.5.2 Macroscopic inclusions

This requirement is applicable to the verification of the macroscopic inclusions in special steels. If verification is agreed, the method and acceptance limits shall be agreed at the time of enquiry and order.

7.6 Internal soundness

The steels shall be free from internal defects likely to have an adverse effect (see B.4).

7.7 Surface quality

7.7.1 All products shall have a smooth surface finish appropriate to the manufacturing processes applied.