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Heat-treatable steels, alloy steels and free-cutting steels — Part 17: Ball and roller bearing steels

Partie 17: Aciers pour roulements

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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 of 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 www.iso.org/iso/foreword.html.

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

This fourth edition cancels and replaces the third edition (ISO 683-17:2014), which has been technically revised.

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

- Requirements for Ca and Ti content have been added for through-hardening bearing steels;
- Requirements for O content have been added for through-hardening and induction-hardening bearing steels;
- Option for H content for premium bearing steels has been added for through-hardening, case-hardening and induction-hardening bearing steels;
- Option for verification of microscopic inclusions in Table A.1 for through-hardening bearing steels has been revised.

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

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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

Part 17: Ball and roller bearing steels

1 Scope

This part of ISO 683 specifies the technical delivery requirements for five groups of wrought ball and roller bearing steels as listed in [Table 3](#), namely

- through-hardening bearing steels (steels with about 1 % C and 1 % to 2 % Cr),
- case-hardening bearing steels,
- induction-hardening bearing steels (unalloyed and alloyed),
- stainless bearing steels, and
- high-temperature bearing steels.

This part of ISO 683 applies to the products and heat-treatment conditions given in [Table 1](#) and the surface conditions given in [Table 2](#).

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 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 642, *Steel — Hardenability test by end quenching (Jominy test)*

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

ISO 3763, *Wrought steels — Macroscopic methods for assessing the content of non-metallic inclusions*

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

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 4969, *Steel — Etching method for macroscopic examination*

ISO 5949, *Tool steels and bearing steels — Micrographic method for assessing the distribution of carbides using reference photomicrographs*

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

ISO 6508-1, *Metallic materials — Rockwell hardness test — Part 1: Test method*

ISO 6929, *Steel products — Vocabulary*

ISO 9443, *Surface quality classes for hot-rolled bars and wire rod*

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 6929 and the following apply.

3.1 ball and roller bearing steels
steels for rings and/or rolling bodies which use balls and rollers to maintain the separation between the moving parts of the bearing

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 steel grades covered by this part of ISO 683 are special steels.

4.2 Designation

For the steel grades covered by this part of ISO 683, the steel names given in the relevant tables are allocated in accordance with ISO/TS 4949.

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 products form (billets, bars, rod, wire, tubes, discs, etc.);
- c) either the reference to the dimensional standard and the dimensions and tolerances selected from it (see 7.6) or the designation of any other document covering the dimensions and tolerances required for the product;
- d) a reference to this part of ISO 683, i. e. ISO 683-17;
- e) the designation of the steel grade (see Table 3);
- f) the symbol for the heat-treatment condition on delivery (see 6.3.1 and Table 1);

- g) usually designation for an inspection certificate [3.1](#) or, if required, an inspection certificate 3.2 in accordance with ISO 10474.

5.2 Options/Supplementary or special requirements

A number of options are specified in this part of ISO 683 and listed below. If the purchaser does not indicate the wish to implement any of these options, the products will be supplied in accordance with the basic specifications of this part of ISO 683 (see [5.1](#)).

- a) If another surface condition than 'hot-worked' or a special surface quality is required, the surface condition (see [Table 2](#)), and the surface quality (see [7.5](#)).
- b) Any requirement concerning the hardenability (+H) (see 7.1.3 and [Table 5](#)) and the verification of hardenability and if agreed the information about calculation of the hardenability (see [9.2.2](#)).
- c) Any supplementary requirement that shall be complied with, the symbol and, where necessary, the details of this supplementary requirement (see [Annex A](#)).

EXAMPLE 50 hot-rolled round bars according to ISO 1035-1 with nominal diameter of 50,0 mm, nominal length of 8 000 mm and with tolerance class S on diameter of $\pm 0,40$ mm and tolerance class L2 on length of +100/0 mm in accordance with ISO 1035-4 and with hot-worked surface made of steel grade ISO 683-17, 100Cr6 (see [Table 3](#)) in annealed condition to achieve spheroidized carbides (+AC), with an inspection certificate [3.1](#) in accordance with ISO 10474:

50 round bars ISO 1035-1/-4 – 50,0 S × 8 000 L2

steel grade ISO 683-17 - 100Cr6+AC

inspection certificate ISO 10474 - 3.1

6 Manufacturing process

6.1 General

With the restrictions given by the requirements in [6.2](#) and [6.3](#) the manufacturing process of the steel and of the products is left to the discretions of the manufacturer.

If requested, the purchaser shall be informed about the steel making process used.

Remelting of the steel may be agreed upon at the time of enquiry and order.

6.2 Deoxidation, vacuum degassing and hydrogen removal

All steels shall be deoxidized.

Vacuum degassing and hydrogen removal treatment for premium applications is at the discretion of the manufacturer.

6.3 Heat treatment and surface condition at delivery

6.3.1 Heat-treatment condition

The products shall be delivered in one of the heat-treatment conditions given in [Table 1](#), lines 2 to 10, as agreed at the time of enquiry and order. If there is no agreement, the products shall be delivered in the untreated condition.

6.3.2 Particular surface conditions

If agreed upon at the time of enquiry and order, the products shall be delivered in one of the particular surface conditions given in [Table 2](#), lines 3 to 9.

6.3.3 Traceability of the cast

Each product shall be traceable to the cast, see [Clause 10](#).

7 Requirements

7.1 General

[Table 1](#) gives a survey of combinations of usual heat-treatment conditions at delivery, product forms and requirements according to [Tables 3](#) to [6](#) (chemical composition, hardenability, maximum hardness, hardness range).

In addition to this part of ISO 683, the general technical delivery requirements of ISO 404 are applicable.

7.2 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 the enquiry and order (see [9.1](#) and [A.2](#)).

7.3 Hardenability

Where the steel is not ordered according to hardenability requirements, i.e. where the steel type designations of [Table 3](#) and not the designations given in [Table 5](#) are applied, the requirements for hardness specified in [Table 6](#) (see also [Table 1](#), column 9) apply, as appropriate, for the particular heat-treatment condition. In this case, the values of hardenability given in [Table 5](#) are for guidance purposes only.

Where the steel is ordered to hardenability requirements by using the designations given in [Table 5](#) the values of hardenability given in [Table 5](#) apply in addition to the requirements cited in [Table 1](#), column 9 (see footnote b to [Table 3](#)).

7.4 Hardness

The hardness in the usual conditions of delivery is given in [Table 6](#).

7.5 Microstructure

7.5.1 Austenitic grain size of case-hardening and induction-hardening bearing steels

Case-hardening steels and induction-hardening steels shall have a fine grain size of 5 or finer (see ISO 643). For verification of the grain size, see [A.3](#).

7.5.2 Spheroidization and distribution of carbides

7.5.2.1 For deliveries in treatment conditions +AC and +AC+C, the carbides of the through-hardening steels shall be spheroidized and the carbides of the stainless and high-temperature bearing steels

shall be predominantly spheroidized. Case-hardening steels may show remnants of incompletely spheroidized carbides. For the degree of spheroidization see [A.4](#).

7.5.2.2 For distribution of carbides, see [A.5](#).

7.5.3 Structure of case-hardening steels in the condition +FP

The structure shall consist of ferrite-pearlite. Bainite contents up to 10 % are, however, permissible.

7.6 Non-metallic inclusions

7.6.1 Microscopic inclusions

The characterization of non-metallic inclusions is critically important to the fatigue life of bearings. Therefore all bearing steels shall have a certain degree of cleanliness. The requirements for the content of non-metallic inclusions apply in every case; however, verification requires a special agreement, see [A.6](#).

7.6.2 Macroscopic inclusions

If verification is agreed then the method and acceptance limits shall be agreed at the time of enquiry and order.

7.7 Internal soundness

Where appropriate, requirements relating to the internal soundness of the products shall be agreed at the time of enquiry and order, see [A.7](#).

7.8 Surface quality

7.8.1 All products shall have a smooth surface finish appropriate to the manufacturing process applied.

7.8.2 Ground or peeled/turned or machined products shall be free from surface discontinuities detrimental to practical use and surface decarburization.

7.8.3 If hot-rolled, forged, cold-reduced or rough-machined products are ordered for peeling or grinding to avoid

- a) surface decarburization, and
- b) surface defects

the machining allowances shall be agreed upon at the time of enquiry and order.

Alternatively, for round bars and rod, the permissible depth of surface discontinuities may be specified in accordance with ISO 9443.

7.9 Shape, dimensions and tolerances

The shape, dimensions and tolerances of the products shall comply with the requirements agreed upon at the time of enquiry and order. The agreements shall, as far as possible, be based on corresponding International Standards (see bibliography) or, otherwise, on suitable national standards.

8 Inspection

8.1 Testing procedures and types of inspection documents

8.1.1 Products complying with this part of ISO 683 shall be ordered and delivered with inspection certificate [3.1](#) or 3.2 as specified in ISO 10474. The type of document shall be agreed upon at the time of enquiry and order. If the order does not contain any specification of this type, an inspection certificate [3.1](#) shall be issued.

8.1.2 The specific inspections and tests described in [8.2](#) and [8.3](#) shall be carried out and the results shall be confirmed in the inspection certificate.

In addition the inspection certificate report shall cover:

- a) confirmation that the material complies with the requirements of the order;
- b) results of the cast analysis for all elements specified in [Table 3](#) for the steel grade concerned;
- c) the results of all inspections and tests ordered by supplementary requirements (see [Annex A](#));
- d) the symbol letters or numbers connecting the inspection document with the relevant test unit.

8.2 Frequency of testing

The amount of testing, the sampling conditions and the test methods to be applied for the verification of the requirements shall be in accordance with the prescriptions in [Table 7](#).

8.3 Specific inspection and testing

8.3.1 Verification of the hardenability and hardness

The hardness requirements given for the relevant heat-treatment condition in [Table 6](#) (see also [Table 1](#), column 9, sub-column [9.2](#)) shall be verified.

For steels ordered with the symbol +H in the designation (see [Table 5](#)), in addition, the hardenability requirements according to [Table 5](#) shall be verified.

8.3.2 Inspection of the surface quality

Unless otherwise agreed at the time of enquiry and order (see [A.8](#)), the extend of testing and the test method is left to the discretion of the manufacturer.

8.3.3 Dimensional inspection

Unless otherwise agreed at the time of enquiry and order (see [A.9](#)), the number of products to be inspected for their shape and dimensions shall be left to the discretion of the manufacturer.

9 Test methods

9.1 Chemical analysis

The choice of a suitable physical or chemical analytical method for the analysis shall be at the discretion of the manufacturer. In cases of dispute, the method for product analysis used shall be agreed, taking into account the relevant existing International Standards.

NOTE The list of available International Standards on chemical analysis is given in ISO/TR 9769.