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**Heat-treated steels, alloy steels  
and free-cutting steels —**

**Part 17:  
Ball and roller bearing steels**

*Aciers pour traitement thermique, aciers alliés et aciers pour décolletage —  
Partie 17: Aciers pour roulements*  
**(standards.iteh.ai)**

ISO 683-17:1999

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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 683-17 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 683-17:1976), which has been technically revised.

ISO 683 consists of the following parts, under the general title *Heat treated steels, alloy steels and free-cutting steels*:

- Part 1: *Direct-hardening unalloyed and low-alloyed wrought steels in form of different black products*
- Part 9: *Wrought free-cutting steels* ([standards.iteh.ai](https://standards.iteh.ai))
- Part 10: *Wrought nitriding steels*
- Part 11: *Wrought case-hardening steels* (<https://standards.iteh.ai/catalog/standards/sist/895dd83a-2709-4050-889a-ccc87c845edc/iso-683-17-1999>)
- Part 14: *Hot-rolled steels for quenched and tempered springs*
- Part 15: *Valve steels for internal combustion engines*
- Part 17: *Ball and roller bearing steels*
- Part 18: *Bright products of unalloyed and low-alloy steels*

Annex A forms a normative part of this part of ISO 683. Annexes B and C are for information only.

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# Heat-treated steels, alloy steels and free-cutting steels —

## Part 17: Ball and roller bearing steels

### 1 Scope

1.1 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.

1.2 This part of ISO 683 gives the technical delivery requirements for five groups of wrought ball and roller bearing steels as listed in Table 3, namely:

- a) through-hardening bearing steels (steels with about 1 % C and 1 % to 2 % Cr);
- b) case-hardening bearing steels;
- c) induction-hardening bearing steels (unalloyed and alloyed);
- d) stainless bearing steels;
- e) high temperature bearing steels.

1.3 In special cases variations in these technical delivery requirements or additions to them may form the subject of an agreement at the time of inquiry and order (see annex A).

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

### 2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 683. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 683 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

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

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

ISO 642:1999, *Steels — Hardenability test by end quenching (Jominy test).*

ISO 643:1983, *Steels — Micrographic determination of the ferritic or austenitic grain size.*

ISO 1035-1:1980, *Hot-rolled steel bars — Part 1: Dimensions of round bars.*

ISO 1035-4:1982, *Hot-rolled steel bars — Part 4: Tolerances.*

ISO 3763:1976, *Wrought steels — Macroscopic methods for assessing the content of non-metallic inclusions.*

ISO 3887:1976, *Steel, non-alloy and low-alloy — Determination of depth of decarburization.*

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

ISO 4967:1998, *Steel — Determination of content of nonmetallic inclusions — Micrographic method using standard diagrams.*

ISO 4969:1980, *Steel — Macroscopic examination by etching with strong mineral acids.*

ISO 5949:1983, *Tool steels and bearing steels — Micrographic method for assessing the distribution of carbides using reference photomicrographs.*

ISO 6506:1981<sup>1)</sup>, *Metallic materials — Hardness test — Brinell test.*

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

ISO 9443:1991, *Heat-treatable and alloy steels — Surface quality classes for hot-rolled round bars and wire rods — Technical delivery conditions.*

ISO/TR 9769:1991, *Steel and iron — Review of available methods of analysis.*

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

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

ENV 10247:1996, *Metallographic test methods — Examination of steels using standard diagrams to assess the content of non-metallic inclusions.*

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### 3 Terms and definitions

For the purposes of this part of ISO 683, the terms and definitions for the product forms given in ISO 6929 apply. The terms "unalloyed steel" and "alloyed steel" are as defined in ISO 4948-1.

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### 4 Ordering and designation

The designation of the product on an order shall cover the following.

- a) The designation of the product form (e. g. bar) followed by
  - 1) either the designation of the dimensional standard and the dimensions and tolerances selected from it (see 5.6) or
  - 2) the designation of any other document covering the dimensions and tolerances required for the product.
- b) If a surface condition other than "hot worked" or a special surface quality is required
  - 1) the surface condition (see Table 2), and
  - 2) the surface quality (see 5.5).
- c) A description of the steel comprising
  - 1) a reference to this part of ISO 683;
  - 2) the designation of the steel type (see Table 3);
  - 3) the symbol for the heat-treatment condition on delivery (see Table 1);
  - 4) the standard designation for the required type of inspection document (see ISO 10474);
  - 5) the symbol and, where necessary, the details of this supplementary requirement (see annex A), if any supplementary requirement shall be complied with.

<sup>1)</sup> This International Standard has been replaced by ISO 6506-1, ISO 6506-2 and ISO 6506-3.

## EXAMPLE

The following are to be ordered.

Hot-rolled round bars

- a) in accordance with ISO 1035-1;
- b) with a nominal diameter of 50,0 mm;
- c) with a nominal length of 8 000 mm;
- d) with a tolerance on diameter of  $\pm 0,40$  mm (class S of ISO 1035-4);
- e) with a tolerance on length of  ${}^{+100}_0$  mm (class L2 of ISO 1035-4);
- f) all other tolerances as given in ISO 1035-4, for normal cases.

Surface

- a) as hot worked

Steel

- a) in accordance with this part of ISO 683, type 100Cr6 (see Table 3);
- b) heat-treatment condition: annealed to achieve spheroidized carbides (symbol +AC, see Table 1);
- c) with an inspection certificate 3.1.B (see ISO 10474).

Designation

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Rounds ISO 1035-1-50,0 S  $\times$  8 000 L2

Steel ISO 683-17-100Cr6+AC-3.1.B

## 5 Requirements

### 5.1 Manufacturing process

#### 5.1.1 General

The manufacturing process of the steel and of the products is, with the restrictions given by the requirements in 5.1.2 and 5.1.3, left to the discretion of the manufacturer.

When he so requests, the purchaser shall be informed on the steel-making process used.

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

#### 5.1.2 Heat-treatment and surface condition at delivery

The heat-treatment and surface condition at delivery shall be as agreed when ordering.

Table 1 in combination with Table 6 covers the various product forms' and steel groups' usual heat-treatment conditions, and Table 2 the usual surface conditions.

#### 5.1.3 Cast separation

The steels shall be delivered separated by casts.

## 5.2 Chemical composition, hardness and hardenability

**5.2.1** Table 1 gives a survey on 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).

**5.2.2** Where the steel is not ordered 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 chemical composition and hardness cited in Table 1, column 10, 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.

**5.2.3** Where the steel is, by using the designations given in Table 5, ordered to hardenability requirements, the values of hardenability given in Table 5 apply in addition to the requirements cited in Table 1, column 10 (see footnote b to Table 3).

## 5.3 Microstructure

### 5.3.1 Austenitic grain size of case-hardening and induction-hardening bearing steels

Case-hardening steels and induction-hardening steels shall be fine grained. This requirement shall be regarded as complied with if

- a) in the case of case-hardening steels after holding the steel for 4 h at  $(925 \pm 10)$  °C, at least 70 % of the microstructure revealed according to one of the procedures given in ISO 643 consists of grains of size 5 or finer;
- b) in the case of induction hardening steels after holding for 1,5 h at  $(850 \pm 10)$  °C the microstructure revealed according to one of the procedures given in ISO 643 consists of grains of size 5 or finer.

For verification of the grain size see annex A.1. [ISO 683-17:1999  
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### 5.3.2 Spheroidization and distribution of carbides

**5.3.2.1** 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. If necessary, the required degree of spheroidization shall be agreed at the time of enquiry and order.

**5.3.2.2** For distribution of carbides, see annex A.2.

### 5.3.3 Structure of case-hardening steels in the condition +FP

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

## 5.4 Non-metallic inclusions

All bearing steels shall have a high degree of cleanness, i.e. a low content of non-metallic inclusions.

For microscopic non-metallic inclusions, see annex A.3 and annex B.

For macroscopic non-metallic inclusions, see annex A.4.

## 5.5 Surface quality

**5.5.1** All products shall have a workmanlike finish.

**5.5.2** Ground or turned or machined products shall be free from surface imperfections and surface decarburization.



**5.5.3** Hot-rolled, forged, cold-reduced, peeled or rough-machined products shall be ordered with sufficient material machining allowances to be removed from all surfaces by machining or grinding to allow for:

- a) surface decarburization and
- b) surface imperfections.

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.

## 5.6 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 or, otherwise, on suitable national standards.

**NOTE** For round bars, the following International Standards cover dimensions and/or tolerances for products included in this part of ISO 683:

ISO 1035-1 and ISO 1035-4.

## 6 Inspection, testing and conformance of products

### 6.1 Inspection and testing procedures and types of inspection documents

**6.1.1** For each delivery, the issue of any inspection document according to ISO 10474 may be agreed upon at the time of enquiry and order.

**6.1.2** If, in accordance with the agreements made at the time of enquiry and order, a test report is to be provided, this shall cover:

- a) the statement that the material complies with the requirements of the order;
- b) the results of the cast analysis for all elements specified for the type of steel supplied.

**6.1.3** If, in accordance with the agreements in the order, an inspection certificate 3.1.A, 3.1.B or 3.1.C or an inspection report 3.2 (see ISO 10474) is to be provided, the specific inspections and tests described in 6.2 shall be carried out and their results shall be certified in the document.

In addition the document shall cover:

- a) the results of the cast analysis provided by the manufacturer for all elements specified for the steel type concerned;
- b) the results of all inspections and tests ordered by supplementary requirements (see annex A);
- c) the symbol letters or numbers connecting the inspection document with the relevant test unit.

### 6.2 Specific inspection and testing

#### 6.2.1 General

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.

#### 6.2.2 Chemical composition

The cast analysis is given by the manufacturer. For product analysis see annex A.5.

### 6.2.3 Verification of the hardenability and hardness

The hardness requirements given for the relevant heat treatment condition in Table 1, column 10, sub-column ii, 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.

### 6.2.4 Inspection of the surface quality

**6.2.4.1** Unless otherwise agreed when ordering (see annex A.7), the number of products to be inspected for surface quality is left to the discretion of the inspector.

**6.2.4.2** Unless otherwise agreed (see annex A.7), the surface quality shall be inspected visually.

### 6.2.5 Dimensional inspection

Unless otherwise agreed when ordering (see annex A.8) the number of products to be inspected for their shape and dimensions shall be left to the discretion of the inspector.

### 6.2.6 Retests

For retests, ISO 404 shall apply.

## 7 Marking

The manufacturer shall mark the products or the bundles or boxes containing the products in a suitable way, so that identification of the cast, the steel type and the origin of the delivery is possible (see annex A.6).

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**Table 1 — Combination of usual heat-treatment conditions at delivery, product forms and requirements according to Tables 3 to 6**

1	2	3	4					5			6			7			8			9			10			11											
			Symbol	billets	bars	rod	wire	tubes	rings and discs	Applicable requirements if the steel is ordered with the designation given in Table 3			Applicable requirements if the steel is ordered with the designation given in Table 5																								
												i	ii		i	ii	iii																				
1	Untreated	None or +U	X	X	X	X	X	X	X	X	X																										
2	Treated for cold shearability	+S	X	-	-	-	-	-	-	-	-																										
3	Annealed (soft annealed)	+A	-	X	X	X	X	X	X	X	X																										
4	Stress relieved	+SR	-	-	-	-	-	-	-	-	-																										
5	Treated to hardness range	+HR	-	X	X	X	X	X	X	X	X																										
6	Annealed to achieve spheroidized carbides	+AC	-	X	X	X	X	X	X	X	X																										
7	Annealed to achieve spheroidized carbides and cold-worked	+AC+C	-	X	X	X	X	X	X	X	X																										
8	Isothermally treated to ferrite-perlite structure and hardness range	+FP	-	X	X	X	X	X	X	X	X																										
9	Others	Other treatment conditions, e.g. the quenched and tempered condition, may be agreed at the time of enquiry and order.																																			