



Standard Specification for Highly Loaded Anti-Friction Bearing Steel¹

This standard is issued under the fixed designation A1089/A1089M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers bars, billets, and blooms of bearing-quality steel to be used in the manufacture of highly loaded anti-friction bearings.

1.2 Supplementary requirements of an optional nature are provided and when desired shall be so stated in the order.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

2. Referenced Documents

2.1 *ASTM Standards*:²

A29/A29M Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought

A751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

E381 Method of Macroetch Testing Steel Bars, Billets, Blooms, and Forgings

E588 Practice for Detection of Large Inclusions in Bearing Quality Steel by the Ultrasonic Method

E1019 Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel, Iron, Nickel, and Cobalt Alloys by Various Combustion and Fusion Techniques

E2283 Practice for Extreme Value Analysis of Nonmetallic Inclusions in Steel and Other Microstructural Features

2.2 *Other Document*:³

ISO 4967 Steel—Determination of Content of Nonmetallic Inclusions—Micrographic Method Using Standard Diagrams

¹ This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.28 on Bearing Steels.

Current edition approved May 15, 2014. Published July 2014. DOI: 10.1520/A1089_A1089M-14

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland, <http://www.iso.org>.

3. Ordering Information

3.1 Orders for material under this specification should include the following information:

3.1.1 Quantity,

3.1.2 Grade identification,

3.1.3 Specification designation and year of issue,

3.1.4 Dimensions, and

3.1.5 Supplementary requirements, if included.

4. Process

4.1 The steel shall be made by a basic oxygen or electric furnace process, with vacuum degassing and suitable shrouding, that provides a high quality product meeting the requirements of this specification. The use of a vacuum-arc remelt or an electro-slag remelt process is not required but is not excluded.

5. Chemical Composition and Analysis

5.1 The chemical composition shall be agreed upon between the manufacturer and purchaser.

5.2 All compositions shall meet the element maximums of **Table 1**.

5.3 An analysis of each heat of steel shall be made by the steel manufacturer in accordance with Test Methods, Practices, and Terminology **A751**. The chemical composition thus determined shall conform to the requirements specified.

5.4 Product analysis may be made by the purchaser in accordance with Test Methods, Practices, and Terminology **A751**. Permissible variations in product analysis shall be in accordance with Specification **A29/A29M**.

6. Sizes, Shapes, and Dimensional Tolerances

6.1 The physical size and shape of the material shall be agreed upon between manufacturer and purchaser.

6.2 Dimensional tolerances shall conform to the requirements specified in Specification **A29/A29M**. For sizes and shapes not covered by Specification **A29/A29M**, dimensional tolerances shall be agreed upon between manufacturer and purchaser.

7. Quality Tests

7.1 The supplier shall be held responsible for the quality of the material furnished and shall make the necessary tests to

TABLE 1 Element Maximums^{A,B}

Phosphorus	Sulfur	Oxygen ^C	Aluminum ^D	Copper	Titanium	Tin	Arsenic	Antimony	Lead
0.015	0.015	See footnote	0.050	0.30	0.0050	0.030	0.040	0.020	0.002

^A Elements not agreed upon between the manufacturer and purchaser shall not be intentionally added to the steel.

^B Intentional additions of calcium or calcium alloys for deoxidation or inclusion shape control are not permitted unless specifically approved by the purchaser.

^C Oxygen content applies to product analysis and shall be determined in accordance with Test Methods E1019. A maximum average oxygen content of 0.0015 shall be required for carburizing and induction hardening steels, and a maximum average content of 0.0010 shall be required for through hardening steels.

^D Total aluminum content.

ensure this quality. The supplier shall report results of the macroetch and micro-inclusion tests detailed below for either heat qualification or product qualification.

7.2 Sampling—Samples taken in accordance with the following paragraphs shall be obtained from rolled or forged sections. A minimum 3 to 1 reduction of rolled or forged sections is required for all products.

7.3 Heat Qualification Sampling:

7.3.1 For the qualification of an entire bottom poured heat, a minimum of six samples shall be examined and shall represent the top and bottom of three ingots. One ingot shall be taken at random from the first usable plate poured, one ingot at random from the usable plate poured nearest to the middle of the heat, and one ingot at random from the last usable plate poured. When two usable plates constitute a heat, two of the sample ingots shall be selected from the second usable plate poured. Where a single usable plate constitutes a heat, any three random ingots may be selected. Other methods of sampling shall be as agreed upon between manufacturer and purchaser.

7.3.2 For the qualification of an entire strand cast heat, a minimum of six samples representing the first, middle, and last usable portion of the heat shall be examined. The first, middle, and last portion of at least one outer strand shall be tested and at least one sample from any usable portion of each remaining strand shall be tested. Other methods of sampling shall be as agreed upon between manufacturer and purchaser.

7.4 Product Qualification Sampling:

7.4.1 For qualification of material not subjected to heat qualification, bars rolled or forged to the same final product size shall be randomly sampled. The number of samples shall be proportional to the amount of the heat applied, but shall not be less than two or more than ten.

7.5 Macroetch—Specimens representative of the full cross section of bars, billets, or blooms shall be macroetched and rated in accordance with Method E381 in hydrochloric acid and water (1:1) at a temperature of 160 to 180°F [71 to 82°C]. Such specimens shall not exceed S1, R1, C2 of Method E381. Indications due to sulfur segregation (commonly referred to as Type A segregates) are not to be included in the rating. For ingot cast material only, if the size and weight of the bars, billets, or blooms prevent the full cross section from being macroetched, an oversize quarter-section may be used as an alternative. The quarter-section must meet the reduction requirement of 7.2 and contain both the surface and center of the original cross section before reduction.

7.6 Inclusion Rating—The specimens shall be approximately 10 by 20 mm and shall be taken from an area halfway between the center and outside of the bar, billet, or bloom. The polished face shall be longitudinal to the direction of rolling. The specimens shall be rated with Method A of ISO 4967. Fields with sizes or numbers of all types of inclusions intermediate between configurations shown on the chart shall be classified as the lesser of the rating number. The worst field of each inclusion type from each specimen shall be recorded as the rating for the specimen. The average of all specimen ratings shall not exceed the rating specified in Table 2.

7.7 Inclusion Size—The maximum stringer length and the maximum globular diameter shall not exceed the limits of Table 3. These maximum values apply only to the qualification procedures described in this specification and cannot be used on material in forms other than the supplied bar, billet, or bloom.

8. Inspection

8.1 The manufacturer shall afford the purchaser's inspector all reasonable facilities necessary to satisfy him that the material is being produced and furnished in accordance with this specification. Mill inspection by the purchaser shall not interfere unnecessarily with the manufacturer's operations. All tests and inspections shall be made at the place of manufacture, unless otherwise agreed to.

9. Certification and Reports

9.1 Upon request of the purchaser in the contract or order, a manufacturer's certification that the material was manufactured and tested in accordance with this specification, together with a report of the test results shall be furnished at the time of shipment. Special requirements agreed to at the time of purchase shall be noted on the certification.

10. Keywords

10.1 anti-friction; bearing steel; nonmetallic inclusions

TABLE 2 Average Inclusion Rating

Rating Units		
Thin Series		Heavy Series
A—2.5		A—1.5
B—1.5		B—1.0
C—0		C—0
D—1.0		D—1.0
		DS—1.5



TABLE 3 Maximum Inclusion Size

Stringer Length (μm)	Globular Diameter (μm)
710	52

SUPPLEMENTARY REQUIREMENTS

One or more of the supplementary requirements described below apply when included in the purchaser's order or contract. When so included, a supplementary requirement shall have the same force as if it were in the body of the specification. Supplementary requirements' details not fully described shall be agreed upon between the purchaser and the supplier, but shall not negate any of the requirements in the body of the specification.

S1. Detection of Large Inclusions by the Ultrasonic Method

S1.1 For the process qualification of a manufacturer, the purchaser may specify Practice E588. The limits shall be as agreed upon between manufacturer and purchaser. This Supplementary Requirement is not intended for the evaluation of material on a production basis.

S2. Extreme Value Analysis of Nonmetallic Inclusions

S2.1 For the process qualification of a manufacturer, the purchaser may specify Practice E2283. The limits shall be as agreed upon between manufacturer and purchaser. This Supplementary Requirement is not intended for the evaluation of material on a production basis.

ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org). Permission rights to photocopy the standard may also be secured from the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, Tel: (978) 646-2600; <http://www.copyright.com/>