



Designation: A485 – 03

Standard Specification for High Hardenability Antifriction Bearing Steel¹

This standard is issued under the fixed designation A485; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This specification covers high hardenability modifications of high-carbon bearing quality steel to be used in the manufacture of antifriction 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 inch-pound units are to be regarded as the standard.

2. Referenced Documents

2.1 *ASTM Standards:*²

A29/A29M Specification for Steel Bars, Carbon and Alloy, Hot-Wrought, General Requirements for²

A255 Test Methods for Determining Hardenability of Steel³

A751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products⁴

E45 Test Methods for Determining the Inclusion Content of Steel⁴

E381 Method of Macroetch Testing Steel Bars, Billets, Blooms, and Forgings⁵

E1019 Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel, Iron, Nickel, and Cobalt Alloys by Various Combustion and Fusion Techniques⁴

E1077 Test Methods for Estimating the Depth of Decarburization of Steel Specimens

2.2 *Other Standards:*

SAE J148a Grain Size Determination of Steel⁶

ISO 683 Part 17: Ball and Roller Bearing Steels⁷

3. Ordering Information

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

3.1.1 Quantity (weight or number of pieces),

3.1.2 Grade identification,

3.1.3 ASTM designation and year of issue,

3.1.4 Dimensions,

3.1.5 Supplementary requirements, if included.

4. Process

4.1 The steel shall be made by a process that is capable of providing a high quality product meeting the requirements of this specification.

5. Chemical Composition and Analysis

5.1 Typical examples of chemical compositions are shown in **Table 1**. Other compositions may be specified.

5.2 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 in **Table 1** for the ordered grade or to other requirements agreed upon between manufacturer and purchaser.

5.3 Product analysis may be made by the purchaser in accordance with Test Methods, Practice, 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 for hot-rolled or hot-rolled and annealed bars, in straight lengths or coils, and cold-finished bars furnished under this specification shall conform to the requirements specified in the latest edition of Specification **A29/A29M**.

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.

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² *Annual Book of ASTM Standards*, Vol 01.05.

³ *Annual Book of ASTM Standards*, Vol 01.03.

⁴ *Annual Book of ASTM Standards*, Vol 03.01.

⁵ *Annual Book of ASTM Standards*, Vol 03.06.

⁶ Available from The Engineering Society for Advanced Mobility of Land, Sea, Air and Space, 400 Commonwealth Drive, Warrendale, PA 15096-001.

⁷ Available from the International Organization for Standardization (ISO), 1, rue de Varembé, Case postale 56, CH-1211, Genève 20, Switzerland.

TABLE 1 Chemical Composition^{A,B}

Number ^C	Name	C	Mn	P (max)	S (max)	Si	Cr	Ni (max)	Ti (max)	Cu (max)	Mo	O (max) ^D	Al (max)
1	Grade 1	0.90–1.05	0.90–1.20	0.025	0.015	0.45–0.75	0.90–1.20	0.25	0.0050	0.30	0.10 (max)	0.0015	0.050
2	Grade 2	0.85–1.00	1.40–1.70	0.025	0.015	0.50–0.80	1.40–1.80	0.25	0.0050	0.30	0.10 (max)	0.0015	0.050
3	Grade 3	0.95–1.10	0.65–0.90	0.025	0.015	0.15–0.35	1.10–1.50	0.25	0.0050	0.30	0.20–0.30	0.0015	0.050
4	Grade 4	0.95–1.10	1.05–1.35	0.025	0.015	0.15–0.35	1.10–1.50	0.25	0.0050	0.30	0.45–0.60	0.0015	0.050
B2	100CrMnSi4–4	0.93–1.05	0.90–1.20	0.025	0.015	0.45–0.75	0.90–1.20	...	^E	0.30	0.10 (max)	0.0015	0.050
B3	100CrMnSi6–4	0.93–1.05	1.00–1.20	0.025	0.015	0.45–0.75	1.40–1.65	...	^E	0.30	0.10 (max)	0.0015	0.050
B4	100CrMnSi6–6	0.93–1.05	1.40–1.70	0.025	0.015	0.45–0.75	1.40–1.65	...	^E	0.30	0.10 (max)	0.0015	0.050
B5	100CrMo7	0.93–1.05	0.25–0.45	0.025	0.015	0.15–0.35	1.65–1.95	...	^E	0.30	0.15–0.30	0.0015	0.050
B6	100CrMo7–3	0.93–1.05	0.60–0.80	0.025	0.015	0.15–0.35	1.65–1.95	...	^E	0.30	0.20–0.35	0.0015	0.050
B7	100CrMo7–4	0.93–1.05	0.60–0.80	0.025	0.015	0.15–0.35	1.65–1.95	...	^E	0.30	0.40–0.50	0.0015	0.050
B8	100CrMnMoSi8–4–6	0.93–1.05	0.80–1.10	0.025	0.015	0.40–0.60	1.80–2.05	...	^E	0.30	0.50–0.60	0.0015	0.050

^A Elements not quoted shall not be intentionally added to the steel without the agreement of the purchaser.

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

^C Steels B2 through B8 meet the requirements of ISO 683, Part 17, Second Edition, Table 3.

^D Oxygen content applies to product analysis and shall be determined in accordance with Test Methods E1019.

^E A maximum titanium content may be agreed upon at the time of inquiry and order.

TABLE 2 Inclusion Rating

Rating Units	
Thin Series	Heavy Series
A—2½	A—1½
B—2	B—1
C—½	C—½
D—1	D—1

TABLE 3 Hardenability Values

Grade	Rockwell C	
	Minimum Rockwell C Values at Sixteenth of Inch	
	10	20
1	46	...
2	...	52
3	46	...
4	...	52

7. Quality Tests

7.1 The supplier shall be held responsible for the quality of the material furnished and shall make the necessary tests detailed below: Quality tests shown in 7.1 through 7.4 are based upon procedures established in Practice E45.

7.2 *Sampling*—Samples taken in accordance with the following paragraphs shall be obtained from 4 by 4 in. (102 by 102 mm) rolled billets or forged sections. Tests may be made on smaller or larger sections by agreement with the purchaser. A minimum of 3 to 1 reduction of rolled billets or forged sections is required for strand cast products.

7.2.1 For top poured products, a minimum of six samples representing the top and bottom of the first, middle and last usable ingots shall be examined.

7.2.2 For bottom poured products, a minimum of six samples shall be taken from semi-finished or finished product representing 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 a heat is constituted by two usable plates, two of the sample ingots shall be selected from the second usable plate poured. When a heat consists of a single usable plate, any three random ingots may be selected. Other methods of sampling shall be as agreed upon between manufacturer and purchaser.

7.2.3 For strand cast products, a minimum of six samples representing the first, middle, and last portion of the heat cast shall be examined. At least one sample shall be taken from each strand.

7.3 *Macroetch*—Specimens representative of cross-sections of billets shall be macroetched and rated in accordance with Method E381 in hydrochloric acid and water (1.1) at 60 to 180°F (71 to 82°C). Such specimens shall not exceed S2, R2, C2 of Method E381.

7.4 *Inclusion Rating*—Specimens approximately ¾ by ¾ in. (9.5 by 19.1 mm) shall be taken from an area halfway between the center and outside of the billet. The polished face shall be longitudinal to the direction of rolling. The scale used for rating the specimens shall be the chart described in Practice E45, Method A, Plate I-r. Inclusion fields with sizes or numbers 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. Two thirds of all specimens and at least one from each ingot tested, or from the first, middle and last portion of the strands tested as well as the average of all specimens, shall not exceed the rating specified in Table 2.

8. Grain Size

8.1 The steels covered by this specification shall have the capability of showing fine fracture grain size (approximately ASTM No. 8) (SAE J418a) when quenched from normal austenizing temperatures not exceeding 1550°F (843°C).

9. Hardenability

9.1 Each heat shall be tested for hardenability. Normalizing followed by spheroidize annealing shall precede heating for end quenching. In heating for end quenching, the test specimens shall be held for a minimum of 30 min at 1500 ± 8°F (815 ± 4.5°C). End-quench procedure shall be in accordance with Test Method A255. The “J” values for hardenability as shown in Table 3 shall apply.

10. Decarburization and Surface Imperfections

10.1 Decarburization and surface imperfections shall not exceed the limits specified in Table 4. Decarburization shall be measured using the microscopical methods described in Test Method E1077.