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An American National Standard

Standard Specification for Stainless Anti-Friction Bearing Steel[1]

This standard is issued under the fixed designation A 756; 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 the requirements for chromium-carbon bearing quality stainless steel to be used in the manufacture of 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 inch-pound units are to be regarded as the standard.

2. Referenced Documents

2.1 *ASTM Standards:*

A 484/A 484M Specification for General Requirements for Stainless Steel Bars, Billets, and Forgings[2]

A 751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products[2]

E 45 Test Methods for Determining the Inclusion Content of Steel[3]

E 381 Test Method of Macroetch Testing Steel Bars, Billets, Blooms, and Forgings [3]

E 1019 Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel and in Iron, Nickel, and Cobalt Alloys[4]

E 1077 Test Method for Estimating the Depth of Decarburization of Steel Specimens[3]

2.2 *Other Standard:*

SAE J418a Grain Size Determination of Steel[5]

3. Ordering Information

3.1 Orders for material under 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, shape, and

3.1.5 Supplementary Requirements, if desired.

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

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 A 751. The chemical composition thus determined shall conform to the requirements specified in Table 1 for the ordered grade or to requirements agreed upon between the manufacturer and the purchaser.

5.3 Product analysis may be made by the purchaser in accordance with Test Methods A 751. Permissible variations in product analysis shall be made in accordance with Specification A 484/A 484M.

6. Dimensions, Mass, and Permissible Variations

6.1 The 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 0.500 in. (12.7 mm) and larger in diameter furnished under this specification shall conform to the requirements specified in the latest edition of Specification A 484/A 484M.

6.3 Dimensional tolerances for cold-finished coils for ball and roller material shall be as shown in Table 2.

6.4 Coil tolerances also apply to cold-finished straight lengths under 0.500 in. (12.7 mm) in diameter.

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 ensure this quality. The supplier shall be required to report on the results of the macroetch and microinclusion rating tests detailed below. Quality tests shown in 7.2 through 7.4 are based upon procedures established in Test Methods E 45.

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 3 to 1 reduction of rolled billets or forged sections

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[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 01.03.

[3] *Annual Book of ASTM Standards*, Vol 03.01.

[4] *Annual Book of ASTM Standards*, Vol 03.05.

[5] Available from Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096.

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TABLE 1 Chemical Composition

Element	440C	440C MOD
Carbon	0.95 to 1.10	1.00 to 1.10
Manganese, max	1.00	0.30 to 1.00
Phosphorus, max	0.025	0.025
Sulfur, max	0.025	0.025
Silicon, max	1.00	0.20 to 1.00
Chromium	16.00 to 18.00	13.00 to 15.00
Nickel, max	0.75	0.75
Copper, max	0.50	0.50
Molybdenum	0.40 to 0.65	3.75 to 4.25

TABLE 2 Dimensional Tolerances for Cold-Finished Coils

Size, in. (mm)	Total Tolerance, in. (mm)
Through 0.096 (2.44)	0.002 (0.05)
Over 0.096 to 0.270 (2.44 to 6.86), incl	0.003 (0.08)
Over 0.270 to 0.750 (6.86 to 19.1), incl	0.004 (0.10)

is required for strand cast products.

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

7.2.2 For bottom poured products, a minimum of six samples shall be examined and they 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 the manufacturer and the 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 Test Method E 381 acid and water (1:1) at 160 to 180°F (71 to 82°C). Such specimens shall not exceed S 2, R 2, and C 2 of Test Method E 381.

7.4 *Inclusion Rating*—The specimens shall be ⅜ by ¾ in. (9.5 by 19.1 mm) and 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 Jernkontoret chart described in Method A of Test Methods E 45, Plate III. Plate I is to be used for inclusion exceeding a rating of 2½. 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. Two thirds of all specimens and at least one from each ingot tested, as well as the average of all specimens, shall not exceed the rating specified in Table 3.

8. Response to Heat Treatment

8.1 Specimens with sections ⅜ in. (9.5 mm) in thickness, cut from a bar, billet, or forging, shall be placed in a furnace that is at 1875 ± 10°F (1023.8 ± 5.5°C), allowed to heat to 1875 ± 10°F, held at heat 25 min, and cooled in still air. Hardness of such specimens shall be not lower than 58 HRC.

8.2 Samples heat treated as in 8.1 shall show a fracture grain size of No. 6 or finer. (See SAE J418a.)

TABLE 3 Inclusion Rating

Rating Units		
Type	Thin Series	Heavy Series
A	2.0	1.5
B	2.5	1.5
C	2.0	1.5
D	2.0	1.0

9. Decarburization and Surface Imperfections

9.1 Decarburization and surface imperfections shall not exceed the limits specified in Table 4 and Table 5. Decarburization shall be measured using the microscopical methods described in Test Method E 1077.

10. Microstructure and Hardness

10.1 The material shall be free of excessive carbide segregation.

10.2 When annealing is specified in the order, the steel shall have a completely spheroidized microstructure and a hardness as specified in Table 6.

10.3 Small sizes where Rockwell B scale hardness readings are impractical shall show a maximum tensile strength of 115 000 psi (792 mPa).

11. Inspection

11.1 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.

12. Certification and Reports

12.1 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 the shipment.

TABLE 4 Decarburization and Surface Imperfections for Coils and Bars for Balls and Rollers

	Decarburization or Surface Imperfections per Side, max, in. (mm)	
Size, in. (mm)	Hot-Rolled or Hot-Rolled Annealed	Cold-Finished Annealed
Through 0.250 (6.35)	0.005 (0.13)	0.003 (0.08)
Over 0.250 (6.35) to 0.500 (12.7), incl	0.006 (0.15)	0.004 (0.10)
Over 0.500 (12.7) to 0.750 (19.1), incl	0.008 (0.20)	0.006 (0.15)
Over 0.750 (19.1) to 1.000 (25.4), incl	0.010 (0.25)	0.008 (0.20)

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TABLE 5 Decarburization and Surface Imperfections for Bars and Tubes

Size, in. (mm)	Decarburization or Surface Imperfections per Side, max, in. (mm)				
		Hot-Rolled Annealed		Cold-Finished Annealed	
	Hot-Rolled Bars	Bars	Tubes	Bars	Tubes
Through 1.000 (25.4)	0.012 (0.31)	0.015 (0.38)	0.012 (0.31)	0.012 (0.31)	0.010 (0.21)
Over 1.000 (25.4) to 2.000 (50.8), incl	0.017 (0.43)	0.022 (0.56)	0.020 (0.51)	0.015 (0.38)	0.014 (0.36)
Over 2.000 (50.8) to 3.000 (76.2), incl	0.025 (0.64)	0.030 (0.76)	0.030 (0.76)	0.025 (0.64)	0.019 (0.48)
Over 3.000 (76.2) to 4.000 (101.6), incl	0.035 (0.89)	0.045 (1.14)	0.035 (0.89)		0.024 (0.61)
Over 4.000 (101.6) to 5.000 (127.0), incl	0.055 (1.40)	0.065 (1.65)	0.040 (1.02)		0.028 (0.71)

TABLE 6 Maximum Hardness for Annealed Material

Product	Condition	Maximum Hardness	
		Brinell	Rockwell
Coils	hot-rolled-annealed	. . .	25 HRC
Bars and tubes	hot-rolled-annealed	255 HB	. . .
Coils, bars, and tubes	cold-drawn-annealed	255 HB	100 HRB
Coils, bars, and tubes	annealed-cold-drawn	as agreed upon between the purchaser and the manufacturer	

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. Residual Elements

S1.1 The purchaser may specify that the analysis of titanium, aluminum, and/or oxygen (Test Methods E 1019) be provided by agreement with the steel manufacturer. The number and location of samples shall be by agreement between the purchaser and manufacturer.

S2. Calcium Additions

S2.1 Intentional additions of calcium or calcium alloys for deoxidation or inclusion shape control are not permitted unless specifically approved by the purchaser. The use oflime or fluorspar, or both, in the steelmaking slag is acceptable.

S3. Magnetic Particle Method

S3.1 The purchaser may specify that the magnetic particle method described be used in addition to the microinclusion rating system described in 7.4. The magnetic particle method measures bearing steel cleanliness by evaluating the total length of macroinclusions for a stated area or per unit area. Results are commonly expressed in millimetres per square metre.

S3.2 *Sampling*—See 7.2.

S3.3 Test specimens shall be straight cylinder quarter section samples prepared and examined in accordance with the magnetic particle method of Test Methods E 45.

S3.4 For purposes of calculation, an inclusion length shall be taken as the mean length of the length bracket into which it falls; that is, an inclusion in the 1⁄16 to 1⁄8-in. bracket shall be taken as being 3⁄32 in. in length. The sum of all lengths for each specimen shall be determined and expressed as total length per area inspected. The average total length per area inspected of all six specimens shall not exceed 200 mm /m^2 (or equivalent).

S4. Sample Reduction Ratio

S4.1 For the sampling described in 7.2, the purchaser may specify that he reduction ratio from as-cast section to test section be provided.

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