



## Standard Specification for Carburizing Steels for Anti-Friction Bearings<sup>1</sup>

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*This standard has been approved for use by agencies of the Department of Defense. Consult the DoD Index of Specifications and Standards for the specific year of issue which has been adopted by the Department of Defense.*

### 1. Scope

1.1 This specification covers the requirements for carburizing bearing-quality 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 29/A29M Specification for Steel Bars, Carbon and Alloy, Hot-Wrought and Cold Finished, General Requirements for<sup>2</sup>

A 255 Method for End-Quench Test for Hardenability of Steel<sup>2</sup>

A 304 Specification for Steel Bars, Alloy, Subject to End-Quench Hardenability Requirements<sup>2</sup>

A 510 Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel<sup>3</sup>

A 519 Specification for Seamless Carbon and Alloy Steel Mechanical Tubing<sup>4</sup>

A 751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products<sup>3</sup>

A 752 Specification for General Requirements for Wire Rods and Coarse Round Wire, Alloy Steel<sup>3</sup>

E 45 Practice for Determining the Inclusion Content of Steel<sup>5</sup>

E 112 Test Methods for Determining the Average Grain Size<sup>5</sup>

E 381 Method of Macroetch Testing, Inspection, and Rating Steel Products, Comprising Bars, Billets, Blooms, and Forgings<sup>5</sup>

E 1077 Test Method for Estimating the Depth of Decarbur-

ization of Steel Specimens<sup>5</sup>

### 3. Ordering Information

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

3.1.1 Quantity,

3.1.2 Alloy grade identification,

3.1.3 Specification designation and year of issue, and

3.1.4 Dimensions, shape, and

3.1.5 Supplementary requirements.

### 4. Materials and Manufacture

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 A 751. 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 A 751. Permissible variations in product analysis shall be in accordance with Specification A 29/A 29M, Practices, and Terminology.

### 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 shall conform to the requirements specified in Specifications A 29/A 29M, A 510, A 519, or A 752 as appropriate for the material or as agreed between manufacturer and purchaser.

6.3 The dimensional tolerances for the forgings shall conform to the requirements of the engineering drawing.

### 7. Quality Assurance

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

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<sup>2</sup> Annual Book of ASTM Standards, Vol 01.05.

<sup>3</sup> Annual Book of ASTM Standards, Vol 01.03.

<sup>4</sup> Annual Book of ASTM Standards, Vol 01.01.

<sup>5</sup> Annual Book of ASTM Standards, Vol 03.01.

**TABLE 1 Chemical Composition<sup>A</sup>**

Alloy Grade	Composition, %				
	Carbon	Manganese	Nickel	Chromium	Molybdenum
4118H	0.17 to 0.23	0.60 to 1.00	...	0.30 to 0.70	0.08 to 0.15
4320H	0.17 to 0.23	0.40 to 0.70	1.55 to 2.00	0.35 to 0.65	0.20 to 0.30
4620H	0.17 to 0.23	0.35 to 0.75	1.55 to 2.00	...	0.20 to 0.30
4720H	0.17 to 0.23	0.45 to 0.75	0.85 to 1.25	0.30 to 0.60	0.15 to 0.25
4817H	0.14 to 0.20	0.30 to 0.70	3.20 to 3.80	...	0.20 to 0.30
4820H	0.17 to 0.23	0.40 to 0.80	3.20 to 3.80	...	0.20 to 0.30
5120H	0.17 to 0.23	0.60 to 1.00	...	0.60 to 1.00	...
8617H	0.14 to 0.20	0.60 to 0.95	0.35 to 0.75	0.35 to 0.65	0.15 to 0.25
8620H	0.17 to 0.23	0.60 to 0.95	0.35 to 0.75	0.35 to 0.65	0.15 to 0.25
9310H	0.07 to 0.13	0.40 to 0.70	2.95 to 3.55	1.00 to 1.45	0.08 to 0.15

<sup>A</sup>These steels also contain silicon—0.15 to 0.35, phosphorus—0.025 max, and sulfur—0.025 max.

the results of the macroetch and micro-inclusion rating tests detailed below. Quality tests shown in 7.2 through 7.4 are based upon procedures established in Practice 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 three to one 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 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 by manufacturer and purchaser.

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

7.3 Macroetch specimens or forged sections representative of cross sections of billets shall be macroetched and rated in accordance with Method E 381 in hydrochloric acid and water (at a ratio of 1 to 1) at 160 to 180°F (71 to 82°C). Such specimens shall not exceed S2, R2, and C2 of Method E 381.

7.4 *Inclusion Rating*—The polished face of the specimens shall be 3/8 by 3/4 in. (9.5 by 19.1 mm) and shall be taken from an area halfway between the center and outside of the billet or forged sections. 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 Practice E 45, Method A, Plate III. Plate I is to be used for inclusion

exceeding a rating of 2 1/2. 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, 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. If specifically ordered and certified to supplementary requirement S8. Type A inclusion ratings shall not exceed 3.0 thin and 2.0 heavy. See S8.1.

**8. Grain Size**

8.1 The grain size shall be six or finer as defined in Test Methods E 112 (see Plate 4, austenitic grain size in steels). Material not meeting this requirement may be normalized at 1700°F (927°C) or above and retested.

**9. Hardenability**

9.1 Each heat shall be tested for hardenability in accordance with Method A 255. The “J” values for hardenability shall conform to limits specified in Specification A 304 or as agreed upon by manufacturer and purchaser.

**10. Decarburization and Surface Imperfections**

10.1 Decarburization and surface imperfections shall not exceed the limits specified in Table 3 and Table 4. Decarburization shall be measured using the microscopical methods described in Test Method E 1077.

**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 upon.

**12. Certification and Reports**

12.1 Upon request of the purchaser in the contract or order,

**TABLE 2 Inclusion Rating**

Rating Units	
Thin Series	Heavy Series
A 2 1/2	A 1 1/2
B 2	B 1
C 1/2	C 1/2
D 1	D 1