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# Standard Specification for Carburizing Steels for Anti-Friction Bearings[1]

This standard is issued under the fixed designation A534; 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 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.

~~1.3The values stated in inch-pound units are to be regarded as the standard.~~

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

## 2. Referenced Documents

2.1 *ASTM Standards:*[2]

A29/A29M Specification for Steel Bars, Carbon and Alloy, Hot-Wrought, General Requirements for
A255 Test Methods for Determining Hardenability of Steel
A304 Specification for Carbon and Alloy Steel Bars Subject to End-Quench Hardenability Requirements
A510 Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
A519 Specification for Seamless Carbon and Alloy Steel Mechanical Tubing
A751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products
A752 Specification for General Requirements for Wire Rods and Coarse Round Wire, Alloy Steel
E45 Test Methods for Determining the Inclusion Content of Steel
E112 Test Methods for Determining Average Grain Size
E381 Method of Macroetch Testing Steel Bars, Billets, Blooms, and Forgings
E1019 Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel, Iron, Nickel, and Cobalt Alloys by Various Combustion and Fusion Techniques
E1077 Test Methods for Estimating the Depth of Decarburization of Steel Specimens

2.2 *ISO Standard:*[3]

ISO 683 Part 17: Ball and Roller Bearing Steels



## 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,
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.

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

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[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, Case postale 56, CH-1211, Geneva 20, Switzerland, http://www.iso.ch.

***A Summary of Changes section appears at the end of this standard.**

## 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, Practices, and Terminology A751. Permissible variations in product analysis shall be in accordance with Specification A29/A29M, 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 A29/A29M, A510, A519, or A752 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 the results of the ~~macroetch and~~ micro-inclusion rating tests detailed below. Quality tests shown in 7.2 through ~~7.4~~ 7.3 are based upon procedures established in Test Methods 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 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 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.

~~7.3Macroetch specimens or forged sections representative of cross sections of billets shall be macroetched and rated in accordance with Method E381 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 E381.~~



**TABLE 1 Chemical Composition**[A,B]

| Number[C] | Name | C | Mn | P (max) | S (max) | Si | Cr | Ni | Mo | Cu (max) | O (max)[D] | Al (max) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ... | 4118H | 0.17 - 0.23 | 0.60 - 1.00 | 0.025 | 0.015 | 0.15 - 0.35 | 0.30 - 0.70 | ... | 0.08 - 0.15 | 0.30 | 0.0020 | 0.050 |
| ... | 4320H | 0.17 - 0.23 | 0.40 - 0.70 | 0.025 | 0.015 | 0.15 - 0.35 | 0.35 - 0.65 | 1.55 - 2.00 | 0.20 - 0.30 | 0.30 | 0.0020 | 0.050 |
| ... | 4620H | 0.17 - 0.23 | 0.35 - 0.75 | 0.025 | 0.015 | 0.15 - 0.35 | ... | 1.55 - 2.00 | 0.20 - 0.30 | 0.30 | 0.0020 | 0.050 |
| ... | 4720H | 0.17 - 0.23 | 0.45 - 0.75 | 0.025 | 0.015 | 0.15 - 0.35 | 0.30 - 0.60 | 0.85 - 1.25 | 0.15 - 0.25 | 0.30 | 0.0020 | 0.050 |
| ... | 4817H | 0.14 - 0.20 | 0.30 - 0.70 | 0.025 | 0.015 | 0.15 - 0.35 | ... | 3.20 - 3.80 | 0.20 - 0.30 | 0.30 | 0.0020 | 0.050 |
| ... | 4820H | 0.17 - 0.23 | 0.40 - 0.80 | 0.025 | 0.015 | 0.15 - 0.35 | ... | 3.20 - 3.80 | 0.20 - 0.30 | 0.30 | 0.0020 | 0.050 |
| ... | 5120H | 0.17 - 0.23 | 0.60 - 1.00 | 0.025 | 0.015 | 0.15 - 0.35 | 0.60 - 1.00 | ... | ... | 0.30 | 0.0020 | 0.050 |
| ... | 8617H | 0.14 - 0.20 | 0.60 - 0.95 | 0.025 | 0.015 | 0.15 - 0.35 | 0.35 - 0.65 | 0.35 - 0.75 | 0.15 - 0.25 | 0.30 | 0.0020 | 0.050 |
| ... | 8620H | 0.17 - 0.23 | 0.60 - 0.95 | 0.025 | 0.015 | 0.15 - 0.35 | 0.35 - 0.65 | 0.35 - 0.75 | 0.15 - 0.25 | 0.30 | 0.0020 | 0.050 |
| ... | 9310H | 0.07 - 0.13 | 0.40 - 0.70 | 0.025 | 0.015 | 0.15 - 0.35 | 1.00 - 1.45 | 2.95 - 3.55 | 0.08 - 0.15 | 0.30 | 0.0020 | 0.050 |
| B20 | 20Cr3 | 0.17 - 0.23 | 0.60 - 1.00 | 0.025 | 0.015 | 0.40 max | 0.60 - 1.00 | ... | ... | 0.30 | 0.0020 | 0.050 |
| B21 | 20Cr4 | 0.17 - 0.23 | 0.60 - 0.90 | 0.025 | 0.015 | 0.40 max | 0.90 - 1.20 | ... | ... | 0.30 | 0.0020 | 0.050 |
| B22 | 20MnCr4-2 | 0.17 - 0.23 | 0.65 - 1.10 | 0.025 | 0.015 | 0.40 max | 0.40 - 0.75 | ... | ... | 0.30 | 0.0020 | 0.050 |
| B23 | 17MnCr5 | 0.14 - 0.19 | 1.00 - 1.30 | 0.025 | 0.015 | 0.40 max | 0.80 - 1.10 | ... | ... | 0.30 | 0.0020 | 0.050 |
| B24 | 19MnCr5 | 0.17 - 0.22 | 1.10 - 1.40 | 0.025 | 0.015 | 0.40 max | 1.00 - 1.30 | ... | ... | 0.30 | 0.0020 | 0.050 |
| B25 | 15CrMo4 | 0.12 - 0.18 | 0.60 - 0.90 | 0.025 | 0.015 | 0.40 max | 0.90 - 1.20 | ... | 0.15 - 0.25 | 0.30 | 0.0020 | 0.050 |
| B26 | 20CrMo4 | 0.17 - 0.23 | 0.60 - 0.90 | 0.025 | 0.015 | 0.40 max | 0.90 - 1.20 | ... | 0.15 - 0.25 | 0.30 | 0.0020 | 0.050 |
| B27 | 20MnCrMo4-2 | 0.17 - 0.23 | 0.65 - 1.10 | 0.025 | 0.015 | 0.40 max | 0.40 - 0.75 | ... | 0.10 - 0.20 | 0.30 | 0.0020 | 0.050 |
| B28 | 20NiCrMo2 | 0.17 - 0.23 | 0.60 - 0.95 | 0.025 | 0.015 | 0.40 max | 0.35 - 0.65 | 0.40 - 0.70 | 0.15 - 0.25 | 0.30 | 0.0020 | 0.050 |
| B29 | 20NiCrMo7 | 0.17 - 0.23 | 0.40 - 0.70 | 0.025 | 0.015 | 0.40 max | 0.35 - 0.65 | 1.60 - 2.00 | 0.20 - 0.30 | 0.30 | 0.0020 | 0.050 |
| B30 | 18CrNiMo7-6 | 0.15 - 0.21 | 0.50 - 0.90 | 0.025 | 0.015 | 0.40 max | 1.50 - 1.80 | 1.40 - 1.70 | 0.25 - 0.35 | 0.30 | 0.0020 | 0.050 |
| B31 | 18NiCrMo14-6 | 0.15 - 0.20 | 0.40 - 0.70 | 0.025 | 0.015 | 0.40 max | 1.30 - 1.60 | 3.25 - 3.75 | 0.15 - 0.25 | 0.30 | 0.0020 | 0.050 |
| B32 | 16NiCrMo16-5 | 0.14 - 0.18 | 0.25 - 0.55 | 0.025 | 0.015 | 0.40 max | 1.00 - 1.40 | 3.80 - 4.30 | 0.20 - 0.30 | 0.30 | 0.0020 | 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 B20 through B32 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.