



# Standard Specification for Balls, Bearings, Ferrous and Nonferrous for Use in Bearings, Valves, and Bearing Applications<sup>1</sup>

This standard is issued under the fixed designation F 2215; 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 ( $\epsilon$ ) 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 requirements for ferrous and nonferrous inch balls. The balls covered in this specification are intended for use in bearings, bearing applications, check valves, and other components using balls.

1.2 This is a general specification. The individual item requirements shall be as specified herein in accordance with the **Annex A2** through **Annex A9** MS sheet standards. In the event of any conflict between requirements of this specification and the **Annex A2** through **Annex A9** MS sheet standards, the latter shall govern.

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.

1.4 This specification contains many of the requirements of MIL-B-1083, which was originally developed by the Department of Defense and maintained by the Defense Supply Center Richmond. The following government activity codes may be found in the Department of Defense, Standardization Directory SD-1.<sup>2</sup>

Preparing Activity	Custodians	Review Activities
DLA-GS	Army-AT Navy-OS Air Force-99	Army-AV, EA, AR, MI Navy-SH Air Force- 11, 84

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory requirements prior to use.*

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee F34 on Rolling Element Bearings and is the direct responsibility of Subcommittee F34.01 on Rolling Element.

Current edition approved Dec. 1, 2008. Published December 2008. Originally approved in 2002. Last previous edition approved in 2005 as F 2215 – 05<sup>ε2</sup>.

<sup>2</sup> The Department of Defense, Standardization Directory, SD-1, may be found at: <http://assist.daps.dla.mil/online/start/>.

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>3</sup>

- A 108 Specification for Steel Bar, Carbon and Alloy, Cold-Finished
- A 276 Specification for Stainless Steel Bars and Shapes
- A 295 Specification for High-Carbon Anti-Friction Bearing Steel
- B 21/B 21M Specification for Naval Brass Rod, Bar, and Shapes
- B 124/B 124M Specification for Copper and Copper Alloy Forging Rod, Bar, and Shapes
- B 276 Test Method for Apparent Porosity in Cemented Carbides
- B 283 Specification for Copper and Copper-Alloy Die Forgings (Hot-Pressed)
- D 3951 Practice for Commercial Packaging
- E 18 Test Methods for Rockwell Hardness of Metallic Materials
- E 112 Test Methods for Determining Average Grain Size
- E 381 Method of Macroetch Testing Steel Bars, Billets, Blooms, and Forgings
- E 384 Test Method for Microindentation Hardness of Materials

### 2.2 ASTM Adjunct:<sup>4</sup>

- ADJE0381 ASTM Adjuncts: Photographs for Rating Macroetched Steels (3 Plates) Plate I, Plate II, and Plate III

### 2.3 ABMA Standard:<sup>5</sup>

- ABMA-STD-10 Metal Balls (Inactive Specification)

### 2.4 ANSI Standards:<sup>6</sup>

- ANSI B46.1 Surface Texture (Surface Roughness, Waviness and Lay)

<sup>3</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>4</sup> Available from ASTM International Headquarters. Order Adjunct No. ADJE0381

<sup>5</sup> Available from the Anti-Friction Bearing Manufacturers' Association, Inc., 1101 Connecticut Ave., N.W., Suite 700, Washington, DC 20036.

<sup>6</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

- ANSI B89.3.1** Sampling Procedures and Tables for Inspection by Attributes
- ANSI/ASQC Z1.4** Sampling Procedures and Tables for Inspection by Attributes
- 2.5 *Federal Standards*:<sup>7</sup>
- FED-STD-151** Metals, Test Methods
- QQ-N-286** Specification for Nickel-Copper Aluminum Alloy, Wrought
- 2.6 *ISO Standard*:<sup>6</sup>
- ISO 3290** Rolling Bearings, Bearing Parts, Balls for Rolling Bearings
- 2.7 *Military Standards*:<sup>7</sup>
- MIL-DTL-197** Packaging of Bearings, Associated Parts and Subassemblies
- MIL-STD-129** Marking for Shipment and Storage
- MS 3224 Balls, Bearing, Aircraft Quality Steel
- MS 3226 Balls, Bearing, Grade 10, Aircraft Quality Steel
- MS 19059 Balls, Bearing, Chrome Alloy Steel
- MS 19060 Balls, Bearing, Corrosion Resistant Steel
- MS 19061 Balls, Bearing, Carbon Steel
- MS 19062 Balls, Bearing, Non-Ferrous Brass
- MS 19063** Balls, Bearing, Bronze
- MS 19064 Balls, Bearing, Nickel-Copper Alloy (K Monel)
- 2.8 *NAS Standard*:<sup>8</sup>
- NAS 410** Certification and Qualification of Nondestructive Test Personnel
- 2.9 *SAE Standards*:<sup>9</sup>
- AMS 5618** Steel, Corrosion Resistant Bars, Wire and Forgings
- AMS 5630** Steel, Corrosion Resistant Bars, Wire and Forgings
- AMS 5749** Steel, Corrosion Resistant Bars, Wire and Forging and Tubing Premium Aircraft Quality for Bearing Applications
- AMS 5880** Steel, Corrosion Resistant Bars, Wire and Forging for Bearing Applications
- AMS 6440** Specification for Steel Bars, Forgings and Tubing 1.45Cr (0.98-1.10C) (SAE 52100) for Bearing Applications
- AMS 6444** Specification for Steel Bars, Forgings and Tubing Premium Aircraft Quality for Bearing Applications
- AMS 6490** Specification for Steel Bars, Forgings and Tubing
- AMS 6491** Specification for Steel Bars, Forgings and Tubing 4.1Cr-4.2Mo-1.0V (0.80-0.85C) Premium Aircraft Quality for Bearing Applications, Double Vacuum Melted

### 3. Terminology

#### 3.1 Definitions of Terms Specific to This Standard:

<sup>7</sup> Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, <http://assist.daps.dla.mil/quicksearch/>.

<sup>8</sup> Available from Global Engineering Documents, 15 Inverness Way, East Englewood, CO 80112-5704, <http://www.global.ihs.com>.

<sup>9</sup> Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

3.1.1 *ball gage deviation* ( $\Delta S$ )—difference between the lot mean diameter and the sum of the nominal diameter and the ball gage.

3.1.2 *basic diameter*—diameter size of the balls, in inches.

3.1.3 *basic diameter tolerance*—maximum allowable deviation from the specified basic diameter for the indicated grade.

3.1.4 *case depth*—thickness, measured radially from the surface of the hardened case to a point where carbon content or hardness becomes the same as the ball core.

3.1.5 *deviation from spherical form* ( $\Delta R_w$ )—greatest radial distance in any radial plane between a sphere circumscribed around the ball surface and any point on the ball surface.

3.1.6 *grade designation* ( $G$ )—indicates the allowable out-of-roundness expressed in millionths of an inch.

3.1.7 *lot*—balls from a single production run of balls that are offered for delivery at one time that are of the same dimensions, made from metal material of the same type and composition, formed and fabricated under the same manufacturing processes.

3.1.8 *marking increments*—standard unit steps to express the specific diameter.

3.1.9 *nominal size* ( $D_w$ )—basic diameter, in inches, that is used for the purpose of general identification (for example,  $\frac{1}{16}$ ,  $\frac{1}{8}$ , and so forth).

3.1.10 *out-of-roundness*—difference between the largest diameter and the smallest diameter measured on the same ball.

3.1.11 *passivation*—treatment for corrosion-resistant steel to eliminate corrodible surface impurities and provide a protective film.

3.1.12 *specific diameter*—diameter marked on the unit container and expressed in the grade standard marking increment nearest to the average diameter of the balls in that container.

3.1.13 *unit container*—container identified as containing balls from the same manufacturing lot of the same composition, grade, and basic diameter, and within the allowable diameter variation per unit container for the specified grade.

#### 3.2 Acronyms:

3.2.1 *VIMVAR*—vacuum induction melt-vacuum arc remelt.

### 4. Classification

4.1 This specification covers balls of Compositions 1 through 14 (see **Table 1**), and Grades 3, 5, 10, 16, 24, 48, 100, 200, 500 and 1000 (see **3.1.6**).

### 5. Ordering Information

5.1 When ordering balls in accordance with this specification, specify the following:

5.1.1 ASTM designation number, including year of issue,

5.1.2 Applicable MS sheet standard number,

5.1.3 Diameter of balls, whether standard or nonstandard,

5.1.4 Composition number required (see **Table 1**),

5.1.5 Grade required (see **ISO 3290** and **ABMA-STD-10**),

5.1.6 Whether a first article sample is required, and arrangements for testing and approval thereof,

5.1.7 Tests, test conditions, and sampling plans, if other than specified herein,

5.1.8 Quantity required,

5.1.9 Applicable levels of preservation and packing,

5.1.10 Special marking, if required, and

5.1.11 For Composition 13 balls (see **Note 1**):

5.1.11.1 Traceability records for each ball, when required, including its corresponding heat treat lot, forging lot, consumable electrode remelt number, process lot number, and VIM-VAR heat of steel,

5.1.11.2 Material identification records, when required,

5.1.11.3 Eddy current inspection records, when required, and

5.1.11.4 Ultrasonic inspection record for bar stock material, when required.

**NOTE 1**—The contract or purchase order should specify the data required in each record, and that the Composition 13 material traceability and identification, eddy current and ultrasonic inspection records are to be maintained for 15 years from the date of purchase order or contract completion, and that the records are to be available for delivery to the purchaser within three working days. For military purposes, the following applicable Data Item Descriptions shall be cited in the contract or purchase order when the above records or certificates of conformance are specified: Certificate of Conformance DI-MISC-81020, Material Identification record DI-QCIC-80451, Eddy current inspection record DI-QCIC-80452, Ultrasonic Inspection record DI-QCIC-80453. The above DIDs were current as of the date of this specification. The ASSIST database should be researched at <http://assist.daps.dla.mil/quicksearch/> or [www.dodssp.daps.mil](http://www.dodssp.daps.mil) to ensure that only current and approved DIDs are cited on the DD form 1423.

## 6. Materials and Manufacture

6.1 *Composition 1*—Composition 1 balls shall be manufactured from chrome alloy steel conforming to the chemical composition of UNS G52986 in accordance with **AMS 6440** or **AMS 6444** and Specification **A 295**. Chemical composition shall be tested in accordance with **11.2**.

6.1.1 Material used in manufacture of Composition 1 balls shall conform to the inclusion rating specifications given in **7.6**.

6.1.2 Material used in the manufacture of Composition 1 balls shall not exhibit defects as shown in **Table 2** when tested in accordance with **11.15.1**.

6.2 *Composition 2*—Composition 2 balls shall be manufactured from corrosion-resistant steel conforming to the chemical composition of UNS S44003, UNS S32900, UNS S42000, UNS S41000, UNS S42700, or UNS S44004 in accordance with Specification **A 276** and **AMS 5618**, 5630, 5749 and 5880. Chemical composition shall be tested in accordance with **11.2**.

6.2.1 Material used in the manufacture of Composition 2 balls shall conform to the inclusion rating specifications given in **7.6**.

6.2.2 Material used in the manufacture of Composition 2 balls shall not exhibit defects as shown in **Table 2** when tested in accordance with **11.15.1**.

6.3 *Composition 3*—Composition 3 balls shall be manufactured from carbon steel conforming to the chemical composition of UNS G10080 through UNS G10220 in accordance with Specification **A 108**. Chemical composition shall be tested in accordance with **11.2**.

6.3.1 The quality of the material used in the manufacture of Composition 3 balls shall have macrograph inspection in accordance with Test Methods **E 381** and ASTM Adjunct **ADJE0381** Adjuncts. Tests shall be in accordance with **11.15.2**.

6.4 *Composition 4*—Composition 4 balls shall be manufactured from selected silicon molybdenum steel UNS T41902 of the through-hardened type as specified in **Table 3**. Chemical composition shall be tested in accordance with **11.2**.

6.5 *Composition 5*—Composition 5 balls shall be manufactured from brass UNS C26000 as specified in **Table 3**. Chemical composition shall be tested in accordance with **11.2**.

6.6 *Composition 6*—Composition 6 balls shall be manufactured from bronze conforming to the chemical composition of UNS C46400 (SAE CDA464) in accordance with Specifications **B 283**, **B 124/B 124M**, B 21/B 21M, and B 21/B<usb>21M. Chemical composition shall be tested in accordance with **11.2**.

6.7 *Composition 7*—Composition 7 balls shall be manufactured from aluminum bronze UNS C62400 and UNS C6300 as specified in **Table 3**. Chemical composition shall be tested in accordance with **11.2**.

6.8 *Composition 8*—Composition 8 balls shall be manufactured from beryllium copper as specified in **Table 3**. Chemical composition shall be tested in accordance with **11.2**.

6.9 *Composition 9*—Composition 9 balls shall be manufactured from nickel copper alloy (Monel) UNS N04400 as specified in **Table 3**. Chemical composition shall be tested in accordance with **11.2**.

6.10 *Composition 10*—Composition 10 balls shall be manufactured from nickel-copper-aluminum alloy conforming to the chemical composition of UNS N05500 (K-Monel) in accordance with **QQ-N-286**. Chemical composition shall be tested in accordance with **11.2**.

6.11 *Composition 11*—Composition 11 balls shall be manufactured from aluminum alloy UNS A92017 as specified in **Table 3**. Chemical composition shall be tested in accordance with **11.2**.

6.12 *Composition 12*—Composition 12 balls shall be manufactured from tungsten carbide material as specified in **Table 3**. Chemical composition shall be tested in accordance with **11.2**.

6.13 *Composition 13*—Composition 13 balls shall be manufactured from aircraft-quality steel conforming to the chemical composition of UNS T11350 or UNS T12001 in accordance with **AMS 6490** or **AMS 6491**. Chemical composition shall be tested in accordance with **11.2**.

6.13.1 *Ultrasonic Inspection of Bar Stock*—Bar and wire stock selected for the manufacture of Composition 13 balls shall be inspected using the ultrasonic inspection test method in **Annex A1**. Composition 13 bar and wire stock shall be tested 100 %.

6.13.2 Material used in manufacture of Composition 13 balls shall conform to the inclusion rating specifications given in **7.6**.

6.13.3 When a first article sample of Composition 13 ball material is required, chemical testing, fracture grain size, and inclusion rating are required in addition to other tests.

6.13.4 Material used in the manufacture of Composition 13 balls shall be macro-examined in accordance with **11.15.3**.

6.14 *Composition 14*—Composition 14 balls shall be manufactured from corrosion-resistant unhardened steel conforming to the chemical composition of UNS S30200, UNS S30400, UNS S30500, UNS S31600, or UNS S43000 in accordance