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AMERICAN NATIONAL STANDARD

AFBMA STANDARD

METAL BALLS

Sponsor
**The Anti-Friction Bearing
Manufacturers Association, Inc.**

Approved June 5, 1989
American National Standards Institute, Inc.



American National Standard

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FOREWORD

(This foreword is not a part of American National Standard 10-1989, Metal Balls.)

This Standard comprises a revision of ANSI/AFBMA Standard 10-1983.

The material in this standard conforms, where possible, to recommendations of the International Standards Organization, Technical Committee 4, Rolling Contact Bearings, in whose work the U.S.A. has actively participated through delegates officially appointed by the American National Standards Institute.

Copies of ISO Standards concerning Rolling Contact Bearings (Ball and Roller Bearings) are available from the American National Standards Institute, Inc., 1430 Broadway, New York, N.Y. 10018.

Suggestions for the improvement of this standard gained through experience with its use will be welcomed. These should be sent to the American National Standards Institute, Inc., 1430 Broadway, New York, N.Y. 10018.

The officers of Accredited Standards Committee B3 operating under American National Standards Institute procedures and the organizations represented at the time this standard was submitted are as follows:

S. R. Ahlman, Chairman

G. T. Satterfield, Secretary

American Society of Agricultural Engineers
Anti-Friction Bearing Manufacturers Association
Hydraulic Institute
National Machine Tool Builders Association
U.S. Department of Defense, DISC
U.S. Department of the Navy

- 1 — Terminology
- 4 — Tolerance Definitions and Gaging Practices
- 7 — Shaft and Housing Fits for Metric Radial Ball and Roller Bearings (Except Tapered Roller Bearings) Conforming to Basic Boundary Plans
- 8.1 — Ball and Roller Bearing Mounting Accessories, Metric Design
- 8.2 — Ball and Roller Bearing Mounting Accessories, Inch Design
- 9 — Load Ratings and Fatigue Life for Ball Bearings
- 10 — Metal Balls
- 11 — Load Ratings and Fatigue Life for Roller Bearings
- 12.1 — Instrument Ball Bearings, Metric Design
- 12.2 — Instrument Ball Bearings, Inch Design
- 13 — Rolling Bearing Vibration and Noise
- 14 — Housing for Bearings With Spherical Outside Surfaces
- 15 — Ball Bearings With Spherical Outside Surfaces and Extended Inner Ring Width (Includes Eccentric Locking Collars)
- 16.1 — Airframe Ball, Roller and Needle Roller Bearings, Metric Design
- 16.2 — Airframe Ball, Roller and Needle Roller Bearings, Inch Design
- 17 — Needle Rollers, Metric Design
- 18.1 — Needle Roller Bearings - Radial, Metric Design
- 18.2 — Needle Roller Bearings - Radial, Inch Design
- 19.1 — Tapered Roller Bearings, Radial, Metric Design
- 20 — Radial Bearings of Ball Cylindrical Roller and Spherical Roller Types, Metric Design
- 21.1 — Thrust Needle Roller and Cage Assemblies and Thrust Washers, Metric Design
- 21.2 — Thrust Needle Roller and Cage Assemblies and Thrust Washers, Inch Design
- 22.1 — Spherical Plain Radial Bearings, Joint Type, Metric Design
- 22.2 — Spherical Plain Radial Bearings, Joint Type, Inch Design
- 23.2 — Thrust Bearings of Tapered Roller Type, Inch Design
- 24.1 — Thrust Bearings of Ball, Cylindrical Roller and Spherical Roller Types, Metric Design
- 24.2 — Thrust Bearings of Ball and Cylindrical Roller Types, Inch Design

An AFBMA Standard is intended as a guide to aid the manufacturer, the consumer and the general public. The existence of an AFBMA Standard does not in any respect preclude anyone, whether he has approved the Standard or not from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standard. AFBMA Standards are subject to revision or withdrawal at any time and users who refer to an AFBMA Standard should satisfy themselves that they have the latest information from the Association.

METAL BALLS

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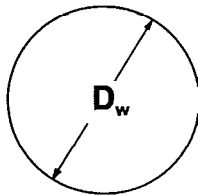
METAL BALLS

BALLS FOR ROLLING CONTACT BEARINGS AND OTHER USES

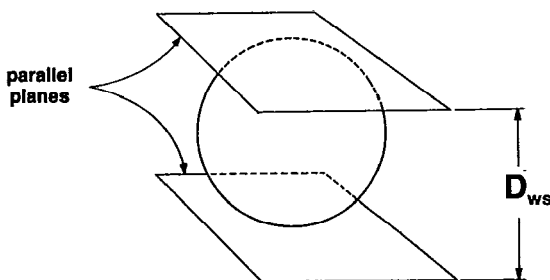
1. SCOPE. This standard establishes the requirements for finished metal balls for rolling contact (ball) bearings and other uses.

2. DEFINITIONS AND SYMBOLS. The following definitions and symbols will apply to terms used in this standard.

2.1 Nominal Ball Diameter, D_w . The diameter value that is used for the purpose of general identification of a ball size; e.g., 1/4", 6mm, etc.

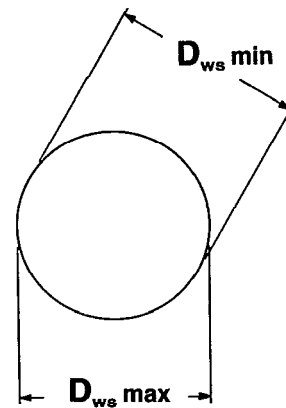


2.2 Single Diameter of a Ball, D_{ws} . The distance between two parallel planes tangent to the surface of the ball.



2.3 Mean Diameter of a Ball, D_{wm} . The arithmetic mean of the largest and the smallest actual single diameters of the ball.

$$D_{wm} = \frac{D_{ws \max} + D_{ws \min}}{2}$$

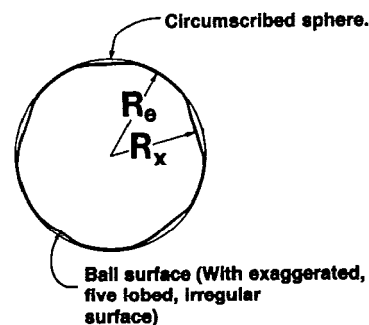


2.4 Ball Diameter Variation, V_{Dws} . The difference between the largest and the smallest actual single diameters of one ball.

$$V_{Dws} = D_{ws \max} - D_{ws \min}$$

2.5 Deviation from Spherical Form, ΔR_w . The greatest radial distance in any radial plane between a sphere circumscribed around the ball surface and any point on the ball surface.

$$\Delta R_w = R_e - R_x$$



2.6 Lot. A definite quantity of balls manufactured under conditions which are presumed uniform and which is considered and identified as an entity.

2.7 Lot Mean Diameter, D_{wL} . (See figure 1) The arithmetic mean of the mean diameter of the largest ball and that of the smallest ball in the lot.

$$D_{wL} = \frac{D_{wm \max} + D_{wm \min}}{2}$$

2.8 Lot Diameter Variation, V_{DwL} . (See figure 1) The difference between the mean diameter of the largest ball and that of the smallest ball in the lot.

$$V_{DwL} = D_{wm \max} - D_{wm \min}$$

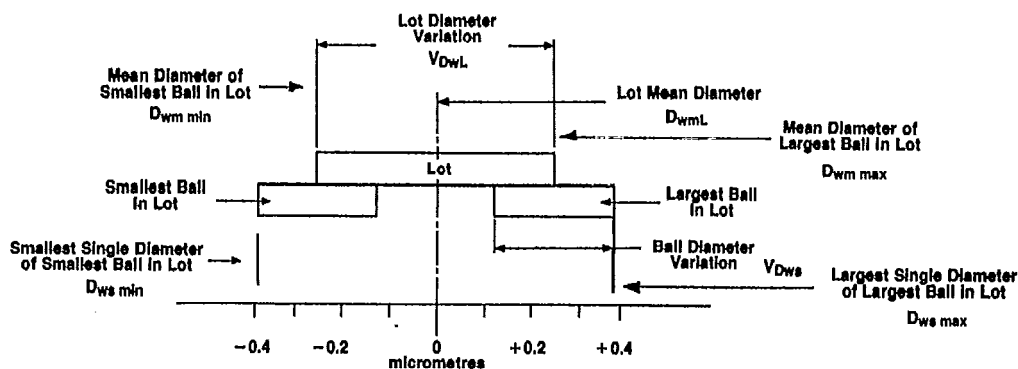


Figure 1, Part 1
VARIATION IN LOT OF GRADE 10 BALLS
(Metric Dimensions)

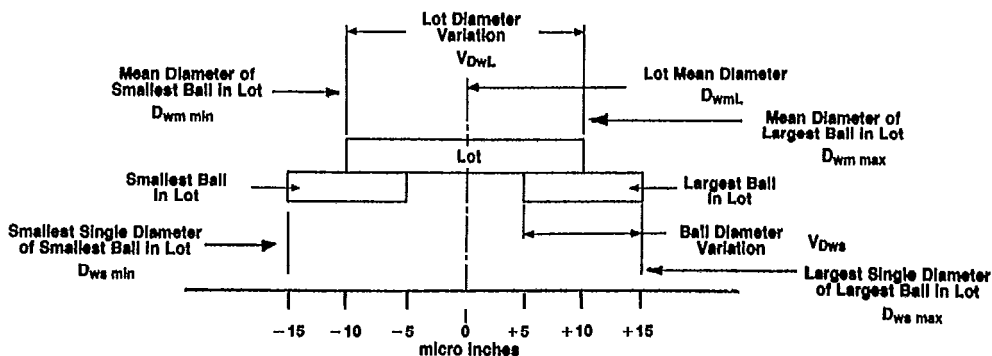


Figure 1, Part 2
VARIATION IN LOT OF GRADE 10 BALLS
(Inch Dimensions)

2.9 Nominal Ball Diameter Tolerance. The maximum allowable deviation of any ball lot mean diameter from the Nominal Ball Diameter.

2.10 Container Marking Increment. The standard unit steps, in micrometres or in millionths of an inch, used to express the Specific Diameter.

2.11 Specific Diameter. The amount by which the lot mean diameter (D_{wml}) differs from the nominal diameter (D_w), accurate to the container marking increment for that grade (Table 4). The specific diameter should be marked on the unit container.

2.12 Ball Grade. A specific combination of dimensional form and surface roughness tolerances. A ball grade is designated by a grade number.

2.13 Ball Gage, S. (See Figure 2) The prescribed small amount by which the lot mean diameter should differ from nominal diameter, this amount being one of an established series of amounts. A ball gage, in combination with the ball grade and nominal ball diameter, should be considered as the most exact ball size specification to be used by a customer for ordering purposes.

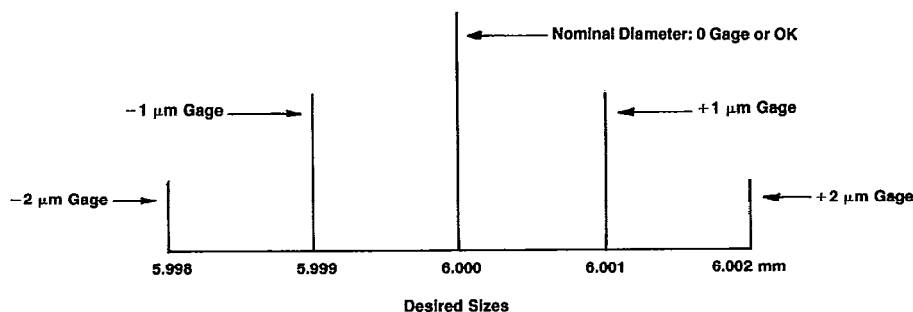


**Figure 2, Part 1
BALL GAGE**

Illustration based on 6mm Nominal Diameter
(Metric Dimensions)

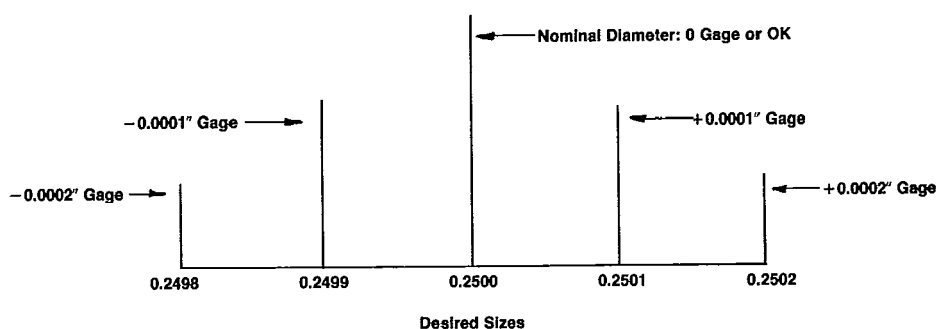


**Figure 2, Part 2
BALL GAGE**

Illustration Based on 1/4" Nominal Diameter
(Inch Dimensions)

2.14 Ball Gage Deviation, ΔS . (See figure 3)

The difference between the lot mean diameter and the sum of the nominal diameter and the ball gage.

$$\Delta S = D_{wml} - (D_w + S)$$

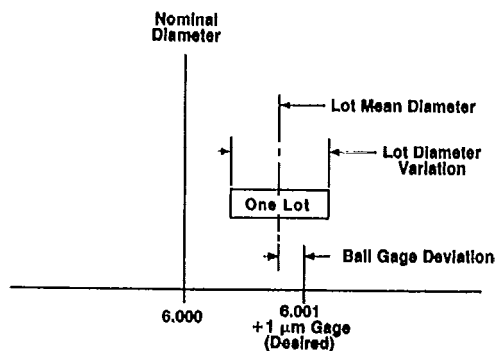


Figure 3, Part 1
BALL GAGE DEVIATION

Illustration based on 6mm Balls ordered as +1 μm Gage
Ball Gage Deviation = $-0.75 \mu\text{m}$

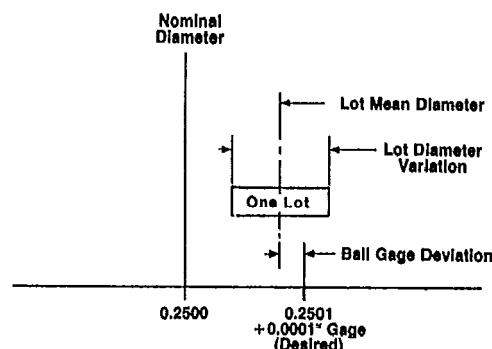


Figure 3, Part 2
BALL GAGE DEVIATION

Illustration based on 1/4" Balls ordered as +0.0001" Gage
Ball Gage Deviation = $-30 \mu\text{inch}$

2.16 Surface Roughness, R_a . Surface roughness consists of all those irregularities which form surface relief and which are conventionally defined within the area where deviations of form and waviness are eliminated.

2.17 Waviness. The more widely spaced circumferential component of surface texture. (Lacking standardized practices in this field, the specifications and tolerances for waviness are subject to agreement between consumer and manufacturer.)

2.18 Hardness. The measure of resistance to penetration of the ball surface or truncated flat of the ball by a specific indenting shape as determined by specified methods.

2.19 Case Depth. The distance measured radially from the surface of the ball to a point where the hardness becomes the equivalent to $R_c 50$. This term is applicable to case hardened balls only.

2.20 Passivation. A chemical treatment to remove corrodible surface impurities and to provide a protective film. This term is applicable to corrosion resisting balls only.

3. REQUIREMENTS

3.1 Materials. The materials listed in Table 1 are the most commonly used, however other materials are available from individual suppliers. For typical chemical analysis and a cross reference of other applicable specifications refer to the Unified Numbering System for Metals and Alloys published by the Society of Automotive Engineers, Inc. 400 Commonwealth Drive, Warrendale, Pennsylvania, 15096.

3.2 Hardness. Hardness of balls manufactured of the materials in 3.1 shall be agreed between manufacturer and purchaser. Table 1 shows typical hardness values.