AEROSPACE STANDARD	AS22227	REV. B
	Issued 2004-02 Revised 2014-09 Superseding AS22227A	

Bearing, Ball, Annular, Generator and Motor Generator

RATIONALE

AS22227 Rev B is a 5-year review and update to this specification. This consists of changes to update the applicable publications

1. SCOPE AND CLASSIFICATION

1.1 Scope

This standard establishes the requirements for antifriction ball bearings primarily intended for use in aircraft electrical generators and motor-generators.

1.2 Classification

Bearings shall be of the following types:

Type I Bearing, Ball, Annular, primarily for aircraft generators and motor-generators, Standard Light (AS17107)

Type II Bearing, Ball, Annular, primarily for aircraft generators and motor-generators, Wide Cartridge (AS17108)

Type III Bearing, Ball, Annular, primarily for aircraft generators and motor-generators, Thin Extra Light (AS17109)

2. APPLICABLE DOCUMENTS

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

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http://www.sae.org/technical/standards/AS22227B

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AMS-QQ-S-763	Steel Corrosion Resistant, Bars, Wire, Shapes, and Forgings
AMS2303	Steel Cleanliness, Aircraft Quality Martensitic Corrosion-Resistant Steels Magnetic Particle Inspection Procedure
AMS2700	Passivation of Corrosion Resistant Steels
AMS5618	Steel, Corrosion-Resistant, Bars, Wire, and Forgings 17Cr - 0.52Mo (0.95 - 1.20C) (440C) Consumable Electrode Vacuum Melted
AMS5630	Steel, Corrosion-Resistant, Bars, Wire, and Forgings 17Cr - 0.52Mo (0.95 - 1.20C) (440C)
AMS5880	Steel, Corrosion-Resistant, Bars, Wire, and Forgings 17Cr - 0.52Mo (0.95 - 1.20C) (SAE 51440C) for Bearings Applications
AMS6440	Steel, Bars, Forgings, and Tubing 1.45Cr (0.93 - 1.05C) (SAE 52100) For Bearing Applications
AMS6444	Steel, Bars, Forgings, and Tubing 1.45Cr (0.93 - 1.05C) (SAE 52100) Premium Aircraft-Quality, Consumable Electrode Vacuum Melted
AIR4127	Steel: Chemical Composition and Hardenability
AS17107	Bearing, Ball, Annular, Primarily for Aircraft Generators and Motor-Generators, Standard Light, Type I
AS17108	Bearing, Ball, Annular, Primarily for Aircraft Generators and Motor-Generators, Wide Cartridge, Type II
AS17109	Bearing, Ball, Annular, Primarily for Aircraft Generators and Motor-Generators, Thin Extra Light, Type III

2.2 U.S. Government Publications

Available from DLA Document Services, Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, Tel: 215-697-6396, http://quicksearch.dla.mil/.

MIL-C-11796	Corrosion Preventive Compound, Petrolatum, Hot Application
MIL-DTL-197	Packaging of Bearings, Associated Parts and Sub-Assemblies
MIL-PRF-7808	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
MIL-PRF-23699	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base, NATO Code Numbers 0-156, 0-152, 0-154, and 0-167
MIL-PRF-27617	Grease, Aircraft and Instrument, Fuel and Oxidizer Resistant
MIL-PRF-81322	Grease, Aircraft, General Purpose Wide Temperature Range, NATO Code G-395
MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-1647	Identification Markings for Domestically Manufactured Bearings, Ball, Annular for Instruments and Precision Components

2.3 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM A240/240M	Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and General Applications
ASTM A313/313M	Standard Specification for Stainless Steel Spring Wire
ASTM A380	Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment and Systems
ASTM A580/580M	Standard Specification for Stainless Steel Wire
ASTM A666	Specification for Annealed or Cold Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar
ASTM A693	Precipitation Hardening Stainless and Heat Resisting Steel Plate Sheet, and Strip
ASTM A967	Chemical Passivation Treatments for Stainless Steel Parts
ASTM D2000	Standard Classification System for Rubber Products in Automotive Applications
ASTM E18	Standard Test Methods for Rockwell Hardness of Metallic Materials
ASTM E45	Standard Test Methods for Determining the Inclusion Content of Steel
ASTM E112	Standard Test Methods for Determining Average Grain Size
ASTM E140	Standard Hardness Conversion Tables for Metals Relationship among Brinell Hardness Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, Scleroscope Hardness, and Leob Hardness
ASTM F2215	Standard Specification for Balls, Bearings, Ferrous and Non-Ferrous for Use in Valves, and Bearing Applications

2.4 ASME Publications

Available from American Society for Quality, 600 North Plankinton Avenue, Milwaukee, WI 53203, Tel: 800-248-1946 (United States or Canada)), 001-800-514-1564 (Mexico) or +1-414-272-8575 (all other locations), www.asq.org or ASME, P.O. Box 2900, 22 Law Drive, Fairfield, NJ 07007-2900, Tel: 800-843-2763 (U.S./Canada), 001-800-843-2763 (Mexico), 973-882-1170 (outside North America), www.asme.org.

ASME B46.1	Surface Texture (Surface Roughness, Waviness and Lay)
ASME B89.3.1	Measurement of Out of Roundness
ASQ Z1.4	Sampling Procedures and Tables for Inspection by Attributes

2.5 American Iron and Steel Institute Publications

Available from American Iron and Steel Institute, 25 Massachusetts Avenue, NW, Suite 800, Washington, DC 20001, Tel: 202-452-7100, www.steel.org.

AISI 305	Steel, Stainless (Austentic)
AISI 440C	Steel, Stainless (Martensitic)
AISI 1008	Steel, Ni-Cr-Mo Carbon
AISI 1010	Steel, Ni-Cr-Mo Carbon
AISI 52100	Chrome Alloy Steel

2.6 American Bearing Manufacturers Association Publications

Available from American Bearing Manufacturers Association, 2025 M Street, NW, Suite 800, Washington, DC 20036-3309, Tel: 202-367-1155, www.americanbearings.org.

ABMA 4	Tolerance Definitions and Gauging Practices for Ball and Roller Bearings
ABMA 9	Load Ratings and Fatigue Life for Ball Bearings
ABMA 10	Metal balls for Unground Bearings and Other Uses
ABMA 20	Radial Bearings of Ball, Cylindrical Roller and Spherical Roller Types, Metric Design

2.7 Department of Defense Publications

FAR	Federal Acquisition Regulations

2.8 Sampling Procedures

Product lot sampling for inspection and acceptance shall be in accordance with ASQ Z1.4 Sampling Procedures and Tables for Inspection by Attributes.

2.9 Order of Precedence

In the event of a conflict between the text of this standard and the reference cited herein, the text of this standard shall take precedence. Nothing in this standard, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

2.10 Definition

2.10.1 BEARING VOID

The volume between the inner and outer rings minus the volume of the balls and retainer.

3. REQUIREMENTS

3.1 AS Part Standards

The individual item requirements specified herein shall be in accordance with the applicable AS Part Standards. In the event of any conflict between the requirements of this standard and the AS sheet, the later shall govern.

3.2 First Article

When specified (see 6.2.1 d), a sample shall be subjected to first article inspection (see 4.4.1).

3.3 Materials

3.3.1 New Materials Versus Reconditioned Component Parts

Bearings purchased as new items under this standard shall not contain parts that have previously been installed in any equipment and operated. There shall be no cracks or fractures of any components. Steels shall have been inspected for relative cleanliness prior to manufacturing. All materials used shall require material certifications.

3.3.2 Ball and Ring Materials

Balls and rings shall be made of chromium-alloy steel, either AISI 52100 (AMS6440 or AMS6444) or AISI 440C (AMS-QQ-S-763, AMS5880, AMS5618, or AMS5630) steel. All rings fabricated of AISI 440C corrosion-resistant steel shall be passivated after completion of all machining or metal removing operations and prior to assembly. The metal shall be homogeneous in structure, free from cracks, pipes, seams, laminations, surface decarburization, excessive inclusion of nonmetallic impurities and other defects which may render it unsuitable for the intended purpose. On microscopic examinations, the metal shall be free from signs of overheating.

3.3.2.1 Material Cleanliness

Chromium-alloy steels used for the production of bearings shall meet the cleanliness requirements of AMS6440 or AMS6444. Stainless steel materials shall meet the cleanliness requirements of AMS5618, AMS5880, and AMS5630.

3.3.3 Grain Size

Shepard grain size shall be six (6) or finer for rings and eight (8) for balls when examined as specified in ASTM E112. Balls and rings shall be dimensionally stable for operation from -67 to +385 °F (-55 to 196 °C).

3.3.4 Dimensional Stability

The balls and rings shall withstand temperature changes and exposures with changes in diameter not exceeding 0.0001 inch per inch of diameter.

3.3.5 Hardness of Rings and Balls

The through hardness of the 52100 (or 440C corrosion-resistant steel) rings and balls shall be 58 to 63 HRC. Chrome steels shall be 58 to 66 HRC as measured in accordance with ASTM E18. The hardness values of any one ring or ball shall not vary by more than three points HRC.

3.3.6 Ball Quality

The minimum quality level of hardness, ball geometry and surface roughness shall be grade 10 as specified in ABMA 10 and in accordance with ASTM F2215.

3.3.7 Retainer

Retainers shall retain the balls within the bearings and shall equally space them circumferentially between the races. They shall be so constructed as not to limit the proper functioning of the bearing to which they are fitted. Retainers shall be of a ball centered design. The retainers shall be formed either with pockets substantially fitting the surface of the balls or with cylindrical type ball pockets, but shall be of such design that the lubricant will be freely admitted. The retainers shall be of materials, workmanship, and finish suitable for the purpose intended. They shall run concentrically with the races. No part of the retainer shall exhibit cracks, burrs, deformities or looseness. Retainers shall be free of burrs and folded over material that might be produced by normal manufacturing processes. They shall not run eccentrically visible to the normal eye.

3.3.7.1 Steel Retainer Materials

Steel retainers shall be made of either AISI 1008 or AISI 1010 low carbon steel. Steel retainers shall be used in part numbers -1 through -4 only. The steel retainers shall withstand the operating speed limits specified in the Aerospace Standard (AS) Part Standards.

3.3.7.2 Machined Phenolic Retainers

Machined phenolic retainers shall be used on part numbers -5 through -8. Bearings supplied with the phenolic retainers shall be capable of continuous operation at 250 °F (121 °C) and at 10 000 rpm or better.

3.3.8 Seals

Two removable and replaceable seals shall be included to prevent loss of lubricant from and entrance of contaminants into the bearing. Seals shall be constructed so as to not limit the proper functioning of the bearing to which they are fitted. Seals shall operate within the specified temperature range without embrittlement, warpage, or loss of lubricant. Regardless of which seal material is utilized, it must meet the requirements of ASTM D2000. When specified, no seals shall be included for open bearing oil flow-lubricated applications. Seals shall be impervious to or compatible with the applied lubricants and solvents and have high abrasion resistance but minimizing the effect of rubbing contact by its moderate degree of flexibility.

3.3.8.1 Seal Retaining Wire (Snap Rings)

Seal retaining wire (snap rings) shall be made of a commercially acceptable steel similar to the rings and balls such as ASTM A313/313M, ASTM A580/580M, ASTM A666, ASTM A240/240M, and ASTM A693.

3.3.8.2 Double Sealed Preferred

Double sealed bearings shall be used in all applications where design considerations will allow.

3.3.8.3 Removable and Replaceable

Seal and snap ring wires shall be easily removed and reinstalled with proper working tools.

3.3.8.4 Detachment

Seals shall be securely attached to the outer ring by removable snap ring wires or shall have integral stainless steel inserts so as to withstand service vibration conditions or realistic (application) radial and axial loads without becoming detached.

3.3.8.5 Placement

Seals shall not project beyond the inner or out ring face nor interfere with retainer or balls under any loading conditions, with end play taken up or when axially preloaded.

3.3.8.6 Ring Distortion

Design of the attaching members shall be such that distortion of outer rings is minimized to the point that applicable tolerance limits of the bearing specified are not exceeded.

3.4 Surface Finish

Surface finish workmanship shall be in accordance with commercial practice used in the manufacture of high grade electric motor quality bearings used in aircraft and similar critical applications requiring smooth and quiet running. Raceways shall have a well-finished appearance characteristic of a honed, polished or lapped process, and free of brinell marks, tool marks chatter, waves, grinding or transverse scratches, pits, rust, soft spots, raised carbides or metal and other surface imperfections. Raceways shall be free of solid non-metallic inclusions. Raceways shall be free of nicks and dents that exceed a width of 0.002 inch or length of 0.015 inch. Raceways shall be ground or honed to a surface finish of 5 microinches maximum in accordance with ASME B46.1. Cylindrical mounting surfaces, lands and faces of both inner and outer rings shall have a finish which is characteristic of grinding, honing, lapping, polishing or tumbling process and shall be free of tool marks, clatter and waviness, scratches with raised metal, pits, rust or other surface imperfections visible to the normal unaided visible eye and shall have a surface finish of 32 microinches maximum. Balls shall have a finish characteristic of a lapping process and meet the requirements of ASTM F2215 Grade 10.

3.5 Particulate Contamination

All exterior surfaces and interior areas of the bearing, including oil/excluding grease, shall be free of foreign particles visible using 10X magnification.

3.6 Marking for Identification

Each bearing shall be permanently marked with the following:

a. The bearing manufacturer's name or symbol and part number or the complete National Stock Number (NSN) in accordance with MIL-STD-130.

b. The complete part number designated in the AS Part Standard.

c. Each bearing with an outer ring diameter greater than or equal to 62 mm shall be permanently marked on the outer ring. Each bearing with less than 62 mm outer ring diameter shall be marked on the package.

d. Material used as applicable.

3.7 Bearing Series

All bearing series described herein shall be deep groove bearings characterized by full raceway shoulders on both sides of both inner and outer rings without loading grooves that permit them to support both radial loads and axial (thrust) loads in either direction at low to relatively high speeds. The following bearing series designations are in accordance with ABMA 20.

3.7.1 Standard Light Series (Type I, AS17107)

This series is designed for applications where housing diameters are restricted and it is desirable to maintain relatively high speed.

3.7.2 Wide Cartridge Series (Type II, AS17108)

This series is made with standard bores and outer diameters and a single row of balls, but has the same width as double row bearings of corresponding size. The extra width offers a larger support area for shaft and housing contact and added space for the prepacked lubricant.

3.7.3 Thin Extra Light Series (Type III, AS17109)

This series is designed for applications involving light to medium loads combined with relatively high speeds.

3.8 Radial Internal Clearance

Radial internal clearance (radial play) shall be as specified in the AS Part Standards.

3.9 Precision (ABEC Tolerance)

Bearings procured to this standard shall conform to ABEC 5 tolerances as defined by ABMA 20 with the exception of bore and outer diameter tolerances which shall be +0.0000/-0.0002 inch.

3.10 Lubrication

Standard light and thin extra light series bearings requiring grease lubricant for use shall be lubricated in accordance with AS17107 or AS17109 with the void filled with the lubricant and adequately distributed within the bearing after being cleaned in accordance with MIL-DTL-197. Wide cartridge series bearings shall be cleaned and lubricated in the same manner and as per AS17108.

3.10.1 MIL-PRF-81322 Grease

Bearings requiring grease lubrication and having application temperatures from -65 to 350 °F shall be lubricated with grease conforming to MIL-PRF-81322.

3.10.2 MIL-PRF-27617, Type III, Grease

Bearings requiring grease lubrication and having application temperatures exceeding the maximum temperature limitation greater than 350 °F but less than or equal to 400 °F (greater than 177 °C but less than 204 °C) shall be lubricated with MIL-PRF-27617, Type III grease.

3.10.3 MIL-C-11796 Class 3 (Preservative)

Bearings requiring open-bearing (no closures) oil flow lubrication shall be preserved with MIL-C-11796 Class 3 preservative in accordance with MIL-DTL-197 but subsequently cleaned and dip lubricated with MIL-PRF-7808 or MIL-PRF-23699 prior to use.

3.11 Limiting Speed

The limiting speeds specified in the AS Part Standards shall represent maximum application values and minimum bearing values required of bearings procured to this standard. Speed values for double-sealed grease-lubricated bearings shall be based on a 3200 feet per minute linear speed of the seal bore. Speed values for open (no-closure) oil flow-lubricated bearings are based on a 300 000 dN (bearing bore in millimeters times RPM from the AS Part Standards) factor. All bearing sizes with phenolic retainers shall be capable of withstanding a minimum speed of 10 000 rpm, based on a 600 000 dN factor.

3.12 Load Ratings

The load ratings given in the AS Part Standards shall represent maximum application values and minimum bearing values required of bearings procured to this standard. The static load rating (C_o) shall be that static radial load which corresponds to a total permanent deformation of ball and raceway at the most heavily stressed contact of 0.0001 inch of the ball diameter. The basic load rating (C) is that calculated, constant, radial load which a group of apparently identical bearings with a stationary outer ring can theoretically endure for a rating life of one million revolutions of the inner ring. The rating life of a group of apparently identical ball bearings is the life in millions of revolutions that 90% of the group will complete or exceed. For a single bearing, rating life also refers to the life associated with 90% reliability. Calculation of load ratings shall be in accordance with American Bearing Manufacturers Association (ABMA) 9. Parameters of bearing material, lubrication, internal clearance, temperature, type, etc. shall be in accordance with ABMA 9. Basic load ratings specified in the AS Part Standards are based on a speed of 33-1/3 rpm.

3.13 Interchangeability

All bearings having the same part numbers shall be directly and completely interchangeable with each other in respect to installation and performance.

3.14 Workmanship

The workmanship shall be in accordance with commercial practice used in the manufacture of high grade bearings used in aircraft and similar critical applications. Bearings shall be free from tool marks, chatter waves, rust, grinding scratches, pits or any other defects that may adversely affect its serviceability.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government or Commercial procurement activity. The procurement activity reserves the right to perform any of the inspections set forth in the standard where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for Compliance

All items shall meet all requirements of Sections 3 through 5. The inspection set forth in this standard shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the standard shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government or Commercial procurement activity for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the procurement activity to accept defective material.

4.2 Classification of Inspection

The inspection requirements specified herein are classified as follows:

a. First article inspection (see 4.4).

b. Quality conformance inspection (see 4.5).

4.3 Inspection Conditions

Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified in 4.4 or 4.5 as applicable.

4.3.1 Inspection Area Cleanliness

Inspection areas shall meet the cleanliness requirements of ISO 14644-1 Class 7 (10 000) area.

4.3.2 Measurement Standards Calibration

Measurement standards shall have calibration traceable to the National Institute of Standards and Technology (NIST). Standard calibration temperature shall be 68 °F (20 °C).

4.3.3 Measurement Temperature

Dimensional measurement made at other than the standard calibration temperature shall be corrected for temperature effects.

4.4 First Article Inspection

4.4.1 "First Article" includes preproduction models, initial production samples, test samples, first lots, pilot models and pilot lots. "Approval" involves testing and evaluating the first article for conformance with specified contract requirements before or in the initial stage of production under a contract. When required by the procuring activity, bearings furnished under this document shall have met the first article inspection prior to the regular production of a contract. First article inspection requirements shall consist of (i) all applicable quality conformance inspection requirements herein and (ii) special requirements as specified by the procurement document pertaining to the bearing's intended application. First article inspection shall be performed on sample bearings of the type and quantity specified by the contracting officer. The bearings shall be subjected to the tests specified in Table 1. Group I tests shall be performed on the entire sample. Two bearings shall be selected at random from the first article sample and subjected to Group II tests and two other bearings from the same first article sample for Group III tests. First article approval: Sample bearings shall be submitted to the procurement activity's designated test facility identified in the acquisition document (see 6.2.2).

4.5 Quality Conformance Sample

A lot shall consist of all bearings of a particular identification number submitted for delivery at the same time. From each lot of assembled bearings, the Government or Commercial procurement activity quality assurance representative shall select a random sample in accordance with ASQ Z1.4 Sampling Procedures and Tables for Inspection by Attributes.

4.5.1 Quality Conformance Inspection

The manufacturer of the bearings is required to perform Quality Conformance Inspections per Table 2 Group "I" and "II" on each lot of parts produced when applicable as prescribed by the Part Number Designation. Inspection of product for delivery shall include Table 2 Group "III" inspections when specified by the procuring activity. Group "III" inspection is generally not performed unless justified and in such case may be more appropriately handled via First Article Inspection.

4.6 Methods of Inspection

4.6.1 Material Inspections

Material inspection methods shall be in accordance with the material specification.

4.6.2 Visual Inspections

Inspection for conformance to the requirements of 3.3.2, 3.3.6, 3.3.7, 3.3.8, 3.4, 3.5, 3.6, 3.7, 3.10, and 3.14 shall be made using a 10X binocular microscope. All other visual inspections shall be made without magnification.

4.6.3 Dimensional Inspections

4.6.3.1 Boundary Dimensions Inspection

The bearing dimensions required in the AS Part Standards, 3.7 and 3.9 shall be measured in accordance with ABMA 20.

4.6.3.2 Roundness Measurements

Roundness measurements specifying MRS method microinch values (see 3.9) shall be made on equipment meeting ASME B89.3.1. Such equipment shall include means to provide a permanent recording on either strip or polar chart-type recorders.

4.6.4 Radial Internal Clearance

Radial internal clearance shall be measured with closures removed and the bearing lubricated with a thin film of oil. Gage pressure shall be the minimum required to overcome friction and weight of moving parts and to obtain repeatable readings. Radial internal clearance shall be the average of three measurements taken with each measurement utilizing a different position of the outer race. The measurements shall be made by comparison with a bearing of known radial play or by the method described in ABMA 20 and ABMA 4.

4.6.5 Ball Quality Inspections

Ball diameter measurements shall be based on comparative measurements with master balls. The measurements of master balls and balls being tested shall be made at the same temperature and with the same gage pressure. If the master balls are of a different material than the balls being tested, readings shall be referred to zero gage pressure and a temperature of 68 °F (20 °C). Five measurements of the ball diameter in random orientations shall be made on each ball of the bearing. Ball diameter shall be the average of the five measurements. Conformance to the ball quality requirements specified in ASTM F2215 shall be verified by 4.6.6 and 4.6.7.

4.6.6 Diameter Variations per Ball

Five measurements of the diameter shall be made in random orientations of each ball in the bearing. The difference between the maximum diameter measured and the minimum diameter measured on each ball is the maximum diameter variation of that ball.

4.6.7 Ball Diameter Variation per Bearing

Five measurements of the diameter shall be made in random orientations of each ball in the bearing. The average diameter of each ball shall be computed by averaging the five measurements of that ball. The difference between the average diameter of the largest ball and the average diameter of the smallest ball in a bearing is the ball diameter variation of the bearing.

4.6.8 Hardness Tests

The bearings selected for this test shall not be the same bearings used for the dimensional stability test. If, because of limited size of surface or for other valid reasons, Rockwell C scale measurements are not feasible, other methods of measuring hardness may be used, provided correlation with the Rockwell C scale measurement values is established. When lighter loads are used, conversion to Rockwell C shall be through the use of charts in ASTM E140. Hardness tests shall be made on flat surfaces.

4.6.9 Surface Roughness Tests

Measurements from less than 1 to 1000 microinches shall be made with equipment meeting the requirements of ASME B46.1. Such equipment shall allow measurements on most surfaces including fine finished or soft materials. The equipment shall include means to provide permanent strip or polar chart-type recordings. Minimum cut-off wavelength shall be determined by dividing width of surface to be measured by 10 and selecting next lowest preferred cut-off wavelength either, 0.001, 0.003, 0.01, or -0.03 inch. In deep groove raceways, the width of the surface is the distance from the bottom of the race to either land corner.

4.6.10 Dimensional Stability Tests

The dimensional stability of the rings and balls of two bearings shall be demonstrated by the following tests: The rings and balls shall be subjected to a temperature of -80 °F (-62 °C) for 25 hours. Immediately following, the parts shall be subjected to a temperature of 385 °F (196 °C) for a total of 100 hours. Diameters shall be measured at 68 °F (20 °C) and compared to values recorded before temperature cycling.

4.6.11 Lubricant Type Inspections

The type of lubricant shall be verified by analysis using an infrared spectrometer.

4.6.12 Inspection of Packaging

The sampling and inspection of the preservation, packing and container marking shall be in accordance with the requirements of MIL-DTL-197.

4.6.13 Passivation

Corrosion resistant steel (440C) shall be passivated per AMS2700, Method 1 (Nitric Acid) or Method 2 (Citric Acid), or ASTM A967, Citric 1, Citric 2, and Citric 3 are acceptable.

5. PREPARATION FOR DELIVERY

5.1 Packaging

Unless otherwise specified, packaging shall be in accordance with MIL-DTL-197.

5.2 Preservation

When MIL-DTL-197 is required, the applicable method of preservation shall also be cited in the contract or order (see 6.2.1).

5.3 Packing

When required, packing level shall be cited in the contract or order (see 6.2.1).

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended Use

Ball bearings defined by this standard are intended for use in aircraft electrical generators and motor generators.

6.2 Ordering Data

6.2.1 Acquisition Requirements

Procurement documents must specify the following:

a. Title, number, and date of the standard.

b. The quantity and part number of the bearing required.

c. Levels of preservation (see 5.2) and packing (see 5.3) as required.

d. First article required (see 3.2).

e. Ring and ball materials (see AS17107, AS17108, or AS17109).

f. Retainer material (see AS17107, AS17108, or AS17109).

g. Seal indication (see AS17107, AS17108, or AS17109).

h. Boundary dimensions.

i. Radial internal clearance.

j. Type lubricant (see AS17107, AS17108, or AS17109).

6.2.2 Test Facilities

When first article tests are required, the procuring activity should designate a test facility. The test facility shall normally be at the manufacturers' plant when a quality representative for the Government or Commercial procuring activity is available to monitor and witness the testing in accordance with Table 1.

6.3 First Article

First article inspection should be conducted on tested first article samples (see 3.2). The first article should consist of the samples specified in 4.4. The contracting officer should include specific instructions in acquisition documents regarding examinations, tests and approval of first article for the quality representative of the Government or Commercial procuring activity.

6.3.1 First Article Provision

The manufacture of bearings on contract should not commence until the samples submitted are pronounced satisfactory by the acquiring activity. The submission of first article samples on contracts may be waived at the discretion of the acquiring activity. Approval of first article samples or the waiving of first article tests does not eliminate the requirements of quality conformance inspection.

6.3.2 First Article Information

It should be understood that the bearings supplied under contract should be identical to the corresponding first article sample in material, design, construction, quality, workmanship and method of manufacture. Deviation from the standards of first article sample should be made only by the acquiring activity. Evidence of unauthorized change should constitute cause for rejection.

6.4 A change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.