



AEROSPACE STANDARD	AS7949™	REV. C
	Issued 1998-04 Revised 2019-09	
	Superseding AS7949B	
(R) Bearings, Ball, Airframe, Antifriction, General Standard for		

RATIONALE

AS7949C is a Five-Year Review. Updating standard to current requirements which are found on applicable drawing standards.

1. SCOPE

This standard covers ball bearings in the -65 to +350 °F temperature range or as specified on the applicable drawing standards.

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.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AMS2417	Plating, Zinc-Nickel Alloy
AMS2700	Passivation of Corrosion Resistant Steels
AMS3652	Polytetrafluoroethylene (PTFE) Film Non-Critical Grade
AMS3666	Polytetrafluoroethylene (PTFE) Sheet, Glass Cloth Reinforced
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)
AMS5655	Steel, Corrosion and Heat Resistant, Bars, Wire, and Forgings 12.5Cr - 0.75Ni - 1.0Mo - 1.0W - 0.24V (0.20-0.25C) Hardened and Tempered

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Documents
Document Sharing Hub

AMS5880	Steel, Corrosion-Resistant, Bars, Wire, and Forgings, 17Cr - 0.52Mo (0.95 - 1.20C) (SAE 51440C), for Bearing Applications
AMS5925	Steel, Corrosion Resistant, Bars, Wire, and Forgings, 15.5Cr – 1.8Mo – 0.20N (0.37 – 0.45C), Electroslag Remelted
AMS5898	Steel, Corrosion Resistant, Bars, Wire, and Forgings, 15.2Cr – 1.0Mo – 0.40N – (0.28 – 0.34C), Consumable Electrode Melted Under Pressure
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 Remelted
AMS-QQ-P-416	Plating, Cadmium (Electrodeposited)
AS21428	Bearing, Ball, Airframe, Anti-Friction, Extra Light Duty, Precision
AS21428/1	Bearing, Ball, Airframe, Anti-Friction, Extra Light Duty, Precision, Corrosion Resistant Nitrogen Steel (CREN)
AS21443	Bearing, Ball, Airframe, Anti-Friction, Pulley
AS21443/1	Bearing, Ball, Airframe, Anti-Friction, Pulley, Corrosion Resistant Nitrogen Steel (CREN)
AS27640	Bearing, Ball, Airframe, Anti-Friction, Heavy Duty
AS27640/1	Bearing, Ball, Airframe, Anti-Friction, Heavy Duty, Corrosion Resistant Nitrogen Steel (CREN)
AS27641	Bearing, Ball, Airframe, Anti-Friction, Intermediate Duty
AS27641/1	Bearing, Ball, Airframe, Anti-Friction, Intermediate Duty, Corrosion Resistant Nitrogen Steel (CREN)
AS27642	Bearing, Ball, Airframe, Extra Light Duty
AS27642/1	Bearing, Ball, Airframe Anti-Friction, Extra Light Duty, Corrosion Resistant Nitrogen Steel (CREN)
AS27643	Bearing, Ball, Airframe, Anti-Friction, Self-Aligning, Double Row, Heavy Duty
AS27643/1	Bearing, Ball, Airframe, Anti-Friction, Self-Aligning, Double Row, Heavy Duty, Corrosion Resistant Nitrogen Steel (CREN)
AS27644	Bearing, Ball, Airframe, Anti-Friction, Double Row, Heavy Duty
AS27644/1	Bearing, Ball, Airframe, Anti-Friction, Double Row, Heavy Duty, Corrosion Resistant Nitrogen Steel (CREN)
AS27645	Bearing, Ball, Airframe, Anti-Friction, Self-Aligning, Light and Heavy Duty
AS27645/1	Bearing, Ball, Airframe, Anti-Friction, Self-Aligning, Light and Heavy Duty, Corrosion Resistant Nitrogen Steel (CREN)
AS27646	Bearing, Ball, Airframe, Anti-Friction, Extra Light Duty
AS27646/1	Bearing, Ball, Airframe, Anti-Friction, Extra Light Duty, Corrosion Resistant Nitrogen Steel (CREN)
AS27647	Bearing, Ball, Airframe, Anti-Friction, Extra Wide, Double Row, Intermediate Duty

AS27647/1	Bearing, Ball, Airframe, Anti-Friction, Extra Wide, Double Row, Intermediate Duty, Corrosion Resistant Nitrogen Steel (CREN)
AS27648	Bearing, Ball, Airframe, Anti-Friction, External Self Aligning, Extra Light Duty
AS27648/1	Bearing, Ball, Airframe, Anti-Friction, External Self Aligning, Extra Light Duty, Corrosion Resistant Nitrogen Steel (CREN)
AS27649	Bearing, Ball, Airframe, Antifriction, Intermediate Duty
AS27649/1	Bearing, Ball, Airframe, Antifriction, Intermediate Duty, Corrosion Resistant Nitrogen Steel (CREN)

2.2 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 A967/A967M	Standard specification for Chemical Passivation Treatments for Stainless Steel Parts
ASTM E1444	Standard Practice for Magnetic Particle Inspection
ASTM F2215	Standard Specification for Balls, Bearings, Ferrous and Nonferrous for Use in Bearings, Valves, and Bearing Applications
ASTM F2094	Standard Specification for Silicon Nitride Bearing Balls

2.3 ASME Publications

Available from 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)
ANSI/ABMA STD 4	Gauging/Tolerancing Practices

2.4 ISO Publications

Copies of these documents are available online at www.webstore.ansi.org/.

ISO 12103-1	Road Vehicles – Test Contaminants for Filter Evaluation – Part 1: Arizona Test Dust
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2.5 U.S. Government Publications

Copies of these documents are available online at <https://quicksearch.dla.mil>.

MIL-DTL-197	Packaging of Bearings, Antifriction, Associated Parts and Subassemblies
MIL-PRF-23827	Grease, Aircraft and Instrument, Gear and Actuator Screw
MIL-PRF-81322	Grease, Aircraft, General Purpose, Wide Temperature Range
MIL-STD-129	Standard Practice for Military Marking
MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-2073-1	DoD Standard Practice for Military Packaging

3. REQUIREMENTS

3.1 Drawing Standards

The individual item requirements shall be as specified herein and in accordance with the applicable drawing standards (see 2.1). In the event of any conflict between the requirements of this general standard and the drawing standards, the latter shall govern.

3.2 Qualification

Products furnished under this standard shall be products which are authorized by the qualifying activity for listing on the applicable Qualified Products List (QPL-AS7949) at the time of award of contract (see 4.3 and 6.4). See Qualified Products Database (QPD) at <https://assist.dla.mil>, <http://quicksearch.dla.mil/>, or <https://qpldocs.dla.mil/>.

3.2.1 Product Change

Any change in product design, including raceway geometry or dimensions, nominal rolling element dimensions, rolling element quantity, seals, materials, or plant location shall be reported to the qualifying activity and may require requalification of the product to an extent determined by the qualifying activity. Any other specific changes that must be brought to the qualifying activity's attention shall be identified in the qualification notification letter.

3.2.2 Product Manufacture

The bearing manufacturer shall be capable of performing the preponderance of manufacturing operations in-house, but may subcontract these operations at its option. Component inspection shall be performed at the plant listed on the QPL. If manufacturing operations are performed at more than one plant, the manufacturer's additional plant(s) shall be reported to the qualifying activity. The manufacturer is responsible for meeting all requirements of this general standard, the requirements of the drawing standard and for the quality of the end product. Inherent in the responsibility for the end product is the responsibility of the bearing manufacturer to verify that their subcontractor's processes and component also meet specification requirements. A change in subcontractor need not be reported to the qualifying activity unless specifically identified in the qualification notification letter or the change has an effect on the product design.

NOTE: Bearings partly or completely manufactured in foreign countries shall be subject to the laws and procurement regulations pertaining to acquisition of foreign-made products.

3.3 Materials

Material used to manufacture the bearing and its components shall conform to the applicable drawing standard. The lubricant used shall be qualified to the applicable grease specification (see 3.11). If the part number for the drawing standard includes more than one option for ring and/or ball material, the qualification activity shall determine the extent at which additional testing is required.

3.4 Bearing Assembly

The bearing assembly shall be as specified in the applicable drawing standard, but the details of the working parts (internal design) are optional. Only unused bearings that meet the requirements of this general standard and the applicable drawing standard shall be furnished.

3.4.1 Out-Of-Roundness

Out-of-roundness shall be tested in accordance with 4.5.1.1. The maximum and minimum bore and outside diameter measurements shall be within the out-of-roundness limits specified on the applicable drawing standard. The average bore and outer diameter measurements shall be within the tolerances specified for dimensions "B" and "D" on the applicable drawing standard.

3.4.2 Seals

Seals shall prevent the entrance of contaminants and retain the lubricant. Seals shall be securely attached to the outer ring and all relative motion shall be between the seal and the inner ring. Removable design seals, which could be disassembled bearing disassembly, shall not be permitted on internal self-aligned bearings.

3.4.2.1 Seal Test (Grease Retention)

The seal test shall be in accordance with 4.5.2.1 using grease that conforms to MIL-PRF-81322 and prior to testing, the bearing lubricant shall be lubricated to the requirements of 3.11. At the end of the test, grease retention shall not be less than 25% of the bearing lubricant by weight.

3.4.2.2 Dust Test (Contamination Prevention)

The dust test shall be in accordance with 4.5.2.2. At the end of the test, the bearings shall meet the following requirements:

- a. Radial clearance shall not increase more than 50% or 0.0002 inch over the pretest value, whichever is greater.
- b. Starting torque shall not increase more than 100% or 2 in-oz over the pretest value, whichever is greater.

3.4.2.3 Seal Retention (Internal Self-Aligning Bearings Only)

The seal retention test shall be in accordance with 4.5.2.3 using the minimum torque to dislodge the seal values specified on the applicable drawing standard. Any seal that is visibly damaged or visibly dislodged prior to achieving the minimum torque value shall be considered to have failed.

3.5 Strength Performance

3.5.1 Radial Strength

3.5.1.1 Radial Limit Load

The radial limit load shall be tested in accordance with 4.5.3.1 using the radial limit load that is equal to or greater than the radial limit load specified on the applicable drawing standard. If the smoothness of operation of the bearing has lessened perceptibly after removing the load, the bearing shall be considered to have failed.

3.5.1.2 Radial Static Ultimate Load

The radial static ultimate strength shall be tested in accordance with 4.5.3.2 using a radial load that is equal to or greater than 1.5 times the radial limit load specified on the applicable drawing standard. After removing the load, the bearings shall meet the following requirements:

- a. Bearing shall be capable of being turned by hand.
- b. None of the components shall have any visible broken or cracked parts.
- c. All rings and balls shall pass magnetic particle inspection per the requirements of ASTM E1444.

3.5.1.3 Radial Dynamic Load

The fatigue life shall be tested in accordance with 4.5.3.3 using a radial load that is equal to or greater than the radial dynamic load specified on the applicable drawing standard. The bearing shall have a minimum L_{50} life of 10000 cycles except bearings covered by AS21443 which shall have a minimum L_{10} of 3500 cycles. A bearing shall be considered to have failed if one of the following occurs prior to 10000 cycles (3500 cycles for AS21443):

- a. Wear of the outer raceway greater than 0.002 inch.
- b. 0.002 inch radial displacement during testing.
- c. Cracking detected by magnetic particle inspection per ASTM E1444.
- d. Fracture of any component.

3.5.2 Axial Strength

3.5.2.1 Axial Limit Load

The axial limit load shall be tested in accordance with 4.5.4.1 using the axial limit load that is equal to or greater than the axial limit load specified on the applicable drawing standard. If the smoothness of operation of the bearing has lessened perceptibly after removing the load, the bearing shall be considered to have failed.

3.5.2.2 Axial Static Ultimate Load

The axial ultimate strength shall be tested in accordance with 4.5.4.2 using a load that is equal to or greater than 1.5 times the axial limit load specified on the applicable drawing standard. After removing the load, the bearing shall meet the following requirements:

- a. Bearing shall be capable of being turned by hand.
- b. None of the components shall have visible cracks or broken parts.
- c. All rings and balls shall pass magnetic particle inspection per the requirements of ASTM E1444.

3.6 Internal Clearance

Radial and axial internal clearance shall be measured in accordance with 4.5.5 and conform to the applicable drawing standard.

3.7 Plating (Except for AS27649)

All external surfaces of the bearing (surfaces outboard of the seals during normal operation) except the inner ring bore, seal retainers and seals shall be cadmium plated in accordance with AMS-QQ-P-416, Type I, Class 2 or zinc-nickel plated in accordance with AMS2417, Type 2, Grade B. The plating thickness for cadmium or zinc-nickel shall be 0.0003 to 0.0006 inch and tested in accordance with 4.5.6. Plating is optional on the inner ring bore chamfers and the ball loading slot however the plating thickness shall not exceed 0.0006 inch.

3.8 Surface Roughness

Surface roughness shall be measured in accordance with 4.5.7 and conform to the applicable drawing standard.

3.9 Hardness

The hardness values for the rings and balls shall be measured in accordance with 4.5.8 and conform to the applicable drawing standard.

3.10 Radial and Lateral Eccentricity

Radial and lateral eccentricity shall be measured in accordance with 4.5.9 and conform to the applicable drawing standard. Internal self-aligning bearings do not need to be tested for eccentricity.

3.11 Lubrication

Bearings shall be filled with grease qualified to MIL-PRF-81322 for a -65 to 350 °F operating range or MIL-PRF-23827 Type I for a -65 to 250 °F operating range. The bearing shall be filled with lubricant not less than 80% by free volume and shall be cleaned prior to lubrication. The bore of all bearings and the outside diameter of the outer ring and the inside diameter of the self-aligning ring of the externally self-aligning bearing shall be coated with the same grease that is packed in the bearing. Inspection of grease shall be in accordance with 4.5.10.

3.11.1 Delivery Date and Shelf Life

Bearings shall not have been lubricated more than 36 months prior to the date of delivery to the end user who in this instance, is defined as the person or organization that will be permanently removing the bearings from their packaging. The shelf life of bearings beyond this point is not defined by this specification.

3.11.2 Relubrication

The relubrication of unused bearings is allowed for some but not all of the drawing standards. The intent of relubrication, as defined in this document, is to reset/restore the shelf life of an unused bearing by replacing the lubricant (grease) which may have degraded over time or may be close to the end of the 36 month shelf life. These requirements do not apply to the refurbishment of previously used bearings or as relubrication requirements for bearings during operation. At a minimum, the following apply:

- a. Bearings with nonremovable (staked) closures or closures that if removed could lead to unintended bearing disassembly shall not be re-lubricated.
- b. Bearings that have been previously used, installed, or show signs of damage which may adversely affect performance of the bearing shall not be re-lubricated.
- c. Bearings that do not have full traceability back to the bearing manufacturer shall not be relubricated.
- d. Bearings made by a manufacturer who is no longer in business shall not be relubricated without approval by the qualifying activity.
- e. Bearings can only be relubricated by the manufacturer or an organization that has written approval from the bearing manufacturer.
- f. The bearing manufacturer and their approved relubrication facility(s) reserve the right to determine which drawing standards can be relubricated along with any additional requirements not specified in this document.

3.12 Dimensional Stability (Stabilization)

Dimensional stability shall be measured in accordance with 4.5.11 and the diameter shall not change more than 0.0001 inch per inch from the last measurement.

3.13 Starting Torque

Starting torque shall be measured in accordance with 4.5.12 and conform to the applicable drawing standard.

3.14 Marking

Each bearing shall be permanently marked and legible without magnification with the bearing manufacturers:

- a. Part number.
- b. Name or symbol (in accordance with MIL-STD-129 and MIL-STD-130).
- c. Lot control number.

Each bearing package shall be marked with:

- a. The complete "MS" or "AS" part number.
- b. Bearing manufacturer's name, brand, or trademark.
- c. Bearing manufacturer's part number and lot number.
- d. Date of lubrication (month and year).

3.15 Workmanship

Workmanship shall be in accordance with high grade, aircraft bearing manufacturing practices. Bearings shall be free from defects such as rust, dirt, and broken or cracked parts or other defects, which may adversely affect performance of the bearing.