



AEROSPACE STANDARD

AS83819™

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Bearings, Plain, Self-Aligning, Self-Lubricating,
1400 cpm (15 fpm), Oscillation, -65 to +160 °F (-54 to +71 °C)

RATIONALE

The reason for creating this standard is to qualify bearings for tail rotor bearing applications. The standard also incorporates an 'A' part number designation for a new liner system that has 2-1/2 times the life of the standard liner system.

1. SCOPE

1.1 Scope

This standard covers the requirements for spherical, self-aligning, self-lubricating, bearings which are for use in the ambient temperature range of -65 to +160 °F (-54 to +71 °C) at high cyclic speeds 1400 cpm (15 fpm). The scope of this standard is to provide a liner system qualification procedure for helicopter sliding bearings defined and controlled by source control drawings. Once a liner system is qualified, the source-controlled bearings are further tested under application conditions.

Under Department of Defense (DoD) Policies and Procedures, any qualification requirements and associated Qualified Products List (QPLs) are mandatory for DoD contracts. Any materials relating to QPLs have not been adopted by SAE and are not part of this SAE technical document.

1.2 Classification

1.2.1 Types

Bearings covered by this standard shall be of the following types:

Type I - Self-Aligning Bearings with liners of a fabric, composite polytetrafluoroethylene (PTFE) material.

Type II - Self-Aligning Bearings with liners of a self-lubricating solid in the race.

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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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-P-416	Plating, Cadmium (Electrodeposited)
AMS1424	Deicing/Anti-Icing Fluid, Aircraft SAE Type I
AMS2417	Plating, Zinc-Nickel Alloy
AMS2700	Passivation of Corrosion Resistant Steels
ARP5448/2	Plain Bearing High Speed Oscillation Test
ARP5448/7	Plain Bearing Wear Measurement
AS83819/1	Bearings, Plain, Self-Aligning, Self-Lubricating, 1400 cpm (15 fpm) Oscillation, -65 to +160 °F (-54 to +71 °C)

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	Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts
ASTM C794	Standard Test Method for Adhesion in Peel of Elastomeric Joint Sealant
ASTM D3951	Standard Practice for Commercial Packaging
ASTM F25 / F25M	Standard Test Method for Sizing and Counting Airborne Particulate Contamination in Clean Rooms and Other Dust Controlled Areas
ASTM F50	Standard Practice for Continuous Sizing and Counting of Airborne Particles in Dust- Controlled Areas and Clean Rooms Using Instruments Capable of Detecting Single Sub-Micrometre and Larger Particles

2.3 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-DTL-197	Packaging of Bearings, Associated Parts and SubAssemblies
MIL-PRF-5606	Hydraulic Fluid, Petroleum Base; Aircraft, Missile and Ordnance
MIL-DTL-5624	Turbine Fuel, Aviation, Grades JP-4, JP-5 and JP-5
MIL-PRF-7808	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
MIL-PRF-83282	Hydraulic Fluid, Fire Resistant, Synthetic Hydrocarbon Base, Aircraft, Metric, NATO Code Number H-537
MIL-STD-129	DoD Standard Practice Military Marking for Shipment and Storage
MIL-STD-2073-1	Standard Practice for Military Packaging

2.4 ANSI/ASME Publications

Available from American National Standards Institute, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org or American Society of Mechanical Engineers, 22 Law Drive, P.O. Box 2900, Fairfield, NJ 07007-2900, Tel: 973-882-1170, www.asme.org.

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

ANSI/ASQ Z1.4 Sampling Procedures and Tables for Inspection by Attributes

3. REQUIREMENTS

3.1 Drawing Package

The individual item requirements shall be as specified in this main document and the associated product definition data located in AS83819/1. In the event of any conflict between the requirements of this main document and the product definition data, the latter shall govern.

3.2 Qualification

Bearings furnished under this standard shall be products which are authorized by the qualifying activity for listing on the applicable Qualified Products List (QPL- AS83819) at the time of award of contract (see 6.3).

3.2.1 Retention of Qualification

To maintain status on a Qualified Products List (QPL), certification shall be submitted by the manufacturer at two year intervals to the original qualifying activity indicating continued compliance with the requirements of this standard (see 4.3.1 and 6.3) and those products are still available from the listed plant. The qualifying activity shall confirm retention of qualification.

3.2.2 Requirements for Qualification Approval

Qualification approval of a self-lubricating liner material is based on the satisfactory performance of test bearings to the requirements of this standard. The test conditions and the associated test bearing dimensions are specified in the product definition data in AS83819/1. Prior to initiating the liner system evaluation tests, the manufacturer shall notify the qualifying agency (Subsystems Division, Attn. Airframe Bearings, Code 4.3.5.4, Bldg. 2187, R1B60, NAVAIRSYSCOMHQ, 48110 Shaw Road, Unit 5, Patuxent River, MD 20670-1906) of the intention to submit for qualification approval. The letter of notification shall state the proposed date of initiation of the tests, the liner system identification (see 3.5) and that qualification approval is desired.

Upon completion of the test program, the test data shall be reported in accordance with 3.2.3. (Note: Data generated during the development phase of the liner system is not acceptable.) The test data shall meet the qualification test criteria listed in Table 1 of AS83819/1 and 3.16. Additional qualification submittal information is located in 4.3 and 6.3. The report and associated test fee specified by the above qualification activity shall be submitted to the Subsystems Division, Attn. Airframe Bearings, Code 4.3.5.4, Bldg. 2187, R1B60, NAVAIRSYSCOMHQ, 48110 Shaw Road, Unit 5, Patuxent River, MD 20670-1906, and 12 test verification samples shall be sent to Subsystems Division, Attn. Airframe Bearings, Code 4.3.5.4, Bldg. 2187, R1B60, NAVAIRSYSCOMHQ, 48110 Shaw Road, Unit 5, Patuxent River, MD 20670-1906.

3.2.3 Requirements for Recording Performance Data

The data recorded for 3.11, 3.12, 3.14, and 3.15 and the performance data for 3.16 shall be summarized in report form. To ensure statistical accuracy of test data, the bearing suppliers (or the testing laboratory) shall certify that the data presented is the performance data for all bearings tested and that no data has been deleted. Any test malfunction resulting in an invalid test shall be noted in the report. A dated drawing uniquely describing the bearing(s), the dimensions, heat treatment, surface finish, platings or coatings, and liner system identification shall be included. The manufacturer's liner material identification, whether by trade name or numerical designation, shall be unique to that liner material and its processing.

TABLE 1 - CONSTANT LOAD DYNAMIC TEST QUALIFICATION APPROVAL CRITERIA

AS83819/1 Dash Number	Maximum Allowable Average Wear Rate (WR) for any Given Sample (10 ⁻⁶ inches/hours)	Verification Test Samples
-4	6.0	12

3.3 First Article

When specified in the contract or purchase order, a sample shall be subjected to first article inspection (see 4.4 and 6.4).

3.4 Materials

Materials shall be as specified on the product definition data located in AS83819/1.

3.4.1 Plating and Coating

Unless otherwise specified in the product definition data, plating or coating of the mating surface for the liner system shall be an option of the manufacturer. The mating material to the liner is part of the liner system and if changed would require requalification. If plating or coating is used, it must be identified in the test report and drawings. Plating of the race shall be in accordance with AMS-QQ-P-416 Type II, Class 2, or AMS2417, Type 2, Grade B and the applicable drawing.

3.4.2 Passivation

Passivation should be in accordance with AMS2700, Method 1 (Nitric Acid) or Method 2 (Citric Acid), or ASTM A967 (Citric 1, Citric 2, and Citric 3 are acceptable). A permissible method for determining passivity is the Copper Sulfate test defined in ASTM A967 or AMS2700.

3.5 Liner System Identification

The liner material and any bonding and curing processes shall be established by the manufacturer and maintained by their in-house manufacturing and quality control documents. The manufacturer's liner system identification, whether by trade name or numerical designation, shall identify the liner material and the associated bonding and curing process requirements. In addition to the trade name or numerical designation, the manufacturer shall specify in his test report (see 3.2.3) the classification type and for Type I bearings the average liner thickness in a finished bearing.

3.6 Design

Bearing design shall conform to the dimensional requirements in AS83819/1. All other design features shall be shown on the manufacturers' drawings and shall be sent to the Qualifying Activity. Drawings shall show in detail the manufacturers' product by specifying all dimensions, tolerances, materials, liners, plating, heat treatment and passivations. Any information the manufacturer deems proprietary must be so indicated. Bearings shall not have loading slots.

3.7 Construction

Bearing construction shall conform to the requirements in AS83819/1. Details of the parts shall be shown on the manufacturers' drawings and shall be sent to the Qualifying Activity.

3.8 Dimensions and Tolerances

Dimensions and tolerances shall be as specified in AS83819/1. Dimensions not shown in the product definition data or specified herein shall be shown on the manufacturers' drawings and shall be sent to the Qualifying Activity.

3.9 Surface Texture

The specified surface texture shall be in accordance with ASME B46.1. The mating surface for the liner system shall have a roughness height rating of R_a 8 maximum. This rating also applies to pins and shafts. These shafts, pins and mating surfaces may be supplied by the bearing user. The inner bore, all faces and outer ring periphery shall have a surface texture of R_a 32 maximum. All other surfaces shall have a texture of R_a 125 maximum.

3.10 Lubrication

The self-lubricating bearings covered by this standard shall operate without subsequent relubrication. Dry film lubrication is acceptable during manufacture if part of the normal manufacturing process. Grease and oil lubrication are not permitted.

3.11 Conformity

The spherical surface of the ball shall be in proper contact (conformity) with its mating surface (see 3.11.1 or 3.11.2).

3.11.1 Conformity Measurement (Type I Bearings)

For spherical bearings with fabric or fabric composite liners, the conformity of the liner and outer rings shall be measured normally. For bearings with molded liners, the conformity of the liner and the outer rings shall be measured both normally and circumferentially.

3.11.1.1 Normal Conformity of Fabric or Fabric Composite Spherical Bearings (Type I Bearings)

When inspected in accordance with 4.7.7.1, the values of "t measured" shall be within the appropriate range specified in Table 2. Measurements shall be taken at a minimum of five uniformly spaced positions across the width of the bearing. When radial looseness is specified, the process used to generate looseness shall not distort the ball-to-outer ring contour beyond the conformity limits specified in Table 2. When overforming of the outer ring is observed during inspection in accordance with 4.7.7.1, two additional measurements shall be taken in the outer 10% of the outer ring width (one measurement on each side). These additional values shall not vary from the center value by more than 0.003 inch. Overforming is allowed in the outer 10% of the ring. Underforming is not controlled. These values apply to bearings whose outer ring width (H) to ball diameter (d) ratio is in the range of 0.44 to 0.62.

TABLE 2 - ALLOWABLE VARIATIONS

Ball Diameter (d) (inches)	Allowable Variation of Conformity Measurements (Type I Bearings)
0 → 2	Swaged & Unswaged Bearings
	$t_{\min} \leq t \text{ measured} \leq (t_{\min} + 0.0030 \text{ inch})$

3.11.2 Conformity Measurement (Type II Bearings)

When inspected in accordance with 4.7.7.2, the variation between measured values shall not be greater than 0.003 inch. Unless otherwise specified in the product definition data, the liner surface shall have a radius of curvature greater than that of the ball. The liner surface shall be machined and installed so that contact between the liner material and the ball occurs in the sector of the liner between positions 1 and 3 (see Figure 5).

3.11.2.1 Normal Conformity of Molded Liner Spherical Bearings (Type II Bearings)

Normal conformity of spherical bearings with molded liners shall be measured in accordance with 4.7.7.1. The precise shape of the cavity containing the liner material is not defined. However, the cavity shall not exhibit sharp angular changes in curvature across the width of the bearing. Dimension "t" shall be measured initially at the midpoint and H/10 positions (see Figure 4(b)). The allowable values at the H/10 positions shall be specified to the Qualifying Activity for all sizes. The maximum liner thickness shall occur at the midpoint. The allowable values of "t" at the midpoint shall be equal to, or greater than, the H/10 values but not greater than 0.022 inch.

3.11.2.2 Circumferential Conformity of Molded Liner Spherical Bearings (Type II Bearings)

In molded liner bearings, the circumferential conformity shall be measured in accordance with 4.7.7.1.1. Variation in the values of "t" shall not be greater than 0.003 inch.

3.12 Liner Integrity

The material(s) used in the liner shall be free of defects or foreign matter which decreases the serviceability of the bearing.

3.12.1 PTFE Liner Condition and Bond Integrity (Type I & Type II Bearings)

3.12.1.1 Visual Examination

The visual appearance of the bonded liner shall exhibit a degree of workmanship consistent with proper manufacturing process controls, as checked per 4.7.8.1.1. The liner shall be uniform in texture and shall contain no embedded contaminants. The liner set-back shall meet the applicable drawing requirements. There shall be no separation or lifting of the liner at any of the edges. There shall be no unraveling or excessive fraying of the liner at any of the edges. Molded liners shall completely fill the cavity between the ball and outer ring and shall not contain embedded contaminants, cracks or bubbles.

3.12.1.2 Bond Integrity and Peel Strength

When tested in accordance with 4.7.8.1.2, the liner shall be tightly adherent to the metallic substrate over at least 90% of the contact area and shall exhibit an average peel strength of 2.0 pounds per inch or greater. The adhesive remaining on the metal substrate shall have no void or unbonded area which cannot be included within a circumscribing circle with a diameter equal to 25% of the outer ring width or 0.250 inch, whichever is smaller.

3.12.1.2.1 Processing Controls

All fabrication of the PTFE liner involving application or mixing of adhesive, and all liner bonding procedures involving application of adhesive, shall be conducted in a controlled area. Any change in the process must be brought to the attention of the qualifying activity (identified in 6.3).

3.12.1.2.2 Controlled Area

The controlled area shall be maintained at a temperature of 75 °F ± 10 °F with a maximum relative humidity of 75%. The enclosed atmosphere of the work area shall be well ventilated and maintained so that a maximum count of 2500/feet³ is allowed for particles 5.0 microns or larger when measured per ASTM F25 or ASTM F50. The particle count measurement shall be performed annually (minimum).

3.12.1.3 Liner Peelability

Each manufacturer shall establish during qualification testing whether the liner is peelable or nonpeelable. If peelable, the manufacturer shall determine the mean and standard deviation peel strength values for the liner based upon a minimum of six peel strength tests conducted in accordance with 4.7.8.1.2. This data shall be recorded in the qualification test report. A liner originally qualified as peelable shall remain peelable in production. A liner originally qualified as nonpeelable shall remain nonpeelable in production.

3.12.2 PTFE Liner Condition (Type II Bearings)

The bearing outer ring shall be inspected for fractured liner elements (see 4.7.8.2). There shall be no fractures through the liner element. Small chips on the edges of an element are acceptable provided they do not exceed 0.005 inch depth, 0.030 inch width, 0.050 inch length, and do not have a cumulative length exceeding 0.200 inch on any side.

3.13 Alignment

Bearings shall be self-aligning. Angular misalignment shall be as specified in the product definition data.

3.14 No-Load Rotational Breakaway Torque

Bearings designed with no clearance between mating surfaces shall have a no-load breakaway torque specified in the product definition data (see 4.7.9).

3.15 Internal Clearance

Bearings designed with clearance (internal play) between mating surfaces shall have the allowable clearance specified in the product definition data (4.7.10).

3.16 Performance

The performance requirements of this standard are intended for qualification testing purposes and are applicable only to the associated test bearings listed in the product definition data located in AS83819/1. The test bearings are intended to provide a means of evaluating and qualifying a liner system to be used in production bearings. The various test conditions in the product definition data were chosen to represent typical size and motion regimes associated with tail rotor components of helicopters but are not presumed to describe actual operational conditions which production bearings will experience in the aircraft.

The bearing manufacturer shall fabricate test bearings to the dimensions shown in the product definition data for which qualification approval is sought. The test bearings shall be produced in accordance with the manufacturer's in-house manufacturing and quality control requirements and with the liner system identified in accordance with 3.6. The bearing manufacturer shall subject the test bearings to the qualification inspections specified in Table 3 and report the results in accordance with 3.2.3. The dynamic and static test loads are given in the product definition data located in AS83819/1.

3.16.1 Radial Static Limit Load

The radial static limit load test shall be performed at the load specified in the product definition data located in AS83819/1 (also see 4.7.1). A load deflection curve shall be prepared and permanent set shall be recorded at the completion of the test. The permanent set shall be not greater than 30% of the liner thickness.

3.16.2 Axial Static Limit Load

The axial static limit load test shall be performed at the load specified in the product definition data located in AS83819/1 (also see 4.7.2). A load deflection curve shall be prepared and permanent set shall be recorded at the completion of the test. The permanent set shall be not greater than 30% of the liner thickness.

3.16.3 Static Ultimate Load

There shall be no fracture of any component or push-out of the ball when subjected to the radial static test (see 4.7.1) and the axial static test (see 4.7.2). These loads are 1.5 times the radial and axial static limit loads specified in 3.16.1 or 3.16.2. The radial and axial static ultimate load and the permanent set shall be recorded upon completion of the test. Bearings from the limit load tests can be used for the ultimate load tests in regards to both axial and radial. Permanent set data can be observed by the addition of the limit and the ultimate figures.

3.16.4 Constant Load

The samples specified in Table 3 shall meet the requirements of 3.16.4.1 through 3.16.4.4. Test data shall meet the qualification approval criteria listed in Table 1. Data indicating the progress of the test shall be recorded at sufficient intervals to produce an accurate plot of wear and bearing housing temperature versus hours. If fan cooling is utilized to maintain the bearing housing temperature at a lower operating level, then the flowrate of cooling air shall be similarly recorded in cubic feet per minute (CFM). Before and after testing, the static breakaway torque of the bearing under load shall be measured and recorded. After the test, the bearing liner shall be inspected and the observations recorded.

3.16.4.1 Water Contaminant Requirement

The sample bearings shall be tested in accordance with 4.7.3. At the conclusion of the 600 (or 1500 for Type A) hour test the bearing shall have a minimum of 0.002 inches of liner remaining per ARP5448/7.

3.16.4.2 Fluid Compatibility Requirement

Sample bearings shall be tested in accordance with 4.7.4. The bearings shall be compatible with the fluids listed. No corrosion of the bearings shall result. (Superficial tarnish that can be removed with a damp cloth shall not be cause for rejection.) At the conclusion of the 200 hour test the bearing shall have a minimum of 0.002 inches of liner remaining per ARP5448/7.

3.16.4.3 Temperature Extremes Requirement

The sample bearings shall be tested in accordance with 4.7.5. At the conclusion of the 600 hour test the bearing shall have a minimum of 0.002 inches of liner remaining per ARP5448/7.

3.16.4.4 Solid Contaminant (Dust) Requirement

Sample bearings shall be tested in accordance with 4.7.6. Procurement information for test dust is as follows:

NOMENCLATURE "SAE Fine Test Dust, NIST traceable"

PART NUMBER: ISO 12103-1, A2 Fine Test Dust

ADDRESS: Powder Technology Inc.
P. O. Box 1464
Burnsville, MN 55337

At the conclusion of the 600 (or 1500 for Type A) hour test the bearing shall have a minimum of 0.002 inches of liner remaining per ARP5448/7.

TABLE 3 - QUALIFICATION REQUIREMENTS

Test	Requirement Paragraph	Test Method Paragraph	Samples to be Tested
Static Tests			
Radial Tests	3.16.1, 3.16.3	4.7.1	3
Axial Tests	3.16.2, 3.16.3	4.7.2	3
Constant Load Oscillation Wear Tests			
Dynamic Tests	3.16.4	4.7.3	
Water Contaminant Test	3.16.4, 3.16.4.1	4.7.3	3
Fluid Compatibility	3.16.4, 3.16.4.2	4.7.4	6
Temperature Extremes	3.16.4, 3.16.4.3	4.7.5	2
Solid contaminants (Dust)	3.16.4, 3.16.4.4	4.7.6	3
Conformity	3.11	4.7.7	2
Liner Integrity	3.12	4.7.8	5
No-Load Rotational	3.14	4.7.9	
Internal Clearance	3.15	4.7.10	5



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