SAE Aerospace
An SAE International Group

AEROSPACE STANDARD

SAE AS39901 REV. B

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Superseding AS39901A

(R) Bearings, Roller, Needle, Airframe, Antifriction, Inch

FSC 3110

RATIONALE

The reason for updating this document is to include AS5927, AS5928, and AS5929 corrosion resistant bearings, update standards referenced in the document and to clarify the definition of Section 3.1.1 Product Change. Additional updates were also done to meet the current SAE Aerospace Technical Report Style Manual dated January 2008.

NOTICE

This document references a part which contains cadmium as a plating material. Consult local officials if you have questions concerning cadmium's use.

1. SCOPE

This standard covers the requirements for non-separable, airframe anti-friction needle bearings, corrosion resistant and traditional materials, intended for use in flight vehicle control systems, with radial loads. Under Department of Defense (DoD) Policies and Procedures, any qualification requirements and associated Qualified Products Lists (QPLs) are mandatory for DoD contracts. Any material relating to QPLs have not been adopted by SAE and are not part of this SAE technical document.

1.1 Classification

Bearings shall be of the following types, as specified (see 6.2).

Type I Bearing, Roller, Needle, Single Row, Heavy Duty, Anti-friction, Inch (AS24461)

Type II Bearing, Roller, Needle, Single Row, Thin Shell, Anti-friction, Inch (AS24462)

Type III Bearing, Roller, Needle, Single Row, Heavy Duty, Self-Aligning, Anti-friction, Inch (AS24463)

Type IV Bearing, Roller, Needle, Double Row, Heavy Duty, Self-Aligning, Anti-friction, Inch (AS24464)

Type V Bearing, Roller, Needle, Single Row, Heavy Duty, Track Roller, Anti-friction, Inch (AS24465) (Inactive for new design)

Bearing, Roller, Needle, Single Row, Heavy Duty, Track Roller, Sealed, Anti-friction, Inch (AS21438)

Bearing, Roller, Needle, Single Row, Heavy Duty, Track Roller, Sealed, Anti-friction, Corrosion Resistant Nitrogen (CREN) Steel, Inch (AS5927)

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SAE values your input. To provide feedback on this Technical Report, please visit
http://www.sae.org/technical/standards/AS39901B

Type VI Bearing, Roller, Needle, Double Row, Heavy Duty, Track Roller, Anti-friction, Inch (AS24466) (Inactive for new design)

Bearing, Roller, Needle, Double Row, Heavy Duty, Track Roller, Sealed, Anti-friction, Inch (AS21439)

Bearing, Roller, Needle, Double Row, Heavy Duty, Track Roller, Sealed, Anti-friction, Corrosion Resistant Nitrogen (CREN) Steel, Inch (AS5928)

Type VII Bearing, Roller, Needle, Track Roller, Integral Stud, Anti-friction, Inch (AS21432) (Inactive for new design)

Bearing, Roller, Needle, Track Roller, Crown Radiused O.D., Integral Stud, Type VII, Anti- friction, Inch (AS21447)

Bearing, Roller, Needle, Track Roller, Crown Radiused O.D., Integral Stud, Type VII, Anti-friction, Corrosion Resistant Nitrogen (CREN) or Corrosion Resistant (CRES), Steel, Inch (AS5929)

Type VIII Bearing, Roller, Needle, Track Roller, Integral Stud, Sealed, Anti-friction, Inch (AS21440)

Type IX Bearing, Roller, Needle, Track Roller, Integral Heavy Stud, Sealed, Anti-friction, Inch (AS21441)

Type X Bearing, Roller, Needle, Heavy Duty, Track Roller, Sealed, Anti-friction, Inch (AS21442)

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 724-776-4970 (outside USA), www.sae.org.

AMS-QQ-C-320 Chromium Plating (Electrodeposited)

AMS-QQ-P-416 Plating, Cadmium (Electrodeposited)

AMS-STD-753 Corrosion Resistant Steel Parts: Sampling, Inspection and Testing for Surface Passivation

AMS2460 Plating, Chromium

AMS2700 Passivation of Corrosion Resistant Steels

AS5927 Bearing, Roller, Needle, Single Row, Heavy Duty, Track Roller, Sealed, Type V, Anti-Friction, Corrosion Resistant Nitrogen (CREN) Steel, Inch

AS5928 Bearing, Roller, Needle, Double Row, Heavy Duty, Track Roller, Sealed, Type VI, Anti-Friction, Corrosion Resistant Nitrogen (CREN) Steel, Inch

AS5929 Bearing, Roller, Needle, Track Roller, Crown Radiused O.D., Integral Stud, Type VII, Anti-Friction, Corrosion Resistant Nitrogen (CREN) Steel and Corrosion Resistant (CRES) Steel, Inch

AS8879 Screw Threads - UNJ Profile, Inch, Controlled Radius Root With Increased Minor Diameter

AS21432 Bearing, Roller, Needle, Track Roller, Integral Stud, Type VII, Antifriction, Inch

AS21438 Bearing, Roller, Needle, Single Row, Heavy Duty, Track Roller, Sealed, Type V, Antifriction, Inch

AS21439 Bearing, Roller, Needle, Double Row, Heavy Duty, Track Roller, Sealed, Type VI, Inch

AS21440 Bearing, Roller, Needle, Track Roller, Integral Stud, Sealed, Type VIII, Antifriction, Inch

AS21441 Bearing, Roller, Needle, Track Roller, Integral Heavy Stud, Type IX, Antifriction, Inch

AS21442 Bearing, Roller, Needle, Track Roller, Sealed, Type X, Antifriction, Inch

AS21447 Bearing, Roller, Needle, Track Roller, Crown Radiused O.D., Integral Stud, Type VII, Antifriction, Inch

AS24461 Bearing, Roller, Needle, Single Row, Heavy Duty, Type I, Antifriction, Inch

AS24462 Bearing, Roller, Needle, Single Row, Thin Shell, Type II, Antifriction

AS24463 Bearing, Roller, Needle, Single Row, Heavy Duty, Self-Aligning, Type III, Antifriction, Inch

AS24464 Bearing, Roller, Needle, Double Row, Heavy Duty, Self-Aligning, Type IV, Antifriction, Inch

AS24465 Bearing, Roller, Needle, Single Row, Heavy Duty, Track Roller, Type V, Antifriction, Inch

AS24466 Bearing, Roller, Needle, Double Row, Heavy Duty, Track Roller, Type VI, Antifriction, Inch

2.2 U.S. Government Publications

Available from the Document Automation and Production Service (DAPS), Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, Tel: 215-697-6257, http://assist.daps.dla.mil/quicksearch/.

MIL-DTL-197 Packaging of Bearings, Associated Parts and Subassemblies

MIL-DTL-13924 Coating, Oxide, Black, For Ferrous Metals

MIL-PRF-23827 Grease Aircraft and Instrument, Gear and Actuator Screw

MIL-PRF-81322 Grease, Aircraft, General Purpose, Wide Temperature Range

MIL-S-7742 Screw Threads, Standard Optimum Selected Series, General Specification For

MIL-STD-129 Standard Practice for Military Marking

MIL-STD-130 Identification Marking of US Military Property

MIL-DTL-2073-1 Standard Practice for Military Packaging

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 E 18 Standard Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials

ASTM B 117 Standard Practice for Operating Salt Spray (Fog) Apparatus

ASTM A 967 Standard Specification for Chemical Passivation Treatment for Stainless Steel Parts

ASTM E 1444 Standard Practice for Magnetic Particle Inspection

ASTM G 44 Standard Practice for Exposure of Metals and Alloys by Alternate immersion in Neutral 3.5% Sodium Chloride Solution.

2.4 ASME Publications

Available from American Society of Mechanical Engineers, 22 Law Drive, P.O. Box 2900, Fairfield, NJ 07007-2900, Tel: 973-882-1170, www.asme.org.

ASME Y14.100 Engineering Drawing Practices

ANSI B46.1 Surface Texture

ANSI/ABMA STD 4 Gauging/Tolerancing Practices

2.5 International Organization of Standardization (ISO) Publications

Available from American National Standards Institute, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ISO 12103-1 Road Vehicles-Test Dust for Filter Evaluation - Part 1: Arizona Road Dust

3. REQUIREMENTS

3.1 Qualification

The bearings furnished under this standard shall be products which are qualified for listing on the applicable Qualified Products List (QPL) at the time set for opening of bids (see 4.3 and 6.3).

3.1.1 Product/Process Change

Any change in product design or processing, including raceway geometry or dimensions, rolling element dimensions, rolling element quantity, seals, materials or plant location shall be reported to the qualifying activity and will require re-qualification of the product to an extent determined by the qualifying activity. Any other specific changes which must be brought to the qualifying activity's attention will be identified in the qualification notification letter. For the purposes of this specification "change in processing" means a change in the following: the company performing any component heat treatment, including case hardening.

3.1.2 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 Qualified Products List. If manufacturing operations are performed in more than one plant, the manufacturer's additional plant(s) shall be reported to the qualifying activity and will be listed accordingly on the QPL. The manufacturer is responsible for meeting all requirements of the standard and for the quality of the end product, whether it is manufactured totally in-house or some of the operations are performed by a subcontractor. Inherent in the responsibility for the end product is the responsibility to verify that the subcontractor's processes meet standard requirements. A change in subcontractor need not be reported to the qualifying activity unless specifically identified in the qualification notification letter. (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.)

3.2 Bearing Assembly

The bearing assembly shall be as specified on AS5927, AS5928, AS5929, AS21432, AS21438, AS21439, AS21440, AS21441, AS21442, AS21447, AS24461, AS24462, AS24463, AS24464, AS24465, and AS24466 standards, but the details that are not specified on the part standards shall be optional. Only factory-new bearings shall be furnished.

3.3 Material

3.3.1 The bearing components shall be fabricated from material as specified on the applicable drawing standard. The lubricant used shall be qualified to the applicable grease specification for the drawing standard or specified on the supplier drawing and approved by the qualifying activity.

3.4 Design and Construction

3.4.1 Dimensions

Dimensions, weights, and tolerances shall be as shown on the applicable drawing standards.

3.4.2 Hardness

The hardness of the inner and outer self-aligning rings, inner studs, end washers and rollers as applicable, shall be tested in accordance to 4.5.2 and shall conform to the values defined on the applicable drawing standard.

3.4.3 Surface Finish

The surface finish shall be measured in accordance with 4.5.3 and shall conform to the values as defined on the applicable drawing standards.

3.4.4 Surface Treatment

3.4.4.1 Plating

All external surfaces, excluding the bores of Types I, II, III, IV, V, VI, and X bearings shall be plated, except AS5927 and AS5928 bearings. Plating shall be as specified on the applicable drawing standards. Black oxide coating per MIL-DTL-13924 is a permissible alternate on the AS21438, AS21439, and AS21442 inner ring external surfaces.

3.4.4.2 Passivation

For all components of AS5927, AS5928, and AS5929 bearings that are not cadmium plated, passivate per, AMS2700, Method 1, Type 2 or ASTM A 967.

3.4.5 Lubrication Provisions

Holes and annular grooves shall be provided for lubrication as specified on the applicable drawing standards. Bearings shall have been lubricated within 60 months of delivery for corrosion resistant nitrogen (CREN) and corrosion resistant (CRES) AS5927, AS5928, and AS5929 bearings and 36 months for all other bearings. Data to support the 60 month value shall be kept on file with the QPL custodian.

3.4.6 Lubrication

The bearings shall be filled with the grease specified on the drawing standard. MIL-PRF-81322 grease shall be used for -65 to +350 °F operating range. All other specified greases shall be used for -65 to +250 °F operating range. At least 80% of the bearing void shall be filled with grease after the bearings have been thoroughly cleaned and dried. The external surfaces of all bearings shall be coated with the same grease that is packed in the bearing.

3.4.7 End Washers

Types I, II, III, IV, V, VI, and X bearings shall include end washers to limit axial play. Types VII, VIII, and IX bearings shall have an integral flange on the stud and an end washer to limit axial play.

3.4.8 Threads

3.4.8.1 Type VII Bearings

Threads shall be fully formed and conform to AS8879.

3.4.8.2 Type VIII and IX Bearings

Threads shall be fully formed and shall conform to MIL-S-7742.

3.5 Performance

3.5.1 Radial Runout

When tested as specified in 4.5.13, excepting Types III and IV bearings and inner raceway of Types VII, VIII, and IX bearings, shall show no radial runout greater than 0.0010 in and 0.0016 in for the inner and outer raceway, respectively.

3.5.2 Radial Internal Clearance

When tested as specified in 4.5.7, the radial internal clearance (total indicator reading) between inner and outer raceways shall be as specified on the applicable drawing standard.

3.5.2.1 Self-Aligning Bearings

When tested as specified in 4.5.7.3 for Types III and IV bearings, the clearance between self-aligning members shall be from 0.0002 to 0.0007 in.

3.5.3 Axial Internal Clearance

When tested as specified in 4.5.8, the axial internal clearance (total indicator reading) of outer rings shall be 0.025 in maximum. The minimum axial internal clearance shall be considered satisfactory if the bearing passes the test specified in 4.5.10.

3.5.4 Dimensional Stability

The bearing components shall be dimensionally stable over the temperature range of -65 to +250 °F, when tested as specified in 4.5.9. Any bearings that show a dimensional change of more than 0.0001 in/in of diameter shall be considered to have failed (see 4.5.9).

3.5.5 Axial Compression Load Test

When tested as specified in 4.5.10, the bearing outer ring shall be easily turned by hand.

3.5.6 End Washer Pushout

When tested as specified in 4.5.11, the force required to push out the end washer of Types I, III, IV, V, VI, and X bearings shall not be less than 100 lb. For Types VII, VIII, and IX bearings the force shall not be less than 22 lb. If the end washers fall off or smoothness of operation is lessened perceptibly, the bearings shall be considered to have failed.

3.5.7 Self-Alignability

The self-aligning bearings shall be capable of the minimum misalignment with the minimum clamping diameters specified on the applicable drawing standard, when tested as specified in 4.5.12.

3.5.8 Seals

The seals shall retain the lubricant in the bearing, prevent the ingress of contaminants, and be capable of venting grease when the bearings are lubricated. Representative bearings from AS21438, AS21439, AS21432, AS21447, AS21440, AS21441, and AS21442 shall be subjected to the test requirements as specified in 4.5.13 and 4.5.14.

3.5.8.1 For grease retention, the tests shall be conducted as specified in 4.5.13. No less than 25% of the original grease by weight shall be retained in the bearing at the end of the test.

3.5.8.2 For the exclusion of contaminants, tests shall be conducted as specified in 4.5.14. The starting torque shall not have increased more than 100%, or 2.0 in-oz over pre-test measurements, and the radial internal clearance shall not have increased more than 50%, or 0.0005 in over the pre-test clearance for a minimum of four of six (4 of 6) bearings tested.

3.5.9 Radial Load Ratings

3.5.9.1 Static Limit Load

The bearings shall meet the static limit loads specified on the applicable drawing standard when tested in accordance with 4.5.15. If friction torque has increased 100% or more of the pre-test value, the bearing shall be considered to have failed.

3.5.9.2 Static Ultimate Load

The minimum static ultimate loads shall not be less than 1.5 times the static limit loads specified in the applicable drawing standard when tested in accordance with 4.5.16. Any bearings that cannot be turned by hand, or that have fractured parts, shall be considered to have failed.

3.5.9.3 Dynamic Load Rating as a Track Roller

The bearings shall have a dynamic load rating as a track roller of not less than the values specified in the applicable drawing standard when tested in accordance with 4.5.17. Any bearings that have seized or that have fractured parts shall be considered to have failed.

3.5.10 Corrosion Resistant

3.5.10.1 Passivated components of AS5929 Type V, AS5928 Type VI, and AS5929 Type VII, except case hardened material code B studs, shall demonstrate corrosion resistance equivalent to or better than passivated 15-5PH steel when tested as described in 4.5.18

3.5.10.2 Material code B studs for AS5929 Type VII bearings shall demonstrate corrosion resistance equivalent to or better than passivated 440C (58 HRC min.) when tested as described in 4.5.18

3.6 Identification of Product

The bearings shall be permanently marked in accordance with MIL-STD-130, with the manufacturer's name or trademark and the complete MS or AS part number, in accordance with the applicable drawing standard. A lot control number shall be included in the part marking, if space is available.

3.7 Interchangeability

All bearings having the same part number shall be functionally and dimensionally interchangeable. The drawing number requirements of ASME Y14.100 shall govern changes in the manufacturer's part numbers.

3.8 Workmanship

The workmanship shall be in accordance with airframe needle roller bearing manufacturing practice. Bearings shall be free from defects such as rust, dirt, and broken or cracked parts which may adversely affect performance of the bearing.

3.9 Drawing Standard

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

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

Unless otherwise specified in the contract or purchase order, the contractor 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 contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the qualifying activity. The qualifying activity reserves the right to perform any of the inspections set forth in this standard where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for Compliance

All items shall meet all requirements of Sections 3 and 5. The inspections set forth in this standard shall become a part of the suppliers' overall inspection system or quality program. The absence of any inspection requirements in the standard shall not relieve the suppliers of the responsibility of insuring that all products or supplies submitted 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 customer to accept defective material.

4.2 Classification of Inspection

The examination and testing of bearings shall be classified as follows:

a. Qualification inspection (4.3)

b. Quality conformance inspection (4.4)

Each bearing shall be inspected in accordance with ANSI/ABMA STD 4 Gauging/Tolerancing Practices.

4.3 Qualification Inspection

Qualification inspection shall consist of all the tests specified under 4.5. The tests shall be conducted as specified in Table 1.

4.3.1 Qualification Test Samples

Twenty-eight (28) bearings of each size indicated in Table 2 shall be tested to qualify each of the types. The bearing samples shall be manufactured with equipment and procedures used in production.

4.3.2 Data to Accompany Qualification Test Samples

Drawings, showing complete external dimensions, tolerances, construction, material, hardness, and date of latest revision, shall be submitted with the qualification test report and test samples.

4.3.3 Qualification Failure

Any failures during examinations or tests shall be reported to the qualifying activity before testing continues. Based on corrective action, authorization to complete the qualification test may be granted by the qualifying activity. Failure of any test shall be cause for refusal to grant qualification.

4.3.4 Retention of Qualification

For retention of qualification, one bearing size from each drawing standard shall be tested per Table 3 at 60 month intervals. The qualifying activity will select the dash number to be tested or an agreed upon dash number actively produced by the manufacturer. The manufacturer's products shall pass all of the retention of qualification tests. Failure to pass all of the tests may result in loss of qualification for that product. The retention of qualification tests may be performed in conjunction with conformance testing when approved by the qualifying activity.

4.3.4.1 Failure of Retention of Qualification

Any failures during retention of qualification testing should be reported immediately to the qualifying activity. Authorization to continue retention of qualification testing will be based on corrective action acceptance by the qualifying activity.

4.3.5 Qualification by Similarity

Qualification by similarity to qualified products, or to products being submitted for qualification, is permissible when materials, designs, or manufacturing processes are identical. When materials, designs, or manufacturing process differ, sufficient testing of the affected characteristics will be required to obtain qualification by similarity. Full details of the similarity and differences, along with the proposed tests, shall be submitted to the qualifying activity or approval prior to the commencing of testing.

4.4 Conformance Inspection

Conformance inspection shall consist of sampling tests specified in 4.4.2 on each lot of bearings.

4.4.1 Lot Control

The inspection lot shall consist of finished bearings having a single part number, manufactured by the procedures established for the originally qualified bearings. The inspection lot shall be produced as one continuous batch, which receives final inspection at the same location. The inspection lot shall be identified by a unique number (Manufacturer's Lot Control Number) to be included on the bearing, in the package marking and on the associated certification that accompanies the shipping paperwork. The manufacturer's lot control number shall be traceable to the finished bearing assembly and the quality conformance inspection or acceptance tests. The samples taken for acceptance testing shall be randomly selected to ensure that they are representative of the production run/lot.

The manufacturer shall have a quality control/assurance system in effect that ensures traceability of the rings/stud and rollers (main components) that make up the final bearing assembly as well as documentation that provides objective evidence that the components meet the drawing standard requirements. Individual component lots shall keep the integrity through all the manufacturing, storage and process operations. The final bearing assembly that makes up the individual production run may have more than one component lot number as long as the traceability is maintained.

4.4.2 Conformance Tests

Samples shall be examined for conformance to the tests listed in Table 4. The sample bearings shall be selected in random from each inspection lot in accordance with Table 5. If no defect is found in the sample, the lot shall be accepted for these tests. If any defects are found in the sample, the entire lot shall be 100% inspected for each defective characteristic found, and all defective parts shall be removed from the lot.

4.5 Inspection Methods

For Qualification, Retention of Qualification and Conformance Tests, as applicable per the attached tables.

4.5.1 Examination of Product

All of the bearings shall be examined for conformance to this specification and applicable standards as to:

a. Dimensions (3.4.1)

b. Lubrication provisions (3.4.5)

c. Lubrication (3.4.6)

d. End washers (3.4.7)

e. Identification of product (3.6)

f. Workmanship (3.8)

g. Threads (Types VII, VIII and IX bearings only) (3.4.8)

4.5.2 Hardness

The hardness shall be measured in accordance with ASTM E 18 on the applicable rings, stud, end washers and three (3) rollers from each of the bearings tested (see 3.4.2).

4.5.3 Surface Finish

The surface finish shall be measured in accordance with ANSI B146.1 on the inner and outer raceways, the inside contact surface of the end washers, the self-aligning surfaces (if applicable), and three (3) rollers from each of the bearings tested (see 3.4.3).

4.5.4 Surface Treatment

4.5.4.1 Plating

Cadmium and chromium plating shall be tested for conformance with AMS-QQ-P-416, AMS2460, or AMS-QQ-C-320, as applicable to comply with the type and class specified on the drawing standard.

4.5.4.2 Passivation

Passivation shall be tested for conformance to , AMS2700 or ASTM A 967 and shall meet the requirements of AMS-STD-753 method 101 or 102 or AMS2700 test method 101 or 102.

4.5.5 Lubrication

The lubrication shall be inspected for quantity and cleanliness and be in accordance with the type of grease specified on the QPL and applicable drawing standard.

4.5.6 Radial Runout

Bearings shall be tested for radial runout. Type I bearings shall be mounted as shown on Figure 1A. Types V, VI, and X bearings shall be hand pushed on a tapered horizontal arbor and the arbor supported on a V-block or on centers (see Figure 1C). Types VII, VIII, and IX bearings shall be mounted as shown Figure 1D. Types III and IV bearings shall not be tested for radial runout. A dial indicator placed against the outer ring shall be used to indicate radial runout. Outer ring radial runout shall be measured by rotating the outer ring while holding the stud or inner ring. Inner ring radial runout shall be measured by rotating the inner ring while holding the outer ring (see 3.5.1).

4.5.7 Radial Internal Clearance

Bearings shall be measured for radial internal clearance under a 5 lb ± 10% reversing radial load. The inner ring or stud shall be held rigidly and the radial load applied alternately in opposite directions to the outer ring. A dial indicator shall be used to indicate this movement. The radial clearance shall not exceed the amount specified on the applicable drawing standard (see Figures 1A, 1B, 1C, and 1D).

4.5.7.1 Types I, V, VI, VII, VIII, IX, and X Bearings

Radial internal clearance shall not exceed the amount specified on the applicable drawing standard (see Figure 1A for Type I bearings, Figure 1C for Types V, VI, and X bearings, and Figure 1D for Types VII, VIII, and IX bearings).

4.5.7.2 Type II Bearings

This type shall be measured while pressed into a housing gage as shown on Figure 1A. The bearing shall not lock up when pressed into the low limit gage. Maximum radial clearance shall not exceed the amount specified on the applicable drawing standard while the bearing is pressed into the low limit gage. High and low limit gage sizes are the high and low limit housing bore sizes indicated in tolerance tables of the appropriate drawing standard.

4.5.7.3 Types III and IV Bearings

Total radial clearance in the bearing shall be measured in the same manner as for other types. Radial clearance shall not exceed the amount specified on the applicable drawing standard (see Figure 1B). A complete bearing shall be used for this test. These types shall also be tested for radial clearance between the self-aligning members while pressed into a low limit gage and mounted snugly on a tapered arbor. Rollers and inner ring shall be removed and the outer ring mounted on the arbor. The radial clearance shall not exceed the amount specified in 3.5.2.1.

4.5.8 Axial Internal Clearance

Bearings shall be measured for axial internal clearance under a 5 lb ± 10% reversing axial load. The outer ring shall be held rigidly and an axial load applied alternately in opposite directions to the inner ring or stud. A dial indicator shall be used to indicate this movement (see Figures 2A and 2B). The axial clearance shall not exceed the maximum specified in 3.5.3.

4.5.9 Dimensional Stability

The outside diameter of three (3) bearings of each drawing size submitted for qualification shall be measured at room temperature and recorded. The test shall be as follows:

a. The bearings shall be heated to +250 °F ± 10 °F and held for 96 h minimum, allowed to cool to room temperature, measured and recorded.

b. The bearings shall then be cooled to -65 °F ± 10 °F and held for 96 h minimum, allowed to warm to room temperature, measured and recorded.

c. The measurements shall be made at the same location for each bearing measurement (see 3.5.4).

4.5.10 Axial Compression Load Test

Bearings shall be tested for freedom of rotation while under an axial load. Types I, II, III, IV, V, VI, and X bearings shall be mounted and the load applied as shown on Figure 3A. Loads applied shall be in accordance with Table 7. Types VII, VIII, and IX bearings shall be mounted as shown on Figure 3B. The nut shall be torqued to value shown on the appropriate drawing standard (see 3.5.5).

4.5.11 End Washer Pushout

Bearings shall be placed in a bearing housing, as shown on Figures 4A and 4B. The appropriate end washer pushout load specified in 3.5.6 shall be applied for 1 min. Position of all types with exception of Types VII, VIII, and IX bearings shall be reversed and the test repeated (see 3.5.6).

4.5.12 Self-alignability

Bearings of Types III and IV shall be tested for self-alignability while clamped with maximum clamping (d_a) diameters specified in the drawing standard (see Figure 1E and 3.5.7).

4.5.13 Seal Test (Grease Retention)

The bearings of each representative size shall be filled at least 80% full by volume with MIL-PRF-81322 grease. Prior to testing the dry bearing weights and greased weights shall be recorded. The bearings shall be wiped free of external grease and weighed. The bearings shall be mounted on a horizontal shaft in the test chamber, with no applied load, at 3 rpm, with the outer rings held stationary. The chamber temperature shall be maintained at a minimum of +250 °F for 100 h. After testing they shall again be wiped free of grease and weighed (see 3.5.8.1).

$$\% \text{ grease retained} = 100(W_{pt} - W_d)/(W - W_d) \quad \text{(Eq. 1)}$$

where:

W = Weight of the greased bearing with grease wiped off external surfaces

W_d = Dry weight of the bearing components (alternate method of weighing bearing components after cleaning is acceptable)

W_{pt} = Weight of bearing after testing with grease wiped off external surfaces

4.5.14 Seal Test (Dust Contamination)

Bearings as specified in 3.5.8 shall be tested for dust contamination in an enclosed chamber as described in 4.5.14.2. The bearings of each size tested shall be mounted on a horizontal shaft in the test chamber, with no applied load, at 3 rpm, with the outer rings held stationary. The bearings shall be tested for a duration of 48 h minimum at an ambient temperature of +77 °F ± 5 °F. The test media shall be SAE Coarse Grade Arizona Road Dust in accordance with ISO 12103.1 (see 4.5.14.1). Pre-test measurements of the starting torque and radial internal clearance shall be made and recorded for each bearing. Post-test measurements for starting torque shall be made in the “as tested“ condition. Before post-test measurement of the radial internal clearance, the bearings shall be disassembled, thoroughly cleaned, re-assembled and re-lubricated with MIL-PRF-81322 grease.

4.5.14.1 Test Media (Dust)

The test media shall be Arizona Road Dust in accordance with ISO 12103-1 supplied to SAE coarse grade (see 6.4). The coarse mixture shall be in accordance with Table 6.

4.5.14.2 Dust Test Chamber

The dust test chamber shall be cubic, approximately 2 ft per side, with viewing ports for test observation. A minimum layer of 1 in test media (see 4.5.14.1) shall be maintained on the chamber floor. Test chamber actuation shall provide a continuous movement of dust, creating a uniform cloud which shall render the test bearings difficult to see through the viewing ports. Test bearings shall have a minimum spacing of 3 in from each other and the chamber walls. The mounting shaft shall be 8 to 16 in above the chamber floor.

4.5.15 Static Limit Load Rating

Types I, II, III, and IV bearings shall be mounted in a rigid support as shown on Figure 5A, Types V, VI, and X bearings shall be mounted in rigid support as shown on Figure 5B, Types VII, VIII, and IX bearings shall be mounted in a rigid support as shown on Figure 5C. The bearings shall be tested according to the following procedure and sequence:

a. Step 1: Rotate the bearing manually to determine operational smoothness.

b. Step 2: Measure the frictional starting torque.

c. Step 3: Apply load equal to the appropriate “Static Limit Load Rating” specified on the applicable drawing standard for 1 min.

d. Step 4: Remove load and inspect for evidence of failure.

e. Step 5: Measure frictional starting torque (see 3.5.9.1).

4.5.16 Static Ultimate Load Rating

A load equal to the Static Ultimate Load Rating (1.5 times the Static Limit Load) specified on the applicable drawing standard shall be applied for 1 min (see Figure 5A for Types I, II, III, and IV, Figure 5B for Types V, VI, and X, and Figure 5C for Type VII, VIII, and IX. After removal of this load, the bearings shall be examined for rotation by hand. The bearings shall be disassembled and the inner and outer rings and the rollers shall be magnetic particle inspected in accordance with ASTM E 1444 (see 3.5.9.2).

4.5.17 Dynamic Load Rating as a Track Roller

Bearings shall be tested under a load equal to the load rating as a track roller. The tests shall be performed at speeds of 10 to 100 rpm until the number of revolutions listed on the standard have been completed or if not listed on the standard, 20 000 revolutions have been completed. The bearings may be relubricated during the test. The test shall be performed on a test support similar to the illustrations on Figure 5C for Types VII, VIII, and IX bearings and Figure 5B for Types V, VI, and X bearings (see 3.5.9.3).

4.5.18 Corrosion Testing of CREN rings and Type A studs and CRES Type B studs.

a. Use either a salt spray test per ASTM B 117, an alternate immersion test per ASTM G 44 or an established electrochemical test approved by the Qualifying Activity, to confirm that the corrosion resistance of the bearing rings or studs meets the requirements in 3.5.10.

b. Expose passivated CREN material per AMS5898, AMS5925 and case hardened AISI 422 steel for the same length of time as a 180 to 200 ksi 15-5PH steel sample (100 h for ASTM B 117). Compare the severity of corrosion and the amount of area covered by corrosion products, for the bearing rings or Type A studs and the 15-5PH sample after the same duration of exposure.

c. Exposed passivated CRES material per AMS5930 for the same length of time as used to produce rust on a passivated 440C sample (about 4 h). Compare the severity of corrosion and the amount of area covered by corrosion products, for the Type B studs and the 440C sample after the same duration of exposure.

4.6 Inspection of Packaging

4.6.1 Packaging shall be examined for conformance with Section 5 of this specification.

5. PACKAGING

5.1 Preservation

Unless otherwise specified in the contract or purchase order, packaging shall be in accordance with MIL-DTL-197 (see 6.2.d).

5.1.1 Marking for Shipment and Storage

Nomenclature marking for interior and exterior containers shall conform to the following in lieu of the item description requirements of MIL-STD-129.

BEARINGS, ROLLER, NEEDLE, (SINGLE ROW, HEAVY DUTY), (SINGLE ROW, THIN SHELL), (SINGLE ROW, HEAVY DUTY, SELF-ALIGNING), (DOUBLE ROW, HEAVY DUTY, SELF- ALIGNING), (SINGLE ROW, HEAVY DUTY, TRACK ROLLER), (SINGLE ROW, HEAVY DUTY, TRACK ROLLER, SEALED), (SINGLE ROW, HEAVY DUTY, TRACK ROLLER, SEALED, CORROSION RESISTANT NITROGEN (CREN)), (DOUBLE ROW, HEAVY DUTY, TRACK ROLLER), (DOUBLE ROW, HEAVY DUTY TRACK ROLLER, SEALED), (DOUBLE ROW, HEAVY DUTY, TRACK ROLLER, SEALED, CORROSION RESISTANT NITROGEN (CREN)), (TRACK ROLLER, INTEGRAL STUD), (TRACK ROLLER, CROWN RADIUSED O.D., INTEGRAL STUD, TYPE VII), (TRACK ROLLER, CROWN RADIUSED O.D., INTEGRAL STUD, SEALED, CORROSION RESISTANT NITROGEN (CREN)) OR CORROSION RESISTANT STEEL (CRES)), (TRACK ROLLER, INTEGRAL STUD, SEALED), (TRACK ROLLER, INTEGRAL HEAVY STUD, SEALED), OR (HEAVY DUTY, TRACK ROLLER, SEALED), ANTIFRICTION, INCH.

6. NOTES

6.1 Intended Use

Airframe anti-friction needle roller bearings are intended primarily for use in flight vehicle control systems in which the load is radial.

6.2 Ordering Data

Procurement documents should specify the following:

a. Title number, and date of this specification

b. Complete MS or AS part number (see 1.2 for type and associated standard)

c. Quantity

d. Applicable level of preservation, packaging and packing (see 5.1)

6.3 Qualification of Product

With respect to products requiring qualification, awards will be made only for products which are, at the time set for opening of bids, qualified for inclusion in the applicable Qualified Products List (SAE- QPL-AS39901), whether or not such products have actually been so listed by that date. The attention of the contractors is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The qualifying activity is the Naval Air Systems Command, Code 4.3.5.4. Information pertaining to qualification of products may be obtained from the qualifying activity, Commander, Naval Air Systems Command, Code 4.3.5.4, Building 2187 Rm 3380, C-4, 48110 Shaw Road, Patuxent River, MD 20670-1906.

6.3.1 Qualification of a Bearing Distributor

Department of Defense (DoD) standardization regulations have specific requirements covering qualification approval of a distributor. Details of these requirements may be obtained from the qualifying activity (see 6.3).

6.3.2 Procurement of Bearings from a Distributor not Listed on the QPL

Government contractors and subcontractors who plan to acquire a qualified bearing from a distributor not listed on the QPL should be aware that distributors frequently stock bearings which were manufactured several years earlier. Since document requirements are occasionally changed without a corresponding change in part marking, the parts offered for sale by the distributor may not meet current document requirements. To assure that parts meet current document requirements, the contractor should require the following information from the distributor:

(1) Certification that the bearings have been inspected for compliance to the current document requirements.

(2) Certification of the original manufacturer's name, part number and date of lubrication on the outside of each unit package.

(NOTE: DoD regulations state that only distributors who have been approved by the qualifying activity for listing on a QPL may re-brand a QPL listed item.)

6.4 Dust Test Media

The dust test media may be purchased from Powder Technologies Inc., P.O. Box 1464, Burnsville, MN 55337, or from other sources.

6.5 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.

PREPARED BY THE AIRFRAME CONTROL BEARINGS GROUP (ACBG)

TABLE 1 - QUALIFICATION EXAMINATIONS AND TEST SAMPLES

Examination or Test	Sample Number														Requirement Paragraph	Test Method Paragraph
	1	2	3	4	5	6	7	8	9	10	11	12	13-18	19-28		
Examination of Product	X	X	X	X	X	X	X	X	X	X	X	X	X-X	X-X	3.4.1, 3.4.8, 3.6, 3.8	4.5.1
Hardness	X	X	X												3.4.2	4.5.2
Plating	X	X	X												3.4.4.1	4.5.4.1
Passivation	X	X	X												3.4.4.2	4.5.4.2
Surface Finish	X	X	X												3.4.3	4.5.3
Lubrication	X	X	X												3.4.5	4.5.5
Radial Runout				X	X	X	X	X	X	X	X	X			3.5.1	4.5.6
Radial Internal Clearance				X	X	X	X	X	X	X	X	X			3.5.2	4.5.7
Axial Internal Clearance				X	X	X	X	X	X	X	X	X			3.5.3	4.5.8
Dimensional Stability				X	X	X									3.5.4	4.5.9
Axial Compression							X	X	X						3.5.3	4.5.10
End Washer Pushout	X	X	X												3.5.6	4.5.11
Self-Alignability										X	X	X			3.5.7	4.5.12
Seals - Grease Retention										X	X	X			3.5.8, 3.5.8.1	4.5.13
Seals - Dust Test													X-X		3.5.8, 3.5.8.2	4.5.14
Radial Static Limit Load				X	X	X									3.5.9.1	4.5.15
Radial Static Ultimate Load							X	X	X						3.5.9.2	4.5.16
Dynamic Load Rating as a Track Roller														X-X	3.5.9.3	4.5.17

TABLE 2 - QUALIFICATION TEST SAMPLES

Type	MS Dash Number		
	Small	Medium	Large
I	-6	-20	
II	-4	-8	-16
III	n/a	-5	n/a
IV	-6	-10	-20
V	-6	-14	-24
	-106	-114	-124
VI	-6	-14	-24
	-106	-114	-124
VII	-2	-4	-6
VIII	-101	-281	-481
IX	-101	-281	-481
X	-121	-281	-481

TABLE 3 - RETENTION OF QUALIFICATION EXAMINATIONS AND TEST SAMPLES

Examination or Test	Sample Number													Requirement Paragraph	Test Method Paragraph
	1	2	3	4	5	6	7	8	9	10	11	12	13		
Examination of Product	X	X	X	X	X	X	X	X	X	X	X	X	X	3.4.1, 3.4.8, 3.6, 3.8	4.5.1
Radial Internal Clearance				X	X	X	X	X	X	X	X	X	X	3.5.2	4.5.7
Axial Internal Clearance				X	X	X	X	X	X	X	X	X	X	3.5.3	4.5.8
Radial Runout				X	X	X	X	X	X	X	X	X	X	3.5.1	4.5.6
End Washer Pushout	X	X	X											3.5.6	4.5.11
Hardness	X	X	X											3.4.2	4.5.2
Plating	X	X	X											3.4.4.1	4.5.4.1
Passivation	X	X	X											3.4.4.2	4.5.4.2
Surface Finish	X	X	X											3.4.3	4.5.3
Lubrication	X	X	X											3.4.5	4.5.5

TABLE 4 - CONFORMANCE TESTS

Examination or Test	Major Characteristic	Minor Characteristic	Requirement Paragraph	Test Paragraph
Dimensions			3.4.1	4.5.1
Bore/Stud Dia.	X		3.4.1	4.5.1
O.D.	X		3.4.1	4.5.1
Inner Ring Width/Stud Length (Type VII, VIII, & IX)	X		3.4.1	4.5.1
Outer Ring Width	X		3.4.1	4.5.1
Track Contact Width (if applicable)		X	3.4.1	4.5.1
Inner Ring/Stud Chamfer/Radius		X	3.4.1	4.5.1
Outer Ring Chamfer/Radius		X	3.4.1	4.5.1
Thread Size (Type VII, VIII, & IX)	X		3.4.1	4.5.1
Thread Length (Type VII, VIII, & IX)		X	3.4.1	4.5.1
Cotter Pin Hole Dia. (If Applicable)		X	3.4.1	4.5.1
Cotter Pin Hole Locations (If Applicable)		X	3.4.1	4.5.1
Endwasher Dia.		X	3.4.1	4.5.1
Annular Groove Width(s)		X	3.4.1	4.5.1
Lubrication Provisions		X	3.4.5	4.5.1
Workmanship		X	3.8	4.5.1
Marking		X	3.6	4.5.1
Hardness		X	3.4.2	4.5.2
Surface Finish		X	3.4.3	4.5.3
Lubrication		X	3.4.5	4.5.5
Radial Internal Clearance	X		3.5.2	4.5.7
Axial Internal Clearance	X		3.5.3	4.5.8
Plating		X	3.4.4.1	4.5.4.1
Passivation		X	3.4.4.2	4.5.4.2

TABLE 5 - SAMPLING PLAN FOR QUALITY CONFORMANCE TESTS

	SAMPLE SIZE "A" indicates the entire lot must be inspected.	
LOT SIZE	**Major Characteristics**	**Minor Characteristics**
1-2	A	A
3-8	A	3
9-12	A	3
13-15	13	3
16-25	13	3
26-50	13	5
51-90	13	6
91-150	13	7
151-280	20	10
281-500	29	11
501-1200	34	15
1201-1249	42	18
1250-3200	42	18
3201-10,000	50	22

TABLE 6 - DUST TEST MEDIA

Particle Size	Percent (%)
0>=<5 microns	12%
5>=<10"	12
10>=<20"	14
20>=<40 "	23
40>=<80 "	30
80>=<200 "	9
	100%

TABLE 7 - AXIAL COMPRESSION LOAD

Bearing Bore Dia. or Stem Dia. -Inch	.1875	.250	.3125	.375	.4375	.500
Axial Load - lbf.	480	870	1,400	2,100	2,850	3,800
Bearing Bore Dia. or Stem Dia. -Inch	.5625	.625	.750	.875	1.000	1.250
Axial Load - lbf.	4,870	6,150	8,950	12,200	16,300	25,800

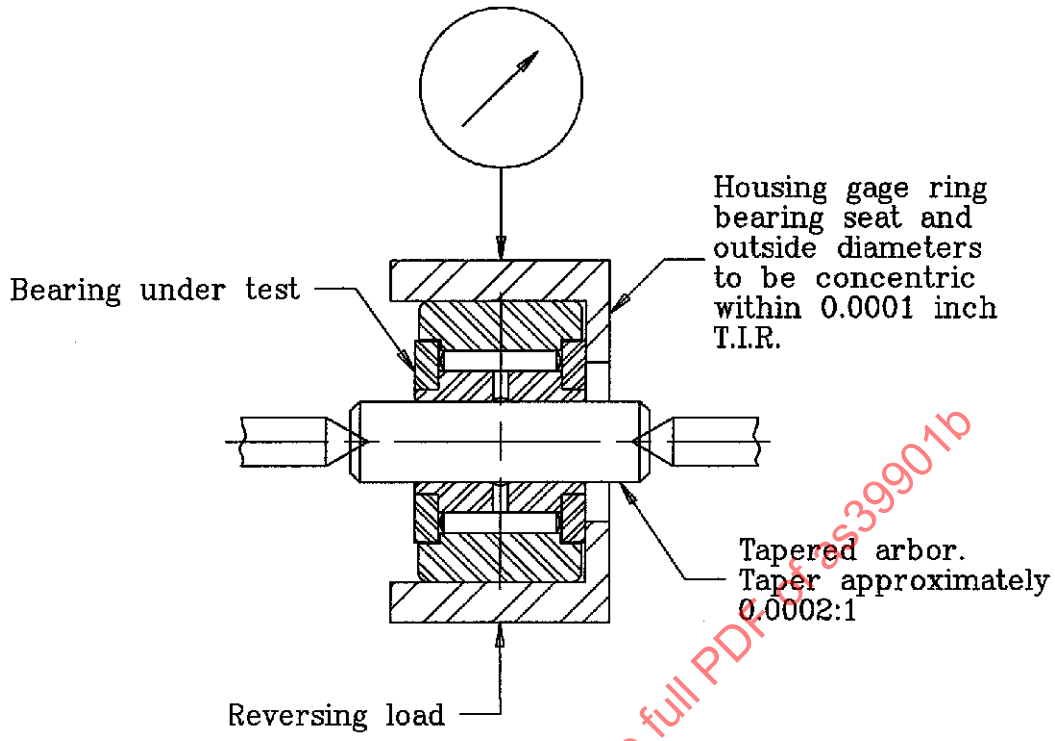

FIGURE 1A - RADIAL INTERNAL CLEARANCE AND RADIAL RUNOUT TEST FOR TYPE I BEARINGS

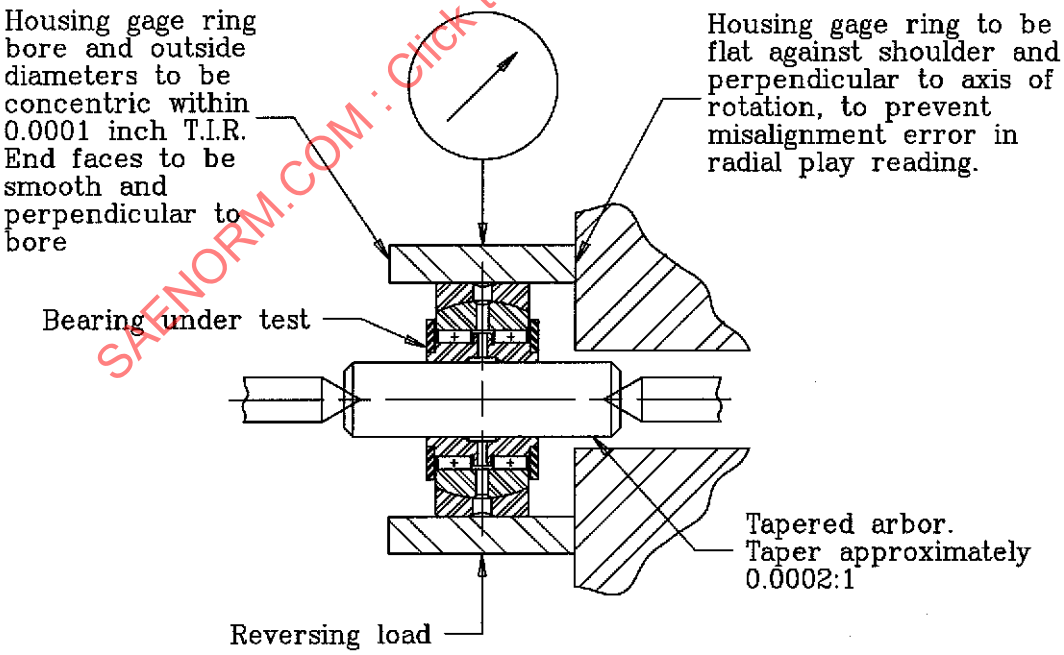

FIGURE 1B - RADIAL INTERNAL CLEARANCE TEST FOR TYPE III AND IV BEARINGS