SAE Aerospace
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AEROSPACE STANDARD

SAE AS8976 | REV. A

Issued 1999-08
Revised 2012-02

Superseding AS8976

(R) Bearings, Plain, Self-Aligning, All Metal General Specification for

RATIONALE

AS8976 Rev A is a 5 year review and reformat of this specification. Clarified plating notes. Added option for zinc nickel plate. Clarified procurement activity address. Clairifed load test dwell times to be approximate. Updated obsolete specifications throughout document. Clarified no material / plating substitutions once qualified unless approved by qualifying activity.

NOTICE

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

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1. SCOPE

This specification covers all metal plain spherical bearings which are self-aligning for use between 65 °F to 250 °F. This specification covers bearings with alloy steel races, aluminum bronze races, and an entierly CRES bearing (ball and race). All units are inches, unless otherwise stated.

1.1 Purpose

This document defines the procurment, performance, testing, and procurement activity for the bearings defined in AS21154 and AS21155.

Classification:

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

Type 1 – Grooved outer race (AS21154)

Type 2 – Chamfered outer race (AS21155)

2. REFERENCES

2.1 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/AS8976A

2.1.1 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)

AMS2417 Plating, Zinc-Nickel Alloy

AMS2460 Plating, Chromium

AS21154 Bearing, Plain, Self-Aligning, Grooved, Outer Ring

AS21155 Bearing, Plain, Self-Aligning, Chamfered, Outer Ring

2.1.2 ASQ Publications

Available from American Society for Quality, 600 North Plankinton Avenue, Milwaukee, WI 53203, Tel: 800-248-1946 (United States or Canada) or +1-414-272-8575 (International), www.asq.org.

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

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

ASTM E 18 Test Methods for Rockwell Hardness and Rockwell superficial hardness of metallic materials

ASME Y14.100 Engineering Drawing Practices

ASME Y14.24 Types and Applications of Engineering Drawings

ASME Y14.34 Associated Lists

ASME Y14.35M Revision of Engineering Drawings and Associated Documents

2.1.4 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 Anti-friction Bearings, Associated Parts and Subassemblies

MIL-G-21164 Grease, Molybdenum Disulfide (For Low and High Temperatures)

MIL-STD-129 Marking for Shipment and Storage

3. REQUIREMENTS

3.1 Qualification

The bearings furnished under this specification shall be products which are qualified for listing on the applicable Qualified Products List at the time set for opening bids (see 4.3 and 6.2).

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3.1.1 Product Design Change

Any change in product design or description may require requalification of the product to an extent determined by the activity responsible for qualification.

3.2 Materials

The ball and outer race shall be in accordance with the applicable AS sheet (AS21154 or AS21155) when examined in accordance with 4.5.1.

3.2.1 Plating

Ball: Chrome plating shall be in accordance with AMS2460, class 2d, 0.0002 inches minimum thickness on spherical surfaces and faces. Shot peen prior to plating not required. Chrome plate runout on I.D. chamfers is permissible. Chrome plating shall be required on 52100 balls at the option of the supplier. Ball material is left up to the supplier and is not a defined part number option. Minimum thickness of chrome plate in runout region is not controlled. Cadmium Plating of the race shall be in accordance with AMS-QQ-P-416 Type I, Class 2 and the applicable AS sheet. Zinc Nickel plating of the outer race shall be in accordance with AMS2417, Type 2, and the applicable AS sheet. Once qualified, the supplier may not change materials or platings without approval of the qualifying activity, see paragraph 6.3.

3.3 Design

Bearing design shall conform to that specified in applicable AS sheet (AS21154 or AS21155).

3.4 Construction

Except as otherwise specified, the details of the working parts shall be optional. The bearings shall not have loading slots.

3.4.1 Dimensions and Tolerances

Dimensions and tolerances shall be as specified on the applicable AS sheet (AS21154 or AS21155). Dimensions not shown shall be at the option of the manufacturer.

3.4.2 Surface Texture

Surface textures shall be in accordance with the applicable AS sheet (AS21154 or AS21155) and ANSI B46.1. Bearings shall be free of any defects which may be detrimental to satisfactory installation, performance or bearing life, as defined by this specification.

3.4.3 Lubrication

The bearings shall be thoroughly cleaned and dried in accordance with MIL-DTL-197. The mating spherical surfaces, lubricant groove and bore shall be coated with grease conforming to MIL-G-21164.

3.4.4 Hardness

The hardness shall be as specified on the applicable AS sheet (AS21154 or AS21155).

3.5 Performance

3.5.1 Radial Static Limit Load

After the application of the radial static load listed on the applicable AS (AS21154 or AS21155) sheet has been applied as specified in 4.6.1, the permanent set shall not exceed the applicable value shown in Table 1.

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3.5.2 Axial Static Limit Load

After the application of the axial static load specified on the applicable AS (AS21154 or AS21155) sheet has been applied as specified in 4.6.2, the permanent set shall not exceed the applicable value shown in Table 1.

NOTE: The axial loads only apply when the bearing is loaded in the fixture defined in Figure 2. Proper bearing support is critical to obtaining the rated loads.

3.5.3 Radial Ultimate Static Load

No fracture of the ball or race nor push-out of the ball shall occur when subjected to 1-1/2 times the radial or axial limit loads specified on the applicable AS sheet are applied, as specified in 4.6.1 and 4.6.2.

NOTE: There is no ultimate axial load requirement. The axial static limit load is the maximum load the bearing is capable of when mounted and tested in the fixture shown in Figure 2, para. 4.6.2. The fixture will not allow the ball to push out of the race because the through-bore is smaller than the ball sphere diameter.

3.5.4 Self Alignment

The bearing shall be self-aligning and shall permit the minimum angular displacement specified on the applicable AS sheet (AS21154 or AS21155).

3.5.5 Internal Play

When tested in accordance with 4.6.3, radial and axial play shall not exceed the values specified in Table 1.

TABLE 1 - RADIAL AND AXIAL STATIC LIMIT LOAD

All Sizes	Permanent Set (inches)		Internal Play (inches)	
	Radial	Axial	Radial	Axial
All	0.003	0.004	0.0005 0.0020	0.010 (max.)

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3.6 Identification of Product

Each bearing shall be permanently and legibly marked with the manufacturer's CAGE code, manufacturer's lot number, and Aerospace Standard part number as a minimum. Where practicable, identification shall appear on the side face of the race; otherwise identification shall appear on the periphery of the race. Any additional marking is optional. Metal impression stamping is prohibited.

3.7 Interchangeability

All parts having the same manufacturer's part number shall be directly and completely interchangeable with each other with respect to installation and performance. The drawing number requirements of ASME Y14.100 shall govern changes in the manufacturer's part numbers.

3.8 Workmanship

The bearings shall be free of tool marks, chatter waves, rust, grinding scratches, pits or any other defects that may adversely affect their 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 as specified herein. Except as otherwise specified in the contract or 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. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Classification of Inspections

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

a. Qualification inspection (4.3)

b. Quality conformance inspection (4.4)

4.3 Qualification Inspection

Qualification inspection shall include all the examinations and tests of this specification. The minimum number of samples per test shall be in accordance with Table 2.

TABLE 2 - QUALIFICATION TEST SAMPLES

Examinations and tests	Paragraph number	Samples to be tested
Examination of product	4.5.1	5
Preparation for delivery	4.5.3	5
Radial static limit load	4.6.1	3
Axial static limit load	4.6.2	3
Internal play	4.6.3	3

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4.3.1 Sampling Instructions

Qualification test samples shall consist of six bearings of each size and material, as specified in AS21154, for which qualification is desired. Approval of the AS21154 bearing shall constitute qualification of the AS21155 bearing of the same size and material. Samples shall be identified as required and forwarded to the activity designated in the letter of authorization from the activity responsible for qualification (see 6.3).

4.3.2 Certified Test Report

The manufacturer shall furnish a certified test report showing that the manufacturer's product satisfactorily conforms to this specification. The test report shall include, as a minimum, actual results of the tests specified herein and shall include copies of the load versus deflection curves from the radial and axial static limit load tests. When the report is submitted, it shall be accompanied by a dated drawing which completely describes the manufacturer's product by specifying all dimensions and tolerances, composition of the ball and outer race material, coating or plating and heat treatment. The manufacturer's part number for each size shall be included on the drawing.

4.4 Quality Conformance Inspections

The quality conformance inspections shall consist of the inspections listed in Table 3.

TABLE 3 - QUALITY CONFORMANCE INSPECTIONS

	Examination or Test		Critical Characteristics	Major Characteristics	Minor Characteristics	Special Insp. Plan	Requirement Paragraph	Test Paragraph
(a)	Dimensions/MS Ref.							
	Bore	"B"		X			3.4.1	4.5.1
	O.D.	"D"		X			3.4.1	4.5.1
	Outer Ring Width	"H"		X			3.4.1	4.5.1
	Ball Flat Diameter	"M"			X		3.4.1	4.5.1
	Ball Flat Width	"W"		X			3.4.1	4.5.1
	Groove Depth (1)	"P"		X			3.4.1	4.5.1
	Groove Pitch Diam. (1)	"E"		X				
	Groove Root Radius (1)				X		3.4.1	4.5.1
	Groove Side Face Angle (1)				X		3.4.1	4.5.1
	Outer Race Chamfer (2)			X			3.4.1	4.5.1
(b)	Identification of Product				X		3.6	4.5.1
(c)	Workmanship				X		3.8	4.5.1
(d)	Preparation for Delivery				X			4.5.2
(e)	Radial Clearance					100% Inspection	3.5.5	4.6.3.1
(f)	Axial Clearance					100% Inspection	3.5.5	4.6.3.2

(1) Inspection required only on AS21154 bearings.

(2) Inspection required only on AS21155 bearings.

4.4.1 Inspection Lot

The inspection lot shall consist of finished bearings, having a single part number, manufactured by the procedures established for the original qualified bearings, which can be defined by means of in-house processing records.

4.4.2 Sampling

4.4.2.1 Sample for Quality Conformance Tests (a) through (d)

The sample bearings shall be selected at random from each inspection lot in accordance with Table 4. 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.

4.4.2.2 Sample for Quality Conformance Ttests (e) and (f)

Inspection shall be 100% of the lot. All defective parts shall be removed from the lot.

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TABLE 4 - SAMPLING PLAN FOR QUALITY CONFORMANCE INSPECTIONS EXCEPT DESTRUCTIVE INSPECTIONS

Zero-Based Acceptance Plan (C=0)

SAMPLE SIZE

Acceptance number in all cases is zero.

"A" indicates the entire lot must be inspected.

LOT SIZE	Critical Characteristics	Major Characteristics	Minor Characteristics
2	A	A	A
3-8	A	A	3
9-12	A	A	3
13-15	A	13	3
16-25	A	13	3
26-50	A	13	5
51-90	A	13	6
91-150	A	13	7
151-280	A	20	10
281-500	A	29	11
501-1200	A	34	15
1201-1249	A	42	18
1250-3200	1250	42	18
3201-10,000	1250	50	22

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4.5 Examinations

4.5.1 Examination of Product

The bearings shall be examined to determine conformance to this specification and the applicable AS sheet (AS21154 or AS21155) for material, plating dimensions, finish, identification of product, workmanship and requirements not covered by tests.

4.5.2 Material Certification

The manufacturer shall furnish to the qualifying activity a material certification specifying the composition of the material used in the manufacture of the bearings.

4.5.3 Inspection of Preparation for Delivery

Preservation, packaging, packing and marking shall be inspected to determine conformance to section 5.

4.6 Test Methods

Unless otherwise specified, all tests shall be performed at room temperature.

Note: Indicator (measurement device) placement is optional and does not need to be placed under the fixtures; however, the test facility technician must ensure the placement will provide for an accurate measurement of the bearing permanent set. See Figure 1 and Figure 2 for details.

4.6.1 Radial Static Load Test

4.6.1.1 Radial Static Limit Load

The test bearing shall be installed in a test fixture as shown in Figure 1, using an 0.000 to 0.001 inch loose fit for the shaft and the housing. The use of differential temperatures for installation will not be allowed. A preload of 4 to 6 percent of the radial static load shall be applied to the bearing. After holding for approximately 15 seconds, the measuring device shall be set to zero. The load shall then be increased at a rate not to exceed 2 percent of the specified load per second until it equals the radial static limit load. The load shall be held for approximately 1 minute, and then reduced at the same rate to the preload value. The permanent set shall be the reading at the preload.

4.6.1.2 Radial Static Ultimate Load

The bearing shall be mounted as described in 4.6.1.1. The same bearing used for radial static limit load testing may be used for the ultimate static radial load test. The ultimate radial load shall be applied at a rate not to exceed 2 percent of the specified load per second until it equals the radial static ultimate load. The load shall be held for 1 approximately minute.

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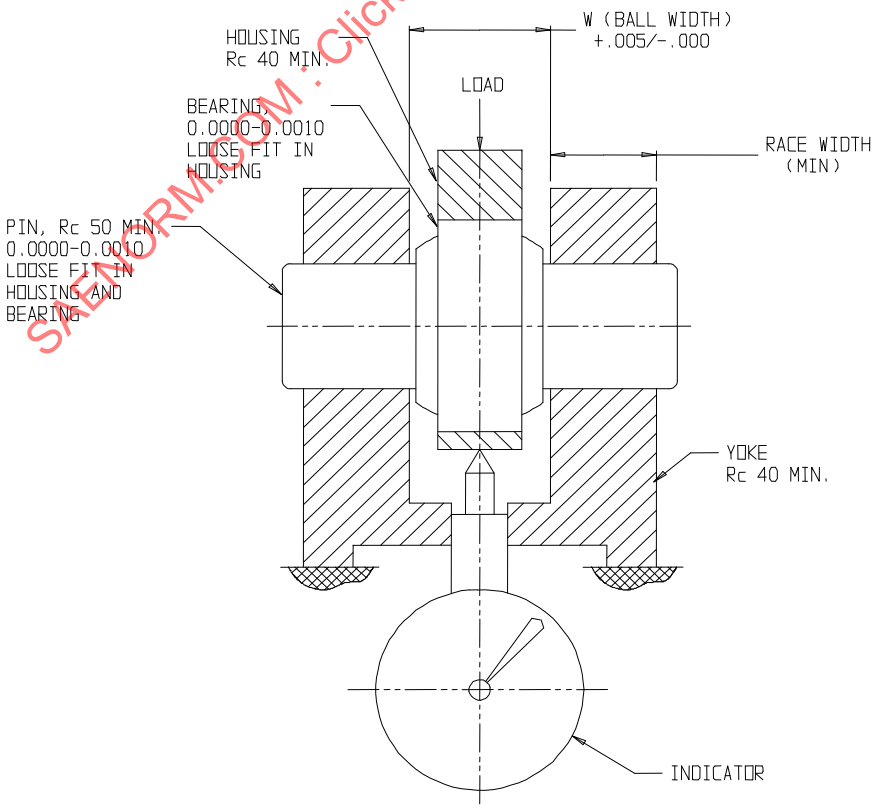

FIGURE 1 - RADIAL TEST FIXTURE

4.6.2 Axial Static and Ultimate Load

The test bearing shall be installed in a fixture as shown in Figure 2. Bearings shall fit in the housing with a 0.000 to 0.001 inch loose fit. The hole in the support fixture for support of the ball shall be in accordance with the support test fixture “Inner Diameter” referenced in the table below Figure 2.

NOTE: The through-bore hole in the support fixture will not allow the ball to push in to because it is smaller than the ball sphere diameter.

A preload of 4 to 6 percent of the axial static load shall be applied to the bearing. After holding for 15 seconds, the measuring device shall be set to zero. The load shall then be increased at a rate not to exceed 2 percent of the specified load per second until it equals the axial static limit load. The load shall be held for approximately 1 minute, and then reduced at the same rate to the preload value. The permanent set shall be the reading at the preload.

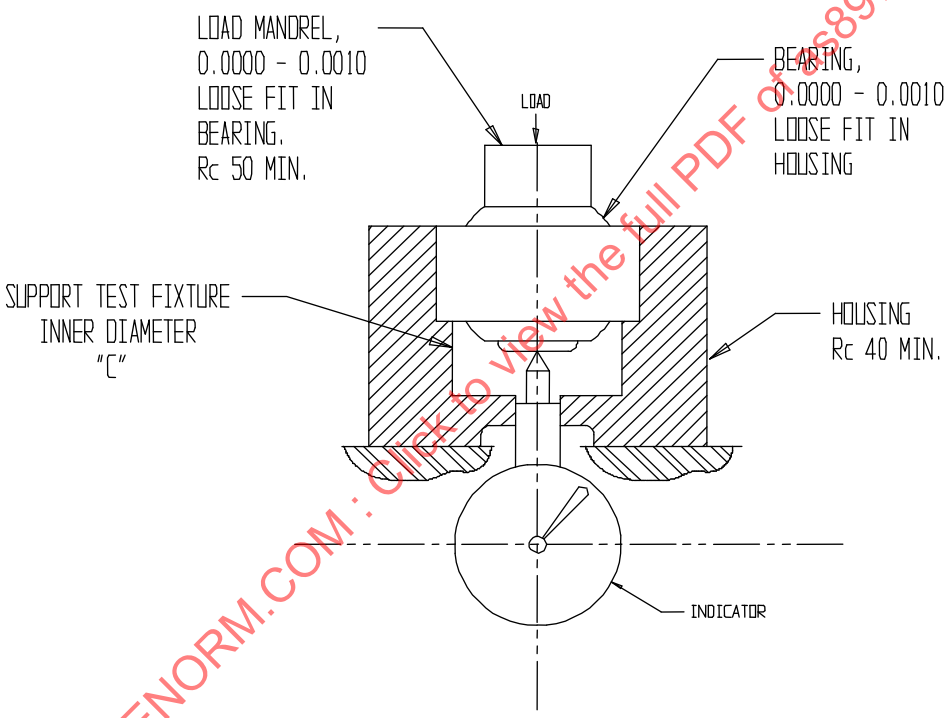

FIGURE 2 - AXIAL TEST FIXTURE

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