SAE Aerospace
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AEROSPACE RECOMMENDED PRACTICE

SAE ARP5483/8 | REV. A

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Superseding ARP5483/8

Rolling Bearing Dynamic Radial Load Test

RATIONALE

ARP5483/8A is a five-year review with only minor editorial changes.

1. SCOPE

This test method outlines the recommended machine function, fixtures and procedures used to test airframe rolling element bearings for dynamic performance under steady unidirectional radial load and oscillatory motion. Bearings covered by this test method shall be ball, roller or needle type in either annular or rod end configuration, used in airframe control applications.

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.

AS6039 Bearings, Ball, Rod End, Double Row, Self-Aligning

AS7949 Bearings, Ball, Airframe, Antifriction, General Standard for

AS8914 Bearings, Roller, Self-Aligning, Airframe, Antifriction

AS8952 Bearings, Roller, Rod End, Antifriction, Self-Aligning

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
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SAE WEB ADDRESS: http://www.sae.org

3. GENERAL REQUIREMENTS

3.1 Dynamic Radial Load

3.1.1 Test Machine

The test machine shall be capable of applying a radial load as defined in the applicable bearing or drawing standard, and oscillatory motion to the bearing for the required angular arc and number of oscillatory cycles per the procurement standard. Instructions for operating and maintaining the test machine are required.

3.1.1.1 Design

The rod end or housed annular test bearing shall be held fixed by the test machine. The shaft passing through the inner ring of the test bearing shall be supported for oscillatory motion and loaded in double shear. The structural member of the test machine shall be suitably stiff so as to limit deflection from the applied load. For guidance purposes, the deflection in the plane of the support bearings should not exceed 0.004 inches per inch within the zone included by the support bearings. The structure, support bearings, drive and linkages shall be designed for continuous operation and high reliability. Multiple test stations are permissible, providing that it can be shown that variables at each station remain within control limits regardless of individual test bearing performance

3.1.1.2 Applied Radial Load

The test load applied through the rod end or bearing housing shall be steady and maintainable. Unless otherwise specified, the direction of loading shall be with the rod in tension.

3.1.1.3 Oscillatory Motion

The oscillatory motion shall produce an angular velocity to the test bearing inner ring approximating a sine wave.

3.1.2 Test Fixture

3.1.2.1 Annular Bearings

Annular bearings shall be mounted in the bore of the housing with a resulting fit of 0.000 to 0.001 in clearance over the outside diameter. Such housing may typically be a square plate or a circular disk, with a threaded shank extending from the edge of the square or disk. The thickness of the housing shall be equal to or greater than the width of the bearing outer ring. The minimum cross sectional area of the housing shall be at least 10 times greater than the test bearing outer ring cross sectional area. The housing shall be made of steel, through hardened to 30-45 HRC. The bore of the housing shall meet a ground roughness of 16 µin Ra. The shank shall be threaded for rigid attachment to a load cell or loading mechanism (see Figure 1).

3.1.2.2 Rod End Bearings

Rod end bearings have an inherent structured provision and shall not require a separate housing.

3.1.2.3 Bearing Inner Ring Support

The shaft or pin to support the bearing inner ring shall be steel, mounted with a resulting fit of 0.000 to 0.001 in clearance. The steel pin shall be through hardened to 50-55 HRC, and meet a ground roughness of 12 µin Ra.

3.1.3 Instrumentation

The test machine shall be provided with the following instrumentation (see Table 1).

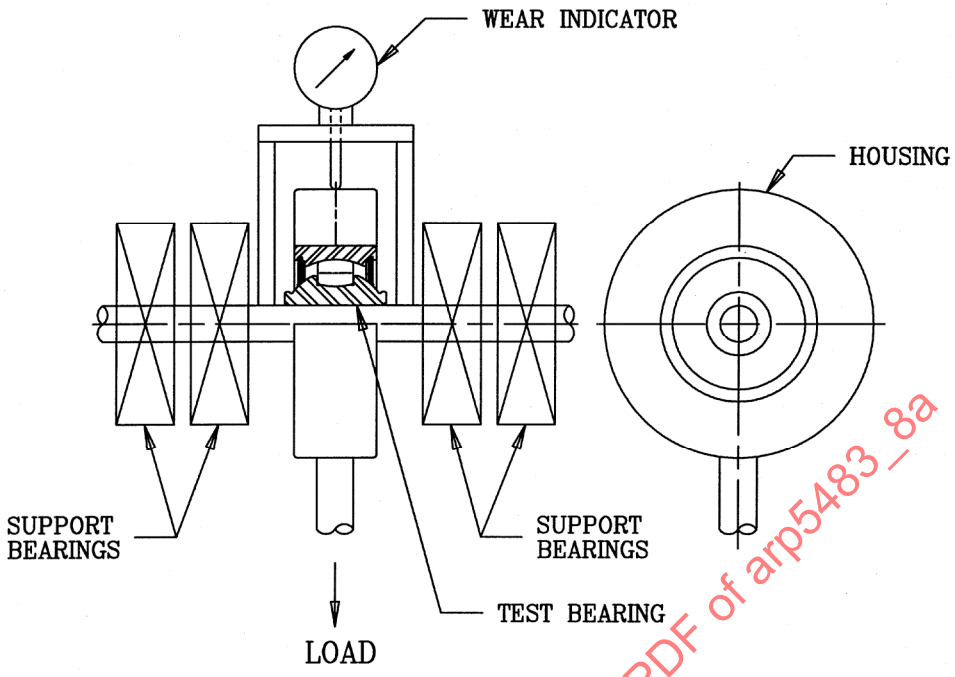

FIGURE 1 - TEST FIXTURE

TABLE 1 - INSTRUMENTATION REQUIREMENTS FOR TEST MACHINE

Parameter	Tolerance
	Limits
Load	±2% of test requirement
Oscillation Angle	±1° of test requirement
Frequency of Oscillation	±2% of test requirement
	Measurement Accuracy
Housing Temperature	±5 °F
Cycles (Counter)	Not applicable
Wear	±0.0001 in
Torque (If Required)	±5% of peak torque

3.1.3.1 Load Cell

The load cell is to measure the applied test load, or calibrate the method employed to apply the test load.

3.1.3.2 Counter

A cycle counter and time clock shall be used.

3.1.3.3 Wear Indicator (approach from inner ring to outer ring)

The preferred method is to use a dial indicator between the test bearing housing and the shaft or pin support system. If the indicator bridges between the support bearing structure and the test bearing housing, provisions shall be made to isolate the effects of support bearing wear.

3.1.3.4 Resistance Torque to Rotation Under Load

The preferred method is to measure the torsion reaction from the test bearing alone. If total drive torque is used, provisions shall be made to isolate the effects of the support bearings.

3.1.3.5 Temperature

Housing temperature shall be monitored using either thermocouples or using hand held contact probes.

3.1.3.6 Calibration

Calibration of the instrumentation shall be in accordance with the test machine's manufacturer's specifications and shall be within limits at the time of the test.

3.1.4 Safety Provisions

The test machine shall be configured to the extent necessary to provide maximum safety to personnel supporting the test. In particular, moving shafts, belts, chains and linkages shall be shrouded or otherwise protected. Electrical controls shall be housed in consoles to avoid shock hazards. Automatic shut-off shall be provided for the test machine to detect mechanical, electrical or hydraulic problems that endanger personnel or cause property damage due to fire, smoke or explosion.

3.1.5 Maintenance

A visual inspection of the test machine shall be performed prior to the start of the test. A general maintenance schedule and procedure to check and replace worn parts before the start of each test is also required.

3.1.6 Quality Assurance

Provisions shall be made to verify and document that the following items have been checked and are acceptable.

a. Operating instructions and maintenance procedures for the test machine are prepared and are understood by the test machine operator.

b. Safety requirements have been met and no additional safety hazards exist.

c. Test machine is operational and all required test parameters are within specified limits.

d. All instrumentation is functional and within calibration limits.

3.2 Specimen

3.2.1 Description

The test specimen shall be as specified in the applicable drawing standard.

3.2.2 Quantity

The number of test specimens shall be as specified in the procurement standard. It is recommended to have one additional bearing for set-up and checking out the test machine.

3.2.3 Disposition After Test

The test bearings shall be removed from the test machine for post-test inspections as required by the procurement standard. Disposition of the tested bearings shall be in accordance with that standard.

4. DETAILED REQUIREMENTS

4.1 Machine Checkout Test

A test procedure that includes a checklist, a list of data requirements, and forms for recording data shall be prepared. Typical data collected or information included on the data sheet is shown in 5.3.4. An extra test bearing is recommended for setup and establishing dynamic machine adjustments, particularly if the operator is not familiar with the test requirements specified in the procurement standard. Unless otherwise specified, during the pretest the operator may determine oscillatory rate so as not to exceed a housing temperature of 130 °F. Before starting the checkout test, a careful examination of the test setup, test machine and instrumentation shall be conducted. Load and motion inputs should then be gradually increased to their final values at the discretion of the test engineer. During this period, procedures and typical values for operating temperature, wear measurements and operating torque can be checked and operation characteristics of the test machine can be assessed. The duration of the checkout test is at the option of the test engineer.

4.2 Test Specimen Installation

Finite diameter measurements shall be recorded for each specimen's outside diameter, bore and pin or shaft outside diameter and housing inside diameter before installation. Part number and sample number shall permanently identify bearing and housing. Record the bearing manufacturer's name and identifying numbers and install the bearing into the housing. Permanently apply index marks on the bearing or housing to document the orientation of the assembly in the test machine. Insure that any thermocouple wires or other instrumentation is properly attached and install assembly into test machine. The inner ring is normally constrained axially and the outer ring given axial freedom in the housing.

4.3 Verification of Test Parameters

Scheduled inspections shall be made to verify that all values or conditions for each test parameter (see 5.3.1) are as specified and maintained during the entire test. Also, verify that all measurements to be used for data requirements (see 3.2) are properly taken and within specified limits. These inspections shall be made at the start and completion of each test and at recurring intervals during the test. The frequency of the interim inspections shall be based on the experience with each specific test machine. A minimum of three interim inspections shall be made to verify load, oscillation angle and wear.

4.4 Temperature

Cooling of the test bearing is not normally required for rolling element bearings. Stabilized temperature of the housing shall be monitored to assure 130 °F maximum and controlled by limiting the oscillation rate. Common rates are in the range of 5 to 50 cycles per minute, and should be maintained within ±2% for the duration of the test.

4.5 Load

The load shall be maintained within ±2% of the applicable document specifications.

4.6 Oscillation Angle

The angle of oscillation shall be maintained within ±1 degree.

4.7 Wear

Displacement measurements of the approach of the inner ring to housing shall be done while the machine is oscillating under the test load. The average value of the minimum and maximum excursions shall be determined arithmetically and used for comparison to subsequent measurements to represent "wear." Successive cycle average readings shall repeat within ±0.0002 in. The initial recording shall be made between the 5th and 25th cycles to allow seating of the component parts.

4.8 Torque

If required, torsion resistance from the test bearing shall be measured under the test load and oscillation angle. The maximum value shall be used to represent the test bearing condition. Successive readings should repeat within ±5%. The initial recording shall be made between the 5th and 25th cycles to allow seating of the component parts.

4.9 Test Duration

Testing shall continue until the test has successfully completed the required number of cycles at load or until failure, as defined in the procurement standard, has occurred.

4.10 Post Test Evaluation

The test bearing shall be removed from the machine and evaluated as required by the applicable standard to confirm internal conditions associated with failure criteria such as spalling. Housing bore, pin outside diameter and bearing mounting diameters shall be measured for comparison to pretest dimensions.

5. NOTES

5.1 Intended Use

This test method is intended to provide means for evaluating the performance of rolling element bearings for airframe applications, subject to steady unidirectional loads and oscillatory motion.

5.2 Method of Reference

This test method shall be referenced in procurement standards for rolling element airframe bearings. Specific test and data requirements are given in the applicable standard. The following note shall be used to reference this test method:

NOTE: The bearings shall be tested in accordance with ARP5483/8.

5.3 Test Data

5.3.1 Test Parameters

Specific test requirements are given in the procurement document. Test requirements shall include the following test parameters as applicable:

a. Test specimen design envelope

b. Shaft and housing configuration

c. Radial loads

d. Oscillation angles

e. Frequency of oscillation

f. Temperature requirements

g. Torque requirements

h. Test duration

i. Failure criteria (contact fatigue, wear, torque, etc.)