AEROSPACE RECOMMENDED PRACTICE

ARP5448™/3 REV. A

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Superseding ARP5448/3

Plain Bearing Low Speed Oscillation Test

RATIONALE

This revision clarifies and expands sections 3.1.1.3, 3.1.1.4, 3.2, 4.2, 4.3, and 5.3.2 in order to better characterize the high and low temperature test setup and procedure. There are also editorial corrections in 4.4 and 5.3.4.j.

1. SCOPE

1.1 Purpose

This test method outlines a recommended procedure for performing unidirectional load dynamic testing of self-lubricating bearings at room temperature, elevated temperature or sub-zero temperature, dry or contaminated with fluids. The wear data from these tests is to be used for qualification and to establish bearing design criteria.

1.2 Classification

Bearings covered by this test method shall be plain spherical bearings, which are self-aligning or plain sleeve bearings.

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.

2.1.1 ASTM Publications

Available from American Society for Quality, 600 North Plankinton Avenue, Milwaukee, WI 53203, Tel: 800-248-1946 (United States or Canada), 001-800-514-1564 (Mexico), or +1-414-272-8575 (all other locations), www.asq.org.

ASTM E4 Standard Methods of Verification of Testing Machines

ASTM E83 Standard Practice for Verification and Classification of Extensometer Systems

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
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2.1.2 ANSI Publications

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

ANSI/NCSL Z540.3 Requirements for the Calibration of Measuring and Test Equipment

2.1.3 ISO Publications

Available from International Organization for Standardization, ISO Central Secretariat, 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland, Tel: +41 22 749 01 11, www.iso.org.

ISO 10012 Measurement Management Systems – Requirements for Measurement Processes and Measuring Equipment

2.2 DEFINITIONS

Not applicable.

3. GENERAL REQUIREMENTS

3.1 Test Apparatus

3.1.1 Test Machine

The test machine shall be capable of applying a unidirectional load of controlled magnitude to the bearing race while the ball (for spherical bearings) or shaft (for sleeve bearings) is oscillated through a prescribed angle. Loads shall be capable of being maintained within +3/-0% of the test requirement. Angle of oscillation shall be capable of being maintained within ±0.5 degrees of the test requirement. The bearing shall be mounted to place the shaft in double shear with a minimum of bending. The machine shall include the following accessory equipment for complete testing capability.

3.1.1.1 Bearing Holders

Appropriate size bearing holders shall be made of steel. Provisions to bush these holders are recommended.

3.1.1.2 Test Shafts

Appropriate size test shafts shall be made of steel with a hardness of Rc 45 minimum or CRES, 13-8, condition H-950, and may be chrome plated or nickel plated. When testing sleeve bearings, it is acceptable for some test machine setups to require bushings to act as an inner race. All further statements about shafts shall also apply to shaft/bushing combinations. Cres is recommended for shafts because of its increased fatigue properties. Shafts for testing sleeve bearings shall have 8 Ra max. surface finish on the outside diameter and be polished after grinding.

3.1.1.3 Temperature Heating System for Elevated Temperature Test

A temperature heating system shall permit heating the test bearing to a controlled temperature and maintaining it there for the duration of a test. One approach to accomplish this is to construct an insulated enclosure that completely surrounds the bearing under test and introducing heated air (from resistance heaters) as a heating medium. As most airframe bearing standards with an elevated temperature test have requirements for controlled temperature (at the ball liner interface for spherical bearings or shaft liner interface for sleeve bearings), the monitor/controller thermocouple shall be located as close as possible to these areas. Locate the thermocouples within ±45 degrees of the center of the load zone. Temperature monitors/controllers shall be accurate within ±5 ºF.

3.1.1.4 Temperature Cooling System for Sub-Zero Temperature Test

A temperature cooling system shall permit cooling the test bearing to a controlled temperature and maintaining it there for the duration of a test. One approach to accomplish this is to construct an insulated enclosure that completely surrounds the bearing under test and introducing N_2 or CO_2 as a cooling medium. As most airframe bearing standards with a sub-zero temperature test have requirements for controlled temperature (at the ball liner interface for spherical bearings or shaft liner interface for sleeve bearings), the monitor/controller thermocouple shall be located as close as possible to these areas. Locate the thermocouples within ±45 ºF of the center of the load zone. Temperature monitors/controllers shall be accurate within ±5 ºF.

3.1.1.5 Radial Displacement Indicator

A dial indicator or electronic pickup device, accurate within 0.0002 inch, shall be mounted to permit measurement of any radial movement of the race with respect to the ball for spherical bearings or radial movement of the journal with respect to the shaft for sleeve bearings. The preferred system is to measure bearing holder displacement with respect to the test shaft. The next preferred method is to measure bearing holder displacement with respect to some fixed surface. The least preferred method is measurement at some remote site.

3.1.1.6 Liquid Contaminator System

A liquid contaminator system shall introduce liquid contaminants to each side of the test bearing during dynamic testing. This system shall have provisions to accurately regulate the flow rate of the contaminant. Provisions shall also be made to catch the fluids.

3.1.1.7 Cycle Counter

Provisions shall be made to count cycles.

3.1.1.8 Load Monitor

Provisions shall be made to monitor load.

3.1.1.9 Torque Monitor

Provisions shall be made to monitor torque to rotate the test spindle for reference purposes. It is advisable for the test laboratory to have previously determined the torque attributable to the support bearings of the test rig spindle in order to isolate torque due to the test bearings.

3.1.2 Calibration

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

3.1.3 Equipment Variations

Variations to the test equipment and associated methods required herein are permissible provided the procuring activity is provided with sufficient calibration data to verify the accuracy of the test conditions/results.

3.2 Test Specimen

Spherical bearings shall be prepared for testing by notching or otherwise permanently marking the outer race to identify the center of load zone. Sleeve bearings shall have the center of the load zone identified on the metallic sleeve.