SAE Aerospace
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AEROSPACE RECOMMENDED PRACTICE

SAE ARP5483/2

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Rolling Element Bearing Hardness Test

1. SCOPE:

This method outlines the standard procedure for testing the hardness of bearing components. Bearings covered by this test method shall be any rolling element bearing used in airframe control.

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 ISO Publications: Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002.

ISO 3290 Metal Balls

2.1.2 ASTM Publications: Available from ASTM, 100 Barr Harbor, West Conshohocken, PA 10036-2959.

ASTM E 3 Standard Methods of Preparation of Metallographic Specimens
ASTM E 18 Standard Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM E 140 Standard Hardness Conversion Tables for Metals, (Relationship Between Brinell Hardness, Vickers Hardness, Rockwell Hardness, Rockwell Superficial Hardness, and Knoop Hardness
ASTM E 384 Standard Test Method for Microhardness of Materials

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2.2 Definitions:

Case Hardness: The hardness measured on the surface of a case hardened part.

Core Hardness: The hardness measured at a point below the total case depth which represents hardness of the product not affected by the case hardening operation.

Effective Case Depth: The perpendicular distance below the surface of the part, at which the specified level of hardness is reached.

Total Case Depth: The perpendicular distance below the surface at which no further decrease in hardness is observed.

2.3 Order of Precedence:

Text of standards and specifications that reference this test method takes precedence over the text of this document.

3. GENERAL REQUIREMENTS:

3.1 Measuring Hardness:

3.1.1 Hardness Tester: The hardness tester shall be capable of both Rockwell Hardness and Rockwell Superficial Hardness tests. Otherwise obtain a separate tester for each type of hardness test. Operation and standardization of the Rockwell Hardness and Rockwell Superficial Hardness tester shall be in accordance with ASTM E 18. Conversions between hardness scales may be made using the tables given in ASTM E 140. All cylindrical specimens tested must be corrected using Tables 6, 7, 13, and 14 from ASTM E 18.

3.1.2 Microhardness Tester: The microhardness tester shall have a precision x-y stage accurate to 0.0005 inch in both axes. Operation and standardization of the microhardness tester shall be in accordance with ASTM E 384. Conversions between hardness scales may be made using the tables given in ASTM E 140.

3.1.3 Metallographic Equipment: Standard metallographic mounting, grinding and polishing equipment shall be available.

3.2 Test Bearings:

Where applicable, bearings shall be disassembled by sectioning the inner and outer rings. The hardness of the inner ring raceway, outer ring raceway and of three rolling elements shall be tested. Hardness of the rod end body or riveted flanges of bellcrank bearings shall be tested also.

3.3 Sample Preparation:

3.3.1 Case Hardened Materials: Cut test specimens approximately 1/4 inch thick from both the inner and outer rings and rolling elements. Cuts shall be made perpendicular to the hardened surface. Mount, grind and polish each specimen in accordance with ASTM E 3.

3.3.2 Through Hardened Materials:

3.3.2.1 Rings: Rockwell hardness test specimens from inner and outer rings shall have at least a 1/8 inch cross sectional thickness and parallel edges. Specimens having a cross sectional thickness less than this shall be tested on a superficial hardness tester. If the specimen is to be tested on a microhardness tester it shall be mounted, ground and polished in accordance with ASTM E 3.

3.3.2.2 Rolling Elements: Rollers that are tapered shall be sectioned and prepared for microhardness testing. Non-tapered rollers shall be tested on a Rockwell hardness (or microhardness) tester or a Rockwell superficial hardness tester. Small diameter rollers may be sectioned and prepared for microhardness testing if the accuracy of non-sectioned results is in question. Balls shall be inspected per ISO 3290. Plain spherical bearing balls shall be treated as rings per 3.3.2.1.

4. DETAILED REQUIREMENTS:

4.1 Case Hardened Materials:

4.1.1 Case Depth: On each polished specimen make a microhardness traverse perpendicular to the hardened surface. The first test shall be 0.001 to 0.003 inch from the surface. Continue testing inwards at 0.005 inch increments until a hardness of below 50 Rockwell C (542 Knoop, 500 gm) is achieved. Graph hardness versus distance from the surface. The effective case depth is defined as the distance below the surface where the hardness reaches 50 Rockwell C.

4.1.2 Core Hardness: In the central region of each polished sample take five microhardness measurements. The average of these readings shall be defined as the core hardness.

4.2 Through Hardened Materials:

4.2.1 Balls: Balls shall be tested in accordance with ISO 3290. Conversions between hardness scales may be made using the tables given in ASTM E 140.

4.2.2 Specimens to be Tested for Rockwell Hardness or Rockwell Superficial Hardness: Sectioned inner and outer ring specimens shall be tested using the Rockwell C scale taking the average of five readings. Rollers shall be tested on a Rockwell hardness, Rockwell Superficial Hardness or other hardness testing equipment. Small diameter rollers may be sectioned and prepared for microhardness testing if the accuracy of non-sectioned results is in question. In all cases, the average of five readings shall be taken.

4.2.3 Specimens to be Tested for Microhardness: On all polished specimens the average of five readings shall be taken. Conversions between hardness scales may be made using the tables given in ASTM E 140. All cylindrical specimens tested must be corrected using Tables 6, 7, 13, and 14 from ASTM E 18.

4.3 Bellcrank Bearings:

Rod end shanks and riveting flanges of bellcrank bearings shall be tested using the Rockwell 30N scale. Readings on the rod end shanks shall be taken as close to the end as possible. The average of five readings shall be taken. Ensure keyslots and/or threads are not damaged.

4.4 Hardness Test Data:

A traceable record of the hardness data for the bearings being evaluated shall be required and established by recording the hardness readings for each component along with the date, bearing part number, lot number, and manufacturer's name. Bearings whose hardness readings meet the requirements specified on the applicable specification, specification sheet or MS shall be judged acceptable (see 6.3).

5. DOCUMENTATION:

5.1 Test Parameters:

The following parameters shall be specified in the individual specification or standard:

a. Failure criteria

5.2 Test Data:

The following information shall be recorded in report format:

5.2.1 Bearing Description:

a. Part number
b. Lot identification
c. Manufacturer

5.2.2 Test Equipment:

a. Equipment name, model number, and serial number
b. Calibration data
c. Operator
d. Date tested