

Rolling Element Bearing Axial and Radial Internal Clearance

1. SCOPE:

This test method outlines the standard procedure for measuring the radial and axial internal clearance of rolling element bearings used in airframe controls.

2. REFERENCES:

2.1 Applicable Documents:

None

2.2 Definitions:

**AXIAL INTERNAL CLEARANCE:** The axial distance through which one of the rings may be displaced relative to the other, from one axial extreme position to the opposite extreme position, using a specific gage thrust load exerted parallel to the bearing axis.

**RADIAL INTERNAL CLEARANCE:** The radial distance through which one of the rings may be displaced relative to the other, from one eccentric position to the diametrically opposite extreme position using a specific gage radial load exerted perpendicular to the bearing axis.

2.3 Order of Precedence:

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

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### 3. GENERAL REQUIREMENTS:

#### 3.1 Test Apparatus:

The test fixtures shall be as shown in Figures 1 to 4. Indicator gage forces and gage point radii shall be as shown in Table 1.

TABLE 1 - Indicator Gage Forces and Gage Point Radii

| Basic Bore Diameter<br>d, inch |           | Indicator Gage Force        | Gage Point Radii  |
|--------------------------------|-----------|-----------------------------|-------------------|
| Over                           | Including |                             |                   |
| 0                              | .254      | Not to exceed 7 oz. (2N)    | .032 inch (0.8mm) |
| .254                           | .762      | Not to exceed 7 oz. (2N)    | .098 inch (2.5mm) |
| .762                           | Up        | Not to exceed 12 oz. (3.5N) | .098 inch (2.5mm) |

| Basic Outside Diameter<br>D, inch | Indicator Gage Force     | Gage Point Radii  |
|-----------------------------------|--------------------------|-------------------|
| All Sizes                         | Not to exceed 7 oz. (2N) | .098 inch (2.5mm) |

#### 3.2 Test Specimen:

The quantities of test specimens shall be in accordance with the applicable specification. Only new bearings shall be subjected to this test.

#### 3.3 Disposition After Test:

Bearings that are not damaged after axial and radial internal clearance tests may be shipped and/or used if within required limits.

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### 4. DETAIL REQUIREMENTS:

#### 4.1 Axial Internal Clearance:

The outer ring of the bearing shall be held rigidly as shown in Figure 1, and tested at a temperature of  $77\text{ }^{\circ}\text{F} \pm 10\text{ }^{\circ}\text{F}$ . With an indicator gage set to record the axial movement of the inner ring, the following steps shall be taken:

- The load specified in Table 2 shall be applied axially to the inner ring.
- While under load, the inner ring shall be oscillated through an angle of  $\pm 10^{\circ}$  to seat the rolling elements.
- When oscillation ceases, the indicator reading shall be taken.
- The specified load shall be applied to the inner ring in the opposite direction.
- Repeat steps b and c.
- The difference in the indicator readings from steps c and e shall be recorded as the axial internal clearance, and shall be within the limits specified in the applicable document.

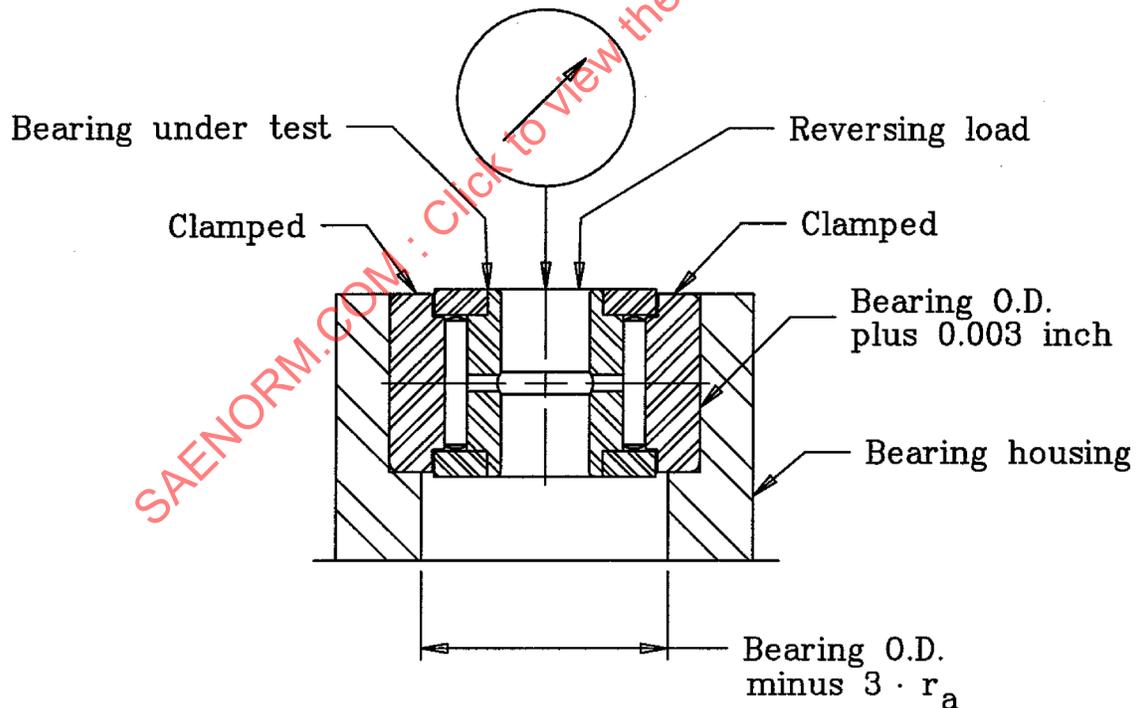


FIGURE 1 - Axial Clearance Test

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### 4.2 Radial Internal Clearance:

The preferred method to determine radial internal clearance for needle roller, ball and roller bearings shall be to measure the components (rolling elements, inner and outer raceway diameters). When that method is not feasible, the following steps shall be taken to measure the radial internal clearance. Testing shall be performed at a temperature of  $77\text{ }^{\circ}\text{F} \pm 10\text{ }^{\circ}\text{F}$ .

#### 4.2.1 Roller and Needle Roller Bearings:

4.2.1.1 Mounting of Bearings: The bearings shall be mounted for the test as follows:

4.2.1.1.1 Track Roller Bearings: The inner ring of bearings shall be held rigidly as shown in Figures 2A and 2B.

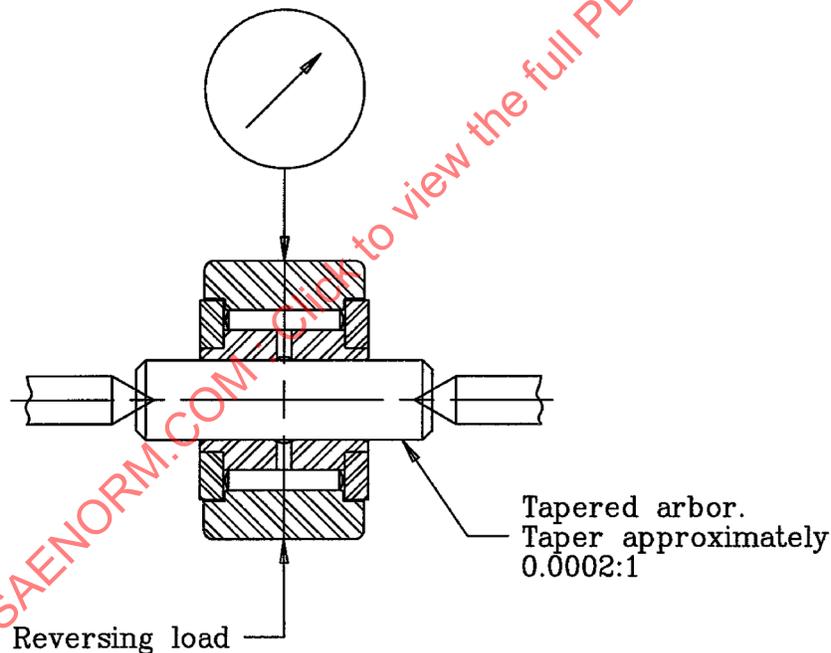


FIGURE 2A - Radial Clearance Test

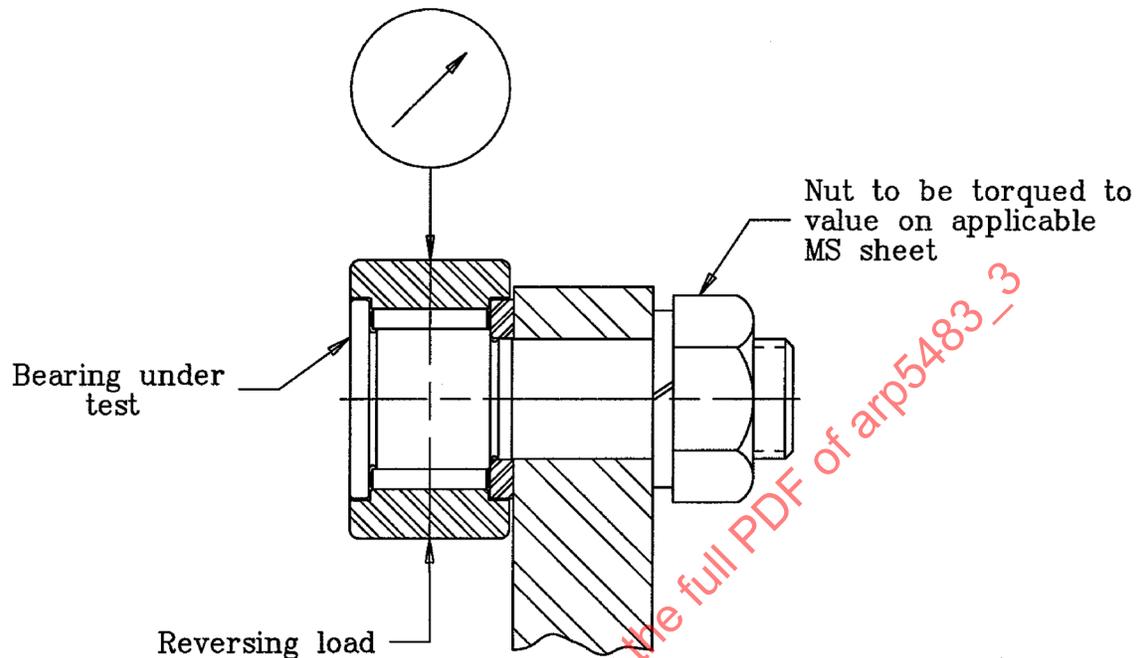


FIGURE 2B - Radial Clearance Test  
Integral Stud Type Bearings

- 4.2.1.1.2 Heavy-Duty Needle Roller Bearings: The bearings shall be mounted in a ring having an inner diameter equal to the maximum outside diameter shown on the applicable document, and the inner ring shall be held rigidly as shown in Figure 3.
- 4.2.1.1.3 Thin Shell Single Row Bearings: The bearings shall be pressed into a ring gage equal in size to the low limit housing bore size shown on the applicable document. The inner ring shall be rigidly held as shown in Figure 3.
- 4.2.1.1.4 Self-Aligning Roller Bearings: The bearings shall be mounted in a test fixture as shown in Figure 3.

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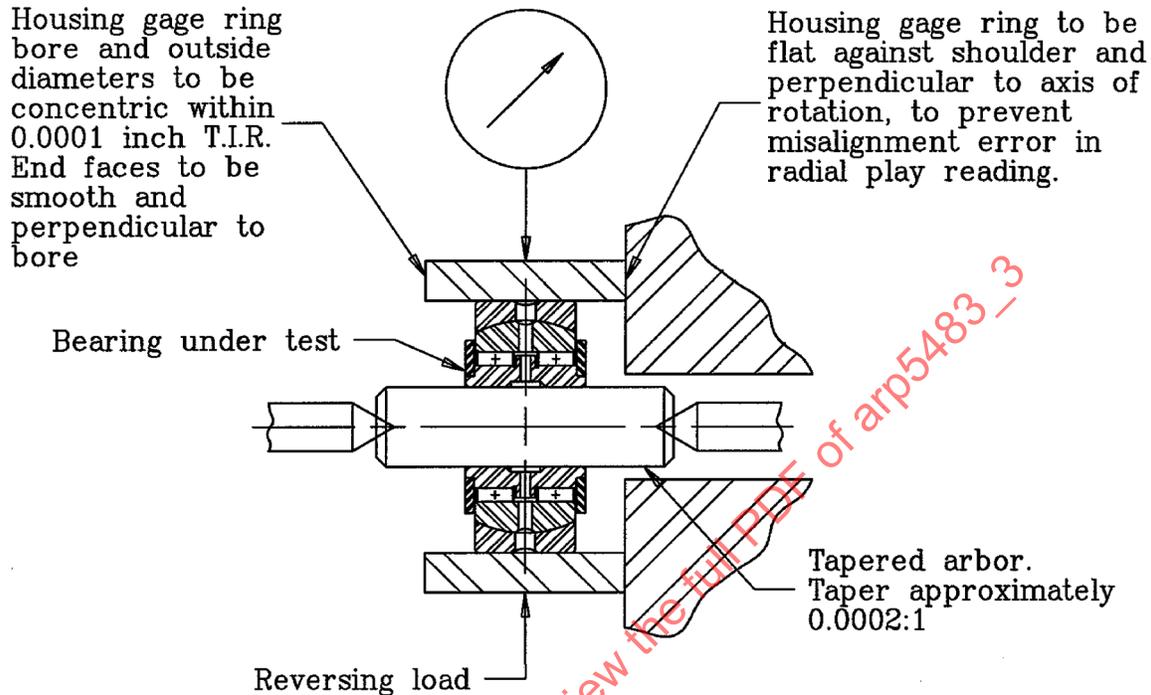


FIGURE 3 - Radial Clearance Test  
Non-Track Roller Needle Bearings and  
Self-Aligning Ball and Roller Bearings

4.2.1.2 Measuring Radial Internal Clearance: With an indicator gage set at the center of the outer ring or ring gage to record the radial movement, the following steps shall be taken:

- The load specified in Table 3 shall be applied to the outer ring or ring gage.
- While under load, the outer ring shall be oscillated through an angle of  $\pm 10^\circ$  to seat the rolling elements.
- When oscillation ceases, the indicator reading shall be taken.
- The specified load shall be applied to the outer ring or ring gage in the opposite direction.
- Repeat steps b and c.
- The difference in the indicator readings from steps c and e shall be recorded as the radial internal clearance, and shall be within the limits specified in the applicable document.

4.2.2 Ball Bearings: When measuring the radial internal clearance directly employing simple means and without the use of a master bearing, the following procedure shall be used.

4.2.2.1 Use of Shims: Fasten the inner ring of the assembled bearing on a horizontal flat plate with a shim as shown in Figure 4. When handling small bearings, it is acceptable to use a piece of ordinary writing paper (0.002 to 0.003 inch thick). When handling large bearings, it is acceptable to use 2 to 3 pieces of ordinary writing paper.

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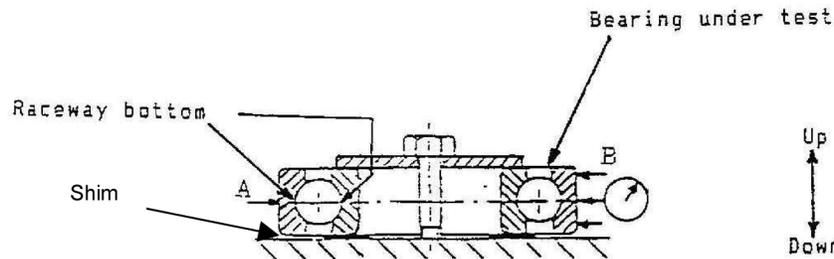


FIGURE 4 - Radial Clearance Test  
Ball Bearings

- 4.2.2.2 Seating of Balls: Position a sensitive indicator against the center of the outer ring outside diameter on the middle of the raceway. Hold the outer ring in contact with the rest of the bearing in direction A as shown in Figure 4. With care not to lift the opposite side, move repeatedly at this point up and down and oscillate circumferentially (for purpose of moving the balls to the bottom of the raceway) until the indicator gives a maximum reading.
- 4.2.2.3 Maximum Reading: While continuing to hold the outer ring gently in contact with the rest of the bearing in direction A as shown in Figure 4, move the outer ring at this point first up and then down without circumferential motion. When the balls pass through the bottom of the raceways, the indicator will show a maximum reading, which shall be recorded.
- 4.2.2.4 Seating of Balls (new location): Without changing the general location of the outer ring, perform sub-section 4.2.2.2 procedure in direction B until the indicator gives a minimum reading.
- 4.2.2.5 Minimum Reading: Perform sub-section 4.2.2.3 procedure in direction B and record the minimum reading. The difference between the maximum and minimum readings is the radial internal clearance.
- 4.2.2.6 Several Readings Required: To compensate for possible out-of-roundness of the outer ring, repeat the same procedure several times at different angular positions of the outer ring relative to the indicator. To compensate for possible out-of-roundness of the inner ring, repeat the same procedure with this ring at different angular positions in relative to the indicator. Take the average of several readings as the clearance of the bearing.
- NOTE: If the indicator needle does not pass through a clear maximum or minimum reading, respectively, the shim is probably too thin.
- 4.2.2.7 Large Bearings: When handling large and heavy bearings, it is helpful to insert three flat pieces, each about 1/2 inch (12.7 mm) thick, between the flat plate and both bearing rings to allow room for the operator's fingers. These pieces shall be located radially with two of them relatively close together, one on each side of the indicator point, and the third directly opposite the indicator. The paper shims, in this case, shall be placed between the inner ring and these pieces.