Department of Transportation
Federal Aviation Administration
Aircraft Certification Service
Washington, DC

TSO-C149

Date: 4/24/98

Technical Standard Order

Subject: **TSO-C149, AIRCRAFT BEARINGS**

1. PURPOSE. This technical standard order (TSO) prescribes property test requirements to obtain the minimum performance of aircraft bearings to be identified with the applicable TSO marking.

2. APPLICABILITY. The standards of this TSO apply to the types of bearings described in appendix 1, Aircraft Bearing Property Test Requirements, intended for rotation and/or oscillatory applications in the manufacture and maintenance of aircraft products. The standards of this TSO are also adaptable to manufacturer's catalog bearings and bearings of proprietary designs. This TSO shall not be used for standard parts or parts known to be used in critical applications.

3. REQUIREMENTS. Aircraft bearings that are to be identified with this TSO and that are manufactured on or after the date of this TSO must meet the minimum performance standards specified in the manufacturer's part drawing(s) and applicable part specification(s) submitted with the bearing manufacturer's application for TSO authorization.

a. Test Requirements. The required performance shall be demonstrated by accomplishing the tests specified for each property in the part drawing(s) and applicable part specification(s), in accordance with the test procedures specified in appendix 1.

b. Deviations. Alternative test procedures or analytical data that produce an equivalent level of safety may be used if specified at the time of TSO application and approved in accordance with 14 CFR §21.609.

4. MARKING.

a. In addition to the marking specified in 14 CFR §21.607(d), the bearing type, the lubrication date (if applicable), and the manufacturer's inspection lot number shall be permanently and legibly marked on each package or container.

b. Each individual bearing that is manufactured under this TSO must be permanently and legibly marked with at least the name or symbol of the manufacturer, the manufacturer's part number, and TSO number. When this is not practical, marking may be accomplished in a manner acceptable by the Administrator.

5. DATA REQUIREMENTS.

a. In accordance with 14 CFR §21.605(a) the following data must be furnished to the Aircraft Certification Office (ACO) manager having purview of the manufacturer's facility with each TSO application:

(1) Part drawing(s) and applicable specifications necessary to define the design and minimum performance for each bearing part number.

(2) Manufacturer's TSO qualification test report in accordance with the test procedures specified in appendix 1.

(3) Inspection lot number(s) of qualification parts.

b. In addition to the data required by paragraph 5.a., the following data must be available for review by the ACO manager having purview of the manufacturer's facility:

(1) Copies of all standards/specifications used in the manufacturer's application for TSO authorization.

(2) Inspection lot number and quantity for each production lot of bearings.

(3) Acceptance inspection test results for each lot of bearings.

c. Data and information that must accompany aircraft bearings manufactured under this TSO:

(1) Inspection lot number(s) and quantity of parts shipped.

(2) Date of lubrication (if applicable) or date of manufacturer.

(3) A note with the following statement: "The parts contained in this shipment have been manufactured and inspected in accordance with TSO-C149. The conditions and tests required for TSO approval of this article are minimum performance standards. Aircraft bearings approved under this TSO are not necessarily interchangeable with other aircraft bearings approved under this TSO. Bearings of similar dimensional properties may have widely varying performance properties. Substitution of bearings may only be done if approved by the Administrator."

6. INSPECTION LOT OF BEARINGS. An inspection lot consists of assembled bearings of a particular part number, assembled at the same time and processed through all final assembly operations as a single group, and subsequently submitted for final inspection at one time.

7. AVAILABILITY OF REFERENCE DOCUMENTS.

a. Military documents may be purchased from: DoDSSP, Customer Service Subscription Service Desk, 700 Robins Avenue, Building 4D, Philadelphia, PA 19111-5094.

b. American National Standards Institute/American Bearing Manufacturers Association (ANSI/ABMA) documents may be purchased from, ABMA, 1200 19th Street NW, Washington, DC 20036.

c. American Society for Testing and Materials (ASTM) documents may be purchased from: ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

d. Federal Aviation Regulations Part 21, Subpart O, may be purchased from: Superintendent of Documents, Government Printing Office, Washington, DC 20402-9325.

e. Advisory Circular 20-110 (current revision), "Index of Aviation Technical Standard Orders," may be obtained from: U.S. Department of Transportation, Subsequent Distribution Office, Ardmore East Business Center, 3341 Q 75th Avenue, Landover, MD 20785.

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APPENDIX 1, AIRCRAFT BEARING PROPERTY TEST REQUIREMENTS

Table 1 - Aircraft Bearing Property Test Requirements, Rotational Motion

	Design Properties					Performance Properties	
Bearing Type	Materials	Hardness	Dimensions	Radial Internal Clearance	Radial Runout	Static Radial Load Rating	Dynamic Radial Load Rating
Ball	X	X	X	X	X	X	X
Miniature/Inst. Ball	X	X	X	X	X	X	X
Roller	X	X	X	X	X	X	X
Needle Roller	X	X	X	X	X	X	X
Applicable Documents	Drawing or Specification	ASTM E18	ANSI/ABMA, Standard 4 ANSI/ABMA, Standard 12.1 ANSI/ABMA, Standard 12.2			ANSI/ABMA, Standard 9 ANSI/ABMA, Standard 11 ANSI/ABMA, Standard 12.1 ANSI/ABMA, Standard 12.2	

Table 2 - Aircraft Bearing Property Test Requirements, Slow Rotational and Oscillatory Motion

	Design Properties							
Bearing Type	Materials	Hardness	Dimensions	Surface Treatment	Lubrication	Radial Internal Clearance	Axial Internal Clearance	**Applicable Documents**
Ball	X	X	X	X	X	X	X	MIL-B-7949
Rod ends with integral ball bearing	X	X	X	X	X	X	X	MIL-B-6039
Roller	X	X	X	X	X	X	X	MIL-B-8914
Rod ends with integral roller bearing	X	X	X	X	X	X	X	MIL-B-8952
Needle Roller	X	X	X	X	X	X	X	MIL-B-3990
Needle track rollers, Stud type	X	X	X	X	X	X	X	MIL-B-3990
Needle track rollers, yoke type	X	X	X	X	X	X	X	MIL-B-3990
Spherical plain, lubricated	X	X	X	X	X			MIL-B-8976
Rod ends with integral spherical plain bearings, lubricated	X	X	X	X	X			*MIL-B-81935 and *MIL-B-8976
Spherical plain bearings, self- lubricated	X	X	X	X				MIL-B-81820
Rod ends with integral spherical plain bearings, self-lubricated	X	X	X	X				MIL-B-81935
Journal bearings, straight and flanged, self-lubricated	X	X	X	X				MIL-B-81934

*MIL-B-81935 is applicable to testing; MIL-B-8976 is referenced for product features.

APPENDIX 1, AIRCRAFT BEARING PROPERTY TEST REQUIREMENTS (continued)

Table 2 (continued)

	Design Properties		**Performance Properties**					
Bearing Type	Radial Runout	Axial Runout	No-Load Breakaway Torque	Static Radial Limit Load	Static Axial Limit Load	Dynamic Radial Load Rating	Ultimate Static Radial Limit Load	**Applicable Documents**
Ball	X	X	X	X	X	X	X	MIL-B-7949
Rod ends with integral ball bearing	X		X	X			X	MIL-B-6039
Roller	X		X	X			X	MIL-B-8914
Rod ends with integral roller bearing	X		X	X			X	MIL-B-8952
Needle Roller				X			X	MIL-B-3990
Needle track rollers, Stud type				X			X	MIL-B-3990
Needle track rollers, yoke type				X			X	MIL-B-3990
Spherical plain, lubricated			X	X	X	X	X	MIL-B-8976
Rod ends with integral spherical plain bearings, lubricated			X	X	X	X	X	*MIL-B-81935 and *MIL-B-8976
Spherical plain bearings, self-lubricated			X	X	X	X	X	MIL-B-81820
Rod ends with integral spherical plain bearings, self-lubricated			X	X	X	X	X	MIL-B-81935
Journal bearings, straight and flanged, self-lubricated				X	X	X	X	MIL-B-81934

*MIL-B-81935 is applicable to testing; MIL-B-8976 is referenced for product features.

AIRCRAFT BEARING PROPERTY TEST REQUIREMENTS

1. BEARING PROPERTIES. Tables 1 and 2 specify bearing property test requirements for each bearing type, as defined on the manufacturers drawing(s) and/or specification(s). The specific material and specific design property values, such as, hardness or dimensions, form the basis of the bearing design; the specific values for performance properties, such as, static radial load rating or ultimate static radial load limit form the basis of the bearing "minimum performance."

2. BEARING SERIES TEST SAMPLE. A bearing series (model) of a particular design and type, with a range defined in the bearing manufacturer's application for TSO authorization, may be qualified by submitting test data for a sample that is most representative of the design encompassed by the series.

APPENDIX 1, AIRCRAFT BEARING PROPERTY TEST REQUIREMENTS (continued)

Applicable Documents. The revision of the documents (or successor documents) listed below in effect on the date of TSO application must be acceptable to the administrator and used to establish the procedures for test and evaluation of aircraft bearings, as indicated in the part drawing and procurement or product specification(s). All additional specifications governing test and evaluation of a bearing covered by this TSO must be specified at the time of application for TSO authorization.

MIL-B-3990	Military Specification, Bearings, Roller, Needle, Airframe, Anti-friction, Inch
MIL-B-6039	Military Specification, Bearing, Double Row, Ball Sealed, Rod End, Anti-friction, Self-Aligning
MIL-B-7949	Military Specification, Bearings, Ball, Airframe, Anti-friction
MIL-B-8914	Military Specification, Bearing, Roller, Self-Aligning, Airframe, Anti-friction
MIL-B-8952	Military Specification, Bearing, Roller, Rod End, Anti-friction, Self-Aligning
MIL-B-8976	Military Specification, Bearing, Plain, Self-Aligning, All-Metal
MIL-B-81820	Military Specification, Bearings, Plain, Self-Aligning, Self-Lubricating, Low Speed Oscillation, General Specification For
MIL-B-81934	Military Specification, Bearings, Plain, Sleeve, Plain and Flanged, Self-Lubricated
MIL-B-81935	Military Specification, Bearings, Plain, Rod End, Self-Aligning, Self-Lubricating, Low Speed Oscillation, General Specification For
ANSI/ABMA	Standard 4, Tolerance Definitions and Gauging Practices for Ball and Roller Bearings
ANSI/ABMA	Standard 9, Load Ratings and Fatigue Life for Ball Bearings
ANSI/ABMA	Standard 11, Load Ratings and Fatigue Life for Roller Bearings
ANSI/ABMA	Standard 12.1, Instrument Ball Bearings, Metric Design
ANSI/ABMA	Standard 12.2, Instrument Ball Bearings, Inch Design
ASTM E 18	Standard Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials