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SUPERSEDING
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10 March 1959
and
MIL-STD-206A PART 2
10 March 1959

MILITARY STANDARD

FRICTION TORQUE TESTING FOR BEARINGS, BALL, ANNULAR (INSTRUMENT TYPE)

AMSC N/A

FSC 3110

DEPARTMENT OF DEFENSE
Washington, DC 20301

Friction Torque Testing for Bearings, Ball, Annular (Instrument Type), Test Requirements.

1. This military standard is approved for use by all Departments and Agencies of the Department of Defense.

2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commanding Officer, Naval Air Engineering Center, Systems Engineering and Standardization Department (Code 53), Lakehurst, NJ 08733-5100, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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1. SCOPE

1.1 Scope. This standard contains requirements for the friction torque testing of instrument type, annular ball bearings. Guidelines for running and starting torque tests and testers are established.

1.2 Purpose. The purpose of this standard is to establish basic guidelines for starting and running torque tests and testers to allow correlation of test results between different facilities.

1.3 Application. This standard applies to the method of evaluating low torque instrument ball bearings, including, but not limited to, gyroscope gimbal rings and servo systems. This standard covers miniature ball bearings as well as all general types of ball bearings in both the inch series and the metric series with torque limits under 20,000 mg-mm.

1.4 Coverage. This standard covers test conditions, measurements, analysis and extent of testing.

2. REFERENCED DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified, the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DODISS) specified in the solicitation form a part of this standard to the extent specified herein.

SPECIFICATIONS

MILITARY

MIL-L-6085 - Lubricating Oil, Instrument, Aircraft, Low Volatility.

MIL-L-81846 - Lubricating Oil, Instrument, Ball Bearing, High Flash Point.

STANDARDS

FEDERAL

FED-STD-209 - Clean Room and Work Station Requirements, Controlled Environment.

(Copies of specifications and standards required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Order of precedence. In the event of a conflict between the text of this standard and the references cited herein, the text of this standard shall take precedence.

3. DEFINITIONS

3.1 Starting torque. Starting torque is the applied torque necessary to start and maintain rotation for a prescribed arc of travel of the rotated raceway member with the other raceway member held stationary unless otherwise specified.

3.2 Standard torque unit. The standard torque unit of measurement for precision instrument bearings shall be a milligram-millimeter (mg-mm).

3.3 Test load. The test load is a specified axial load applied coincident with the axis of rotation of the bearing.

3.4 Axis position. Axis position is defined as the angular position of the rotation of the bearing with respect to vertical.

3.5 Ramp speed. The amount of time it takes to go from a static state to maximum calibrated torque.

3.6 Running torque. The torque required to continue rotation of an already rotating bearing. Determined by the amount of torque from zero torque to centerline average of the torque trace.

3.7 Average running torque. The sum of the absolute value of running torque in both clockwise and counterclockwise directions divided by two (see Figure 1).

3.8 Peak running torque. The maximum torque recorded during the torque trace from zero torque, either during clockwise or counterclockwise testing of the bearing (see Figure 1).

3.9 Maximum hash. The maximum peak-to-peak value of torque variations recorded during clockwise or counterclockwise testing of the bearing, excluding torque excursion (see Figure 1).

3.10 Average hash. The average predominant bandwidth recorded (measured with the test of the bearing in any one direction) (see Figure 1).

3.11 Torque excursion (wander). A gradual change in running torque, sometimes an individual event returning to the original torque level, at others cyclic (sinusoidal) by nature (see Figure 1).

4. GENERAL REQUIREMENTS

4.1 Ambient conditions. Testing shall be conducted in an atmosphere-controlled clean environment in accordance with FED-STD-209, Class 10,000 or better. Temperature shall be maintained within 68 to 77°F and relative humidity between 30 and 50 percent.

4.2 Pretest condition of bearings. Unless otherwise specified before testing, bearings shall have been demagnetized and cleaned thoroughly with clean solvents filtered through a 0.5 micron or better filter. After cleaning, bearings shall be lubricated in accordance with Table I unless an alternate lubrication method is specified. The oil used for torque testing shall be light instrument oil having a viscosity not exceeding 14 cs

(centistrokes) at 100°F, and shall be filtered through a 0.45 micron filter. After the lubricant is applied, the bearing shall be rotated slowly prior to test to distribute the oil evenly. Unless otherwise specified, MIL-L-6085 oil or MIL-L-81846 oil shall be used.

TABLE I. Lubrication of bearings.

Bearing O.D.	Amount of Oil 1/
Less than 0.6250 inch	1 drop
Equal to or greater than 0.6250 inch	2 drops

1/ Oil drops from #26 needle, free forming from a nominal needle angle of 45° from vertical, or an equivalent application method.

4.3 Test loading.

4.3.1 Torque testing loads. Two test loads shall be specified as standards. They are 75 grams and 400 grams.

4.3.2 Test load vs. bearing size. Unless otherwise specified, the 75 gram test load shall be used for all bearings with an outside diameter of 0.3125 inch or less. The 400 gram test load shall be used for bearings with an outside diameter greater than 0.3125 inch.

4.3.3 Test load application. The test loads shall be applied axially with the bore of the bearing in a vertical position unless otherwise specified.

5. DETAILED REQUIREMENTS

5.1 Starting torque.

5.1.1 Extent of testing.

5.1.1.1 Test cycle. Unless otherwise specified, the test cycle shall be as shown in Table II.

TABLE II. Test cycle.

Non-Flanged Bearings
a. 5 consecutive starts clockwise
b. 5 consecutive starts counterclockwise
c. Turn bearing over
d. Repeat steps a and b above

TABLE II. Test cycle - Continued

Flanged Bearings
Steps a and b above only

5.1.1.2 Ambient vibration. Ambient vibration shall be less than the point at which it will interfere with or affect the starting torque trace, with the recorder set at the proper level of sensitivity for the bearing under test. If no recorder is available, the vibration shall be less than the point where it will affect the test results.

5.1.1.3 Acceptance testing. The bearing undergoing acceptance testing shall be tested in accordance with 4.2.

5.1.1.4 Bearing mounting. The bearing shall be mounted with the spin axis of the bearing vertical and axially loaded in a fixture which is capable of receiving a calibrated amount of torque.

5.1.1.5 Torque transmitter. The torque transmitter may be of various designs but shall be capable of applying a minimum calibrated torque of 15,000 mg-mm accurate within 10 percent at operating range. The transmitter shall be capable of applying a torque which starts at a static state and slowly increases to maximum calibrated torque. The ramp speed shall be 14 $\pm$ 2 seconds.

5.1.1.6 Cycle testing. The bearings shall have started rotation by the time the transmitter has reached maximum calibrated torque. The angle of rotation shall be not less than 30°. The transmitter shall then return to static state and the bearing be allowed to stop without operator intervention.

5.1.1.7 Retest. A bearing test lot failing to meet all criteria established above shall be rejected. The test lot may then be tested 100 percent for acceptance or recleaned and retested in accordance with 4.2.

5.1.2 Calibration standard.

5.1.2.1 75 gram load. When using a 75 gram axial load, the calibrator shall permit a readout in increments of 50 mg-mm per minor division or less.

5.1.2.2 400 gram load. When using a 400 gram axial load, the calibrator shall permit a readout in increments of 100 mg-mm per minor division or less.

5.2 Running torque.

5.2.1 Test equipment parameters.

5.2.1.1 Test equipment. The test equipment shall be capable of testing a bearing with an outside diameter of not greater than 30 millimeters, excluding the flange.

5.2.1.2 Test length. The test length shall be a minimum of one full rotation in each direction.

5.2.1.3 Test load. The load of the bearing under test shall be applied axially (see 4.3.1, 4.3.2 and 4.3.3).

5.2.1.4 Amplitude and response. The amplitude and response of the transducer shall be flat within 1 dB to a minimum of 40 Hz. The system amplitude and response shall be flat within 1 dB to a minimum of 5 Hz.

5.2.1.5 Recorder sensitivity. The minimum recorder sensitivity shall be 100 mg-mm per minor division.

5.2.1.6 Bearing RPM. The rpm of the bearing under test shall be set between .5 and 2.0 rpm unless otherwise specified and will be of constant speed.

5.2.1.7 Torque measurement. Torque shall be measured by either inner or outer ring rotation of the bearing.

5.2.1.8 Torque capacity. The torque measuring system shall have a torque capacity of not less than 20,000 mg-mm.

5.2.1.9 Critical parameters. Critical equipment parameters as they pertain to this document shall be maintained.

6. NOTES

6.1 Intended use. This standard provides procedures for testing ball bearings in order to determine their torque values. The intent of this document is to provide a standard whereby uniformity of torque measurement can be obtained for precision instrument bearings.

6.2 Supersession data. This document supersedes MIL-STD-206A, Parts 1 and 2.

6.3 Subject term (key word) listing.

Bearings, ball annular
Bearings, instrument type
Torque transmitter
Calibration standard

6.3 Changes from previous issue. Vertical lines or astericks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

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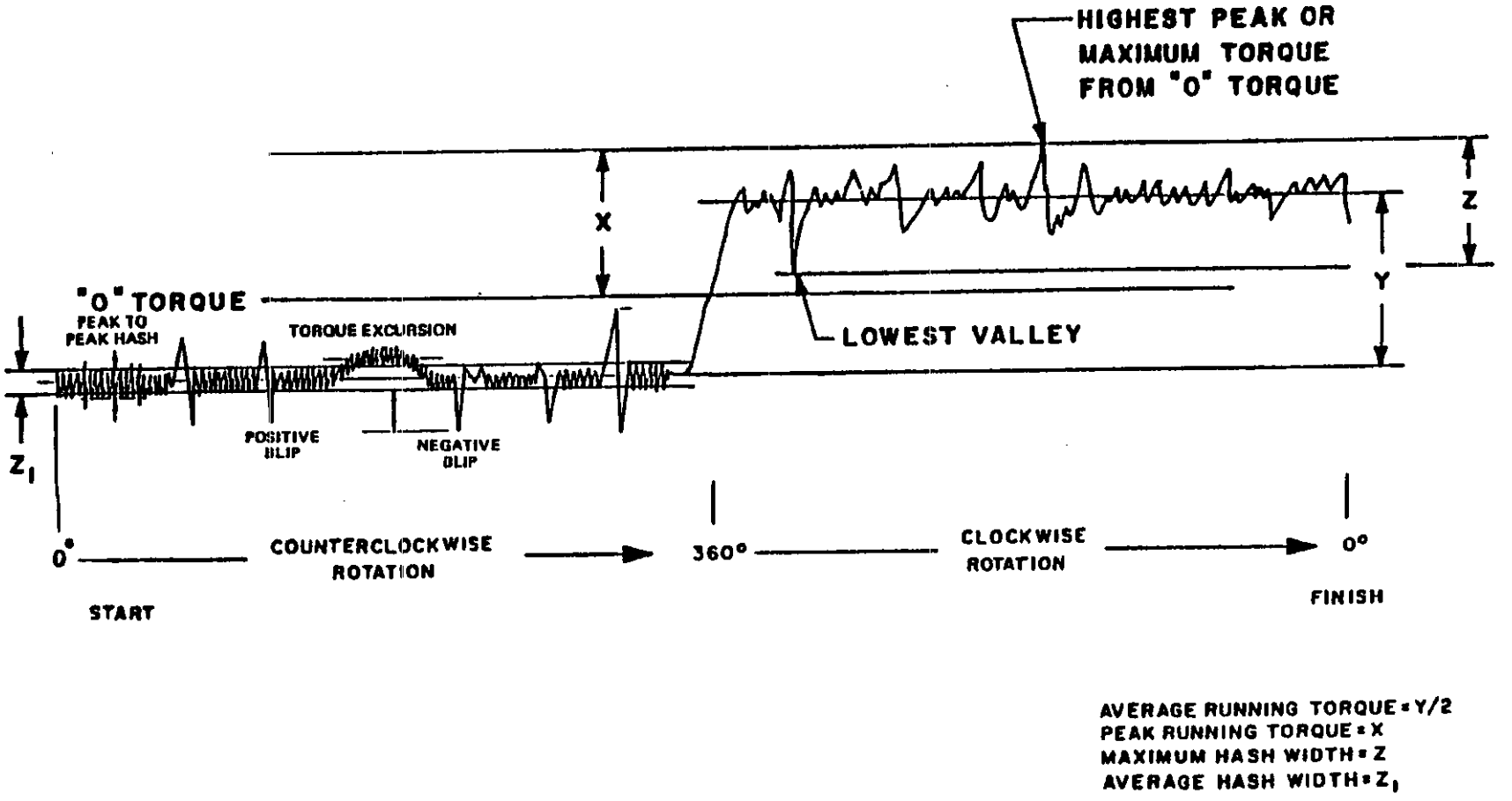

FIGURE 1. Quantitative parameters of the running torque of a bearing.