

MIL-B-6039D
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 SUPERSEDING
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MILITARY SPECIFICATION

BEARING, DOUBLE ROW, BALL, SEALED ROD END, ANTI-FRICTION, SELF-ALIGNING

This specification is approved for use by all departments
 and Agencies of the Department of Defense

1. SCOPE

*1.1 **Scope.** This specification covers sealed, self-aligning, anti-friction, rod end ball bearings with application in temperature ranges (1) -65°F to 250°F and (2) -65° to 300°F with 20% reduction of dynamic load carrying capacity.

1.2 **Classification.** The bearings shall be of the following types, as specified (see 6.2):

- Type I - Bearing, ball, solid shank, rod end (MS 21150)
- Type II - Bearing, ball, external thread, rod end (MS 21151)
- Type III - Bearing, ball, hollow shank, rod end (MS 21152)
- Type IV - Bearing, ball, hollow shank, rod end (MS 21153)

2. APPLICABLE DOCUMENTS

2.1 Government Documents

2.1.1 **Specifications and Standards.** Unless otherwise specified (see 6.2), 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 specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

QQ-P-416	Plating, Cadmium (Electrodeposited)
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MILITARY

MIL-B-197	Bearings, Anti-Friction, Associated Parts and Subassemblies, Preparation for delivery of
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MIL-B-1083	Balls, Bearing, Ferrous and Non-Ferrous (for use in bearings and valves)
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Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: WR-ALC/MMEDT, Robins GA 31098 by using the self-addressed Standardization Document Proposal (DD Form 1426) appearing at the end of this document or by letter.

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MIL-S-6758	Steel, Chrome-Molybdenum (4130), Bars, and Reforged Stock (Aircraft Quality)
MIL-I-6868	Inspection Process, Magnetic Particle
MIL-S-8879	Screw Threads, Controlled Radius Root with Increased Minor Diameter; General Specification for
MIL-G-23827	Grease, Aircraft and Instrument, Gear and Actuator Screw
MIL-G-81322	Grease, Aircraft General Purpose, Wide Temperature Range

STANDARDS

FEDERAL

Fed Test Method Std No 151	Metals; Test Methods
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MILITARY

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-130	Identification Marking of US Military Property
MIL-STD-810	Environmental Test Methods
MS 211150	Bearing, Double Row, Ball, Rod End, Precision, Solid Shank, Self Aligning, Anti-Friction, Airframe, Type I, -65°F to 300°F.
MS 211151	Bearing, Double Row, Ball, Rod End, Precision, External Thread, Self Aligning, Anti-Friction, Airframe, Type II, -65°F to 300°F.
MS 211152	Bearing, Double Row, Ball, Rod End, Precision, Hollow Shank, Self Aligning, Anti-Friction, Airframe, Type III, -65°F to 300°F
MS 211153	Bearing, Double Row, Ball, Rod End, Precision, Internal Thread, Self Aligning, Anti-Friction, Airframe, Type IV, -65°F to 300°F

(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.)

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2.2 Other Publications. The following document forms a part of this specification to the extent specified herein. The issues of the documents which are indicated as DoD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

AMERICAN NATIONAL STANDARD

ANSI B46.1

Surface Texture (Surface Roughness,
Waviness and Lay)

(Copies of the above publication may be obtained from the American National Standards Institute, 1480 Broadway, New York, NY 10018 or The American Society of Mechanical Engineers, United Engineering Center, 345 East 47th Street, New York NY 10017).

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

3. REQUIREMENTS

3.1 Military Standards (MS). The individual item requirements shall be specified herein and in accordance with the applicable MS sheets. In the event of any conflict between the requirements of this specification and the MS sheet, the latter shall govern.

3.2 Qualifications. The bearing furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids (see 4. and 6.).

3.3 Material. The bearing shall conform to materials as listed on MS21150, MS21151, MS21152, or MS21153, as applicable (see 6.2b). Recycled and recovered raw materials should be used to the maximum extent possible in lieu of virgin raw materials as long as these materials do not jeopardize the intended use and fully comply with all contract requirements. Materials used shall be free from defects which would adversely affect the performance or maintainability of individual components or the overall assembly. Materials not specified herein shall be of the same quality used for the intended purpose in commercial practice. None of the above shall be interpreted to mean that the use of used or rebuilt products will be allowed.

3.4 Design and construction. Only factory new bearings, as specified herein, shall be furnished. Details of the working parts shall be optional.

3.4.1 Rings. The outer ring shall be of single-piece construction with the rod end shank. The inner ring shall be of a single-piece construction.

3.4.2 Balls. Balls shall meet the requirements of MIL-B-1083, Grade 25.

3.4.3 Threads. Threads shall conform to UNJF-3A and UNJF-3B in accordance with MIL-S-8879. External threads shall be fully formed by a single rolling process after final heat treat. Internal threads may be machined.

3.4.4 Dimensions and tolerances. Dimensions and tolerances shall be in accordance with the applicable MS.

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3.4.5 Shank alignment. The point representing the center of self-alignment motion shall be coincident with the axis of the rod end within 0.010 inch.

3.4.6 Weight. The weight of the bearing shall be as specified on the applicable MS.

3.4.7 Finish. All external surfaces of the rod end, excluding the bore and seal retainer, shall be plated. Plating shall be in accordance with QQ-P-416, as specified in the applicable MS.

3.4.8 Identification of products. Bearings shall be permanently and legibly marked with the manufacturer's name and part number. The individual bearing package and container shall be marked with the complete MS part number, and the manufacturer's name and part number, and date of lubrication in accordance with MIL-STD-130.

3.4.9 Hardness. The inner ring and balls shall be through-hardened and shall have a hardness as specified on the applicable Military Standards (MS). The outer raceways shall be case hardened, and the hardness on the surface shall be as specified on the applicable MS. The effective case depth shall be from a minimum of 25 percent to a maximum of 50 percent of the ring thickness. The rod end shank shall have a uniform cross-sectional hardness and shall have a tensile strength of 90,000 pounds per square inch (PSI) minimum.

3.4.10 Surface roughness. The sides of the inner ring shall have a smooth machine finish that will not exceed 63 roughness height rating (RHR). Otherwise, the surface roughness shall be as specified on the applicable MS.

3.4.11 Seals. Polytetrafluorethylene seals shall be provided to prevent the entrance of dust and to retain the lubricant throughout the range of temperature specified herein. The seal shall be of the contact type which will operate satisfactorily under the conditions specified in Section 4.5.13. Closure may be either removable or non-removable. However, bonded pop-in type enclosures are not permitted. The seal retainer shall be of corrosion resistant steel. Closures shall withstand temperatures of -65°F to 350°F (-55°C to 177°C) without warpage and embrittlement which would prevent retention of the lubricant.

3.4.12 Lubrication. The bearing shall be thoroughly cleaned prior to lubrication. Grease conforming to MIL-G-81322 or MIL-G-23827 shall be injected into the bearing, filling the bearing voids 80 percent minimum full. The bearing bore and the inside diameter of hollow or internally threaded shanks shall also be coated with MIL-G-81322 or MIL-G-23827 Grease. The bearing shall have not been lubricated more than 24 months prior to date of delivery of the bearing under contract. The bearing shall be coated with the same grease that is packed in the bearing.

3.4.13 Stability. The bearing components shall be dimensionally stable for operation at the temperature specified on the applicable MS and shall be tested as specified in 4.5.6.

3.5 Performance.

3.5.1 Internal play (qualification). Radial and axial play, measured before the radial and axial limit load rating tests (4.5.7 and 4.5.8), shall not exceed the limits as specified on the applicable MS.

3.5.2 Internal play (acceptance). The radial play and axial play, depending on the method of manufacture (see QPL for manufacturer's method), shall be within the limits specified on the applicable MS.

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3.5.3 Radial strength.

3.5.3.1 Radial limit load rating. The bearing shall have a radial limit load rating of not less than the values specified on the applicable MS.

3.5.3.2 Radial fracture load. The minimum static fracture load shall be not less than 1-1/2 times the radial limit load value specified on the applicable MS.

3.5.4 Axial strength.

3.5.4.1 Axial limit load rating. The bearing shall have an axial limit load rating of not less than the values specified on the applicable MS.

3.5.4.2 Axial fracture load. The minimum static fracture load shall be not less than 1-1/2 times the axial limit load value specified on the applicable MS.

3.5.5 Radial dynamic load rating.

3.5.5.1 Performance to 250°F. The bearing shall have a radial dynamic load rating at 250°F of not less than the value specified on the MS for an average life of 15,000 cycles when oscillated through an arc of 90 degrees.

3.5.5.2 Performance to 300°F. The bearing shall have a radial dynamic load rating to 300°F of not less than 80% of the value specified on the applicable MS for an average life of 15,000 cycles of oscillation through an arc of 90 degrees.

3.6 Workmanship. Part shall not contain sharp edges, burrs, loose chips, dirt, or other foreign matter. The raceways and balls shall be free of tool marks, galling, and scratches after assembly.

4. QUALITY ASSURANCE PROVISION

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any other commercial laboratory acceptable to the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Test records. The manufacturer shall maintain a record showing quantitative results of all tests performed to the requirements of this specification. This record shall be available to the purchaser and shall be signed by an authorized representative of the manufacturer or the testing laboratory, as specified.

4.2 Classification of inspection. The examination and testing of the bearing shall be classified as:

- a. Qualification inspection (4.3).
- b. Quality conformance inspection (4.4).

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4.3 Qualification inspection. Qualification inspection shall consist of all the examinations and tests specified under 4.5 and in accordance with Table I.

4.3.1 Test samples. Test samples shall consist of 26 bearings representative of the production bearing. The samples shall be identified with the manufacturer's part number and such other information as required by the procuring activity (see 6.3).

4.4 Quality conformance inspection. Quality conformance inspection shall consist of individual tests and sampling tests.

4.4.1 Individual tests. The individual tests shall consist of the examination of product and 100 per cent magnetic particle inspection of banjo portion of bearing in accordance with MIL-I-6868.

4.4.2 Sampling tests. The sampling tests shall consist of the tests of 4.5 except 4.5.4, 4.5.6, and 4.5.13.

4.4.2.1 Lot. A lot shall consist of all bearings of the same type and part number manufactured under the same conditions and offered for acceptance at one time.

4.4.2.1.1 Samples. Sample bearings shall be selected in accordance with inspection level II of MIL-STD-105 and shall be representative of the complete manufacturing lot. The acceptable Quality Level (AQL) shall be 1.0 percent.

4.5 Inspection methods.

4.5.1 Examination of product. Each bearing in the sample shall be carefully examined for conformance to this specification and the applicable MS with respect to materials, construction, dimensions, tolerances, weight, finish, identification, marking and workmanship.

4.5.1.1 Magnetic particle inspection. This inspection shall be in accordance with MIL-I-6868. The bearing outer race and shank shall be magnetically inspected by both longitudinal and circular methods. Certification of such inspection shall be furnished with qualification sample.

4.5.1.2 Plating. Cadmium plating as specified on the applicable MS shall be tested for thickness and adhesion in accordance with QQ-P-416. Two bearings of each size shall be tested. Failure of any bearing to conform to the applicable MS shall be cause for rejection of the represented lot.

4.5.2 Hardness. Three bearings of each part number shall be disassembled and tested for hardness using a standard Rockwell hardness tester. The test shall be made on the rolling contact area of the inner and outer raceways and on three balls. Readings for balls shall be taken on a flat surface. Readings for rod ends shall be taken on the shank and neck area. The hardness shall be as specified in 3.3.1; otherwise the bearing shall be rejected. The effective case depth shall be determined by the micro hardness method and shall be defined as that distance from the raceway to the point where the hardness diminishes to a value less than Rockwell C50.

4.5.3 Surface roughness. Surface roughness shall be measured in accordance with ANSI B46.1. The test shall be made on the bearing disassembled in 4.5.3. Any failure to comply with the surface roughness requirements of the applicable MS shall be cause for rejection.

4.5.4 Seals (qualification). At least three bearings of each MS size shall be held at -65°F for 300 hours, then at 300°F for 100 hours. While being operated in the test chamber at thirty oscillations per minute through an arc of ± 45 degrees, the bearings shall be subjected to sand and dust

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test of MIL-STD-810. Seal deterioration, or ingress of dust into the bearings shall be considered seal failure. At least 60 percent of the lubricant by weight shall be retained in the bearing at the end of this test.

4.5.5 Lubrication. The lubricant shall be inspected for quality and cleanliness and shall be in conformance with the type of grease specified in 3.3.4.

4.5.6 Stabilization (qualification). Three bearings of each MS size submitted for qualification shall be tested at $250^{\circ} \pm 10^{\circ}$ F for 300 hours allowed to return to room temperature, then measured. Any bearings that show a dimensional change of more than .0001 inch per inch of diameter shall be considered to have failed. The bearings shall then be cold soaked at $-65^{\circ} \pm 10^{\circ}$ F for four hours, allowed to return to room temperature, then measured. Any bearings that show a dimensional change of more than .0001 inch per inch of diameter from the last reading shall be considered to have failed. All measurements shall be made at room temperature and shall be made at a single reference position on the bearing outside diameter.

4.5.7 Radial play. Five bearings of each size shall be tested for radial play. The inner ring shall be held rigidly and a radial load of 5-1/2 pounds applied alternately in opposite directions to the outer ring. A dial indicator shall be used to measure total movement of the outer ring. This value should be recorded. As applicable from para 3.5.2, the radial movement shall be in conformance with the radial clearance values specified on the applicable MS.

4.5.8 Axial play. Five bearings of each MS size shall be tested for axial play. The outer ring shall be held rigidly and an axial load of 5-1/2 lbs applied alternately in opposite directions to the inner ring. A dial indicator shall be used to measure total movement of the inner ring. This value should be recorded. As applicable from para 3.5.2, the axial movement shall be in conformance with the axial clearance values specified on the applicable MS.

4.5.9 Radial limit load (qualification). The bearings tested per 4.5.7 shall be mounted in a rigid support as shown in figure 1. A 5-1/2 lb radial load shall be applied, and the bearing shall be rotated by hand to determine smoothness of operation before testing. The load shall then be removed and the applicable radial limit load, specified on the applicable MS, shall be removed, and the 5-1/2 lb radial load shall be reapplied. The radial play shall then be measured as specified in 4.5.7. If the smoothness of operation of the bearing has been lessened perceptively or the radial play has increased by more than .0002 inch from the initial measurement, the bearing shall be considered to have failed and the lot rejected.

4.5.10 Radial fracture load (qualification). The radial fracture load of 1-1/2 times the radial limit load specified on the applicable MS shall be applied to the bearing for 1 minute. After removal of the load, the bearings shall be examined for failure. Bearings that cannot be turned by hand, or that have parts fractured, shall be considered to have failed. Three bearings of each MS part number submitted shall be tested.

4.5.11 Axial limit load (qualification). The bearings tested per 4.5.8 shall be mounted in rigid support as shown in figure 2. A 5-1/2 lb axial load shall be applied, and the bearing shall be rotated by hand to determine smoothness of operation before testing. The load should then be removed, and the applicable axial limit load, specified on the applicable MS, shall be applied 1 minute. The limit load shall then be removed and the 5-1/2 lb axial load shall be reapplied. The axial

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play shall then be measured as specified in 4.5.8. If the smoothness of operation of the bearing has been lessened perceptively or if the axial play has increased by more than .0005 inches from the initial measurement, the bearing shall be considered to have failed and the lot rejected.

4.5.12 Axial fracture load (qualification). The axial fracture load of 1-1/2 times the axial limit load specified on the MS shall be applied to the bearing for 1 minute. After removal of the load, the bearing shall be examined for failure. Bearings that cannot be turned by hand, or that have parts fractured, shall be considered to have failed. Three bearings of each MS part number submitted shall be tested.

4.5.13 Radial dynamic load (qualification). The bearing shall be mounted in a test fixture having suitable support bearings and drive linkages to provide oscillation of the inner ring. The radial dynamic load specified on the applicable MS shall be applied and maintained within ± 1 percent for the duration of the test. The bearing shall be oscillated through an ARC of 90 degrees and back to the starting position for 15,000 cycles at room temperature. The bearing shall be assembled and the raceways inspected. Any pitting or evidence of surface fatigue on the raceways or balls shall be considered as evidence of bearing failure. Ten bearings of each part number submitted shall be tested. If more than 5 bearings show evidence of failure, the entire lot shall be considered to have failed the test.

4.5.14 Preservation, packaging, and marking. Preservation, packaging, and marking shall be examined for conformance with Section 5.

5. PACKAGING

5.1 Cleaning, preservation, packaging, packing and marking. Unless otherwise specified, bearing shall be cleaned, preserved, packaged, and marked in accordance with MIL-B-197, method IA-8.

6. NOTES

*6.1 Intended Use. These sealed, antifriction, rod end bearings are intended for use in aircraft control systems where high rotative speeds are not involved. These bearings are rated for operation up to 250 degrees F maximum. When subjected to operation above 250 degrees F, the ratings should be reduced 20%.

6.2 Ordering data. Procurement documents should specify:

- a. Title, number, and date of this specification.
- b. Type, and complete MS number (see 1.2 and 3.2).
- c. Quantity.
- d. Levels of preservation, packaging, and packing (see 5.1).

*6.3 Qualification. With respect to product requiring qualification, awards will be made only for such products as have, prior to the time set for opening for bids, been tested and approved for inclusion in the applicable Qualified Products List, whether or not such products have actually been so listed by that date. The attention of the suppliers is called to this requirement, and manu-

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TABLE I - QUALIFICATION INSPECTION SAMPLES

INSPECTION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	26	Test Paragraph
Examination of Produce	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	4.5.1
Preservation, Packaging, Packing and Marking	X	X	X	X	X	X													4.5.14
Lubrication	X	X	X																4.5.5
Hardness	X	X	X																4.5.2
Surface Roughness	X	X	X																4.5.3
Plating	X	X																	4.5.1.2
Radial Play				X	X	X	X	X											4.5.7
Radial Limit Load				X	X	X	X	X											4.5.9
Radial Fracture Load					X	X													4.5.10
Axial Play									X	X	X	X	X						4.5.8
Axial Limit Load									X	X	X	X	X						4.5.11
Axial Fracture Load									X	X	X	X							4.5.12
Radial Dynamic Load																	X		4.5.13

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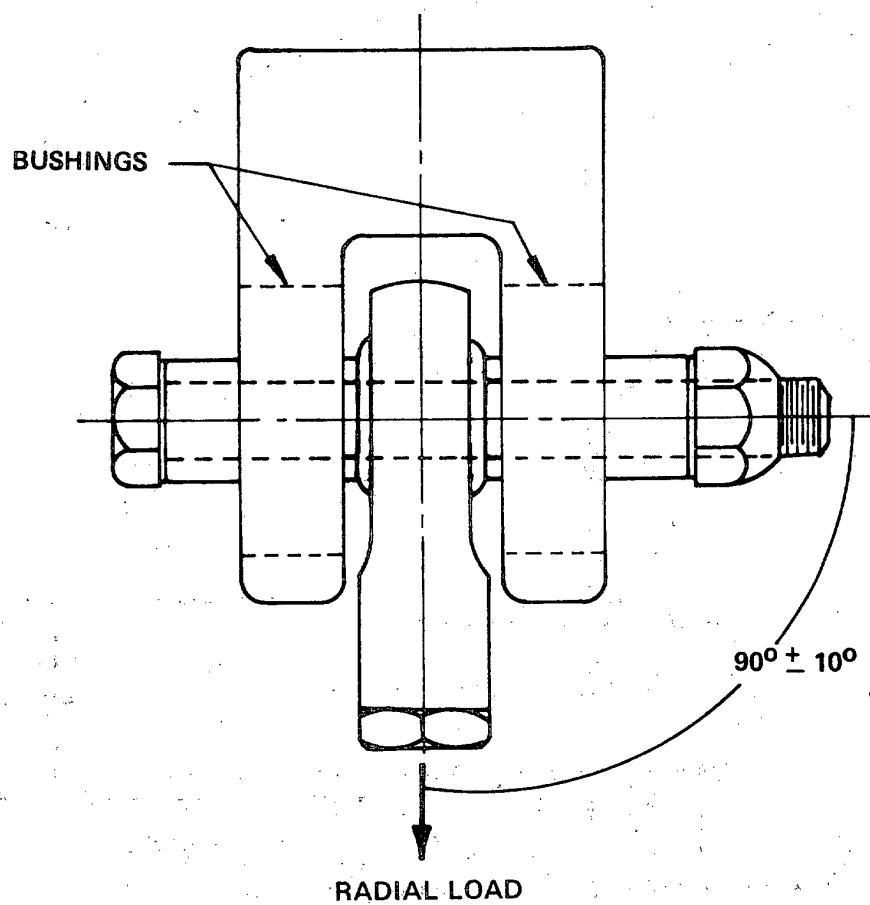


FIGURE 1. Radial Strength Test Setup

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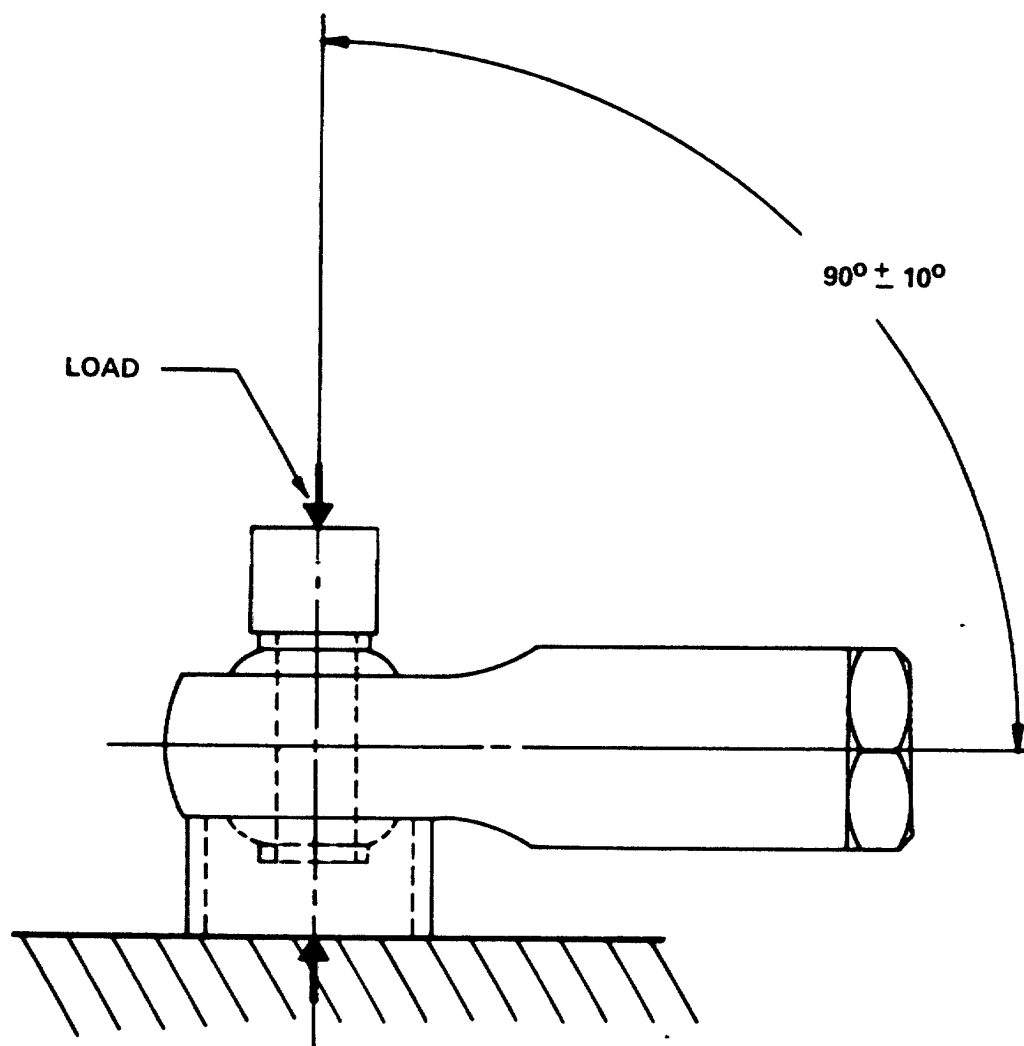


FIGURE 2. Axial Strength Test Setup

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facturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the Qualified Products List is WR-ALC/MMTRDC, Robins Air Force Base, Georgia 31098, and information pertaining to qualification of products may be obtained from that activity.

6.4 "Changes from previous issue." The margins of this specification are marked with an asterisk to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationships to the previous issue.

Custodian:

Navy - AS
Air Force - 99

Preparing Activity:

Air Force - 84

International interest (see 6.4)

Project Number:

3110-0614

Review Activity:

Army - AT

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL	
(See Instructions – Reverse Side)	
1. DOCUMENT NUMBER MIL-B-6039D	2. DOCUMENT TITLE
3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION (Mark one)
	<input type="checkbox"/> VENDOR
	<input type="checkbox"/> USER
	<input type="checkbox"/> MANUFACTURER
	<input type="checkbox"/> OTHER (Specify): _____
b. ADDRESS (Street, City, State, ZIP Code)	
5. PROBLEM AREAS	
a. Paragraph Number and Wording:	
b. Recommended Wording:	
c. Reason/Rationale for Recommendation:	
6. REMARKS	
7a. NAME OF SUBMITTER (Last, First, MI) – Optional	b. WORK TELEPHONE NUMBER (Include Area Code) – Optional
c. MAILING ADDRESS (Street, City, State, ZIP Code) – Optional	8. DATE OF SUBMISSION (YYMMDD)