

MIL-B-3990D  
8 August 1980  
 SUPERSEDING  
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 28 January 1977

## MILITARY SPECIFICATION

### BEARINGS, ROLLER, NEEDLE, AIRFRAME, ANTIFRICTION, INCH

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

#### 1. SCOPE

1.1 Scope. This specification covers the requirements for non-separable, antifriction needle bearings.

\* 1.2 Classification. Bearings shall be of the following types, as specified (see 6.2).

- |          |   |
|----------|---|
| Type I   | Bearing, Roller, Needle, Single Row, Heavy Duty, Antifriction, Inch (MS24461)   |
| Type II  | Bearing, Roller, Needle, Single Row, Thin Shell, Antifriction, Inch (MS24462)   |
| Type III | Bearing, Roller, Needle, Single Row, Heavy Duty, Self-Aligning, Antifriction, Inch (MS244063)   |
| Type IV  | Bearing, Roller, Needle, Double Row, Heavy Duty, Self-Aligning, Antifriction, Inch (MS24464)  |
| Type V   | Bearing, Roller, Needle, Single Row, Heavy Duty, Track Roller, Antifriction, Inch (MS24465)(Inactive for new design) Bearing<br><br>Bearing, Roller, Needle, Single Row, Heavy Duty, Track Roller, Sealed, Antifriction, Inch (MS21438) |
| Type VI  | Bearing, Roller, Needle, Double Row, Heavy Duty, Track Roller, Antifriction, Inch (MS24466)(Inactive for new design) Bearing<br><br>Bearing, Roller, Needle, Double Row, Heavy Duty, Track Roller, Sealed, Antifriction, Inch (MS21439) |
| Type VII | Bearing, Roller, Needle, Track Roller, Integral Stud, Antifriction, Inch (MS21432)  |

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: ASD/ENESS, Wright-Patterson AFB, OH 45433 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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Type VIII Bearing, Roller, Needle, Track Roller, Integral Stud, Sealed, Antifriction, Inch (MS21440)

Type IX Bearing, Roller, Needle, Track Roller, Integral Heavy Stud, Sealed, Antifriction, Inch (MS21441)

Type X Bearing, Roller, Needle, Heavy Duty, Track Roller, Sealed, Antifriction, Inch (MS21442)

## 2. APPLICABLE DOCUMENTS

\*2.1 Issues of documents. The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

## SPECIFICATIONS

## FEDERAL

QQ-C-320 Chromium Plating (Electrodeposited)  
 QQ-P-416 Plating, Cadmium (Electrodeposited)

## MILITARY

MIL-B-197 Bearing, Antifriction, Associated Part and Subassemblies, Packaging of  
 MIL-S-7742 Screw Threads, Standard Optimum Selected Series, General Specification For  
 MIL-S-8879 Screw Threads, Controlled Radius Root With Increased Minor Diameter; General Specification For

## STANDARDS

## MILITARY

MIL-STD-100 Engineering Drawing Practices  
 MIL-STD-105 Sampling Procedures and Tables for Inspection by Attributes  
 MIL-STD-130 Identification Marking of US Military Property  
 MS21432 Bearings, Roller, Needle, Track Roller, Integral Stud, Type VII, Antifriction, Inch  
 MS21438 Bearing, Roller, Needle, Double Row, Heavy Duty, Track Roller, Sealed, Antifriction, Inch  
 MS21439 Bearing, Roller, Needle, Double Row, Heavy Duty, Track Roller, Sealed, Antifriction, Inch  
 MS21440 Bearing, Roller, Needle, Track Roller, Integral Stud, Type VIII, Sealed, Antifriction Inch  
 MS21441 Bearing, Roller, Needle, Track Roller, Integral Stud, Type IX, Sealed, Antifriction, Inch  
 MS21442 Bearing, Roller, Needle, Track Roller, Type X, Sealed, Antifriction, Inch  
 MS24461 Bearing, Roller, Needle, Single Row, Heavy Duty, Type I, Antifriction, Inch  
 MS24462 Bearing, Roller, Needle, Single Row, Thin Shell, Type II, Antifriction, Inch

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MS24463	Bearing, Roller, Needle, Single Row, Heavy Duty, Self-Aligning, Type III, Antifriction, Inch
MS24464	Bearing, Roller, Needle, Single Row, Heavy Duty, Self-Aligning, Type IV, Antifriction, Inch
MS24465	Bearing, Roller, Needle, Single Row, Heavy Duty, Track Roller, Type V, Antifriction, Inch
MS24466	Bearing, Roller, Needle, Double Row, Heavy Duty, Track Roller, Type VI, Antifriction, Inch

(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following document forms a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

American National Standards Institute

ANSI B46.1                      Surface Texture

(Application for copies should be addressed to the American National Standards Institute, 1430 Broadway, New York, New York 10018.)

3. REQUIREMENTS

3.1 Qualification. The bearings 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 4.3 and 6.3).

\* 3.2 Bearing types. Bearing types shall be as specified on MS21432, MS21438, MS21439, MS21440, MS21441, MS21442, MS24461, MS24462, MS24463, MS24464, MS24465, and MS24466. Only factory-new bearings shall be furnished.

3.3 Material. The bearing components shall be fabricated from material as specified on the applicable MS standard.

3.4 Design and construction

3.4.1 Dimensions. Dimensions, weights, and tolerances shall be as shown on the applicable MS Standards.

\* 3.4.2 Hardness. The inner raceways, outer rings, rollers and end washers (except for washers of Type II bearings) shall be heat treated by through hardening, carburizing and hardening, or induction hardening. Hardness of inner raceways, outer rings and rollers shall be equivalent to 58-66 HRC. End washers of type II bearings need not be hardened. Hardness of end washer surface adjacent to the rollers shall be 51-60 HRC for all other end washers. Hardness of the extended portion of the stud of types VII, VIII and IX bearings shall be 36-44 HRC.

\* 3.4.3 Surface finish. Rollers shall be ground or lapped to a surface finish of 8 micro inches maximum; inner raceway to a surface finish of 16 micro inches maximum; outer raceway to a surface finish of 40 micro inches maximum; roller

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retaining surface of end washers to a surface finish of 63 micro inches maximum; and self-aligning surfaces to a surface finish of 45 micro inches maximum; as defined in ANSI B46.1.

3.4.4 Plating. All external surfaces, excluding the bores of types I, II, III, IV, V, VI and X bearings shall be plated. Plating shall be as specified on the applicable MS standards.

3.4.5 Lubrication provisions. Holes and channels shall be provided for lubrication as specified on the applicable MS standards. Bearings shall have been lubricated within 24 months of delivery.

3.4.6 Lubrication. The bearings shall be filled with the grease specified on the MS standards. The bearings shall be thoroughly cleaned and dried before being lubricated.

\* 3.4.7 End washers. Types I, II, III, IV, V, VI and X bearings shall include end washers to limit axial play. Types VII, VIII and IX bearings shall have an integral flange on the stud and an end washer to limit axial play.

3.4.8 Threads

\* 3.4.8.1 Type VII bearings. Threads shall be fully formed and conform to MIL-S-8879.

\* 3.4.8.2 Type VIII and IX bearings. Threads shall be fully formed and shall conform to MIL-S-7742.

3.5 Performance

3.5.1 Load rating. When tested as specified in 4.5.6 and 4.5.7, the load ratings of the bearings shall be not less than the load rating values specified on the applicable MS standard.

3.5.1.1 Load rating as a track roller. When tested as specified in 4.5.9, the load rating as a track roller shall be not less than the values specified on the applicable MS standard.

3.5.2 Axial compression load test. When tested as specified in 4.5.8, bearing outer ring shall be easily turned by hand.

\* 3.5.3 End washer pushout. When tested as specified in 4.5.10, the force required to push out the end washer of types I, II, III, IV, V, VI and X bearings shall not be less than 100 pounds and of types VII, VIII and IX bearings shall be less than 22 pounds.

3.5.4 Radial play. When tested as specified in 4.5.11, the radial play (total indicator reading) between inner and outer raceway shall be as specified on the applicable MS standard.

\* 3.5.4.1 Self-aligning bearings. When tested as specified in 4.5.11.3 for types III and IV bearings, the clearance between self-aligning members shall be from 0.0002 inch to 0.0007 inch.

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\* 3.5.5 Axial play. When tested as specified in 4.5.12, the axial play (total indicator reading) of outer rings shall be 0.025 inch maximum. The minimum axial play shall be considered satisfactory if the bearing passes the test specified in 4.5.8.

\* 3.5.6 Radial runout. When tested as specified in 4.5.13, excepting types III and IV bearings and inner raceway of types VII, VIII and IX bearings, shall show no radial runout greater than 0.0010 inch and 0.0016 inch for the inner and outer raceway, respectively.

3.5.7 Self-alignability. When tested as specified in 4.5.14, self-aligning bearings shall be capable of the minimum misalignment with the maximum clamping diameters specified on the applicable MS standard.

3.6 Identification of product. The bearings shall be marked in accordance with MIL-STD-130, with the manufacturer's name or trademark and the complete MS part number, if space is available.

3.7 Interchangeability. All bearings having the same MS standard part number shall be functionally and dimensionally interchangeable. The drawing number requirements of MIL-STD-100 shall govern changes in the manufacturer's part numbers.

\* 3.8 Stability. The bearing components shall be dimensionally stable for operation from -65° to 250°F.

3.9 Workmanship. The workmanship shall be in accordance with airframe needle roller bearing manufacturing practice.

#### 4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by 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.

4.2 Classification of inspection. The examination and testing of bearings shall be classified as follows:

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

4.3 Qualification inspection. Qualification inspection shall consist of all the tests specified under 4.5. The tests shall be conducted as specified in table I.

4.3.1 Qualification test samples. Twenty bearings each of the sizes indicated in table II shall be tested to qualify each of the types.

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TABLE I. Qualification examination and test samples.

Examination or Test	Sample Number of Each Dash Number Listed in Table II																				Test
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Examination of Product	X	X	X	X	X																4.5.1
Preservation Packaging, Packing & Marking	X	X	X	X	X																4.6
Radial Play	X	X	X	X	X																4.5.11
Axial Play	X	X	X	X	X																4.5.12
Runout																					
Hardness	X																				4.5.2
Surface Finish	X																				4.5.3
Plating	X	X																			4.5.4
Lubrication	X	X	X																		4.5.5
End Washer Pushout						X	X	X													4.5.10
Axial Compression Load									X	X	X										4.5.8
Limit Load Rating												X	X	X							4.5.6
Ultimate Load Rating															X	X	X				4.5.7
Load Rating as a Track Roller																		X	X	X	4.5.9

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\* TABLE II. Sampling.

Type	MS Standard Suffix Number		
	Small	Medium	Large
I	-6	-10	-20
II	-4	-8	-16
III	--	-5	--
IV	-6	-10	-20
V	-4	-8	-12
	-104	-108	-112
VI	-6	-14	-24
	-116	-114	-124
VII	-2	-4	-6
VIII	-101	-281	-481
IX	-101	-281	-481
X	-121	-281	-481

4.3.2 Data to accompany qualification test samples. Drawings, showing complete external dimensions, tolerances, construction, material, hardness, and date of latest revision, shall be submitted with qualification test samples.

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

4.4.1 Sampling plan and tests. Sample bearings shall be selected in accordance with inspection level II of MIL-STD-105. Each sample bearing shall be inspected in accordance with 4.5.1 and lots shall be accepted or rejected in accordance with Acceptable Quality Level 1.0 percent defective.

4.4.1.1 Lot. The lot definition, formation, and size shall be in accordance with MIL-STD-105.

#### 4.5 Inspection methods

4.5.1 Examination of product. All of the bearings shall be examined for conformance to this specification and applicable standards as to:

- a. Dimensions . . . . . 3.4.1
- b. Lubrication provisions . . . . . 3.4.5
- c. Lubrication . . . . . 3.4.6
- d. End washers . . . . . 3.4.7
- e. Identification of product . . . . . 3.6
- f. Workmanship . . . . . 3.9
- g. Threads (types VII, VIII and IX bearings only) . . . . . 3.4.8

4.5.2 Hardness. One bearing, of each MS standard size submitted, shall be disassembled and tested for hardness of the inner ring, outer ring, and three rollers.

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4.5.3 Surface finish. Surface roughness shall be measured in accordance with ANSI B46.1.

4.5.4 Plating. Cadmium and chromium plating shall be tested for conformance with QQ-C-320 or QQ-P-416, as applicable, to comply with the type and class specified on the MS standard.

4.5.5 Lubrication. The lubrication shall be as specified on the applicable MS standard.

4.5.6 Limit load rating. Types I, II, III and IV bearings shall be mounted in a rigid support as shown on figure 1a, types V, VI, and X bearings shall be mounted in rigid support as shown on figure 1b, types VII, VIII and IX bearings shall be mounted in a rigid support as shown on figure 1c. The bearings shall be tested according to the following procedure and sequence:

- a. Step 1: Rotate the bearing manually to determine operational smoothness.
- b. Step 2: Measure the friction starting torque.
- c. Step 3: Apply load equal to the appropriate "Limit Load Rating" specified on the applicable MS standard for 1 minute.
- d. Step 4: Remove load and inspect for evidence of failure.
- e. Step 5: Measure friction starting torque. If friction torque has increased 100 percent or more, the bearing shall be considered to have failed.

4.5.7 Ultimate load rating. A load equal to the ultimate load (1.5 times the limit load) rating specified on the applicable MS standard shall be applied for one minute (see figure 1a for types I, II, III and IV and figure 1b for types V, VI and X, and figure 1c for type VII, VIII and IX. After removal of this 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.

4.5.8 Axial compression load test. Bearings shall be tested for freedom of rotation while under an axial load. Types I, II, III, IV, V, VI and X bearings shall be mounted and the load applied as shown on figure 2a. Loads applied shall be in accordance with table III. Types VII, VIII and IX bearings shall be mounted as shown on figure 2b. The nut shall be torqued to value shown on appropriate MS standard.

TABLE III. Axial compression load.

Bearing Bore or Bolt Diameter inch	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1-1/4 & Larger
Axial Load lbf	480	870	1400	2100	2850	3800	4870	6150	8950	12200	16300	25800

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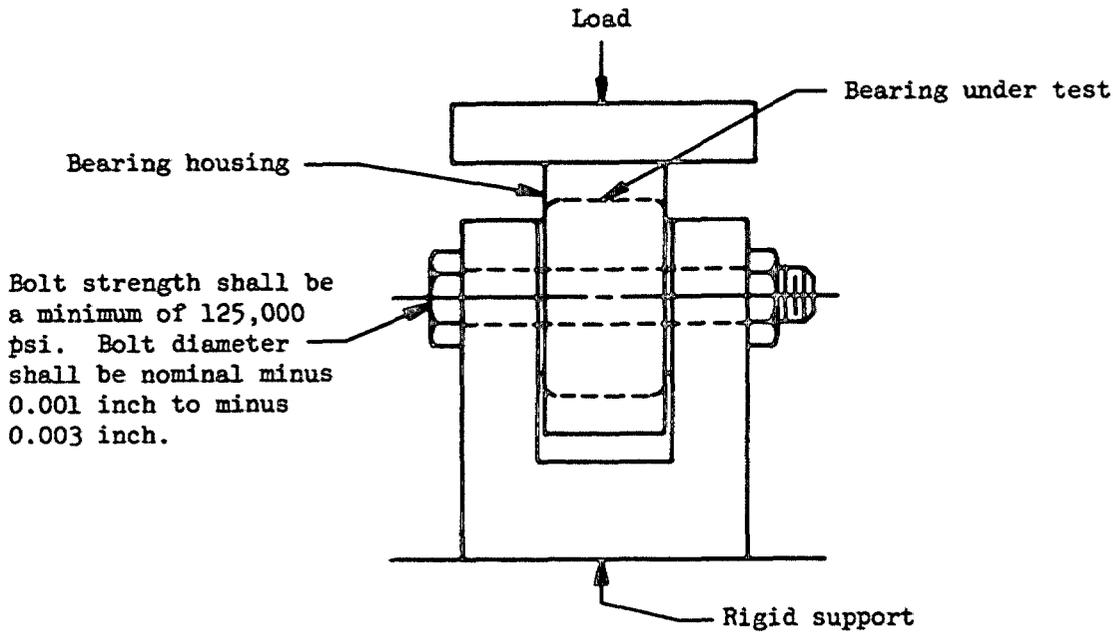


FIGURE 1a. Test for limit load rating and ultimate load rating for types I, II, III, and IV bearings.

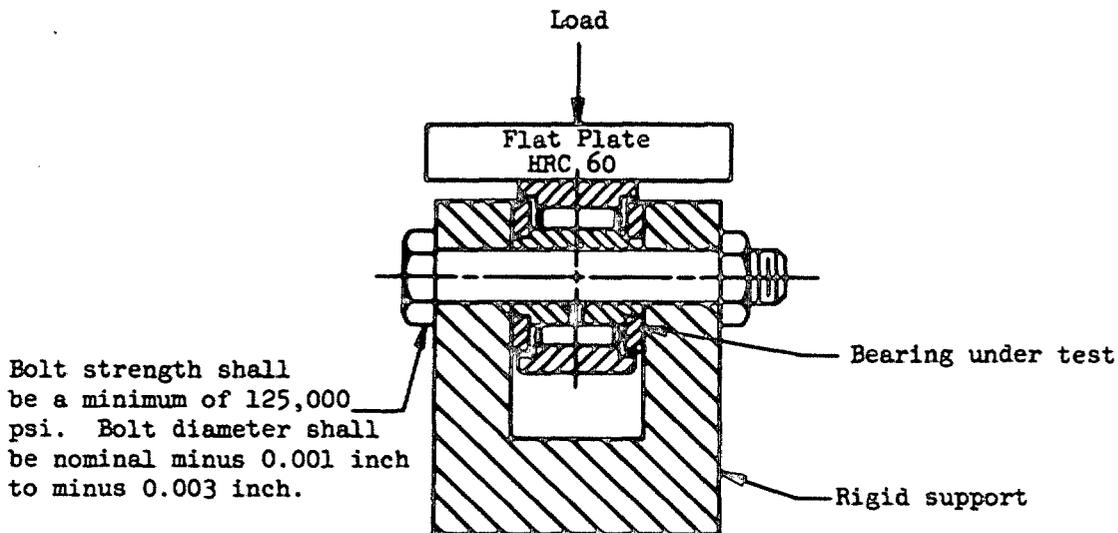


FIGURE 1b. Test for load rating as a track roller, limit load rating and ultimate load rating for types V, VI and X bearings.

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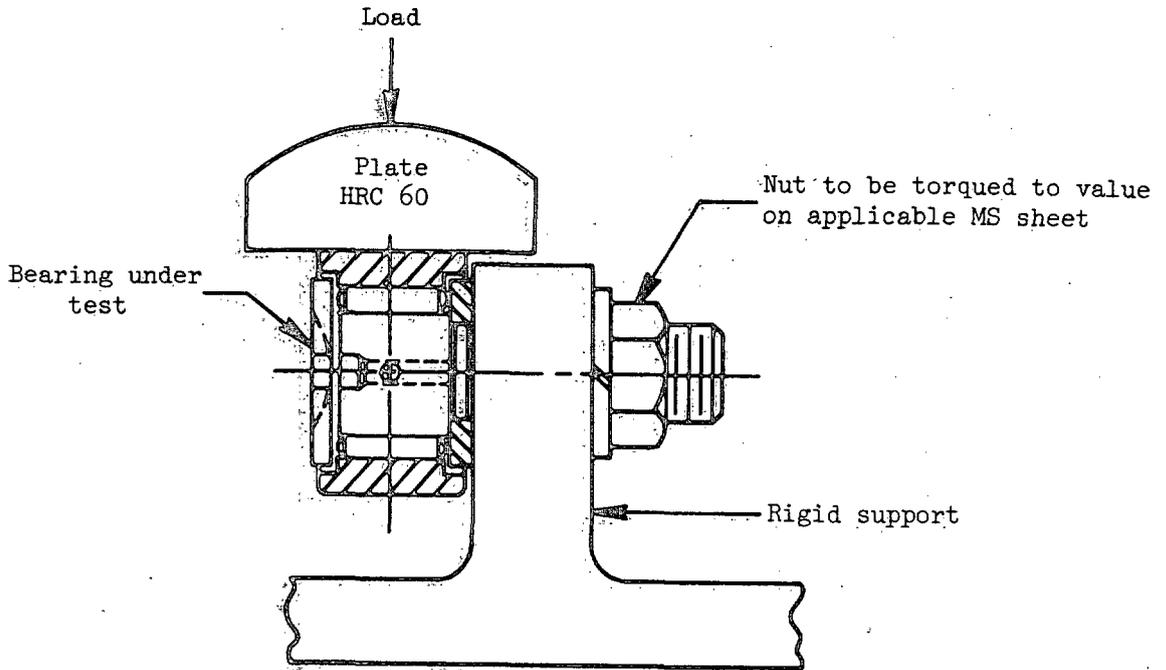


FIGURE 1c. Test for load rating as a track roller, limit load rating and ultimate load rating for types VII, VIII and IX bearings.

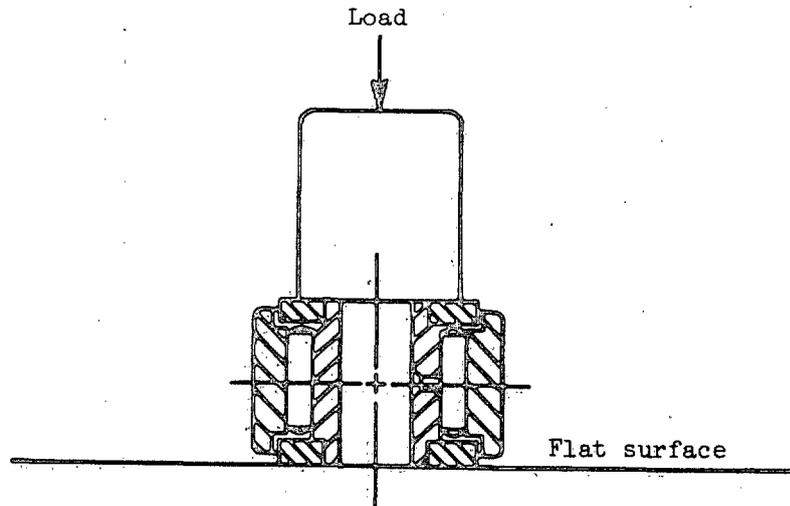


FIGURE 2a. Axial compression load test for types I, II, III, IV, V, VI and X bearings.

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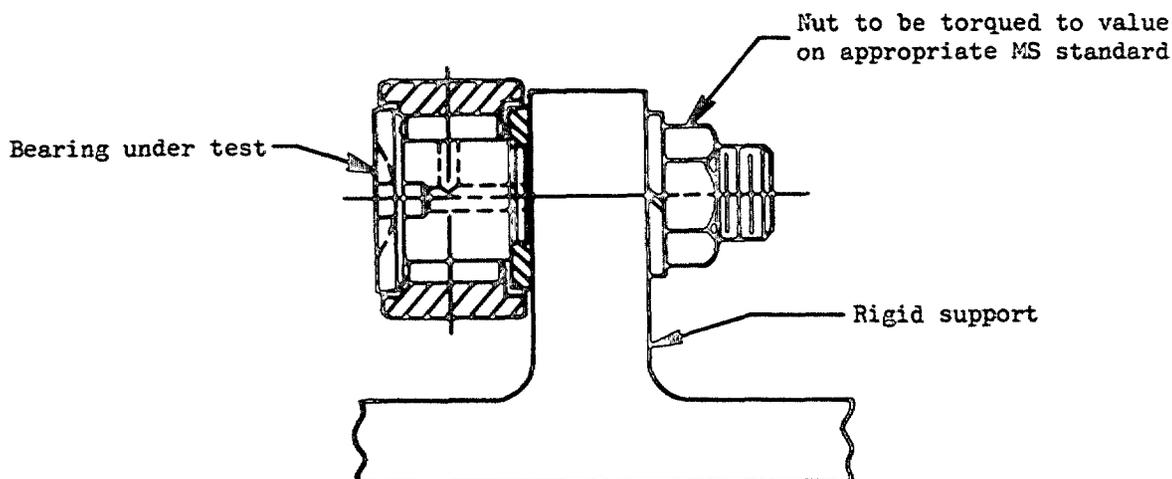


FIGURE 2b. Axial compression load test for types VII, VIII and IX bearings.

- 4.5.9 Load rating as a track roller. Bearings shall be tested under a load equal to the load rating as a track roller. The tests shall be performed at speeds of 10 to 100 revolutions per minute until 20,000 revolutions have been completed. The bearings may be relubricated during the test. The test shall be performed on a test support similar to the illustrations on figure 1c for types VII, VIII and IX bearings and figure 1b for types V, VI and X bearings.
- 4.5.10 End washer pushout. Bearings shall be placed in a bearing housing, as shown on figures 3a and 3b. The appropriate end washer pushout load specified in 3.5.3 shall be applied for 1 minute. Position of all types with exception of types VII, VIII and IX bearings shall be reversed and the test repeated. If the end washers fall off or smoothness of operation lessened perceptibly, the bearings shall be considered to have failed.
- 4.5.11 Radial play. Bearings shall be tested for radial play. The inner ring or stud shall be held rigidly and a radial load of 5 pounds applied alternately in opposite directions to the outer ring. A dial indicator shall be used to indicate this movement. Radial play shall not exceed the amount specified on the applicable MS standard (see figures 4a, 4b, 4c and 4d).
- 4.5.11.1 Types I, V, VI, VII, VIII, IX and X bearings. Radial play shall not exceed the amount specified on the applicable MS standard (see figure 4a for type I bearings, figure 4c for types V, VI and X bearings, figure 4d for types VII, VIII and IX bearings).

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4.5.11.2 Type II bearings. This type shall be measured while pressed into a housing gage as shown on figure 4a. The bearing shall not lock up when pressed into the low limit gage. Maximum radial play shall not exceed the amount specified on the applicable MS standard while the bearing is pressed into the low limit gage. High and low limit gage sizes are the high and low limit housing bore sizes indicated in tolerance tables of the appropriate MS standard.

4.5.11.3 Types III and IV bearings. Total radial play in the bearing shall be measured in the same manner as for other types. Radial play shall not exceed the amount specified on the applicable MS standard (see figure 4b). A complete bearing shall be used for this test. These types shall also be tested for radial clearance between the self-aligning members while pressed into a low limit gage and mounted snugly on a tapered arbor. Rollers and inner ring shall be removed and the outer ring mounted on the arbor. The radial clearance shall not exceed the amount specified in 3.5.4.1.

▣ 4.5.12 Axial play. Bearings shall be tested for axial play. Outer ring shall be held rigidly and an axial load of 5 pounds applied alternately in opposite directions to the inner ring or stud. A dial indicator shall be used to indicate this movement (see figures 5a and 5b).

▣ 4.5.13 Radial runout. Bearings shall be tested for radial runout. Type I bearings shall be mounted as shown on figure 4a. Types V, VI and X bearings shall be hand pushed on a tapered horizontal arbor and the arbor supported on a V-block or on centers (see figure 4c). Types VII, VIII and IX bearings shall be mounted as shown on figure 4d. Types III and IV bearings shall not be tested for radial runout. A dial indicator placed against the outer ring shall be used to indicate radial runout. Outer ring radial runout shall be measured by rotating the outer ring while holding the stud or inner ring. Inner ring radial runout shall be measured by rotating the inner ring while holding the outer ring.

4.5.14 Self-alignability. Bearings of types III and IV shall be tested for self-alignability while clamped with maximum diameters specified on the MS standard (see figure 4e).

4.6 Inspection of packaging. Packaging shall be examined for conformance with section 5 of this specification.

## 5. PACKAGING

5.1 Preservation. Packaging, packing and marking shall be in accordance with MIL-B-197 for levels and packaging method as specified in the contract or order.

5.1.1 Marking for shipment and storage. Nomenclature marking for interior and exterior containers shall conform to the following in lieu of the item description requirements of MIL-STD-129.

BEARINGS, ROLLER, NEEDLE, (SINGLE ROW, HEAVY DUTY), (SINGLE ROW, HEAVY DUTY, SELF-ALIGNING), (DOUBLE ROW, HEAVY DUTY, SELF-ALIGNING), (SINGLE ROW, HEAVY DUTY, TRACK ROLLER), (DOUBLE ROW, HEAVY DUTY, TRACK ROLLER), OR (TRACK ROLLER, INTEGRAL STUD), ANTIFRICTION, (INCH).

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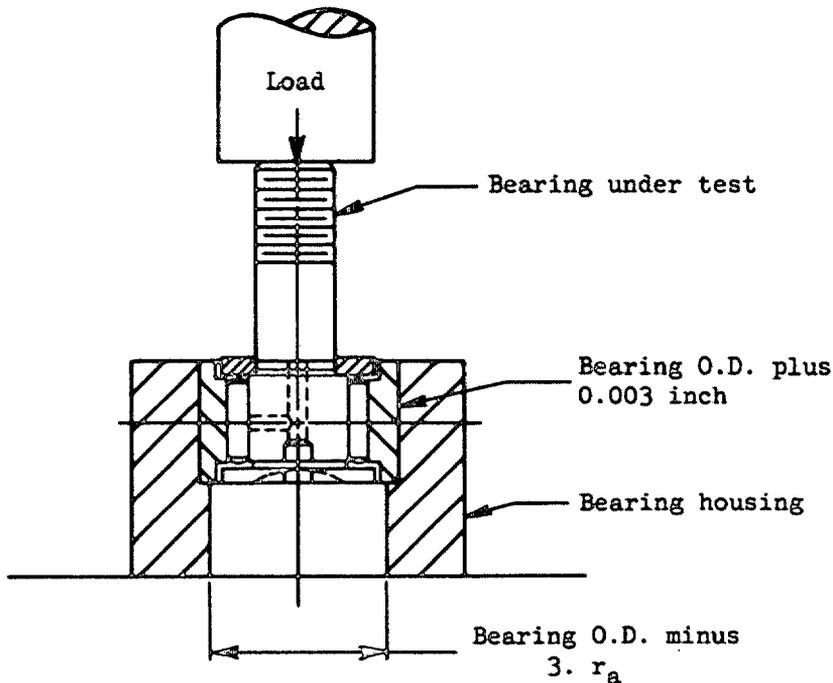


FIGURE 3a. End washer pushout test for types VII, VIII and IX bearings.

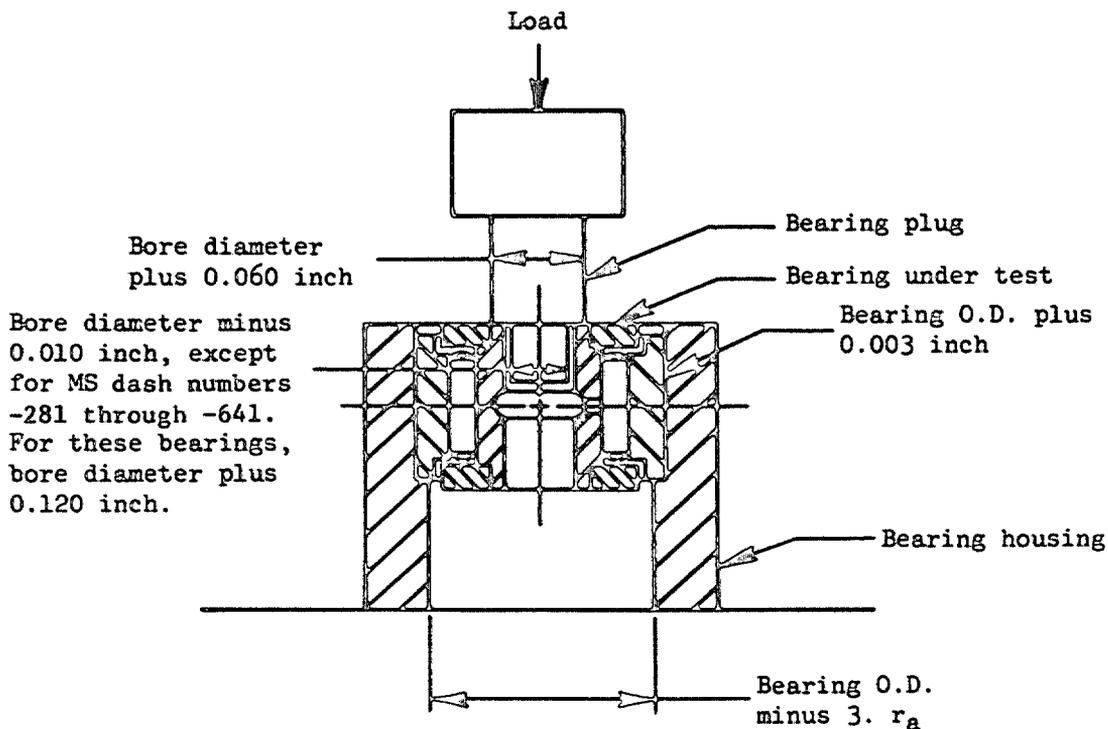


FIGURE 3b. End washer pushout test for types I, III, IV, V, VI and X bearings.

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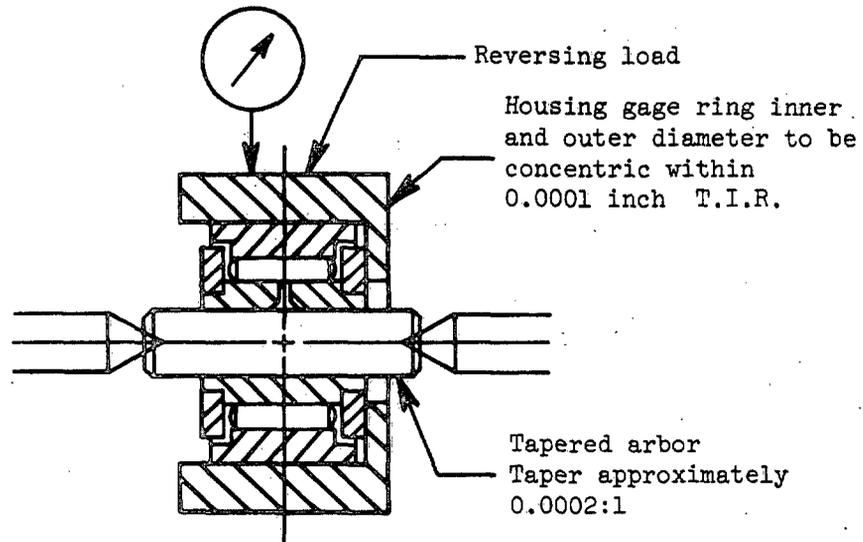


FIGURE 4a. Radial play - radial runout test for type I bearings.

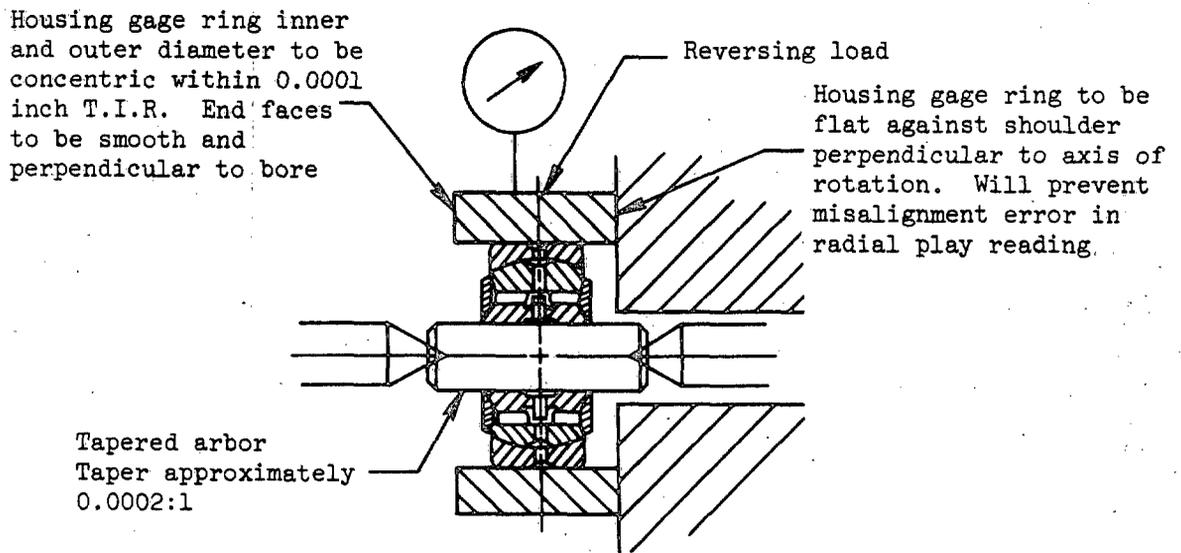


FIGURE 4b. Radial play test for types III and IV bearings.

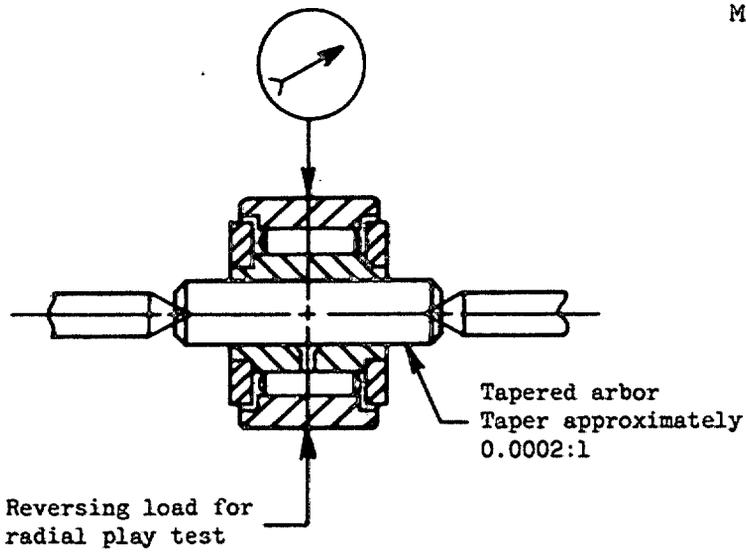


FIGURE 4c. Radial play and radial runout tests for types V, VI and X bearings.

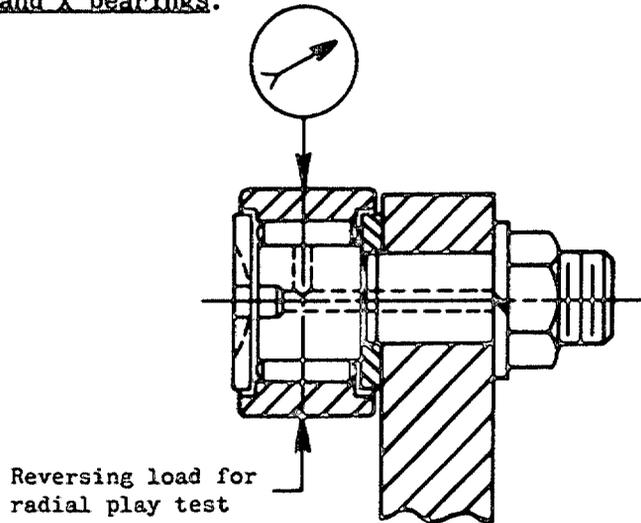


FIGURE 4d. Radial play and radial runout tests for types VII, VIII and IX bearings.

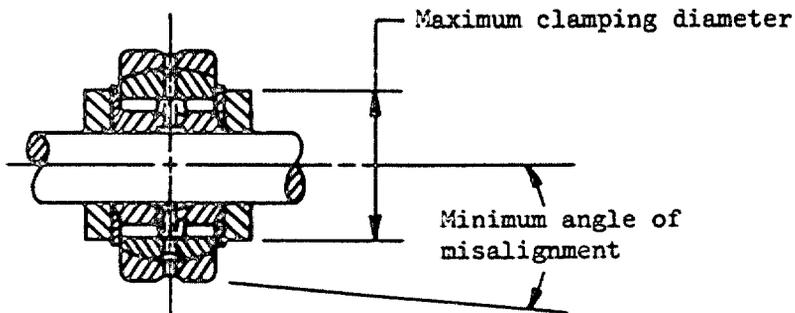


FIGURE 4e. Self-alignment test for types III and IV bearings.

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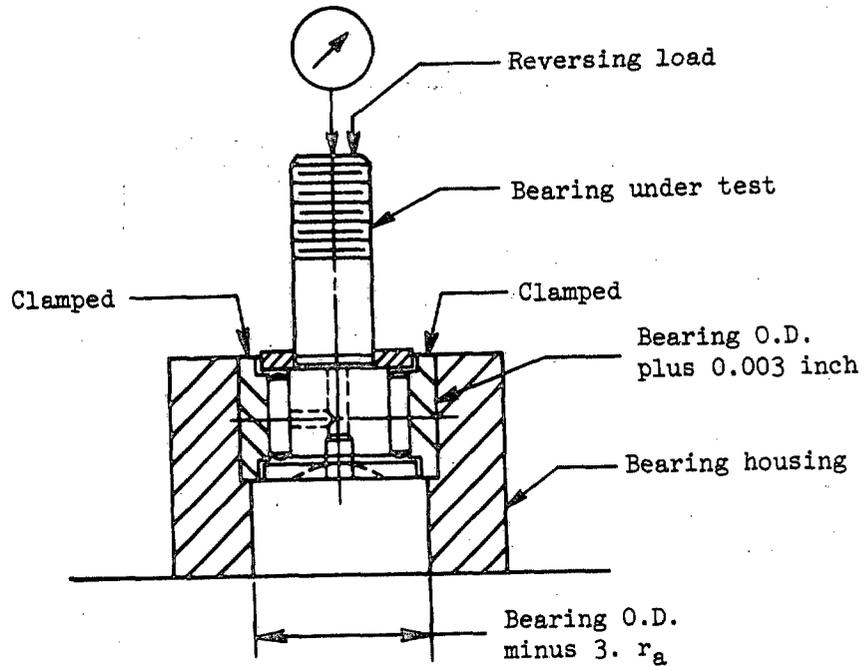


FIGURE 5a. Axial play test for types VII, VIII and IX bearings.

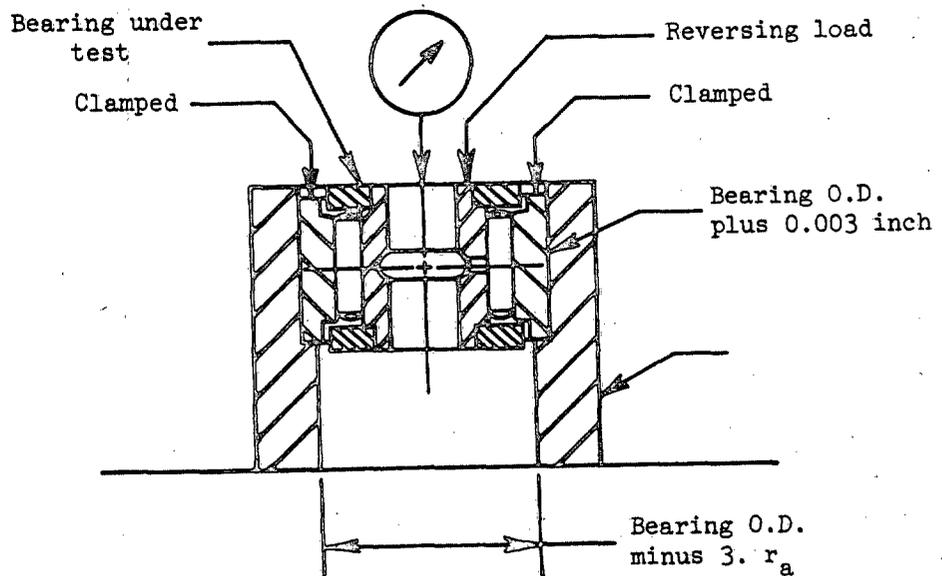


FIGURE 5b. Axial play test for types I, III, IV, V, VI and X bearings.

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## 6. NOTES

6.1 Intended use. Airframe antifriction needle roller bearings are intended primarily for use in flight vehicle control systems in which the load is radial.

6.2 Ordering data. Procurement documents should specify the following:

- a. Title number, and date of this specification
- b. Quantities and type required (see 1.2)
- c. Applicable level of preservation-packaging and packing (see 5.1)
- d. Method or symbol of MIL-B-197 (when applicable)

6.3 Qualification of product. With respect to products requiring qualification, awards will be made only for products which are, at the time set for opening of bids, qualified 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 contractors is called to this requirement, and manufacturers 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 the Commander, Aeronautical Systems Division, ATTN: ENFEM, Wright-Patterson AFB, OH 45433, 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 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 last previous issue.

## Custodians:

Army - AT  
Navy - AS  
Air Force - 11

Preparing activity:  
Air Force - 11

Project No. 3110-0580

## Review activities:

Air Force - 99  
DLA - IS

U.S. GOVERNMENT PRINTING OFFICE: 1959 - O33-121/9743

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A. GIVE PARAGRAPH NUMBER AND WORDING

B. RECOMMENDED WORDING CHANGE

C. REASON FOR RECOMMENDED CHANGE(S)

2. REMARKS

SUBMITTED BY (Printed or typed name and address - Optional)

TELEPHONE NO.

DATE