

INCH/POUND
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FF-B-2844

15 FEBRUARY 1994

SUPERSEDING

FF-B-171A (IN PART)

September 24, 1956

(SEE 6.5)

**FEDERAL SPECIFICATION****BEARINGS, BALL, ANNULAR (GENERAL PURPOSE)**

The General Services Administration has authorized the use of this specification by all Federal Agencies.

**1. SCOPE AND CLASSIFICATION**

**1.1 Scope.** This specification covers annular ball bearings for general purpose use that conform to boundary dimensions and Annular Bearing Engineering Committee (ABEC) ABEC-1, ABEC-3, and ABEC-5 tolerances as defined in the American National Standards Institute (ANSI) Anti-Friction Bearing Manufacturers Association (AFBMA) STD 20.

**1.2 Classification**

**1.2.1 Series.** The bearings furnished under this specification shall be of the following series:

Miniature Size..Instrument Type
Extra Light.....R Series
Extra Light.....XLS Series
Light.....LS Series
Medium.....MS Series

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Defense Industrial Supply Center, Attn: DISC-EHB, 700 Robbins Avenue, Philadelphia PA 19111-5096, 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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AMSC N/A

FSC 3110

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## 2. APPLICABLE DOCUMENTS

2\*1 Government publications. The following documents, of the issues in effect on the date of the invitation for bids or request for proposal, form a part of this specification to the extent specified herein:

## SPECIFICATIONS

## FEDERAL

- QQ-S-763 - Steel Bar, Wire, Shape and Forging, Corrosion-resisting
  - QQ-S-766 - Steel Plate, Sheet and Strip, Corrosion-resisting
  - FF-B-171A - Bearings, Ball, Annular (General Purpose), Metric
- (See supplement 1 for list of associated specification sheets.)

## MILITARY

- MIL-P-197 - Packaging of Anti-Friction Bearings, Associated Parts and Subassemblies
- MIL-B-1083 - Balls, Bearing, Ferrous and Non-ferrous (for use in Bearings and Valves)
- DoD-G-24508 - Grease, High Performance Multipurpose (Metric)
- MIL-G-81322 - Grease, Aircraft, General Purpose, Wide Temperature Range, NATO Code Number G-395

## STANDARDS

- MIL-STD-102 - Anti-Friction Bearing Identification Code
- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes
- MIL-STD-109 - Quality Assurance Terms and Definitions
- MIL-STD-129 - Marking for Shipment and Storage
- MIL-STD-130 - Identification Marking of U.S. Military Property
- MIL-STD-1647 - Identification Markings for Domestically Manufactured Bearings, Ball, Annular for Instruments and Precision Components

(Unless otherwise indicated, copies of federal and military specifications, standards and handbooks are available from the Department of Defense Single Stock Point DODSSP, Customer Service, Standardization Document Order Desk, 700 Robbins Avenue, Bldg. 4D, Philadelphia, PA 19111-5096).

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless a specific issue is identified, the issue in effect on the date of invitation for bids or request for proposal shall apply.

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AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)/AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA) (FORMERLY THE ANTI-FRICTION BEARING MANUFACTURERS ASSOCIATION (AFBMA)).

- ANSI/AFBMA STD 4 - Tolerance Definitions and Gaging Practices for Ball and Roller Bearings and Roller Bearing Steel
- ANSI/AFBMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings
- ANSI/AFBMA STD 10 - Metal Balls
- ANSI/AFBMA STD 12.2 - Instrument Ball Bearings Inch Design
- ANSI/AFBMA STD 20 - Radial Bearings of Ball, Cylindrical Roller and Spherical Roller Types, Metric Design

(Application for copies should be addressed to the **American Bearing Manufacturers Association, Inc., 1101 Connecticut Avenue, N.W., Suite 700, Washington, DC 20036-3283**].

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- ASTM A 295 - Standard Specification for High Carbon and Roller Bearing Steel
- ASTM A 313 - Specification for Chromium Nickel Stainless and Heat Resisting Steel Spring Wire
- ASTM A 380 - Practice for Cleaning and Descaling Stainless Steel Parts, Equipment, and Systems
- ASTM A 580 - Specification for Stainless and Heat Resisting Steel Wire
- ASTM E 18 - Standard Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
- ASTM E 112 - Standard Methods for Determining Average Grain Size

(Application for copies should be addressed to the American Society for Testing and Materials, 2916 Race Street, Philadelphia, PA 19103-1187].

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

- SAE HS J1086 (ASTM DS-56C) - Metals and Alloys in the Unified Numbering System (UNS), Fourth Edition

(Application for copies should be addressed to the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096-0001).

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated detail specifications, specification sheets, or MS standards) the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

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### 3. REQUIREMENTS

3\*1 **Specification sheets.** The individual item requirement shall be as specified herein and in accordance with the applicable specification sheets. In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern.

3.2 **Materials** Materials for the bearing component parts shall meet the requirements of 3.2.1 through 3.2.5.

3.2.1 **Ring and ball materials.** Bearing rings and balls shall be made of either chromium-alloy steel 52100 (UNS G52986) in accordance with ASTM A 295 or, corrosion resistant steel 440C (UNS 44004), conforming to QQ-S-763. Grain size shall be determined in accordance with ASTM E 112. The 52100 steel shall be produced by the electric furnace process and vacuum-carbon-deoxidized or any other steel making process that produces steel in accordance with ASTM A295. Each specification sheet shall represent a single material.

3.2.1.1 **Passivation.** Passivation shall be accomplished in accordance with ASTM A380 on all bearing components fabricated from corrosion resistant steel after completion of all machining or metal removing operations and prior to assembly (see 4.5.1).

3.2.2s **Cage material** Materials shall be compatible with and shall be resistant to deterioration due to lubricant, preservative, hydraulic fluid, solvents or other substances and chemicals that can be expected to come into contact with the bearing and shall cause no deterioration of the same. Bearings with nonmetallic cages shall meet the same inspections and performance requirements as conducted on bearing's with metallic cages. Materials shall operate from -65° F (-54°C) to 230°F (110°C). The cage type shall be specified in the part number as indicated on the individual specification sheet (see 6.2.1).

#### 3.2.3 **Closures.**

3.2.3.1 **Shields.** Shields shall be fabricated from any material unless otherwise specified (see 6.2.1). Materials shall be compatible with and shall be resistant to deterioration due to lubricant, preservative, hydraulic fluid, solvents or other substances and chemicals that can be expected to come into contact with the bearing and shall cause no deterioration of the same. Materials shall operate from -65°F (-54°C) to 230°F (110°C). For corrosion resistant bearings, the shields shall be made of corrosion resistant steel conforming to QQ-S-766. This specification covers both removable and non removable type shields. The inclusion and number of shields shall be specified in the part number as indicated on the individual specification sheet.

3.2.3.2 **Seals.** Seals shall be fabricated from any material unless otherwise specified (see 6.2.1). Materials shall be compatible with and shall be resistant to deterioration due to lubricant, preservative hydraulic fluid, solvents, or other substances and chemicals that can be expected to come into contact with the bearing and shall cause no deterioration of the same. Materials shall operate from -65°F (-54° to 230°F (110°C) 1 This specification covers removable and non

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removable, impervious contact seals and removable and non removable, non contact type seals. The number and type of seals shall be specified in the part number and indicated on the individual specification sheet.

3.2.4 Lubricants and preservative compounds. Unless otherwise specified (see 6.21), bearings shall be supplied with grease in accordance with DoD-G-24508 or MIL-G-81322 or preservative compound in accordance with MIL-P-197. When grease is specified, the bearing void (the airspace between the inner and outer ring of the assembled bearing) shall be 25% to 50% filled for non-instrument sizes and 25% to 40% filled for instrument sizes. The lubricant or preservative compound shall be specified in the part number as indicated on the individual specification sheet.

3.2.5 Recovered materials. The offeror/contractor is encouraged to use recovered materials in accordance with Public Law 94-580 to the maximum extent practicable.

3.3 Visual requirements Bearings furnished under this specification shall conform to the visual requirements relative to surface quality, marking and workmanship (see 4.4.3).

3.3.1 Surface quality The surface quality of the bearing shall be such that the manufactured bearing shall be uniform in appearance and free of defects visible to the unaided eye.

3.3.2 Marking. Each bearing shall be permanently marked with the following:

- a. The bearing manufacturer's name or symbol and part number or the complete National Stock Number (NSN) in accordance with MIL-STD-130.
- b. The complete specification sheet part number.
- c. Each bearing with an outer ring diameter greater than or equal to 2.500 inches shall be permanently marked on the outer ring. Bearings less than 2.500 inches outer ring diameter shall be marked on the package.
- d. Miniature and Instrument size bearings shall be marked in accordance with MIL-STD-1647.

### 3\*4 Metrology

3.4.1 Metrology of assembled bearings The dimensions of bearings shall conform to tolerance classes and radial internal clearances as specified in the part number.

3.4.1.1 Tolerance class. The tolerance limits for bearings shall be either tolerance class ABEC-1, ABEC-3P, or ABEC-5 and shall be specified in the part number as indicated on the individual specification sheet (see 4.5.2).

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3.4.1.2 **Radial internal clearance** The tolerance limits for radial internal clearance for bearings shall be specified in the individual specification sheets (see 4.5.2).

3.4.2 **Ball grade and geometric quality** Unless otherwise specified herein, bearings shall be assembled with balls that conform to a ball grade and geometric quality requirements as tabulated in ANSI/AFBMA STD 10. Manufacturers shall specify the ball grade and geometric quality.

3.5 **Heat Treatment** The heat treatment process shall be such that the finished rings and balls meet the requirements as specified in 3.5.1 and 3.5.2.

3.5.1 **Hardness of rings** Measured hardness of rings shall not be less than 58 HRC as measured in accordance with ASTM E 18. Measured hardness of rings shall not vary more than three points on the Rockwell C scale on any one ring (see 4.5.3).

3.5.2 **Hardness of balls** Measured hardness of balls shall be within 60-67 HRC, or equivalent. Case hardened or work hardened balls shall not be acceptable (see 4.5.3).

3.6 **General assembly requirements** Unless otherwise specified herein, the details of the component parts shall be optimal with the contractor. Bearings shall be manufactured using new, unused component parts only.

3.6.1 **Balls** Balls for bearings shall be in accordance with MIL-B-1083 or ANSI/AFBMA STD 10 and as specified herein (see 4.5.3).

3.6.2 **Cage** Bearings shall have cages for spacing the balls in their proper relationship within the bearings. Cages shall be assembled so as not to degrade the primary function of the bearing. The cage shall admit the lubricant freely to the raceway and ball surfaces of the bearing (see 4.4).

3.6.3 **Shields and seals** Shields and seals, when utilized, shall not affect the dimensional tolerance specified herein. Contact seals shall not inhibit the free rotation of the bearing rings (see 4.5.2).

3.6.4 **Assembly** Bearings shall be assembled correctly utilizing the components and requirements specified herein (see 4.4).

3.7 **Dynamic load rating** Dynamic load rating for all bearings covered by this specification shall be in accordance with ANSI/AFBMA STD 9. Bearing performance shall meet or exceed the dynamic load rating tabulated in each individual specification sheet (see 4.3).

3.8 **Workmanship** Bearing surfaces shall be free of contamination from foreign particle debris, rust and dirt. Additionally, all functional surfaces shall be free from mechanical and physical damage which would be detrimental to satisfactory performance of the bearing. Such damage shall include, but not be limited to, tool marks, grinding scratches, pits, indentations and cracks visible to the unaided eye (see 4.4.3).



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## 4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection Unless otherwise specified in the contract, or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, or purchase order, 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 that supplies and services conform to prescribed requirements.

4.1.1 Responsibility for Compliance. All items must meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

" 4.1.2 Inspection terms and definitions. <sup>10</sup> Inspection terms and definition shall be as defined in MIL-STD-109.

4.1.3 Measurement standards calibration. Measurement standards used by the contractor for calibrating measuring and test equipment (M&TE) other measurement standards shall be traceable and shall have accuracy, stability, range and resolution required for intended use.

4.1.4 Environmental controls. M&TE and measurement standards shall be calibrated and used in an environment controlled to the extent necessary to assure continued measurements of required accuracy, giving due consideration to temperature, cleanliness and other controllable factors.

4.1.5 Gaging practices. A standard gaging method shall be developed and used by the manufacturer to verify the product conformance to the requirements of this specification. The gaging methods shall be acceptable to the authorized government representative. In areas of dispute ANSI/AFBMA Standard 4 shall referee.

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

4.2 Classification of examinations and tests. The examination and test requirements specified herein are classified as follows:

- a. Certification of performance (see 4.3).
- b. Quality conformance inspection (see 4.4).

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4.3 Certification of performance. Manufacturer shall certify in writing that bearing performance shall meet or exceed the dynamic load rating-listed in the specification sheet as calculated in accordance with ANSI/AFBMA STD 9.

4.4 Quality conformance inspection. Quality conformance inspection shall be conducted at the contractors facility under surveillance of the government quality assurance representative. Quality conformance inspection shall be in accordance with 4.4.1 through 4.5.3.

4.4.1 Lot. A lot shall consist of assembled bearings of a particular part number assembled at the same time on the same assembly set-up and processed through all final assembly operations as a single group submitted for delivery at the same time.

4.4.2 Sampling for quality conformance inspection Samples shall be drawn from each lot of bearings which are to be inspected to evaluate the characteristics specified in Table I. Sampling shall be conducted in accordance with the single sample plan of MIL-STD-105.

4.4.3 Visual examination. All sample beatings submitted shall be subjected to visual examination to varify conformance with this specification regarding surface quality, workmanship and marking, Irregularities may be observed under magnification to establish identification. Defects shall be classified as specified in Table I.

**TABLE I. CLASSIFICATION OF DEFECTS**

Category	AQL	Defects	Inspection method
Critical	.01		
01		Shields or seals, if required, interfere with rotating parts of bearing (see 3.6.3)	Visual
02		Lubricant or preservative is missing or is not as specified (see 3.2.4)	Visual
03		Radial runout, inner ring is not within required limit for grade specified-measured (see 4.5.2)	1/
04		Radial runout, outer ring is not within required maximum limit for grade specified - measured (see 4.5.2)	1/
Major:	1.0		
101		Bearings are not of the material specified (see 4.4)	1/
102		Bearings show evidence of corrosion (see 3.8)	Visual
103		Bearing shows evidence of contamination (see 3.8)	Visual
104		Bore diameter, inner ring is not within required limits for grade specified - measured (see 4.5.2)	1/
105		Outside diameter, outer ring is not within required limits for grade specified - measured (see 4.5.2)	1/



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TABLE I. CLASSIFICATION OF DEFECTS - Continued

Category	AQL	Defects	Inspection method
Major:	1.0		
106		Hardness of balls is not within required limits - measured (see 4.5.3)	1/
107		Hardness of inner rings is not within required limits - measured (see 4.5.3)	1/
108		Hardness of outer rings is not within required limits - measured (see 4.5.3)	1/
109		Radial internal clearance is not within required limits for Category specified - measured	1/
110		Cage is not of adequate construction, interferes with rotation of bearing or impedes entrance of lubricant (see 3.6.2)	Visual
111		Seal(s) or shield(s), if required, interfere with rotating parts of bearing (see 3.6.3)	Visual
112		Contact seals inhibit free rotation of rings (see 3.6.3)	Visual
113		Bearing is not marked as required (see 3.3.2)	Visual
114		Packaging, packing and marking are not as specified (see 4.4.4)	Visual
115		Passivation (see 3.2.1.1)	Visual
116		Each ball scheduled for assembly is not within required quality limits for ball grade specified - measured (see 3.4.2)	1/
117		Each ball scheduled for assembly is not within diameter tolerance required - measured (see 3.4.2)	1/
118		Width, (individual) inner ring is not within required limits for grade specified - measured (see 3.4.1)	1/
119		Width, (individual) outer ring is not within required limits for grade specified - measured (see 3.4.1)	1/
Minor:	4.0		
201		Bearings are not of the part number specified	Visual
202		Surface Quality, inner ring is not in accordance with requirements (see 3.3.1)	Visual
203		Surface Quality, outer ring is not in accordance with requirements (see 3.3.1)	Visual
204		Surface quality, each ball is not in accordance with requirements (see 3.3.1)	1/
205		Corners, inner ring, at intersections of bore and side surfaces, are not within required limits - measured (see 3.4.1)	Visual
206		Corners, outer ring, at intersections of outside diameter and side surfaces, are not within required limits - measured (see 3.4.1)	1/
207		Reference side runout with bore, inner ring, is not within the required maximum limit - measured (see 4.5.2)	1/

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TABLE I. CLASSIFICATION OF DEFECTS - Continued

Category	AQL	Defects	Inspection method
Minor: 208	4.0	Raceway runout with reference side, inner ring, is not within the required maximum limit - measured (see 4.5.2)	1/
209		Outside cylindrical surface runout with reference side, outer ring is not within required maximum limit - measured (see 4.5.2)	1/
210		Raceway runout with reference side, outer ring, is not within required maximum limit - measured (see 4.5.2)	1/

## 1/ Commercial Inspection Equipment

4.4.4 Inspection of packaging. The packaging, packing and marking shall be inspected for compliance with section 5 of this document.

4.5 Test procedures. Descriptions of the tests and procedures of analysis for quality conformance shall be as specified in 4.5.1 through 4.5.3

4.5.1 Passivation tests. The passivation test solution shall conform to ASTM A380 (see 3.2.1.1).

4.5.1.1 Passivation test of rings. A sample of the passivated lot shall be tested for corrosion resistance. The test rings shall be immersed in the test solution of 4.5 which is maintained at room temperature 70° to 75°F (21 to 24°C) for 6 ± 0.5 minutes. The test rings shall be gently washed with clean running water. (Clean water is defined as distilled or demineralized water with a maximum total solids content (soluble or insoluble) of 10 PPM (Parts Per Million) and a PH between 5.5 and 7.5). Each ring shall be examined under 10X magnification for any evidence of copper deposit. The presence of copper deposit indicates a failure.

4.5.1.2 Passivation test of balls. A sample lot of balls from the unit container shall be randomly selected for test. The test sample will be completely immersed in the test solution of 4.5.1. The solution shall be maintained at room temperature 70° to 75°F (21 to 24°C) and the time of immersion shall be 6 ± 0.5 minutes. The sample shall be gently rinsed in clean, warm, running water at 160° F (71° C). The tested balls shall be spread out on white paper under defused light to prevent brilliant highlights. The balls shall be examined under 10X magnification while being slowly rolled or turned for examination of all of the surface. Any evidence of copper deposit indicates test failure.

4.5.2. Metrology of assembled bearings. All samples of assembled bearings shall be measured to verify conformance with this specification regarding bore diameter, outside diameter, width, ring runout as appropriate for the tolerance class of the bearing and radial

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internal clearance. Runout measurements shall be made in accordance with ANSI/AFBMA STD 4, and shall be in accordance with ANSI/AFBMA STD 20. Defectets shall be classified as specified in Table I.

4.5.3 Hardness test. Rings and balls, shall be subject to a hardness test in accordance with ASTM E 18 for rings and MIL-B-1083 for composition 1 balls. Defects shall be classified as specified in Table I.

**4.6 Acceptance and rejection for quality conformance inspection.** Acceptance or rejection of the lot and parts or assembled bearings subjected to the sampling specified in accordance with the procedures of MIL-STD-105 using inspection level II and the applicable Acceptance Quality Level (AQL) as specified in Table I. Defects shall be classified as listed in Table I. Defects observed in each classification shall apply to that classification only for purposes of acceptance or rejection and defects shall be cumulative (i.e., critical defects shall not be included in the major/minor defect count).

## 5. PACKAAGING

501 Preservation Preservation shall be in accordance with MIL-P-197, Level A, C, or commercial as specified.

5.2 Packing packing shall be in accordance with MIL-P-197, Level A, B, C or commercial as specified.

5.3 Marking. Marking shall be in accordance with MIL-P-197 and MIL-STD-129.

5\*4 Navy fire-retardant requirements Requirements shall be as specified in MIL-P-197.

## 6. NOTES

6.1 Intended use. This specification is to be used in the acquisition of annular ball bearings intended for general purpose use by the U.S. Government. This specification does not include all types of general purpose annular ball bearings, but is intended to cover only those types generally used by the federal government.

### 6.2 Ordering data

6.2.1 Acquisition requirements Acquisition documents should specify the following:

- a. Title, number and date of this specification.
- b. Complete specification sheet part number.
- c. Cage Material (see 3.2.2)
- d. Shield or Seal Material (see 3.2.3.1 or 3.2.3.2).
- e. Lubricant/ Preservative (see 3.2.4)
- f. Levels of Preservation (see 5.1)
- g. Levels of Packing (see 5.2)
- h. Special marking required (see 5.3)
- j. Navy fire-retardant requirements (see 5.4)

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### 6.3 Definitions

6.3.1 **General Purpose Bearings** General purpose bearings on specification sheets 1,2,4, and 5 are ball bearings with ANSI/ABMA precision classification of ABEC-1 or ABEC-3P tolerances. The Bearings on specification sheets 3,6,7, and 8 are ball bearings with ANSI/ABMA precision classification of ABEC 1 or ABEC 5 tolerances.

6.4 **Caution.** Caution should be taken during any plating, cleaning, descaling, passivation, or similar process. The contractor shall be responsible for the safe reutilization and disposal of all material generated by this process in accordance with ASTM A380 , sections 8.2 and 8.7.

**6.5 Inch-pound specification.** This document supersedes only the Inch-Pound bearings specified by FF-B-171A. See FF-B-171B for coverage of the metric bearings specified by FF-B-171A.

6.6 **Cross reference to FF-B-171A** specification sheets 1 through 8 have been developed to replace type 115, radial, single row, inch bearings, of FF-B-171A. MIL STD 102 coded bearings, 015 and 075, have been added to this specification. These bearings have not had previous specification coverage.

MILITARY COORDINATING ACTIVITY:  
DLA - IS

CIVIL AGENCY COORDINATING ACTIVITY:  
GSA - FSS

Custodians:  
Army - AT  
DLA - IS  
Air Force - 11

Preparing Activity:  
DLA - IS  
(Project 3110-0887)

Review Activities:  
Army - AR, EA, MI  
Navy - OS

User Activities:  
Army - GL, ME