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MILITARY SPECIFICATION

BEARINGS, SLEEVE, WASHERS, THRUST, SINTERED, METAL POWDER, OIL-IMPREGNATED, GENERAL SPECIFICATION FOR

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

1. SCOPE

1.1 Scope. This specification covers oil-impregnated, sintered metal powder bearings and thrust washers.

1.2 Classification. Oil-impregnated, sintered metal powder bearings and thrust washers shall be of the following types and grades as specified (see 6.2).

Type I - Copper Base
Grade 1 - Copper-Tin
Grade 2 - Copper-Tin-Lead

Type II - Iron Base
Grade 1 - Iron-Carbon - 0.25 percent max carbon
Grade 2 - Iron-Carbon - 0.25 to .60 percent carbon
Grade 3 - Iron-Copper - 7.0 to 11.0 percent copper
Grade 4 - Iron-Copper - 18.0 to 22.0 percent copper

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. Unless otherwise specified, the following specifications, standards, and handbooks 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.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: HQ AFLC CASO/LODS, Federal Center, Battle Creek, MI 49016 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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SPECIFICATIONS

FEDERAL

- PPP-B-576 - Boxes, Wood, Cleated, Veneer, Paper Overlaid
- PPP-B-585 - Boxes, Wood, Wirebound
- PPP-B-601 - Boxes, Wood, Cleated-Plywood
- PPP-B-621 - Boxes, Wood, Nailed and Lock-Corner
- PPP-B-636 - Boxes, Shipping, Fiberboard
- PPP-B-640 - Boxes, Fiberboard, Corrugated, Triple-Wall

MILITARY

- MIL-P-116 - Preservation, Methods of
- MIL-L-6085 - Lubricating Oil, Instrument, Aircraft, Low Volatility
- MIL-L-17331 - Lubricating Oil, Steam Turbine and Gear, Moderate Service

STANDARDS

FEDERAL

- FED-STD-151 - Metals; Test Methods

MILITARY

- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes
- MIL-STD-129 - Marking for Shipment and Storage
- MIL-STD-1188 - Commercial Packaging of Supplies and Equipment
- MS17795 - Bearing, Sleeve, Plain, Sintered Bronze, Oil Impregnated
- MS17796 - Bearing, Sleeve, Flanged, Sintered Bronze, Oil Impregnated
- MS21782 - Bearing, Sleeve, Plain, Sintered Iron Base, Oil Impregnated
- MS21783 - Bearing, Washer, Thrust, Sintered Bronze, Oil Impregnated

(Copies of specifications, standards, handbooks, drawings, and publications 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 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.

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American Society for Testing and Materials (ASTM)

ASTM B 328 - Density and Interconnected Porosity of Sintered Powder
Metal Structural Parts and Oil-Impregnated Bearings

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103).

(Industry association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

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

3. REQUIREMENTS

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

3.2 First article. When specified (see 6.2.1) a sample of the bearings and thrust washers shall be subjected to first article inspection (see 4.3.1).

3.3 Materials. The metal powder shall produce bearings conforming to all the requirements of this specification. The bearings shall be supplied impregnated with a high grade, nongumming petroleum oil (see 3.7) and be in accordance with the applicable Military Standard sheet.

3.4 Chemical requirements. The material shall conform to the chemical requirements shown in Table I.

3.4.1 Analysis. The contractor shall furnish an analysis of each lot of bearings on an oil free basis showing the percentages of the elements specified in Table I. Testing of chemical composition shall be as specified (see 4.6.1).

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TABLE I. CHEMICAL REQUIREMENTS.

ELEMENT	COMPOSITION, PERCENT ^{1/}					
	TYPE I		TYPE II			
	GRADE 1	GRADE 2	GRADE 1	GRADE 2	GRADE 3	GRADE 4
Copper	87.5 to 90.5	82.6 to 88.5			7.0 to 11.0	18.0 to 22.0
Iron	1.0 max	1.0 max	96.25 min	95.9 min	Remainder ^{4/}	
Tin	9.5 to 10.5	9.5 to 10.5				
Lead		2.0 to 4.0				
Zinc, max		0.75				
Nickel, max		0.35				
Antimony, max		0.25				
Silicon, max			0.3	0.3		
Aluminum, max			0.2	0.2		
Carbon	1.75 ^{2/}	1.75 ^{2/}				
Total other elements by difference, max	0.5	0.5	3.0	3.0	3.0	3.0
Combined ^{3/} carbon (on basis of iron only)			0.25 max	0.25 to 0.60		

^{1/} See 6.4

^{2/} Commonly graphite. A maximum of 1.5 percent of another type of solid lubricant may be substituted when authorized.

^{3/} The combined carbon may be a metallographic estimate of the carbon in the iron.

^{4/} Total of iron plus copper shall be 97 percent, min.

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3.5 Physical requirements. The physical requirements of the bearings are as follows:

3.5.1 Density: The density of the bearings shall be in accordance with Table II. Testing shall be performed as specified (see 4.6.2.1).

TABLE II. DENSITY AT AMBIENT TEMPERATURE.

TYPES	GRADE	DENSITY g/cm^3	
		MIN	MAX
I	1	6.4	6.8
	2	6.5	6.9
II	1 and 2	5.7	6.1
	3 and 4	5.8	6.2

3.5.2 Porosity. The interconnected void by volume as determined by the method specified (see 4.6.2.2) shall be not less than 20 percent for Type I and Type II bearings.

3.5.3 Radial crushing strength. The radial crushing strength shall conform to the applicable Military Standard sheet. Testing shall be conducted as specified (see 4.6.2.3).

3.6 Oil excretion. The porosity of the bearings, as supplied, impregnated with oil, shall be such that appreciable sweating is evidenced on the bearing surface when subjected to test (see 4.6.2.4).

3.7 Lubricant. Bearings shall be impregnated with oil in accordance with MIL-L-6085 or MIL-L-17331, (Military Symbol 2190-TEP), and as specified in the applicable Military Standard sheet (see 6.2).

3.8 Design. The bearing design shall conform to that shown on the applicable Military Standard sheet (see 6.2).

3.9 Dimensions and tolerances. Dimensions and tolerances shall be as specified in the applicable Military Standard sheets.

3.10 Workmanship. The workmanship of bearings shall be uniform in composition. When cut or fractured, the exposed surface shall be free from defects. Bearings shall be free of toolmarks, chatter waves, grinding scratches, pits, or other surface defects which may be detrimental to satisfactory installation performance or bearing life.

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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 supplies and services conform to prescribed requirements.

4.1.1 Records. Records of examinations and tests performed by or for the contractor shall be maintained by the contractor and made available to the Government, upon the Government's request, at any time, or from time to time, during the performance of the contract and for a period of two years after delivery of the supplies to which such records relate.

4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. First article inspection (see 4.3.1)
- b. Quality conformance inspection (see 4.4)

4.3 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified (see 4.6.2.1, 4.6.2.2 and 4.6.2.4).

4.3.1 First article inspection. First article inspection shall be performed on the bearings when a first article sample is required (see 3.2 and 6.2.1). This inspection shall be in accordance with 4.5.1 and 4.6 except that four sample units shall be required for this inspection. Chemical testing is not required for first article inspection.

4.4 Quality conformance inspection. Quality conformance inspection shall be in accordance with MIL-STD-105 and as specified in Tables III and IV.

TABLE III. QUALITY CONFORMANCE INSPECTIONS.

INSPECTION	INSPECTION LEVEL	AQL (DEFECTS PER 100 UNITS)
Visual		
Major defects	II	1.0
Total defects (major and minor combined)	II	6.5
Dimensional examination	S-1	2.5

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4.5 Quality conformance inspection sampling.

4.5.1 Sampling for visual and dimensional examination. Sampling for examination shall be in accordance with MIL-STD-105 and as specified in table III. The unit of product for sampling purposes shall be one sleeve bearing or one thrust washer as applicable. The bearing or thrust washer shall also be examined for defects in dimensions. Any dimension not within the tolerances specified on the applicable military standard shall be classified as a defect (see 6.2).

4.5.2 Certificates of quality. Certificates of quality supplied by the manufacturer of the sintered metal bar may be furnished in lieu of actual performance of such testing by the contractor, provided lot identity has been maintained and can be demonstrated to the government. The certificate shall include the name of the contractor, contract number, name of the manufacturer or supplier, NSN, item identification, name of the component or material, lot number, lot size, sample size, date of testing, test method, individual test results, and the specification requirements.

4.5.3 Inspection lot. An inspection lot shall consist of bearings of the same dimensions, made from metal powders of the same type and composition, formed and sintered under the same manufacturing processes offered for delivery at one time.

4.5.4 Quality conformance tests. Sampling for tests shall be in accordance with MIL-STD-105 and as specified in Table IV. Acceptance number shall be zero for all sample series. The unit of product for sampling purposes shall be one sleeve bearing or one thrust washer as applicable.

TABLE IV. QUALITY CONFORMANCE TESTS.

COMPONENT (UNIT OF PRODUCT)	CHARACTERISTIC	REQUIREMENT	TEST PROCEDURE	INSPECTION LEVEL
As required	Chemical requirements	3.4	4.6.1	S-1
1 bearing or washer as applicable	Density	3.5.1	4.6.2.1	S-4
1 bearing or washer as applicable	Porosity	3.5.2	4.6.2.2	S-4
1 bearing	Radial crushing strength	3.5.3	4.6.2.3	S-4
1 bearing	Oil excretion	3.6	4.6.2.4	S-4

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4.5.5 Classification of defects. Examination of defects shall be as specified in table V. The unit of product for examination shall be one sleeve bearing or one thrust washer. Examination shall not be restricted to the classified possible defects listed in Table V.

TABLE V. CLASSIFICATION OF DEFECTS.

CATEGORY	DEFECTS	INSPECTION METHOD
Critical	Bearings not of the type, grade, or design specified	Visual
Major 101	Lubricant not in accordance with requirements	Visual
102	Protective coating missing or inadequate (MS21782 only)	Visual
103	Thrust washer not free of chatter waves or gouging	Visual
104	Not free of cuts or fractures	Visual
Minor 201	Bearing or washer not free of toolmarks, grinding, scratches or pits	Visual

4.6 Methods of inspection.

4.6.1 Visual and dimensional examination tests. Tests shall be in accordance with 4.5.1 and as specified in Table V.

4.6.1.1 Chemical composition. Four ounces from each lot of material shall be tested in accordance with FED-STD-151.

4.6.2 Physical tests. Physical tests are to be conducted as follows (see 6.2).

4.6.2.1 Density. Testing of density shall be as specified in ASTM B 328. Testing shall be performed under ambient conditions.

4.6.2.2 Porosity. Testing of porosity shall be as specified in ASTM B 328. Testing shall be performed under ambient conditions.

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4.6.2.3 Radial crushing strength. Radial crushing (bearings only). The cylindrical bearings and the flanges shall be compressed radially by a gradually applied load until the load drops owing to the first crack. Both the cylindrical bearing and flanges shall meet the minimum strength requirements. The minimum strength requirements shall be computed from the mathematical equation in the applicable Military Standard sheet. The flanges should be cut off of flanged bearings, in order that the flange and cylindrical parts of the bearing can be tested separately.

4.6.2.4 Oil excretion. The bearings shall be heated in an oven or other suitable means. The temperature shall not exceed 149°F (300°C) and be held for a period of not more than 5 minutes. During the period, an oil film or beads shall exude uniformly from the bearing surface (see 3.6).

4.6.2.5 Rejection. Parts not conforming to the requirements of this specification and the applicable Military Standards shall be cause for the rejection of the entire lot of material.

4.6.2.6 Inspection of packaging. Sampling and inspection requirements of preservation-packaging, packing, and container marking shall be in accordance with section 5 of the specification and MIL-STD-105. Defects shall be scored but not limited to those specified in Table VI. The sample unit shall be one container fully prepared for delivery.

TABLE VI. EXAMINATION OF PACKAGING.

CATEGORY	DEFECTS	INSPECTION METHOD
Minor 301	Packaging, packing and marking not in accordance with requirements	Visual

5. PACKAGING

5.1 Preservation. Preservation shall be level A or industrial as specified (see 6.2).

5.1.1 Level A.

5.1.1.1 Unit packs. Unless otherwise specified (see 6.2) each item shall be individually packaged in accordance with method IC-1 of MIL-P-116.

5.1.2 Industrial. The industrial preservation of items shall be in accordance with MIL-STD-1188.

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5.2 Packing. Packing shall be level A, B, or industrial as specified (see 6.2).

5.2.1 Level A. Unit packs shall be packaged in boxes conforming to overseas class or type as specified in PPP-B-576, PPP-B-585, PPP-B-601 and PPP-B-621.

5.2.2 Level B. Unit packs shall be packed in domestic type or class boxes as specified in PPP-B-576, PPP-B-585, PPP-B-601, PPP-B-621, PPP-B-636 and PPP-B-640.

5.2.3 Industrial packing. Packing shall be in accordance with MIL-STD-1188.

5.3 Marking.

5.3.1 Levels A or B. In addition to any special or other identification marking required by the contract (see 6.2) each unit pack intermediate and exterior container shall be marked in accordance with MIL-STD-129.

5.3.2 Industrial. Industrial marking shall be in accordance with the requirements of MIL-STD-1188.

6. Notes

6.1 Intended use. The bearings covered by this specification are intended for use where a self-lubricated, high-shock and high-impact application is required.

6.2 Ordering data. Acquisition documents should specify the following:

- a. Title, number and date of this specification sheet
- b. Type and grade of bearings and washers (see 1.2)
- c. First article when required (see 3.2)
- d. Oil to be used for impregnating the bearings (see 3.7)
- e. Applicable drawings or Military Standards (see 3.8)
- f. Sampling when required (see 4.5.1)
- g. Tests when required (see 4.6.2)
- h. Applicable levels of preservation and packing (see 5.1 and 5.2)
- i. Special marking of shipments (including lubrication specification and grade) (see 5.3)

6.2.1 First article. When a first article inspection is required, the item will be tested as specified in 3.1, 4.5.1 and 4.6. The first article should consist of four units. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examinations, test approval of the documents first article.

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6.3 Cross reference.

Classification used prior to MIL-B-5687D	Classification of MIL-B-5687D	Remarks
Type I - Composition A	Type I - Grade 1	
Type I - Composition B	Type I - Grade 2	To comply
Type II- Composition A1	Type II - Grade 1	with,
Type II- Composition A2	Type II - Grade 2	standard
Type II- Composition A3	No replacement	industry
Type II- Composition B (cancelled)	Replaced by Type II, either Grade 3 or 4	practices

6.4 Design information. In calculating permissible loads, the operating conditions, housing conditions and construction should be considered. In general, Type I material has more resistance to seizing and corrosion than Type II material. The formula for calculating permissible loads is as specified in the applicable Military Standard for the material and design required.

6.5 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodians:

Army - AT
Navy - OS
Air Force - 99

Preparing activity:

Air Force - 84

(Project 3120-0594)

Review activities:

Army - AR, MI
Navy - AS, OS
Air Force - 11
DLA - IS, CS
NSA - NS

Agent:

DLA - IS

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