

MIL-B-13506C
28 August 1984
SUPERSEDING
MIL-B-13506B
4 October 1968

MILITARY SPECIFICATION

BEARING, SLEEVE (STEEL-BACKED)

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

1. SCOPE

1.1 Scope. This specification covers general requirements for sleeve bearings constructed of low-friction metal bonded to a steel back. This specification does not cover marine, diesel, and aircraft engine bearings.

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

Type I	- Plain, full-cylinder.
Type II	- One-piece, split.
Type III	- Two-piece, split.
Style a	- Straight.
Style b	- Flanged.
Class 1	- Preformed fit (precision).
Class 2	- Assembly fit (nonprecision).

1.2.1 Composition. Bearings shall be classified according to composition as specified in table I (see 6.3.2).

1.2.2 Size. Size of bearings shall be designated by the nominal shaft diameter and axial length.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: US Army Tank-Automotive Command, ATTN: DRSTA-GSS, Warren, MI 48090, 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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2. APPLICABLE DOCUMENTS

2.1 Government documents.

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

SPECIFICATIONS
MILITARY

MIL-B-5687 - Bearings, Sleeve; Washers, Thrust,
Sintered Metal Powder, Oil-Impregnated.

STANDARDS
FEDERAL

FED-STD-151 - Metals, Test Methods.

MILITARY

MIL-STD-105 - Sampling Procedures and Tables for
Inspection by Attributes.
MIL-STD-109 - Quality Assurance Terms and Definitions.
MIL-STD-130 - Identification Marking of US Military
Property.

(Copies of specifications, standards, 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 documents form a part of this specification to the extent specified herein. The issue of the document which is indicated as DoD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A109 - Steel, Carbon, Cold-rolled Strip.

(Copies of ASTM publications may be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE) HANDBOOK

SAE Standards and Recommended Practices.

SAE J460 - Bearing and Bushing Alloys.
SAE J506 - Sleeve Type Half Bearings.

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

(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 cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 First article. Unless otherwise specified (see 6.2), the contractor shall furnish sleeve bearings which shall be subjected to first article inspection (see 4.4 and 6). First article inspection samples, properly marked with identifying information shall be representative of the unit to be furnished to the Government. All subsequent bearings delivered to the Government shall conform to these samples in all of their pertinent physical and performance attributes.

3.2 Design and construction.

3.2.1 Construction materials. Bearings shall be manufactured of materials as specified herein (see 4.1.2). See 6.4 for use of recycled material.

3.2.1.1 Backs. The backs of bearings shall be made of steel conforming to ASTM A109 or as otherwise specified on the applicable drawings or military standards (see 4.6.1).

3.2.1.2 Liners. Liners for bearings shall be manufactured from materials specified in table I, from oil impregnated, sintered metal powder conforming to MIL-B-5687, or as otherwise specified on the applicable drawings or military standards (see 4.6.1).

3.2.1.3 Overlay. An overlay when specified by the applicable drawing shall be applied to the bearing surface of the liner. The overlay shall be of a composition specified in table I (see 4.6.1) and shall have a nominal thickness of 0.001 inch (in) [0.03 millimeter (mm)] or less.

3.2.1.4 Graphite inserts. Graphite inserts shall be provided in the bearing liner when specified by the applicable drawings (see 4.1.2).

3.2.2 Construction and physical characteristics. Bearings shall conform to applicable drawings or military standards (see 4.1.3 and 6.2).

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TABLE I. Chemical compositions (percent) for bearing alloys.

Element		Description			
		Tin Base	Lead Base		
			SAE Composition No.		
			12	13	14
Aluminum	Al	0.005	0.005	0.005	0.005
Antimony	Sb	7.0-8.0	9.0-11.0	14.0-16.0	14.0-15.5
Arsenic	As	0.10	0.25	0.60	0.80-1.20
Bismuth	Bi	0.08	0.10	0.10	0.10
Cadmium	Cd	- - -	0.05	0.05	0.02
Copper	Cu	3.0-4.0	0.50	0.05	0.50
Iron	Fe	0.08	- - -	- - -	- - -
Lead	Pb	0.50	Remainder	Remainder	Remainder
Manganese	Mn	- - -	- - -	- - -	- - -
Nickel	Ni	- - -	- - -	- - -	- - -
Phosphorus	P	- - -	- - -	- - -	- - -
Silicon	Si	- - -	- - -	- - -	- - -
Silver	Ag	- - -	- - -	- - -	- - -
Tin	Sn	88.25	5.0-7.0	9.25-10.75	0.90-1.25
Titanium	Ti	- - -	- - -	- - -	- - -
Zinc	Zn	0.005	0.005	0.005	0.005
Total others:		0.20	0.20	0.20	0.20

TABLE I. Chemical compositions (percent) for bearing alloys - Continued.

Element		Description				
		Lead-tin overlay		Copper lead		
		SAE Composition No.				
		19	190	48	480	49
Aluminum	Al	- - -	- - -	- - -	- - -	- - -
Antimony	Sb	- - -	- - -	- - -	- - -	- - -
Arsenic	As	- - -	- - -	- - -	- - -	- - -
Bismuth	Bi	- - -	- - -	- - -	- - -	- - -
Cadmium	Cd	- - -	- - -	- - -	- - -	- - -
Copper	Cu	- - -	- - -	67.0-74.0	60.0-70.0	73.0-79.0
Iron	Fe	- - -	- - -	0.35	0.35	0.35
Lead	Pb	Remainder	Remainder	25.0-32.0	30.0-40.0	21.0-27.0
Manganese	Mn	- - -	- - -	- - -	- - -	- - -
Nickel	Ni	- - -	- - -	- - -	- - -	- - -
Phosphorus	P	- - -	- - -	0.025	- - -	- - -
Silicon	Si	- - -	- - -	- - -	- - -	- - -
Silver	Ag	- - -	- - -	1.5	1.5	- - -
Tin	Sn	8.0-12.0	5.0-9.0	0.25	0.50	0.50
Titanium	Ti	- - -	- - -	- - -	- - -	- - -
Zinc	Zn	- - -	- - -	0.1	- - -	- - -
Total others:		3.5	3.5	0.15	0.30	0.45

NOTE: Single percentages are maximum unless specified minimum.

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TABLE I. Chemical compositions (percent) for bearing alloys - Continued.

Element		Description			
		Aluminum	Copper base <u>1/</u>		
			SAE Composition No.		
			770	792 or 797	793 or 798
Aluminum	Al	Remainder	- - -	- - -	- - -
Antimony	Sb	- - -	0.50	0.50	0.50
Arsenic	As	- - -	- - -	- - -	- - -
Bismuth	Bi	- - -	- - -	- - -	- - -
Cadmium	Cd	- - -	- - -	- - -	- - -
Copper	Cu	0.70-1.30	77.0 Min	83.0 Min	68.5-75.5
Iron	Fe	0.70	0.35	0.35	0.35
Lead	Pb	- - -	9.0-11.0	7.0-9.0	21.0-25.0
Manganese	Mn	0.10	- - -	- - -	- - -
Nickel	Ni	0.70-1.30	0.50	0.50	0.50
Phosphorus	P	- - -	- - -	- - -	- - -
Silicon	Si	0.70	- - -	- - -	- - -
Silver	Ag	- - -	- - -	- - -	- - -
Tin	Sn	5.5-7.0	9.0-11.0	3.5-4.5	3.0-4.0
Titanium	Ti	0.20	- - -	- - -	- - -
Zinc	Zn	- - -	0.75	4.0	3.0
Total others:		0.30	0.40	0.30	0.40

NOTE: Single percentages are maximum unless specified minimum.

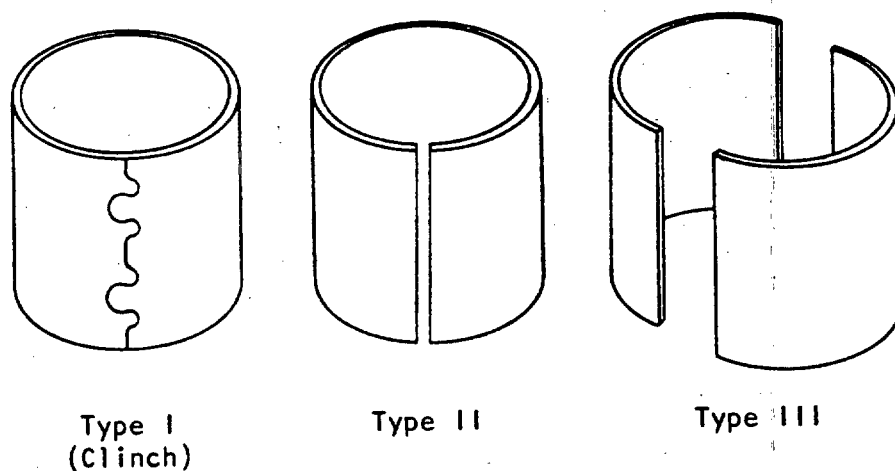
1/ Compositions 797, 798, and 799 are SAE sintered designations.3.2.2.1 Types (see figure 1).

3.2.2.1.1 Type I plain full cylinder. Type I bearings shall be constructed from seamless tubing or cylinders formed from strips. Bearing backs manufactured from strips shall be joined by a seam-weld, butt-joint, or clinch-joint. Both diameters, inside and outside (ID and OD), of the joined bearing back shall be machined flush with the surface to facilitate proper coating of the ID and proper assembly of the OD into the mating part.

3.2.2.1.2 Type II one piece split. Type II bearings shall have a longitudinal split the full length of the bearing. They shall be constructed to meet specified housing and shaft bore dimensions with the split closed.

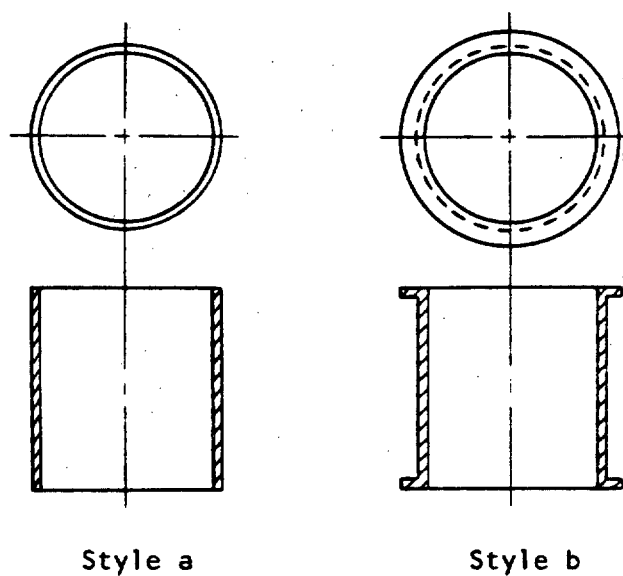
3.2.2.1.3 Type III two piece split. Type III bearings shall be constructed of two mating parts, 180° each. They shall be designed to be pressed into place and held firmly by the housing bore to ensure bearing action on the internal bore only, or to permit bearing action on both the shaft and housing bore.

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FIGURE 1. Bearing types.3.2.2.2 Styles (see figure 2).

3.2.2.2.1 Style a. Style "a" bearings shall be of straight-wall construction and without flange.

3.2.2.2.2 Style b. Style "b" bearings shall be flanged.

FIGURE 2. Bearing styles.

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3.2.2.3 Classes.

3.2.2.3.1 Class 1. Precision bearings (preformed fit) shall be presized to an assembly fit (see 3.2.2.4).

3.2.2.3.2 Class 2. Nonprecision bearings (assembly fit) shall be manufactured to specified dimensions with enough bearing metal on the bearing surfaces to permit tooling to size at assembly (see 3.2.2.4).

3.2.2.4 Dimensions and tolerances. Dimensions and tolerances shall be as specified by the applicable drawings or military standards. When specified by the acquiring activity, bearing bores shall be furnished undersized by the specified amount to permit finish machining at assembly (see 4.1.3).

3.2.2.4.1 Indentations, oil holes and grooves. When specified by the applicable drawings or military standards, indentations, oil holes and grooves shall be provided.

3.3 Performance.

3.3.1 Bonding. Backs and liners shall be bonded by either a chemical or metallurgical bond. Separation or flaking of the liner from the steel back shall not occur when the bearing is tested as specified in 4.6.2.

3.4 Identification and marking. Each bearing shall be marked on the steel back for identification in accordance with MIL-STD-130 (see 4.5.2).

3.5 Workmanship. Bearings shall be uniform in quality and free from defects that will adversely affect their life and serviceability (see 4.1.3).

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order (see 6.2), the contractor is responsible for 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 inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Inspection equipment. Unless otherwise specified in the contract (see 6.2), the supplier is responsible for the provision and maintenance of all inspection and test equipment necessary to assure that supplies and services conform to contract requirements. Commercial, modified commercial, or supplier-designated inspection equipment or measuring set ups must be capable of repetitive measurements to an accuracy of 10 percent of the component tolerance. Calibration of inspection equipment shall be in accordance with MIL-STD-45662.

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4.1.2 Construction materials. To determine conformance to 3.2.1, inspection and material certification records shall be maintained by the contractor. Records shall be subject to review by the Government and shall include date, part, or characteristics identification, inspection results, and disposition of lot (accepted or rejected). Corrective action taken on noted defects shall be subject to approval by the Government.

4.1.3 Construction and physical characteristics. Conformance to 3.2.2, shall be determined by visual and tactile examination and measurement with standard inspection equipment.

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

- a. First article inspection (see 4.4).
- b. Quality conformance inspection (see 4.5).
 1. Examinations (see 4.5.2).
 2. Control test (see 4.5.3).

4.3 Inspection conditions. Unless otherwise specified (see 6.2), all inspections shall be conducted under the following conditions:

- a. Air temperature $23^{\circ} + 10^{\circ}\text{C}$
- b. Barometric pressure $725 + 50, -75\text{mm Hg}$
- c. Relative humidity 50 ± 30 percent

4.4 First article.

4.4.1 First article inspection. Unless otherwise specified (see 6.2), the Government shall select three sleeve bearings from the first ten sleeve bearings produced under the production contract (see 6.2) for first article inspection. First article samples shall be examined as specified in 4.5.2 and tested as specified in 4.5.3. Approval of the first article sample by the Government shall not relieve the contractor of his obligation to supply sleeve bearings that are fully representative of those inspected as a first article sample. Any changes or deviation of the production units from the first article sample shall be subject to the approval of the contracting officer.

4.4.1.1 First article inspection failure. Test item deficiencies during, or as a result of, the first article test, shall be cause for rejection of the items until evidence has been provided by the contractor that corrective action has been taken to eliminate the deficiency. Any deficiency found during, or as a result of the first article test, shall be prima facie evidence that all items already produced prior to completion of the first article test are similarly deficient unless evidence satisfactory to the contracting officer is furnished by the contractor that they are not similarly deficient. Such deficiencies on all items shall be corrected by the contractor at no cost to the Government. The Government shall not final accept products until first article testing is completed to the satisfaction of the Government.

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4.5 Quality conformance inspection.

4.5.1 Sampling.

4.5.1.1 Lot formation. An inspection lot shall consist of all sleeve bearings of one type and part number, from an identifiable production period, from one manufacturer, submitted at one time for acceptance.

4.5.1.2 Sampling for examination. Samples for quality conformance examination shall be selected in accordance with general inspection level II of MIL-STD-105.

4.5.1.3 Sampling for testing. A sample of one bearing from each 500 bearings shall be selected at random for quality conformance control testing, provided the bearings are from a statistically controlled process. Otherwise, one bearing shall be taken from each source, heat, melt, or other factor affecting homogeneity as determined by the Government.

4.5.2 Quality conformance examinations.

4.5.2.1 Examination. Sleeve bearings shall be examined for conformance to applicable drawings or military standards and this specification. Examinations shall be performed against the classification of defects and with the acceptable quality levels (AQLs) specified in 4.5.2.2 and table II.

4.5.2.2 Acceptable quality level. Each sample selected in accordance with 4.5.1.2 shall be examined for conformance to the following acceptable quality levels (AQLs), on the basis of percent defective:

<u>Classification</u>	<u>AQL</u>
Major	1.0
Minor	2.5

4.5.2.3 Classification of defects. For examination purposes, defects shall be classified as listed in table II.

TABLE II. Classification of defects.

Category	Defect	<u>Bearing Type</u>			<u>Method of Inspection</u>
		I	II	III	
<u>Critical</u>					
001	Improper materials (see 3.2.1).	X	X	X	COC <u>1/</u>
<u>Major</u>					
101	OD <u>2/</u> out of tolerance (see 3.2.2.4).	X	X	-	SIE <u>4/</u>
102	ID <u>3/</u> out of tolerance (Class 1 only) (see 3.2.2.4).	X	X	-	SIE
103	Wall thickness out of tolerance (see 3.2.2.4) (Class 1 only).	X	X	X	SIE
104	Wall eccentric out of tolerance (Class 1 only) (see 3.2.2.5).			X	SIE
105	Length out of tolerance (see 3.3.1).	-	-	X	SIE

TABLE II. Classification of defects - Continued.

Category	Defect	Bearing Type			Method of Inspection
		I	II	III	
106	Indentations, oil holes and grooves improperly located and out of tolerance (see 3.2.2.4.1).	X	X	X	SIE
107	Parting line height out of tolerance (see 3.2.2.4).	-	-	X	SIE
108	Flange thickness out of tolerance (Style b only) (see 3.2.2.4).	X	-	X	SIE
109	Width between flanges out of tolerance (Style b) (see 3.2.2.4).	X	-	X	SIE
110	Overlay, liner or inserts not bonded (see 3.3.1).	X	X	X	Visual
111	Improper workmanship affecting function (see 3.5).	X	X	X	Visual
<u>Minor</u>					
201	ID out of tolerance (Class 2 only) (see 3.2.2.5).	X	X		SIE
202	Wall thickness out of tolerance (Class 2 only) (see 3.2.2.5).	X	X	X	SIE
203	Length out of tolerance (see 3.2.2.5).	X	X	-	SIE
204	Flange O.D. out of tolerance (Style b) (see 3.2.2.5).	X	-	X	SIE
205	Flange radii out of tolerance (see 3.2.2.5).	X	-	X	SIE
206	Chamfers do not conform to drawing: i.e., size location, tolerances (see 3.2.2.5).	X	X	X	SIE
207	Back thickness out of tolerance (see 3.2.2.5).	X	X	X	SIE
208	Back thickness at base of grooves or indentations out of tolerance (see 3.2.2.5.1).	X	X	X	SIE
209	Liner thickness out of tolerance (see 3.2.2.5).	X	X	X	SIE
210	Grooves do not conform to requirements for size, shape, location and tolerances (see 3.2.2.5.1).	X	X	X	SIE
211	Indentations do not conform to requirements for size, shape, location and tolerances (see 3.2.2.6).	X	X	X	SIE
212	Locking lip out of location (see 3.2.2.5).	-	-	X	SIE
213	Locking lip projection out of tolerance (see 3.2.2.5).	-	-	X	SIE
214	Locking lip dimensions out of tolerance (see 3.2.2.5).	-	-	X	SIE
215	Crush relief out of tolerance (see 3.2.2.5).	-	-	X	
216	Free-spread dimension out of tolerance (see 3.2.2.5).	-	-	X	SIE

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TABLE II. Classification of defects - Continued.

Category	Defect	Bearing Type			Method of Inspection
		I	II	III	
217	Diameter of oil holes out of tolerance (see 3.2.2.5.1).	X	X	X	SIE
218	Surface finish not as specified (see 3.2.2.5).	X	X	X	SIE
219	Identification marking out of location, missing, illegible or nonpermanent (see 3.4).	X	X	X	Visual
220	Improper workmanship affecting appearance (see 3.5).	X	X	X	Visual

1/ Certificate of Conformance (COC)

2/ OD = Outside diameter.

3/ ID = Inside diameter.

4/ SIE = Standard inspection equipment.

4.5.3 Quality conformance tests.

4.5.3.1 Control tests. Control tests shall be conducted on one sample sleeve bearing (see 4.5.1.3) taken from each lot as specified in 4.5.1.1 (see table III).

TABLE III. Classification of tests.

Test	Requirement	First article	Control
Chemical analysis	3.2.1	4.6.1	4.6.1
Bonding	3.3.1	4.6.2	4.6.2

4.5.3.2 Failure. Failure of any sleeve bearing to pass any of the specified tests shall be cause for the Government to refuse acceptance of the production quantity represented and until action taken by the contractor to correct defects and prevent recurrence has been approved by the Government.

4.6 Methods of inspection.

4.6.1 Chemical analysis. Chemical analysis of the backs, liners, and overlays shall be conducted in accordance with Method III of FED-STD-151. A mill certificate for the composition of the steel backs may be substituted for the chemical analysis (see 3.2.1).

4.6.2 Bonding test. A 180° section of the bearing shall be used for the adhesion test. The bearing liner shall be scored the depth of the liner metal to leave 1/4-inch lands parallel to the axis of the bore. The liner metal shall be separated from the back by chiseling at the bond line at right angles to the lands. Separation of any one of the lands as a unit or any flaking from the back shall cause rejection of the lot (see 3.3.1).

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5. PACKAGING

5.1 Preservation, packaging, packing, and marking. Preservation, packaging, packing, and marking for the desired level of protection shall be in accordance with the applicable packaging standard or packaging data sheet specified by the contracting authority (see 6.2).

6. NOTES

6.1 Intended use. Bearings covered by this specification are intended for use in all applications requiring a strong, rigid bearing shell possessing conformability or hard friction surfaces; low friction or self-lubricating properties; and fatigue, shock, and corrosion resistance. The bearings are to be usable on either hardened or soft shafts, for rotating or oscillating motions as engineering design dictates (see 6.2). Marine, diesel and aircraft engine bearings are not covered by this specification.

6.2 Ordering data. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Type, style, class, composition, length, size of bearing and applicable engineering drawings or military standards (see 1.2 and 3.2.2).
- c. If first article samples are not required (see 3.1).
- d. If responsibility for inspection shall be other than as specified (see 4.1).
- e. If responsibility for inspection equipment shall be other than as specified (see 4.1.1).
- f. If inspection conditions shall be other than as specified (see 4.3).
- g. If first article inspection is not required (see 4.4).
- h. Selection of applicable levels of packaging and packing of referenced specification (see 5.1).
- i. Undersize bores, if required (see 3.2.2.4).

6.3 Definitions.

6.3.1 Glossary of terms. Bearing parts are defined in accordance with SAE Standard J506e.

6.3.2 Composition designators. Except for bearing backs numerical designations used in this specification for the identification of chemical composition of bearing alloys are those given by the Society of Automotive Engineers in SAE Standard J460.

6.4 Recycled materials. Use of recycled materials which meet the requirements of applicable material specifications without jeopardizing intended use of the item shall be encouraged (see 3.2.1).

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

Custodian:

Army - AT

Navy - OS

Air Force - 11

Preparing activity:

Army - AT

(Project No. 3120-0631)

Review activities:

Army - EA

Navy - MC, SH

Air Force - 84

DLA-IS

User activity:

Army - MI

