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SUPERSEDING
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(See 6.8)

MILITARY SPECIFICATION

BEARING, PROPULSION LINE SHAFT, OIL DISC LUBRICATED

This specification is approved for use within the Naval Sea Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers disc lubricated journal bearing units for journals between 8 and 36 inches in diameter. These bearing units are used to support propulsion line shafts on Naval ships.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. The following specifications and standards form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation.

SPECIFICATIONS

FEDERAL

L-P-391 - Plastic Sheets, Rods and Tubing, Rigid Cast, Methacrylate (Multiapplication).
QQ-C-390 - Copper Alloy Castings (Including Cast Bar).
QQ-C-465 - Copper-Aluminum Alloys (Aluminum Bronze) (Copper Alloy Numbers 606, 614, 630, and 642), Rod, Flat Products with Finished Edges (Flat Wire, Strip, and Bar), Shapes, and Forgings.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 55Z3, Department of the Navy, Washington, DC 20362-5101 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 2010

THIS DOCUMENT CONTAINS 23 PAGES.

FEDERAL (Continued)

QQ-N-281 - Nickel-Copper Alloy Bar, Rod, Plate, Sheet, Strip, Wire, Forgings, and Structural and Special Shaped Sections.
QQ-N-286 - Nickel-Copper-Aluminum Alloy, Wrought (UNS N05500).
QQ-T-390 - Tin Alloy Ingots and Castings and Lead Alloy Ingots and Castings (Antifriction Metal) for Bearing Applications.

MILITARY

MIL-S-1222 - Studs, Bolts, Hex Cap Screws, and Nuts.
MIL-P-2845 - Packaging of Main Propulsion Shafting, Bearings, Boat and Ship Propellers, and Associated Repair Parts.
MIL-P-5516 - Packing, Preformed, Petroleum Hydraulic Fluid Resistant, 160°F.
MIL-R-6855 - Rubber, Synthetic, Sheets, Strips, Molded or Extruded Shapes.
MIL-P-15024 - Plates, Tags, and Bands for Identification of Equipment.
MIL-P-15024/5 - Plate, Identification.
MIL-I-17244 - Indicators, Temperature, Direct-Reading, Bimetallic (3- and 5-inch Dial).
MIL-L-17331 - Lubricating Oil, Steam Turbine and Gear, Moderate Service.
MIL-T-17600 - Turbines, Steam, Propulsion Naval Shipboard.
MIL-F-18240 - Fastener, Externally Threaded, 250°F Self-Locking Element for.
MIL-T-24270 - Thermo-Wells for Thermometers and Electrical Temperature Sensors, General Specification for.
MIL-T-24388 - Thermocouple and Resistance Temperature Element Assemblies, General Specification for (Naval Shipboard).
MIL-T-24388/8 - Thermocouple and Resistance Temperature Element Assemblies, Type RTE (EM Installation).
MIL-L-24479 - Lubricant, Red Lead and Graphite In Mineral Oil.
MIL-B-24480 - Bronze, Nickel-Aluminum (UNS No. C95800) Castings, for Seawater Service.
MIL-N-25027 - Nut, Self-Locking, 250°F, 450°F, 800°F.

STANDARDS

FEDERAL

FED-STD-H28 - Screw-Thread Standards for Federal Services.
FED-STD-H28/2 - Screw-Thread Standards for Federal Services Section 2 Unified Inch Screw Threads - UN and UNR Thread Forms.

MILITARY

MIL-STD-278 - Welding and Casting Standard.
MIL-STD-792 - Identification Marking for Special Purpose Components.

MILITARY (Continued)

DOD-STD-2183 - Bond Testing, Babbitt-Lined Bearings.
DOD-STD-2188 - Babbitting of Bearing Shells.
MS3402 - Connectors, Receptacle, Electric, Box Mounting, Front Release, Crimp Contact, AN Type.
MS17829 - Nut, Self-Locking, Hexagon, Regular Height, 250°F, (Non-Metallic Insert) Non-Corrosion-Resistant Steel.
MS18229 - Plug for "O" Ring Gasket.
MS33540 - Safety Wiring and Cotter Pinning, General Practices for.

2.1.2 Other Government drawings and publications. The following other Government drawings and publications form a part of this specification to the extent specified herein. Unless otherwise specified, the issues shall be those in effect on the date of the solicitation.

DRAWINGS

NAVAL SEA SYSTEMS COMMAND (NAVSEA)

803-1385953 - Bearing, Propulsion Line Shaft, Oil Disc Lubricated.
803-2145807 - Propulsion Shafting and Components.

PUBLICATIONS

NAVAL SEA SYSTEMS COMMAND (NAVSEA)

0900-LP-001-7000 - Fabrication and Inspection of Brazed Piping Systems.
DDS-072-1 - Shock Design Values.

SUPERVISOR OF SHIPBUILDING (SUPSHIP BROOKLYN)

280-8 - Shock Design Criteria for Trident Submarine.

(Application for copies should be addressed to Supervisor of Shipbuilding, Conversion and Repair, USN, Brooklyn, NY 11251.)

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

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted shall be those listed in the issue of the DoDISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS shall be the issue of the non-government documents which is current on the date of the solicitation.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

B18.15 - Eyebolts, Forged. (DoD adopted)
B46.1 - Surface Texture (Surface Roughness, Waviness and Lay). (DoD adopted)

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

A 27 - Standard Specification for Steel Castings, Carbon, for General Applications. (DoD adopted)
A 36 - Standard Specification for Structural Steel. (DoD adopted)
A 148 - Standard Specification for Steel Castings, High Strength, for Structural Purposes. (DoD adopted).
A 582 - Standard Specification for Free-Machining Stainless and Heat-Resisting Steel Bars, Hot-Rolled or Cold-Finished. (DoD adopted)
B 23 - Standard Specification for White Metal Bearing Alloys Known Commercially as "Babbitt Metal".
B 148 - Standard Specification for Aluminum-Bronze Sand Castings. (DoD adopted)
B 271 - Standard Specification for Copper-Base Alloy Centrifugal Castings. (DoD adopted)
B 584 - Standard Specification for Copper Alloy Sand Castings for General Applications. (DoD adopted)

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

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

AMS 3208 - Chloroprene Rubber, Weather Resistant 45-55. (DoD adopted)

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

(Nongovernment standards and other publications are normally available from the organizations which prepare or which distribute the documents. These documents also may be available in or through libraries or other informational services.)

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

3. REQUIREMENTS

3.1 Materials. Bearing unit materials shall be as specified in table I and on Drawing 803-1385953. If nonmagnetic materials are required (see 6.2.1), bearing unit materials shall be as specified in table II.

TABLE I. Materials.

Component	Material	Applicable documents
Bearing pedestals and caps	Cast steel	ASTM A 27, ASTM A 148
Bearing shell (thick-walled and precision insert types)	Cast steel	ASTM A 27
Bearing precision insert	Cast steel	ASTM A 27
Oil seal housing	Cast steel	ASTM A 27
Oil seal retaining plate	Steel	ASTM A 36
Dipstick	Steel	ASTM A 36
Dipstick sleeve	SST	Commercial
Vent valve	SST	Commercial
Anti-rotation pin	SST	ASTM A 582, type 303
Plug	Steel	MS18229
Dowel pins	Steel	Commercial
Anti-friction (babbitt) metal for bearings	White metal bearing alloy (tin base)	QQ-T-390, grade 2; ASTM B 23, alloy 2
Bolts	Steel and alloy steel	MIL-S-1222, type I, grade 8
Hex head screws	Steel and alloy steel	MIL-S-1222, type I, grade 2
Self-locking socket head screws	Steel and alloy steel	MIL-S-1222
Drive screws	Steel and alloy steel	Commercial
Square head jack screws	Steel	Commercial
Eyebolts	Steel	ANSI B18.15

TABLE I. Materials. - Continued

Component	Material	Applicable documents
Self-locking hex nuts	Steel and alloy steel	MS17829
Hand hole covers	Steel casting and steel	ASTM A 27, grade 60-30; ASTM A 36
Disc oil view port	Plastic	L-P-391, grade A
Gaskets	Synthetic rubber	MIL-R-6855, class 2, type A; AMS 3208
Shaft oil seal	Synthetic rubber	Commercial
O-ring seals	Synthetic rubber	MIL-P-5516
Resistance temperature elements, 3-lead type only, range minus 40 to 530°F	Platinum with stainless steel jacket	MIL-T-24388/8
Thermometers, 3-inch dial 20 to 240°F range	SST	MIL-I-17244
Thermometer well, 4-inch long	Brass	MIL-T-24270
Electric receptacle connector	SST	MS3402
Drain assembly	SST	Commercial
Identification and direction of rotation plates	Brass	MIL-P-15024
Thread lubricant (bearing shell and housing parting line bolting)	Red lead and graphite in mineral oil	MIL-L-24479
Bearing lubricant	Mineral oil	MIL-L-17331, military symbol 2190-TEP

TABLE II. Nonmagnetic materials.

Component	Material	Applicable documents
Bearing pedestals and caps	Aluminum-bronze	MIL-B-24480; ASTM B 271; ASTM B 148
Bearing shell	Aluminum-bronze (cast) Tin bronze	ASTM B 148; QQ-C-390; ASTM B 271 ASTM B 584
Bearing precision insert	Cast copper alloy	QQ-C-390; ASTM B 271; ASTM B 584
Oil seal housing	Aluminum-bronze (cast)	MIL-B-24480; ASTM B 271; ASTM B 148
Oil seal retaining plate	Aluminum-bronze	QQ-C-465
Dipstick	Aluminum-bronze	QQ-C-465
Dipstick sleeve	--	Commercial
Vent valve	--	Commercial
Anti-rotation pin	--	ASTM A 582, type 303
Plug	--	MS18229
Dowel pins	--	Commercial
Anti-friction (babbitt) metal for bearings	White metal bearing alloy (tin base)	QQ-T-390, grade 2; ASTM B 23, alloy 2
Bolts	Nickel-copper-aluminum alloy	QQ-N-286 MIL-S-1222
Eyebolts	--	ANSI B18.15
Self-locking hex nuts	Nickel-copper alloy	QQ-N-281
Hex head screws	Nickel-copper-aluminum alloy	QQ-N-286 MIL-S-1222
Self-locking socket head screws	Nickel-copper-aluminum alloy	MIL-S-1222
Drive screws	--	Commercial
Square head jack screws	--	Commercial

TABLE II. Nonmagnetic materials. - Continued

Component	Material	Applicable documents
Hand hole covers	Aluminum-bronze	MIL-B-24480
Disc oil view port	Plastic	L-P-391
Gaskets	Synthetic rubber	MIL-R-6855, class 2, type A; AMS 3208
Shaft oil seal	Synthetic rubber	Commercial
O-ring seal	Synthetic rubber	MIL-P-5516
Resistance temperature elements, 3-lead type only, range minus 40 to 530°F	--	MIL-T-24388/8
Thermometers, 3-inch dial 20 to 240°F range with 4-inch long well	--	MIL-I-17244
Thermometer well	Brass	MIL-T-24270
Electric receptacle connector	--	MS3402
Drain assembly	--	Commercial
Identification and direction of rotation plates	Brass	MIL-P-15024
Thread lubricant (bearing shell and housing parting line bolting)	Red lead and graphite in mineral oil	MIL-L-24479
Bearing lubricant	Mineral oil	MIL-L-17331, military symbol 2190-TEP

3.1.1 Cast iron parts. The use of common cast iron parts shall not be permitted. Materials used in the bearing assembly shall be compatible with respect to corrosion when exposed to a sea atmosphere and the lubricating oil specified in tables I and II.

3.1.2 Substituted materials. The use of materials differing from those specified herein will be considered only when (a), (b), (c), and (d) below all apply.

(a) The contractor shows the necessity for such substitutions.
(b) Materials proposed are satisfactory substitutes, as substantiated by a comparison of the chemical composition, and mechanical and physical properties between the specified and substitute material.
(c) Minimum factors of safety can be met with material in accordance with the applicable Government specification.
(d) The use of substitute materials represents no cost increase to the Navy.

3.1.3 Non-specified materials. Materials for parts not specified in table I or II and on Drawing 803-1385953 shall be selected by the manufacturer provided the materials perform the intended function in the bearing unit and conform to the requirements specified herein.

3.1.4 Prohibited materials. Materials of the following types shall not be used:

(a) Toxic pyrolytic materials which emit toxic gases or other harmful products when exposed to high temperatures.
(b) Flammable materials in a form which will explode or ignite from any electric spark, flame or from heating, and which, if so ignited, will independently support combustion in air.
(c) Fragile or brittle materials.
(d) Magnesium or magnesium base alloys.
(e) Radioactive materials.
(f) Mercury.
(g) Asbestos.
(h) Cadmium.

3.1.5 Recovered materials. Unless otherwise specified herein, all equipment, materials, and articles incorporated in the products covered by this specification shall be new and may be fabricated using materials produced from recovered materials to the maximum extent practicable without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of used or rebuilt products is allowed under this specification unless otherwise specifically specified.

3.2 Special tools and equipment. Special tools needed for removal and replacement of line shaft bearing parts, including precision inserts and shells, shall be furnished. Special tools are defined as tools not listed in the Federal Supply Catalog (copies of this catalog may be consulted in the office of the Defense Contract Administration Services Management Area (DCASMA)).

3.2.1 Lifting and handling provisions. Tapped holes for jacking screws shall be provided as shown on Drawing 803-1385953 in the bearing cap for breaking loose the cap and in the pedestal base for aligning the bearing during installation. Tapped (or drilled) holes shall be provided in the pedestal, bearing cap, bearing shell and bearing oil disc to permit the attachment of eyebolts for handling during installation, servicing or replacement. Eyebolts and jacking screws shall be furnished by the bearing manufacturer. The jacking screws shall be installed in the bearing cap and pedestal for storage.

3.3 Construction.

3.3.1 General. The propulsion line shaft bearings (see 6.4.1) shall be constructed to assure reliability, and no compromise of this principle shall be made with any other basic design requirement. Bearing design shall conform to the requirements of Drawing 803-1385953, and as specified herein. Bearing assemblies shall be such that subassemblies and parts shall be interchangeable (for a particular size and manufacturer). The line shaft bearing housing shall be watertight and shall be as small and as lightweight as feasible based on shock and the journal diameter which shall be as specified (see 6.2.1).

3.3.1.1 Construction. The bearing shall consist of a spherical, self-aligning bearing shell, with a housing constructed to facilitate removal and replacement of all essential components. The housing shall consist of a pedestal and cap constructed of the materials specified in table I or table II as applicable and on Drawing 803-1385953. The bearings shall utilize thick-wall babbitted shells or thin precision babbitted bearing inserts; however, thin precision bearing inserts shall only be used on journal diameters 15 inches or smaller (see 3.3.7.2). Bearings shall be disc lubricated utilizing a self-contained lubrication system.

3.3.1.2 Loading. The maximum allowable static pound per square inch (lb/in^2) bearing unit load (based on projected area) shall be not greater than 75 lb/in^2 based on bearing load (in pounds) to be specified (see 6.2.1). When specified in the contract or order, calculations indicating bearing unit loads shall be prepared (see 6.2.2).

3.3.2 Shock resistance. Journal bearing unit shall be designed for resistance to shock loading in accordance with either 3.3.2.1 or 3.3.2.2, whichever procedure is specified (see 6.2.1).

3.3.2.1 Static design. Tables III and IV shall be provided to the contractor complete with numerical values.

TABLE III. Shock design loads.

Load source	Direction of load	
	Vertical	Athwartship
Load on bearings due to shock acceleration of connected shafting and propeller	+ xxx lb	+ xxx lb
Load on foundation flange and bolting due to shock acceleration of nonrotating parts (housing and internals)	+ xxx lb	+ xxx lb

TABLE IV. Shock design accelerations.

Direction	Acceleration
Vertical	+ 35 g's
Athwartship	+ 16 g's

Static shock design shall be based on application of the loads of table III, in one direction at a time. Loads from both sources shall be applied simultaneously for each of the three directions. In vertical and athwartship shock, the shafting load shall be applied at the mid-point of the journal bearing. In all directions of shock, the load due to nonrotating parts shall be taken to act at the center of gravity of the nonrotating parts. Loads imposed by individual nonrotating parts, other than those covered in table III, shall be calculated by the contractor by multiplying their weight by the acceleration given in table IV. These loads shall be included in the design report (see 6.2.2). Allowable stresses shall be in accordance with MIL-T-17600. It is required in this specification that shock and operating stresses be combined when comparing calculated stresses against allowable stresses.

3.3.2.1.1 Allowable stresses. The combination of calculated shock and operating stresses shall not exceed the effective yield strength. For this purpose, the effective yield strengths in tension, shear and crush shall be calculated from the 0.2 percent offset yield strength of the material, at operating temperature, using the equations specified in MIL-T-17600 for static shock design of main propulsion steam turbine equipment. For babbitted bearings, the 0.2 percent offset yield strength shall be limited to 20,000 lb/in^2, unless otherwise approved by NAVSEA. The calculated combined shock and operating stresses and the comparison with calculated allowable stresses shall be included in the design report (see 6.2.2).

3.3.2.2 Dynamic design. Bearing unit shall be designed for grade A shock resistance in accordance with SUPSHIP 280-8. The contractor shall be provided with both DDS-072-1 and sufficient details of the propulsion shafting system, including bearing foundation stiffness and other details of the ship structure, to permit mathematical modeling of the journal bearing assembly for the purposes of dynamic analysis. A report shall be prepared that describes the mathematical model used in the dynamic analysis for approval by NAVSEA (see 6.2.2).

3.3.2.3 Shock tests. Line shaft bearings shall be hull mounted, class I equipment, but shall not be shock tested or vibration tested unless specified (see 6.2.1).

3.3.2.4 Calculations. The shock requirements specified in 3.3.2.1 shall apply to the following shock loading components: hold down bolts, housing parting line bolts, feet, structural members and subbases. When specified in the contract or order, calculations on all shock loading shall be prepared (see 6.2.2).

3.3.3 Foundation bolting arrangement. Except in cases where the dynamic analysis shows the values of 16 G's athwartship and 35 G's vertical are exceeded, the foundation bolting shall conform to Drawing 803-1385953.

3.3.4 Bearing housing (see 6.4.2). The housing shall be in halves, split on the horizontal, consisting of a pedestal and cap. The housing shall be in accordance with Drawing 803-1385953 and shall permit the lower bearing shell to be freely rolled out without removal of the shaft when the weight of the shaft is taken up by lifting gear.

3.3.4.1 Bearing pedestal (see 6.4.3). The bearing pedestal shall be in accordance with Drawing 803-1385953 and shall act as the oil sump. Holes and channels shall be provided in the bearing pedestal to permit drainage of all spaces to the main reservoir. The space between the parallel walls that contains the spherical supports for the bearing shell shall have channels that slope downward from the center toward the port and starboard sides to holes which connect the fore and aft portions of the reservoir formed by the parallel walls specified above. The pedestal shall contain hand holes (see 6.4.4) with removable inspection and cleanout covers to permit access and cleaning of all cavities. The bottom surface of the pedestal shall be sloped towards the hand holes. The strength of the pedestal shall not be weakened due to hand holes and covers.

3.3.4.2 Bearing cap (see 6.4.5).

3.3.4.2.1 Sight hole. The sight hole shall have a transparent cover for observing the volume of disc oil flow. The cover material shall not discolor, craze or crack and shall be impact resistant. The sight hole shall be located at the top of the cap, over the oil disc, and shall be of sufficient size to permit repair and removal of the oil scraper when the scraper is the type that scrapes oil from the outside diameter of the oil disc.

3.3.4.2.2 Anti-rotation pin (see 6.4.6). The anti-rotation pin shall be screwed into the top of the bearing cap and project into a slot in the bearing shell. The pin shall be hollow, providing an access hole for the insertion of a depth micrometer to measure bearing wear. A plug with straight threads and O-ring shall be provided to seal the access hole and to prevent debris, moisture and seawater from entering the bearing. The plug shall be removable for taking the micrometer reading.

3.3.4.2.2.1 Precision insert anti-rotation pin. In addition to the bearing shell anti-rotation pin, the precision insert type shell shall have an anti-rotation pin which shall be in accordance with Drawing 803-1385953 and shall prevent rotation of the precision insert with the shaft.

3.3.4.3 Seals and gaskets (see 6.4.11). The housing shall contain seals and gaskets to prevent leakage of oil from the bearing, and to prevent the ingress of seawater when flooded up to a head of 8.6 lb/in^2. Seal and gasket shall conform to Drawing 803-1385953. The seals and gaskets shall pass the watertight integrity test specified in 4.4.3.

3.3.4.4 Dipstick (see 6.4.7). Provisions for a dipstick assembly shall be provided as an integral cast section of the bearing cap. The dipstick assembly shall consist of bayonet type dipstick, a dipstick sleeve, and an O-ring seal. The dipstick shall fit into the dipstick sleeve. The dipstick shall pass the bearing watertight integrity test specified in 4.4.3. The dipstick shall be located away from the turbulence created by the disc on the walkway side of the bearing. Calibration of the dipstick shall be made by the manufacturer with the bearing tilted at the ship's rake angle and to suit the requirements specified in 3.3.6. Level markings on the dipstick shall read "Full" and "Add".

3.3.5 Resistance temperature elements and thermometers.

3.3.5.1 Resistance temperature elements (RTE's). RTE's as specified in MIL-T-24388 and MIL-T-24388/8 shall be embedded 1/16 inch below the babbitted surface of the bearing shell. They shall have the structural strength to support the pressures generated in the bearing and shall be supported on a steel (or bronze, as applicable) shoulder. The RTE's shall be located 25 percent of the bearing length from each end and at an angular distance from the bottom of the bearing as close as practicable to the predicted line of minimum oil film, at full ahead power. The minimum and maximum shaft revolutions per minute (r/min) and direction of rotation shall be as specified (see 6.2.1).

3.3.5.2 Thermometers. A dial thermometer as specified in MIL-I-17244 or resistance temperature element as specified in MIL-T-24388 (see 6.2.1) shall be installed in the bearing housing to provide a direct readout of sump oil temperature. The device shall be in direct contact with the sump oil in all conditions of trim, list, pitch, and roll as specified in 3.3.9.1.

3.3.6 Oil disc and scraper assembly (see 6.4.8). The disc and scraper assembly shall be designed by the bearing manufacturer. The bearing manufacturer shall show through in-service experience that their disc and scraper assembly has exhibited a long service life without suffering degradation in performance or safety. If the manufacturer has no in-service experience, he may choose to conduct an extended life test in the laboratory. The test shall be witnessed by a Government representative. The test agenda shall be approved by NAVSEA.

3.3.7 Bearing shell (see 6.4.9). Bearing shells shall be of the thick-walled or precision insert type. Bearing shells shall be made in halves (lower and upper) and mounted in their respective pedestal and cap. A spherical self-aligning mount shall be provided on the outside diameter. The spherical mount shall allow for thermal expansion while in operation under normal operating conditions under the ambient temperature specified (see 6.2.1). Bearing shell configuration and dimensions shall be in accordance with Drawing 803-1385953.

3.3.7.1 Precision insert type shell. The inside diameter of the bearing shell shall be machined to receive and lock the precision inserts. The bearing shell shall permit the insertion and removal of the precision inserts without difficulty. Ferrous bearing shells shall withstand force fits with a calculated

compressive hoop stress of 12,000 lb/in^2, minimum. Nonferrous bearing shells shall withstand force fits with a calculated hoop stress of 6,000 lb/in^2, minimum. Mechanical dowels or fasteners shall not be used to attach precision inserts to the bearing shell.

3.3.7.2 Precision insert (see 6.4.10). The babbitt thickness shall be from 0.060 to 0.090 inch. The upper half insert may be doweled to the lower half insert. The outside diameter shall be machined with a free spread of from 0.002 to 0.006 inch to ensure a force fit in the bearing shell. The precision insert wall thickness shall be as follows:

Journal diameter (inches)	Wall thickness of precision insert (inches)
8 - 13	0.280 ± 0.002
14 - 15	0.400 ± 0.002

Note: Wall thickness = backing thickness + babbitt thickness

3.3.7.3 Babbitted surfaces. Babbitting of thick-walled shells shall be in accordance with DOD-STD-2188. The precision insert or thick-walled shell shall be preheated and tinned before lining with antifriction metal. The babbitt shall be metallurgically (tin) bonded to the bearing shell or insert by pouring under a definite head if statically cast, or under a head created by centrifugal casting. Centrifugal casting shall be used whenever practical. Bonding test procedures and acceptance criteria shall be in accordance with DOD-STD-2183. Bearing surfaces shall be finished to 32 RMS as specified in ANSI B46.1 to the design clearance. The antifriction metal shall be slightly relieved along the joint seam, except for a narrow strip at the ends, where the full amount of metal shall be retained to prevent loss of oil (except that provision shall be made for a small chamfer at the joint to prevent scoring of the journal). Babbitt thickness on thick-walled shells shall be as specified on Drawing 803-1385953.

3.3.8 Bearing clearances. Bearing clearances shall be determined based on the bearing bore dimensions specified on Drawing 803-1385953 and the journal diameter tolerances specified on Drawing 803-2145807.

3.3.9 Lubrication system. The bearing lubrication system shall be self-contained and shall deliver the required volume of oil through the full range of shaft speeds by utilizing disc oiling mechanisms to maintain a constant oil film on the bearing. The oil shall be as specified in table I or II.

3.3.9.1 Trim, list, roll and pitch. Unless otherwise specified (see 6.2.1), the bearing lubrication system shall operate satisfactorily, maintaining adequate lubrication and without loss of oil from the bearing, under the conditions shown in table V (trim and list or roll and pitch can occur simultaneously).

TABLE V. Trim, list, roll and pitch.

Condition	Degrees
Permanent trim (down, bow or stern)	5
Permanent list (port or starboard)	15
Roll (port or starboard from normal)[1]	45
Pitch (up or down from normal)[1]	10

[1] Roll and pitch time cycles shall be as specified (see 6.2.1).

3.3.10 Oil sampling and drain assembly (see 6.4.12). The oil sampling and drain assembly shall consist of a drain line, a spring loaded valve that must be held open to drain, and a threaded cap that fits over the end of the drain line. The drain assembly shall be attached to the bearing pedestal at the aft end of the bearing at the bottom of the reservoir during shipboard installation of the bearing. The assembly shall have a foundation support near its end so that it will not be damaged if stepped on. The end cap shall have a gasket or O-ring to prevent leakage and tethered by a stainless steel wire rope. The arrangement of the oil sampling and drain assembly shall be in accordance with Drawing 803-1385953.

3.3.10.1 Drain line. Ferrous piping joints shall be socket welded in accordance with MIL-STD-278. Nonferrous piping joints shall be silver brazed as specified in NAVSEA 0900-LP-001-7000. Materials and fittings for the assembly shall be in accordance with Drawing 803-1385953.

3.3.10.2 Size. The size of the sampling and drain assembly shall be as specified in table VI.

TABLE VI. Oil sampling and drain assembly sizes.

Journal size (inches)	Sampling and drain assembly pipe size (nps) (inches)
8.00-16.00	1/2
16.01-24.00	3/4
24.01-36.00	1

3.3.10.3 Location and clearances. The piping shall have sufficient standoff from the bearing pedestal to permit manual operation of the valve. The valve shall be positioned athwartships to clear the rotating shafting but shall not restrict access to the aft inspection and clean out covers. The assembly shall be located to either the port or starboard side as specified (see 6.2.1). The assembly shall be sloped approximately 1/4 inch per foot to permit gravity drainage of the oil. Adequate vertical clearance shall be provided below the assembly end cap to facilitate draining oil into a container. The drain outlet shall terminate in a safe location.

3.3.11 Vent valve (see 6.4.13). A vent valve shall be provided in the upper part of the bearing cap as shown on Drawing 803-1385953. The vent shall relieve internal bearing pressure greater than 2 lb/in^2 over external pressure and shall close when external pressure is equal to or greater than internal pressure. The vent valve shall pass the watertight integrity test specified in 4.4.3.

3.3.12 Security. Access hand hole and sight hole covers on the housing shall be safety wire locked as specified in MS33540.

3.3.13 Threaded fastenings. Threads shall be in accordance with FED-STD-H28. Screw threads shall be right hand, unified form as specified in FED-STD-H28/2. Threaded fastener sizes shall be as specified on Drawing 803-1385953.

3.3.13.1 Locking of fastenings. Fastenings internal to the bearing and for the sight hole and the hand hole covers shall be self-locking unless otherwise approved by NAVSEA. Self-locking nuts shall be used for housing parting line bolts between the bearing cap and pedestal and for shell parting line bolts.

3.3.13.1.1 Self-locking nuts. Self-locking nuts in accordance with MIL-N-25027 shall be as specified in MS17829 unless nonmagnetic materials are required (see 6.2.1). In this case, self-locking nuts shall be dimensioned and fabricated, and the material used for the collar shall be as specified in MS17829 and the material for the nuts shall be in accordance with QQ-N-281.

3.3.13.1.2 Self-locking bolts and screws. Self-locking bolts and screws shall be in accordance with MIL-F-18240. Housing and shell parting line bolts shall be grade 8 of MIL-S-1222, and hex head self-locking screws for the seal parting line, hand hole and sight hole covers shall be grade 2 of MIL-S-1222.

3.3.13.2 Torque values. Torque values for housing and shell parting line and foundation bolts shall be based on the use of lubrication, as specified in MIL-L-24479. The torque values for these bolts shall be as specified on Drawing 803-1385953.

3.3.13.3 Access for wrenching. Adequate clearance shall be provided around bolt heads and nuts to permit the use of standard tools. Standard tools are those tools listed in the Federal Supply Catalog.

3.3.14 Welding, brazing, and allied processes. Welding, brazing and allied processes shall be in accordance with MIL-STD-278. Prior to assembly of finished bearings, all cast or welded bearing parts shall be cleaned of sand, weld spatter, or other foreign matter such as machining chips.

3.4 Marking.

3.4.1 Identification plate. Each bearing assembly shall have an identification plate attached to the housing. The identification plate shall be for normal service as specified in MIL-P-15024 and MIL-P-15024/5. The plate shall contain the following information and shall be of sufficient size to allow the addition of two additional lines of data:

Line shaft bearing (location) _____
Ship class _____
National stock number _____
Drawing number _____
Contract number _____
Manufactured by _____
Date manufactured _____

3.4.2 Bearing shell and housing marking. Bearing shell and housing markings shall be in accordance with MIL-STD-792. The upper and lower halves of the bearing shell shall be marked by stamping, etching or casting "upper half fwd" and "lower half fwd." An arrow shall indicate the forward direction on each unit. The bearing housing, both the cap and pedestal, shall have a raised cast arrow pointing in the forward direction. The abbreviation "fwd" shall be stamped or cast just below the arrow. A direction of rotation plate shall be attached to the forward end of the bearing cap. The plate shall contain an arrow pointing in the direction of rotation with the inscription "Shaft Rotation".

3.5 Assembly drawings. When specified in the contract or order, the drawings shall be prepared (see 6.2.2).

3.6 Workmanship. External projecting edges and sharp corners normally exposed shall be rounded or chamfered. Joined parts shall fit tightly. The bearings shall be free of cracked or displaced parts, burrs or other defects which will affect the life, serviceability, or appearance.

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 Responsibility for compliance. All items must meet all requirements of section 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, or does it commit the Government to acceptance of defective material.

4.1.2 Inspection system requirements. When specified in the contract or order, an inspection system program plan shall be prepared (see 6.2.2).

4.2 Quality conformance inspection. A quality conformance inspection shall be performed on line shaft bearings which have been produced with equipment and procedures normally used in production. When specified in the contract or order, a test report shall be prepared (see 6.2.2).

4.2.1 Inspection lot for bond testing. Bearings to be delivered to the contracting activity on the same contract or purchase order shall be divided into lots. A lot shall consist of bearings of the same dimensions and materials and produced under the same conditions.

4.2.1.1 Sample size. Test sample preparations and the number of samples shall be as specified in DOD-STD-2183 for the bond tests specified in 4.4.1.

4.2.2 Sample for ultrasonic tests. Each bearing shall be ultrasonically tested (see 4.4.2).

4.2.3 Inspection lot for watertight integrity testing. The inspection lot for watertight integrity testing shall consist of all assembled bearings of the same dimensions and materials produced for the first ship of a class and offered for inspection at one time.

4.2.3.1 Sample size. One assembled bearing of each inspection lot shall be subjected to the watertight integrity test specified in 4.4.3. Bearings for the remaining ships of the class need not be tested.

4.3 Examination.

4.3.1 Visual and dimensional examination. Each assembled bearing, removable insert, and spare part shall be visually and dimensionally examined to verify that the materials, configuration, construction, physical dimensions, marking, and workmanship are as specified in the applicable requirements (see 3.1, 3.2, 3.3, 3.4, and 3.6).

4.4 Tests.

4.4.1 Bond tests. Bond tests to determine adequacy of the bond between the babbitt and backing shall be conducted as specified in DOD-STD-2183. Bond strength shall be as specified in DOD-STD-2183.

4.4.2 Ultrasonic test. An ultrasonic test of bonding shall be conducted as specified in DOD-STD-2183. The permitted area of unbonding shall be as required in DOD-STD-2183.

4.4.3 Watertight integrity test. The watertight integrity of the shaft seal and the bearing assembly shall be tested. This includes all portions of the bearing cap and bearing pedestal which are bolted together and penetrations such as sight hole, electrical receptacles, gauges, vent, thermometer, dipstick, and fill and drain plugs.

4.4.3.1 Test preparation. The bearing shall have a length of simulated shafting installed with the same dimensions and surface finish as the shaft used for actual service. The bolts shall be torqued as specified on the assembly drawing. The oil reservoir shall be empty.

4.4.3.2 Performance of test. The bearing unit and shafting assembly shall be immersed in water in a tank, which shall be pressurized to 8.6 lb/in^2, for 24 hours. Upon completion of the test, the bearing unit drain shall be opened and the water, if any, collected in a container.

4.4.3.3 Failure criteria. If more than 1/2 pint of water is collected, the bearing assembly shall be rejected.

4.4.4 Oil delivery test. The disc lubricated bearing shall deliver oil at the flowrate specified in table VII. The test shall be witnessed by a government representative. The test agenda shall be approved by NAVSEA.

TABLE VII. Oil delivery flowrate (gal/min).

Shaft speed (r/min)	Journal size (inches)		
	8.00 - 17.00	17.01 - 26.00	26.01 - 36.00
5	0.1	0.2	0.3
20	0.6	1.1	1.6
50	1.4	2.4	3.5
100	6.1	10.5	15.1
150	7.8	13.5	19.5
200	9.6	16.5	23.8

4.5 Inspection of packaging. Sample packages and packs, and the inspection of the preservation, packing and marking for shipment and storage shall be in accordance with the requirements of section 5 and the documents specified therein.

5. PACKAGING

(The packaging requirements specified herein apply only for direct Government acquisition. For the extent of applicability of the packaging requirements of referenced documents listed in section 2, see 6.3.)

5.1 Packaging. Line shaft bearings shall be preserved level A, C or commercial, packed level A, B, C or commercial, as specified (see 6.2.1) and marked in accordance with MIL-P-2845.

6. NOTES

6.1 Intended use. The line shaft bearing units are used to provide radial support for the main propulsion line shafting on Naval ships.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

(a) Title, number, and date of this specification.
(b) When nonmagnetic materials are required (see 3.1).
(c) Propulsion line shaft journal diameter (see 3.3.1).
(d) Bearing load (in pounds) (see 3.3.1.2).
(e) Design procedure for resistance to shock loading (see 3.3.2).
(f) Shock requirements (max r/min) when dynamic analysis shows that 16 G's arthwartship and 35 G's vertical are exceeded (see 3.3.2.1).
(g) Line shaft bearings shock or vibration tested, if required (see 3.3.2.3).
(h) The minimum and maximum shaft r/min (see 3.3.5.1).
(i) The direction of shaft rotation looking aft (see 3.3.5.1).
(j) Method of monitoring oil temperature (see 3.3.5.2).
(k) Ambient temperature of the space where the bearing is to be located (see 3.3.7).
(l) Maximum degree of roll and pitch if other than specified and pitch and roll time cycles, if required (see 3.3.9.1 and table V).
(m) Location of oil sampling and drain assembly, port or starboard (see 3.3.10.3).
(n) Levels of preservation and packing required (see 5.1).

6.2.2 Data requirements. When this specification is used in an acquisition and data are required to be delivered, the data requirements identified below shall be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved Contract Data Requirements List (CDRL), incorporated into the contract. When the provisions of DoD FAR Supplement, Part 27, Sub-Part 27.475-1 (DD Form 1423) are invoked and the DD Form 1423 is not used, the data specified below shall be delivered by the contractor in accordance with the contract or purchase order requirements. Deliverable data required by this specification are cited in the following paragraphs.

Paragraph no.	Data requirement title	Applicable DID no.	Option
3.3.1.2, 3.3.2.1, 3.3.2.1.1, 3.3.2.2 and 3.3.2.4	Diagrams, calculations and stress	UDI-E-23253	Submit to Supervisor of Shipbuilding Conversion and Repair, USN Brooklyn, NY 11251
3.5	Drawings, engineering and associated lists	DI-E-7031	Level 3
4.1.2	Inspection system program plan	DI-R-4803	----
4.2	Reports, test	DI-T-2072	10.1.b

(Data item descriptions related to this specification, and identified in section 6 will be approved and listed as such in DoD 5010.12-L., AMSDL. Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the Naval Publications and Forms Center or as directed by the contracting officer.)

6.2.2.1 The data requirements of 6.2.2 and any task in sections 3, 4, or 5 of this specification required to be performed to meet a data requirement may be waived by the contracting/acquisition activity upon certification by the offeror that identical data were submitted by the offeror and accepted by the Government under a previous contract for the identical item acquired to this specification. This does not apply to specific data which may be required for each contract regardless of whether an identical item has been supplied previously (for example, test reports).

6.2.2.2 Technical manuals. The requirement for technical manuals should be considered when this specification is applied on a contract. If technical manuals are required, Military specifications and standards which have been cleared and listed in DoD 5010.12-L (AMSDL) must be listed on a separate CDRL (DD Form 1423), included as an exhibit to the contract. The technical manuals must be acquired under separate contract line item in the contract.

6.3 Sub-contracted material and parts. The packaging requirements of referenced documents listed in section 2 do not apply when material and parts are acquired by the contractor for incorporation into the equipment and lose their separate identity when the equipment is shipped.

6.4 Definitions.

6.4.1 Propulsion line shaft bearing. Propulsion line shaft bearings are supported by the inner foundations of the ship and are spaced at intervals along a length of shafting located inside the ship between the aftermost propulsion gear, engine or motor flange and the stern tube seal. They provide radial support for the main propulsion line shafting on Naval ships.

6.4.2 Bearing housing. A bearing housing is the assembly of the bearing pedestal and cap.

6.4.3 Bearing pedestal. A bearing pedestal is the bottom part of the bearing housing, which contains the mount that positions and aligns the bearing shell. The pedestal supports the entire assembly of the bearing and is bolted to the bearing foundation.

6.4.4 Hand holes. Hand holes (always provided with covers) are located on the bearing pedestal. They are used for oil sump cleanout and inspection.

6.4.5 Bearing cap. A bearing cap is a detachable top bearing housing part whose primary function is to secure bearing elements within the bearing housing. The bearing cap is bolted to the bearing pedestal.

6.4.6 Anti-rotation pin. An anti-rotation pin is a hollow pin which prevents the rotation of the bearing shell with the shaft and allows for the insertion of a micrometer to measure bearing clearance. A precision insert anti-rotation pin, used in addition to the shell anti-rotation pin, prevents the rotation of the precision insert with the shaft.

6.4.7 Dipstick. The oil gauge dipstick is a gauge used to identify the sump full oil level and add oil level.

6.4.8 Oil disc and scraper assembly. The oil disc is a metal ring which rotates with the shaft. Oil in the sump adheres to the rotating ring and is carried with it. The oil scraper is a metal deflector loaded against the disc's oil supply surface. It scrapes the oil from the disc and diverts it to a pocket in the back side of the upper half bearing shell.

6.4.9 Bearing shell. The bearing shell is a self-aligning component that supports the shaft and in which the shaft rotates. The inside surface of the bearing shell is babbitted, or has a babbitted insert. This antifriction surface adjoins the precision surface of the shaft and is separated from it (during shaft rotation) by an oil film. The oil from the pocket in the back side of the upper half of the bearing shell drains, by gravity, through holes onto the journal surface.

6.4.10 Precision insert. A precision insert is a cylindrical split, precision machined part which consists of a thin layer of babbitt over a steel backing. The insert is force-fitted into the cylindrical bore of the bearing shell. The amount of force necessary for placement is less than the yield strength of the bearing shell. The critical dimension of any insert is its radial length, which permits a designed crush to occur when the upper and lower bearing shell halves are bolted together.

6.4.11 Seals and gaskets. Seals and gaskets in the bearing housing prevent the leakage of oil from the bearing and the ingress of seawater and foreign matter into the bearing.

6.4.12 Oil sampling and drain assembly. The oil sampling and drain assembly provides for drainage of the oil sump or for sampling of oil during static and underway conditions.

6.4.13 Vent valve. The vent valve is a detachable component whose function is to vent excess vapor pressure from the bearing cavity to the surrounding space. The vent valve prevents ingress of sea water during flooding.

6.5 Provisioning. Provisioning Technical Documentation (PTD), spare parts, and repair parts should be furnished as specified in the contract.

6.5.1 When ordering spare parts or repair parts for the equipment covered by this specification, the contract should state that such spare parts and repair parts should meet the same requirements and quality assurance provisions as the parts used in the manufacture of the equipment. Packaging for such parts should also be specified.

6.5.2 On board repair parts. The minimum on board repair parts for each ship should consist of the following:

(a) One insert set or one babbitted shell set for each type and size bearing per line of shafting.
(b) One oil disc per ship for ships with one or two shafts per journal size.
(c) Two oil discs per ship for ships with more than two shafts per journal size.

(d) One complete set of seals and gaskets for all line shaft bearings on board the vessel.
(e) One oil scraper per journal size for ships with one or two shafts.
(f) Two oil scrapers per journal size for ships with more than two shafts.

6.5.3 Stock repair parts. Stock repair parts are those bearing parts which are considered essential to replenish the on board usage of repair parts for a period of 1 year, plus such additional parts that are subject to such infrequent breakdown and slight wear that they do not qualify for inclusion as on board repair parts but should be immediately available in the supply system for low-rate usage replacement.

6.6 Assembly drawings. Assembly drawings should include the following:

(a) Unit weights, wet and dry, with location of center of gravity.
(b) Bearing rated load and unit load, operating temperature range, speeds and friction losses.
(c) Lube oil capacity.
(d) Torque values for foundation bolts, housing and shell parting line bolts, shell bolts, and oil disc screws (in tabular form).
(e) Applicable notes listed on Drawing 803-1385953.

6.7 Subject term (key word) listing.

Bearings
Oil disc, lubricated
radial support
Propulsion line shaft
Resistance temperature
Shock loading

6.8 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.

Preparing activity:
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