INCH-POUND
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(See 6.15)

MILITARY SPECIFICATION

CLUTCHES FOR PROPULSION UNITS AND AUXILIARY MACHINERY, NAVAL SHIPBOARD

This specification is approved for use by 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 clutches for Naval shipboard propulsion units and auxiliary machinery. This specification does not include all types of clutches but is intended to cover those types most widely used in shipboard propulsion and auxiliary systems.

1.2 Classification. Clutches shall be of the following types as specified (see 6.2):

Type I - Nonpositive drive hydraulic (fluid drive).
Type II - Nonpositive drive friction (tire and tube)
Type III - Nonpositive drive friction (disc, drum, or cone) (see 6.8 2).
Type IV - Nonpositive drive overrunning (see 6.8.3).
Type V - Positive drive (see 6.8.1) forced synchronizing.
Type VI - Positive drive overrunning.
Class A - Automatically actuated
Class B - Remotely controlled.

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 3010

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

FEDERAL

FF-B-171	- Bearings, Ball, Annular (General Purpose).
FF-B-185	- Bearings, Roller, Cylindrical; and Bearings, Roller, Self-Aligning.
FF-B-187	- Bearings, Roller, Tapered.
FF-W-92	- Washer, Flat (Plain).
QQ-A-601	- Aluminum Alloy Sand Castings.
QQ-B-728	- Bronze Manganese; Rod, Shapes, Forgings, and Flat Products (Flat Wire, Strip, Sheet, Bar, and Plate).
QQ-S-365	- Silver Plating, Electrodeposited General Requirements for,
QQ-T-390	- Tin Alloy Ingots and Castings and Lead Alloy Ingots and Castings (Antifriction Metal) for Bearing Applications.
QQ-W-390	- Wire , Nickel-Chromium-Iron Alloy.

MILITARY

MIL-S-901	- Shock Tests, H.I. (High-Impact); Shipboard Machinery, Equipment and Systems, Requirements for.
MIL-A-907	- Antiseize Thread Compound, High Temperature.
MIL-S-1222	- Studs, Bolts, Hex Cap Screws, Socket-Head Cap Screws and Nuts.
MIL-S-5000	- Steel Chrome-Nickel-Molybdenum (E4340) Bars and Reforging Stock.
MIL-A-8625	- Anodic Coatings, for Aluminum and Aluminum Alloys
MIL-I-8846	- Inserts, Screw-Thread, Helical Coil.
MIL-T-17286	- Turbines and Gears, Shipboard Propulsion and Auxiliary Steam; Packaging of.
MIL-B-17931	- Bearings, Ball, Annular, for Quiet Operation.
MIL-F-18240	- Fastener, Element, Self Locking, Threaded Fastener, 250°F Maximum.
MIL-S-22698	- Steel Plate, Shapes and Bars, Weldable Ordinary Strength and Higher Strength. Structural.
MIL-S-23284	- Steel Forgings, Carbon and Alloy, for Shafts, Sleeves, Couplings, and Stocks (Rudders and Diving Planes).
MIL-S-24093	- Steel Forgings, Carbon and Alloy Heat Treated.
DOD-F-24669	- Forgings and Forging Stock, Steel Bars, Billets and Blooms, General Specification for. (Metric)

MILITARY (Continued)

DOD-F-24669/1 - Forgings and Forging Stock, Steel (Carbon and Alloy) Blooms, Bars, Billets and Slabs. (Metric)
DOD-F-24669/2 - Forgings and Forging Stock, Steel Bars and Billets - Chromium-Molybdenum Alloy. (Metric)
DOD-F-24669/3 - Forgings and Forging Stock, Steel Bars and Billets for Nitriding. (Metric)
MIL-C-24707/1 - Castings, Ferrous, for Machinery and Structural Applications.
MIL-C-24707/5 - Castings, Ductile Iron and Austenitic Ductile Iron.
MIL-N-25027 - Nut, Self-Locking, 250°F, 450°F, and 800°F.
MIL-C-26074 - Coatings, Electroless Nickel, Requirements for.
MIL-C-83488 - Coating, Aluminum, Ion Vapor Deposited.

STANDARDS

MILITARY

MIL-STD-29 - Springs, Mechanical; Drawing Requirements for.
MIL-STD-129 - Marking for Shipment and Storage.
MIL-STD-167-1 - Mechanical Vibrations of Shipboard Equipment (Type I - Environmental and Type 11 - Internally Excited).
MIL-STD-248 - Welding and Brazing Procedure and Performance Qualification.
MIL-STD-271 - Requirements for Nondestructive Testing Methods.
MIL-STD-278 - Welding and Casting Standard.
MIL-STD-438 - Schedule of Piping, Valves, Fittings, and Associated Piping Components for Submarine Service.
MIL-STD-777 - Schedule of Piping, Valves, Fittings, and Associated Piping Components for Naval Surface Ships.
MIL-STD-792 - Identification Marking Requirements for Special Purpose Components.

HANDBOOK

MILITARY

MIL-HDBK-149 - Rubber.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, BLDG. 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.1.2 Other Government documents. drawings. and publications The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

DRAWING

NAVAL SEA SYSTEMS COMMAND (NAVSEA)

B 214 - Root Connections for Attaching Pipe.

PUBLICATION

NAVSEA
0901-LP-420-0007, Chapter 9420 - Propulsion Reduction Gears, Couplings, and Associated Components.

(Application for copies should be addressed to the Standardization Documents Order Desk, BLDG. 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
A 228 - Standard Specification for Steel Wire, Music Spring Quality. (DoD adopted)
A 313 - Standard Specification for Chromium-Nickel Stainless and Heat-Resisting Steel Spring Wire. (DoD adopted)
B 26 - Standard Specification for Aluminum Alloy Sand Castings. (DoD adopted)
B 85 - Standard Specification for Aluminum-Alloy Die Castings. (DoD adopted)
B 108 - Standard Specification for Aluminum-Alloy Permanent Mold Castings. (DoD adopted)
B 138 - Standard Specification for Manganese Bronze Rod, Bar and Shapes. (DoD adopted)
B 148 - Standard Specification for Aluminum-Bronze Sand Castings. (DoD adopted)
B 169 - Standard Specification for Aluminum Bronze Plate, Sheet, Strip, and Rolled Bar. (DoD adopted)
B 247 - Standard Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings. (DoD adopted)
B 271 - Standard Specification for Copper-Base Alloy Centrifugal Castings. (DoD adopted)
B 505 - Standard Specification for Copper-Base Alloy Continuous Castings.
B 584 - Standard Specification for Copper Alloy Sand Castings for General Applications. (DoD adopted)
F 1166 - Standard Practice for Human Engineering Design for Marine Systems, Equipment and Facilities.

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
B46.1 - Surface Texture, (Surface Roughness, Waviness, and Lay). (DoD adopted)

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

(Non-Government standards and other publications are normally available from the organizations that prepare or 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 document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First article. When specified (see 6.2), a sample shall be subjected to first article inspection (see 6.5) in accordance with 4,3.

3.2 Materials. Unless otherwise specified (see 6.2), materials shall be as specified in tables I and II.

TABLE I. Materials of principal parts.

Part	Applicable document	Material	Hardness 1/	Hardening method	Remarks
Anti-friction material	QQ-T-390				Grades 2 or 3
Bearings Ball Roller	 MIL-B-17931 FF-B-171 FF-B-185 FF-B-187				
Cages, structural	MIL-S-22698 MIL-S-24093	Steel plates and shapes Steel forgings			Grades A, B, or D Class B, type I or II
Casings, covers, bases and guards	MIL-C-24707/1 MIL-S-24093 MIL-S-22698	Steel castings Steel forgings Steel plates and shapes			Grade A1Q or WCA Class H, type V Grade B
Casings and guards, weight critical	QQ-A-601	Aluminum alloy casting			Alloy C355.0 or A356.0 weight critical 7/

See footnotes at end of cable.

TABLE I. Materials of principal parts - Continued.

Part	Applicable document	Material	Hardness 1/	Hardening method	Remarks
Clutch drive pieces and plates	MIL-S-24093	Steel forgings	275 BHN 2/		Class C, type I or II
	DOD-F-24669/1	Steel: bars and billets	56 Rc 2/	Carburize 3/	Class 4615 or 8615
	MIL-C-24707/5	Cast iron			Grade 60-45-15
Cones	MIL-S-24093	Steel forgings	275 BHN		Class C, type I or II Class H, type V
	QQ-B-728	Manganese bronze forging and bars			Class B
	ASTM B 138	Manganese bronze			Copper alloy, C67000 or C67500
Drums	MIL-C-24707/1	Steel castings			Grades A1Q or WCA
	MIL-C-24707/5	Cast iron			Grade 60-45-15
	MIL-S-24093	Steel forgings			Class H, type V
	DOD-F-24669/2	Steel bars, billets, and forgings			F-22, condition HT
	DOD-F-24669/3	Nitralloy 135 M steel bars, billets, and forgings	59 Rc	Nitride 4/	Class A, condition 2, type III
	MIL-S-22698	Steel plates and shapes			Grade B
Flanges	MIL-S-24093	Steel forgings			Class H, type V Class B, type I or II

See footnotes at end of table.

TABLE I. Materials of principal parts - Continued.

Part	Applicable document	Material	Hardness 1/	Hardening method	Remarks
Friction and rubbing pieces	ASTM B 271	Copper base alloy centrifugal castings			Copper alloy C90500, C92200, C93800
	ASTM B 505	Copper base alloy continuous castings			
	ASTM B 584	Copper alloy sand castings			
	QQ-B-728	Manganese bronze forgings and bars			Class B
	ASTM B 148	Aluminum bronze sand castings			
Hubs	DOD-F-24669/1	Steel bars and billets	56 Rc	Carburize	Class 4615 or 8615
	DOD-F-24669/3	Nitralloy 135 M steel bars, billets and forgings	59 Rc	Nitride	Class A, condition 2, type III
	DOD-F-24669/1	Steel bars and billets for reforging	49 Rc	Nitride	Grade 4340
Pins	DOD-F-24669/1	Steel bars and billets	56 Rc	Carburize	Class 4615 or 8615
	DOD-F-24669/3	Nitralloy 135 M steel bars, billets, and forgings	59 Rc	Nitride	Class A, condition 2, type III
	MIL-S-5000	Steel bars and forging stock	45 Rc	Through hardened 5/	Condition F, rough turned
	DOD-F-24669/1	Steel bars and billets for reforging	49 Rc	Nitride	Grade 4340

See footnotes at end of table.

TABLE I. Materials of principal parts - Continued.

Part	Applicable document	Material	Hardness 1/	Hardening method	Remarks
Pistons	MIL-S-24093	Steel forgings	275 BHN		Class C, type I or II
	ASTM B 26	Aluminum alloy sand castings 6/			Alloy C355.0 or A356.0
	ASTM B 85	Aluminum alloy die castings 6/			Alloy A360 or A380
	ASTM B 108	Aluminum alloy permanent mold castings 6/			Alloy C355.0 or A356.0
	ASTM B 247	Aluminum alloy die and hand forgings 6/			Alloy 2014-T6 or 6061-T6
	MIL-C-24707/1	Steel castings			Grades A1Q or WCA
Rotors	MIL-C-24707/1	Steel castings			Grades A1Q or WCA
	DOD-F-24669/1	Steel bars and billets	56 Rc	Carburize	Class 4615 or 8615
	DOD-F-24669/3	Nitralloy 135 M steel bars, billets and forgings	59 Rc	Nitride	Class A, condition 2, type III
	DOD-F-24669/2	Steel bars, billets, and forgings			F-22 condition HT
	MIL-S-5000	Steel bars and forging stock	45 Rc	Through hardened 5/	Condition F, rough turned
	DOD-F-24669/1	Steel bars and billets for reforging	49 Rc	Nitride	Grade 4340
	MIL-S-22698	Steel plates and shapes			Grade B
Elastomer pieces	MIL-HDBK-149	Rubber			

See footnotes at end of table.

TABLE I. Materials of principal parts - Continued.

Part	Applicable document	Material	Hardness 1/	Hardening method	Remarks
Shafts	MIL-S-24093	Steel forgings	275 BHN		Class B, type I or II
			275 BHN		Class C, type I or II
	MIL-S-5000	Steel bars and forging stock	45 Rc	Through hardened 5/	Condition F, rough turned
	MIL-S-23284	Steel forgings, carbon and alloy			Class 2
	DOD-F-24669/1	Steel bars and billets for reforging	49 Rc	Nitride	Grade 4340
Sleeves	DOD-F-24669/1	Steel bars and billets	56 Rc	Carburized	Class 4615 or 8615
	DOD-F-24669/3	Nitralloy 135 M steel bars, billets and forgings	59 Rc	Nitride	Class A, condition 2, type III
Spiders	MIL-S-22698	Steel plates and shapes			Grade B
Springs	QQ-W-390	Nickel-chromium-iron alloy wire			Temper C
	ASTM A 313	Steel spring, wire, heat resisting			Alloy 302 Class 1
	ASTM A 228	Steel wire, spring quality			Hard drawn
	MIL-STD-29				Drawing require-ments

See footnotes at end of table.

TABLE I. Materials of principal parts - continued.

Part	Applicable document	Material	Hardness 1/	Hardening method	Remarks
Tube, scoop	ASTM B 271	Copper-base alloy centrifugal castings			Copper alloy C90500, C92200, C93800
	ASTM B 505	Copper-base alloy centrifugal castings			
	ASTM B 584	Copper alloy sand castings			
	ASTM B 148	Aluminum bronze sand castings			
	QQ-B-728	Manganese bronze forgings and bars			Class B
	ASTM B 169	Aluminum bronze plate, sheet, strip, and bar			

1/ Hardness is minimum.
2/ BHN is standard Brinell hardness number. Rc is hardness designated in Rockwell C scale.
3/ Carburizing steels, when case hardened, shall have a minimum case depth of 0.025 inch; tooth and splines shall have a case depth (see 6.8.4) of 0.025 inch or 10 percent of the tooth chordal thickness whichever is greater. Tooth and spline surfaces shall have a minimum surface hardness of 56 Rockwell C, other surfaces as specified by the contractor and approved by the contracting activity.
4/ Nitriding steels, when case hardened, shall have a minimum case depth (see 6.8.4) of 0.020 inch; teeth and spline surfaces shall have a minimum surface hardness of 49 Rockwell C, other surfaces as specified by the contractor and approved by the contracting activity.
5/ Through-hardened parts shall have a surface hardness as specified by the contractor and approved by the contracting activity.
6/ Aluminum alloy parts for salt water service shall be of a high-corrosion resistant alloy.
7/ See 3.4.13.

TABLE II. Materials other than principal parts.

Part	Applicable document	Material	Remarks
Threaded fasteners Bolts, studs, hex cap screws, socket head cap screws, and nuts	MIL-S-1222 1/	Carbon and alloy steel and corrosion-resisting steel	
Nuts, self locking	MIL-N-25027	Carbon steel and corrosion-resisting steel	
Self-locking elements	MIL-F-18240	Nylon	
Threaded insert	MIL-I-8846	Carbon steel or corrosion-resisting steel	
Piping Connections Root connections	 MIL-STD-438 MIL-STD-777 Drawing B 214		 Submarine vessels Surface vessels
Washers	MIL-S-24093 DOD-F-24669/1 FF-W-92	Carbon and alloy steel forgings Carbon and alloy steel Carbon and corrosion-resisting steel	Class D, spacing washers Standard washer; flat washer Class A and B
Gaskets			In accordance with specification requirements of parent equipment

1/ See 3.4.8.1.1.

3.2.1 Use of cast iron. Unless otherwise specified (see 6.2) or in accordance with tables I and II, cast iron parts shall not be used.

3.2.2 Prohibited materials. The following materials are prohibited to the extent stated.

3.2.2.1 Asbestos. Asbestos or any material containing asbestos that could become airborne is prohibited.

3.2.2.2 Mercury and mercury compounds. Clutches and parts shall not contain mercury or mercury compounds and shall be free of mercury contamination. Use of mercury shall be prohibited for inspection, examination, and tests.

3.2.2.3 Materials prohibited from lube oil contact. Paint, plastic, cadmium and zinc coatings shall not be applied to any surface that will be in contact with lubricating oil.

3.2.3 Surfaces. Metal surfaces shall be free of defects (see 4.6.1 through 4.6.1.2.1).

3.2.4 Surface hardened parts. Minimum case depth shall be in accordance with 3.2, tables I and II, where applicable.

3.2.5 Castings. Castings shall pass the inspection specified in 4.5.4.

3.2.6 Recovered materials. Unless otherwise specified herein, all equipment, material, 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

3.2.7 Substitute materials. Materials other than those specified are substitute materials (see 6.10 and 6.10.1).

3.3 General. Clutches shall be constructed for engagement, operation, and disengagement without interruption under all specified expected conditions of misalignment, shaft flexure, bearing wear, and any other specified anticipated motion between the driving and driven shafts.

3.3.1 Operating characteristics. The design of all clutches shall be matched with driver and driven equipment to provide stable operation under all steady state, maneuvering, reverse, windmilling, locked shaft, trail shaft, and disconnect operation (as applicable) conditions for propulsion clutches and transient state load changes, including overloads for auxiliary clutches (see 6.3 and appendix A). Design shall also consider increased torque which occurs during maneuvering and crash astern from full ahead, and then crash ahead to full power for propulsion machinery. Time required for various operating conditions and increased torque shall be in accordance with gear specification requirements or parent equipment specifications when clutch requirements are contained therein, or as required (see 6.2). Unless otherwise specified (see 6.2), the design torque load of propulsion machinery clutches shall be 120 percent of full torque.

3.3.1.1 Natural frequencies. The natural frequency of a clutch design shall not fall within 10 percent of the following:

(a) Any speed within the range from minimum to full power revolutions per minute (r/rein) (see 6.2).
(b) Two times any speed within the same range as (a) above.

(c) Any other speed or exciting frequency cited in the contract or order (see 6.2)

3.3.1.2 Collaboration. The clutch contractor shall collaborate with the driven or driving machinery contractors, as applicable, to assure that construction, installation, and operating requirements are identical and mutually acceptable (see 6.2).

3.3.1.3 Life endurance). Clutches shall be designed for 30-year life, when life requirement is not stated. When life required for the parent equipment (see 6.2) is other than 30 years, clutches shall be designed for the same life. Where different life is indicated for associated equipment, clutches shall be designed for the greater life requirement. Required operating hours for clutches shall be equal to the greater value required for driver or driven equipment (see 6.2). The clutch shall also be designed to meet the expected number of engagements and disengagements at various power levels (see 6.2).

3.3.1.3,1 Operating hours, propulsion clutches, steam turbine powered units and all propeller shaft speed applications.

Clutch life in operating hours shall be as follows:

(a) Total hours - 150,000.
(b) Full power hours - 15,000,
(c) Between 50 and 100 percent full power hours - 60,000.
(d) Less than 50 percent full power hours - 75,000.

3.3.1.3.2 Operating hours, propulsion clutches, gas turbine and diesel powered units, intermediate and high speed applications.

Clutch life in operating hours shall be as follows:

(a) Total hours - 150,000.
(b) Full power hours - 75,000.
(c) Between 50 and 100 percent full power hours - 37,500.
(d) Less than 50 percent full power hours - 37,500.

3.3.1.3.3 Operating hours, auxiliary clutches. Auxiliary clutch life shall be 100,000 hours at design rated conditions.

3.3.1.4 Over torque. Clutches shall transmit 200 percent of rated torque at the maximum specified misalignment (see 6.2) for a minimum period of 1 minute for each occurrence. Contracting activity shall specify number and frequency of occurrences (see 6.2).

3.3.2 Maintenance.

3.3.2.1 Accessibility. Design shall, within space limitations, provide the maximum accessibility to parts which require routine inspection, maintenance, and repairs. Design shall provide for minimum effort required to accomplish planned maintenance actions and to effect repairs.

3.3.2.2 Interchangeability. In no case shall parts be physically interchangeable or reversible unless such parts are also interchangeable or reversible with regard to function, performance and strength.

3.3.2.3 Scheduled maintenance. Table III provides the minimum requirements for scheduled (periodic) maintenance. Equipment vendors shall submit other necessary periodic maintenance requirements for their equipment,

TABLE III. Scheduled maintenance requirements.

Clutch type	Maintenance interval	Action
All types Self-contained lubricant type	Semi-annual Quarterly	Inspect Lubricate

3.3 3 Safety.

3.3.3.1 safety objectives. Clutches shall be designed and constructed to minimize or preclude hazard to equipment or personnel during testing and when installed and operational on board ship as specified (see 6.2).

3.3.3.2 Equipment and personnel safety. Appropriate safety provisions shall be included in design, test, and ship installation to satisfy equipment and personnel safety requirements specified in MIL-STD-882 (see 6.3).

3.3 3.3 Safety hazard Where clutch operating requirements ❑ay be hazardous to equipment or personnel, special instructions and safety requirements shall be imposed by the contractor to the depth required by means of design, warning plates, and training requirements.

3.4 Construction, general requirements (see 6.3 and appendix B).

3.4 1 Revolution indicator. For all clutch types, except type I and VI, class A, a revolution indicator, located as approved by the contracting activity, shall be provided to indicate the revolutions of the driving or driven shafts to facilitate engagement of clutches at near synchronous speed.

3.4.2 Controls. Controls provided for the pneumatic or hydraulic systems of all clutches shall be suitable for remote operation (see 6.2). Location and safety features of controls shall be as approved by the contracting activity. Provision shall be made for gauges and temperature detectors, interlock features, and indicating lights as approved by the contracting activity. Type V and VI clutches shall have indicating lights that show clutch engaged and clutch disengaged. Also , additional indicating lights shall be as specified in 6.2.

3 4.3 Attachment of mating parts.

3.4.3.1 Securing to shafts. Parts such as sleeves, hubs, plates and flanges shall be secured to shafts or distance pieces by fitted bolts or shall be splined, shrunk, or keyed, as applicable Where such parts are splined or shrunk, retaining nuts shall be employed unless otherwise specified (see 6.2). Nuts used on through bolts shall be of the self-locking type (see table II).

3.4.3.2 Clutch hubs. Wall thickness of clutch hubs shall be sufficient to prevent cracking or fracture under shrink fit, torque, bending moment, and centrifugal and other loading imposed during normal operation of the clutch. Wall thicknesses shall also allow for the effects of keyways, splines, holes, or other features that introduce stress concentrations.

3.4.4 Bearings.

3.4.4.1 **Sliding surface journal bearings**. Unless otherwise specified (see 6.2), sliding surface of journal bearings shall be lined with the anti-friction materials specified in table I (see 3.2).

3.4.4.2 **Rolling element bearings**. Bearings shall be in accordance with table I.

3.4.5 Lubrication. Unless otherwise specified (see 6.2), lubricant shall be supplied to the clutch from the associated equipment.

3.4.6 Fasteners.

3.4.6.1 Bolting for casings. Fasteners for casings shall be in accordance with table II (see 3.2).

3.4.6.2 Bolting for rotating and stationary parts. Fasteners for all rotating and stationary parts shall be in accordance with table II and shall conform to grade 5 or better of MIL-S-1222 (see 3.2). All fasteners shall be locked in accordance with MIL-N-25027 and MIL-F-18240.

3,4.6.3 Bolt holes. When clutches are nitrided or carburized, bolt hole and adjacent areas shall not be case hardened to permit reaming at assembly.

3.4.6.4 Fasteners. weight balance. Clutch bolts, nuts, and cap screws shall be weight balanced to values given below:

Speed, r/min	Balance, grams
o to 1000	plus or minus 1.0
1000 to 2000	plus or minus 0.5
2000 to 3600	plus or minus 0.2
over 3600	plus or minus 0.1

3.4.6.5 Fastener sets. Bolts shall be furnished as sets or sized for their respective holes and marked.

3.4.6.6 Fastener torque. Installation torque limits and thread lubricant requirements shall be established by the clutch contractor. The lower limit of installation torque shall be sufficient to prevent joint separation under the normal operating loads and, when required (see 3.4.9), under shock. Where not otherwise specified:

(a) Combined stress in the fastener threads under the upper limit of installation torque shall not exceed 75 percent of yield strength of the bolt material.

(b) Compressive stress of load-baring surfaces including washers at the upper limit of installation torque shall not exceed 100 percent of ultimate compressive strength of the material.

3.4.6.7 Fastener deterioration. In order to prevent deterioration due to corrosion, bolts, nuts, studs, pins, springs, screws, cap screws. and other fastenings or fittings shall be of corrosion resisting material, or of a material treated in a manner to render it resistant to corrosion. Where threaded surfaces or close fitting surfaces may require disassembly in service, an antiseize compound in accordance with MIL-A-907 shall be used. Cadmium and zinc plating are prohibited. Substitute with QQ-S-365, MIL-C-26074, or MIL-C-83488.

3.4.7 Flanges, hubs and sleeves.

3.4.7.1 Centering. Flange connections shall be provided with a rabbet or fitted bolts or dowels for centering. Rabbets shall be machined to achieve a loose diametral fit not greater than 0.001 inch total or 0.001 inch per foot of diameter, whichever is larger. Fitted bolts or dowels used in place of the rabbet fit shall maintain equal or better concentricity at the locating diameter. Dowels shall be positively secured and not rely on friction alone to prevent them from coming out.

3.4.7.2 Counterboring. Flanges for main gear clutches and clutches operating above 2200 r/rein shall be counterbored to shroud bolt head and nuts.

3.4.7.3 Hub and sleeve interface. For positive drive clutches (types V and VI), a hub and sleeve interface shall be utilized that results in a gear-type coupling constructed to transmit 120 percent full power torque (see 3 3.1). Unless otherwise specified (see 6.2), hub and sleeve material shall be in accordance with table I (see 3.2).

3.4.7.4 Hub and sleeve tooth form Teeth used shall be of the involute or modified involute form. The teeth shall accommodate the misalignment requirements (see 6 2). When crowned teeth are required, tooth crown radius shall be determined.

3.4.7.5 Wear margin. Hubs and sleeves for positive drive clutches (types V and VI) shall be designed so that replacement due to wear is not required until backlash is at least equal to design backlash plus 50 percent of case thickness for surface-hardened teeth.

3.4.7.6 Sleeve pitch diameter concentricity. For positive drive clutches (types V and VI) hubs used with main reduction gear assemblies, and for operating speeds above 2200 r/rein, the pitch diameter of sleeve teeth shall be concentric with the locating diameter within O 001 inch per foot of diameter.

3.4.7.7 Hub tooth concentricity. For positive drive clutches (types V and VI) with toothed hubs used with main reduction gear assemblies, and for all clutches operating above 2200 r/min, the pitch diameter of the hub teeth shall be concentric with the bore diameter within 0.001 inch for diameters up to 12 inches, and 0.001 inch per foot for diameters over 12 inches.

3.4.7.8 Tooth finish. Tooth contacting surfaces acting as flexible couplings shall have a surface finish of 32 roughness height rating (RHR) or better. All other tooth surfaces shall have a surface finish of 63 RHR or better

3.4.7.9 Tooth corners. Corners at ends of engaging dental teeth shall be chamfered or rounded off.

3.4.7.10 Tooth crack inspection. Teeth shall be inspected in accordance with MIL-STD-271 by the magnetic particle or liquid penetrant method after completion of machining and heat treatment.

3.4.7.11 Tooth contact. Hubs and sleeves shall be checked in an aligned position to assure that at least 80 percent of the teeth are in contact or as specified (see 6.2).

3.4.7.12 Tooth stress calaculations. Unless otherwise specified (see 6.2), calculations shall be made at 125 percent of full-power torque for propulsion clutches, and 110 percent of full-power torque for auxiliary clutches using the contractor's procedure. When calculations are for stress or percent deformation, the calculated values shall be less than allowable limits, if specified (see 6.2).

3.4.7.12.1 Tooth stress. The following calculations for dental tooth elements of clutches shall be made:

(a) Hertzian contact stress in crowned dental teeth for clutch in aligned condition with 100 percent of the teeth in contact, calculated in accordance with the following formula:

$$Sc = 2290\sqrt{T/(rRHN)}$$

Where:

Sc = contact stress, pounds per square inch
T = torque, inch-pounds
r = radius of pitch circle, inches
R = radius of tooth face crown, inches
H = active tooth height, inches
N = total number of teeth in hub or sleeve.

Unless approved by the contracting activity, the calculated value of Sc shall not exceed the following allowable values:

Minimum tooth surface hardness	Maximum allowable contact stress in pounds per square inch
28 Rc	8,000
38 Rc	12,000
49 Rc	15,000
56 Rc	18,000
59 Rc	19,500

(b) Pitch line shear stress in dental teeth for clutch in aligned condition with 100 percent of the teeth in contact.

3.4.7.13 Tooth hardness. Tooth and spline surfaces shall be hardened by nitriding or carburizing in accordance with table I, footnotes 3 and 4.

3.4.8 Use of aluminum alloys. Housing parts or guards may be made of aluminum alloy in weight critical applications (see table I), if specified (see 6.2).

3 4.8.1 Corrosion protection. In order to prevent deterioration due to corrosion, bolts, nuts, studs, pins, springs, screws, cap screws, and other fastenings or fittings used with aluminum alloy parts shall be of a corrosion resisting material, or of a material treated in a manner to render it resistant to corrosion. Aluminum alloy parts shall be anodized in accordance with MIL-A-8625 or otherwise treated by a process that provides at least equal protection against corrosion. Zinc and cadmium plating shall not be used on fasteners or other parts exposed to lubricating oil. Substitute with QQ-S-365, MIL-C-26074, or MIL-C-83488. Contact between dissimilar aluminum alloys or dissimilar metals shall be avoided as much as possible. Where assembly of dissimilar metals with aluminum alloys is unavoidable, the alloys shall have their faying surfaces anodized. Where threaded surfaces or faying surfaces may require disassembly in service, an antiseize compound in accordance with MIL-A-907 shall be used.

3.4.8.2 Fastener installation. Through bolting is preferred for the assembly of aluminum alloy parts, and is mandatory when the assemblies are highly stressed or subject to vibrating loads (see 3.4.8.1). Where the use of cap screws , stud bolts, or machine screws is necessary, parts shall be threaded into steel inserts cast or screwed into the aluminum alloy. The steel inserts shall be pinned or prick punched in such a manner to prevent their backing out. Copper alloys, such as brass or bronze, shall not be used in threaded contact with aluminum alloys.

3.4.9 Shock. Unless otherwise specified (see 6.2), clutches shall meet the shock design requirements of the parent equipment. When alternative shock design requirements are specified, they shall be in accordance with the grade A, hull-mounted requirements of MIL-S-901 Clutches shall be tested with parent equipment

3.4.10 Balance. Clutch parts rotating at more than 150 r/rein shall be balanced dynamically. The addition of weights to correct for balance after finish machining shall not be permitted. Balance shall be accomplished by removal of metal. Balancing shall be in accordance with MIL-STD-167-1.

3.4.10.1 Assembly. dynamic balance. Distance pieces with all integral parts shall be given a final dynamic balance as a unit. Clutch elements which are mounted on connected machinery shall be given a final dynamic balance with the attached machinery assembly, where possible.

3.4.10.2 Low noise or vibration requirement. When low noise or vibration requirements are imposed for parent equipment, or when in situ balancing is required for parent equipment (see 6.2), the parent equipment requirements shall also apply for the clutches.

3.4.11 Welding, brazing, and allied processes Welding, brazing and allied processes shall conform to MIL-STD-248 and MIL-STD-278.

3.4.12 Piping. Piping connections shall be in accordance with MIL-STD-438 for submarine vessel applications and MIL-STD-777 for surface vessel applications.

3.4.13 Housing. Housings, casings, covers, and bases shall be constructed of materials in accordance with table I. For applications where weight is critical, aluminum parts in accordance with table I may be used, if specified (see 3.4.8 through 3.4.8.2). Housing guards shall be removable.

3.4.14 Lifting. Provisions or arrangements shall be made for lifting parts which weigh more than 35 pounds.

3.4.15 Weight. Weight of clutches shall be plus or minus 5 percent of the weight specified on the drawings.

3.4.16 Marking.

3.4.16.1 Match marking. Parts that may affect balance if not reinstalled to their original position, or are individually fitted, shall be marked so that they may be reinstalled in their original position.

3.4.16.2 Part identification. Major clutch parts and subassemblies shall be marked to indicate contract number, manufacturer, date manufactured, and manufacturer's assembly or detail drawing number. Proprietary marking may be added at the discretion of the contractor.

3.4.16.3 Mark application. Marks shall be applied in accordance with MIL-STD-792 in an area of low stress. Depth of marking shall not exceed 0.020 inch.

3.4.17 Special features. Clutch special features shall be as specified (see 6.2).

3.5 Type I nonpositive drive hydraulic clutch (fluid drive).

3.5.1 Construction. The nonpositive drive hydraulic clutch (fluid drive) shall consist of a driving rotor or simplified centrifugal pump runner, and a driven rotor or simplified hydraulic turbine runner. Each rotor shall consist of a ring of approximately semicircular cross section. An inner ring, of approximately semicircular cross section held concentrically with the first by a number of radial ribs, may be used. The two rotors together shall form a ring of approximately circular cross section and a smaller similar ring within it. The annular space between these two rings shall thus form a closed circuit or vortex ring for the circulation of the liquid when the driving rotor is rotated. Means shall be provided to take the thrust developed by the clutch in both directions. Primary and secondary rotors shall be separated to the extent necessary to allow for thermal expansion and possible misalignment and shall be of welded construction, or machined from solid forgings, or cast of aluminum alloy, as specified (see 6.2). The clutch shall be of the twin type when necessary to reduce the overall diameter.

3.5.1.1 Oil filling. Filling of clutches shall be accomplished by admitting oil through manifolds or through a bore in the input or output shaft, as specified (see 6.2). Filling and dumping valves shall be provided. The valve controls shall be arranged so that when one valve is closed, the other is open. Valve actuation may be by electrical, pneumatic, or hydraulic operation. In addition, valves shall incorporate provision for manual operation in case of emergency. The time for clutch filling and dumping shall be as specified (see 6.2).

3.5.1.2 Oil circulation. Hydraulic clutches shall be provided with leakoff ports, fixed scoop tubes, or sliding scoop tubes for circulation of oil. Sliding scoop tubes shall be actuated hydraulically or pneumatically, as specified (see 6.2). In addition, provision shall be made for manual operation in case of emergency.

3.5.1.2.1 Slip. Unless otherwise specified (see 6.2), the percentage of slip shall not exceed 3 percent.

3.6 Type II nonpositive drive friction clutch (tire and tube).

3.6.1 Construction. Nonpositive drive friction clutches (tire and tube) shall consist of rubber tires and tubes that, when inflated with air, will engage the surface of a cast or fabricated steel drum, or will actuate the engagement of friction discs. For radial engagement with a steel drum, the interfacing surfaces of the tires and tubes shall be faced with a friction material as specified (see 6.2). Pneumatic clutches incorporating a rubber tire and tube shall be of the dry friction type. Clutches shall be arranged for either radial or axial (drum or disc) engagement. Material for discs and drums shall be as specified in table I.

3.6.1.1 Tires and tubes. Rubber tires and tubes may be thermally bonded to the driving ring or secured thereto by pins or snap rings. Rubber tires and tubes designed for axial engagement need not be bonded if retained inside a suitable housing. Each tire and tube shall be provided with a vulcanized air valve as an integral part of the tire and tube. The tires and tubes shall be in accordance with MIL-HDBK-149. The body of the tire and tube shall be constructed of multiple plies of tire cord fabric reinforcement thoroughly impregnated with rubber friction compound, laminated and integrated by vulcanization. The inner tube and cover shall consist of rubber layers vulcanized to the body.

3.6.1.2 Friction linings. Friction linings shall be of a heat-resistant, non-asbestos composition. Linings shall be one of the following types:

(a) Secured to their disc cores by riveting or thermal bonding.
(b) Thermally bonded to rubber tires and tubes.
(c) Secured to tires and tubes by pins.
(d) Of the floating plate type.
(e) Radially arranged as independent shoe and plate units positioned by driving bars.

Friction lining material shall not emit poisonous gases.

3.7 Type III nonpositive drive friction (disk, drum, or cone).

3.7.1 Construction. Nonpositive drive friction clutches shall consist of flat discs, drums, or mating cone surfaces mounted on driving and driven hubs and engaged and disengaged pneumatically or hydraulically.

3.7.1.1 Disc clutch. Disc friction clutches shall be hydraulically or pneumatically actuated and shall operate in oil unless otherwise specified (see 6.2). The construction shall incorporate alternating flat discs of steel and friction material. Cast iron discs may be used when specified (see 6.2). The friction discs shall be provided with oil grooves, or other means for cooling oil circulation.

3.7.1.2 Cone clutch. Cone friction clutches shall be hydraulically or pneumatically actuated and shall operate in oil unless otherwise specified (see 6.2). The clutch shall incorporate a driven member constructed of forged steel. The friction member shall be machined from a bronze centrifugal casting or manganese bronze forging in accordance with table I or shall be of heat-resistant, non-asbestos composition friction material thermally bonded to a forged steel drum.

3.7.1.3 Lubrication. A continuous flow of oil for cooling shall be supplied from the bearing lubricating oil system. The clutches shall use the same oil as employed for the associated equipment.

3.7.1.4 Disc and cone requirements. Discs or cones of clutches shall be moved axially for engaging and disengaging by hydraulic or pneumatic cylinder and piston assemblies. Surface finish of friction disc and cone friction surfaces shall be 63 RHR or better. Rubbing faces of discs shall be flat within 0.020 inch and parallel with 0.002 inch per foot of diameter. Cone surfaces shall have 85 percent minimum contact with mating part surfaces.

3.7.1.5 Splines. Discs and cones shall be arranged to slide axially on splines machined on shafts or sleeves as applicable. Spline teeth shall have a surface finish of 32 RHR or better and shall be surface hardened by nitriding or carburizing in accordance with table I, footnotes 3 and 4.

3.8 Type IV nonpositive drive overrunning.

3.8.1 General. Nonpositive drive overrunning clutches shall be self-synchronizing clutches constructed to automatically engage the driving and driven shafts under any condition where the driven shaft is between zero r/rein and the maximum design speed, while the driving shaft is accelerating from any speed equal to or less than the driven shaft. Nonpositive drive overrunning clutches shall also automatically disengage the driving and driven shafts, allowing the driven shaft to rotate freely relative to the drive shaft upon a reduction in the relative speed of the drive shaft.

3.8.2 Engagement. The automatic engagement and disengagement shall be independent of any speed sensing devices and shall not rely on any type of servomechanism for engagement. The driving and driven shafts shall be coupled through the engagement of elements integral to the overrunning clutch assembly Upon initial engagement, the elements shall maintain their relative positions and share the load among individual elements.

3.8.3 Lubrication. Unless otherwise specified (see 6.2), oil for lubrication and cooling shall be supplied from the parent equipment bearing lubrication system.

3.8.4 Flanges. hubs. and sleeves. Unless otherwise specified (see 6.2), flanges, hubs, and sleeves shall be as specified in 3.4.7 through 3.4.7.13.

3.9 Type V positive drive forced synchronizing clutch.

3.9.1 General. Positive drive forced synchronizing clutches shall consist of hydraulically or pneumatically actuated friction elements and gear tooth elements. The friction elements shall be constructed to synchronize the speeds of the driving and driven shafts and allow for the engagement of gear tooth elements. Gear tooth elements shall be engaged with no slippage, and shall transmit full power torque.

3.9.2 **Engagement.** Upon command, under any specified operating conditions (see 6.2), the forced synchronizing positive drive clutch shall perform the following functions:

(a) Automatically synchronize the speeds of the driving and driven shafts .
(b) Prevent premature contact of the engaging coupling teeth until synchronous speed is reached.
(c) Maintain synchronous speed during transition from friction to positive drive.
(d) Connect the driving and driven shafts for the transmission of full power by means of a gear-type coupling between the clutch sleeve and hub.

If the clutch is hydraulically engaged or disengaged, provision shall be made to prevent pressure overload of the actuating system. The maximum pressure of the actuating system shall be limited to prevent the clutch from engaging with a force or speed which would result in impact damage to the clutch or other parts of the propulsion unit.

3.9.3 Clutch sleeve position. The clutch sleeve shall be provided with a mechanism to specifically position the connecting sleeve in either the engaged or disengaged position so that the position will not change when actuation pressure is removed.

3.9.4 Flanges, hubs and sleeve. Unless otherwise specified (see 6.2), flanges, hubs and sleeves shall be as specified in 3.4.7 through 3.4.7.13.

3.9.5 Sleeve position indicator. A visual indicator shall be provided to show the position of the clutch sleeve.

3.9.6 Disengagement. Upon command, the coupling between the driving and driven shafts shall be disengaged so that the shafts may rotate independently of each other.

3.9.7 Synchronizing mechanism. The speed synchronizing elements of the clutch shall be of the friction type and shall be constructed to operate in oil. The torque required for synchronization shall be as specified (see 6.2). If the clutch is hydraulically engaged or disengaged, provision shall be made for positive separation of the clutch disks when oil pressure is relieved,

3.9.8 Balking mechanism. A positive, mechanical balking mechanism may be used to sense synchronization of shaft speeds and prevent premature engagement of the coupling teeth.

3.9.9 Actuation and control. The clutches shall be actuated pneumatically or hydraulically. The method of supplying the actuation pressure shall be as specified (see 6.2).

3.9.10 Oil for actuation. Unless otherwise specified (see 6.2), oil for actuation and cooling of a hydraulic clutch shall be the same as that used for lubricating the associated equipment.

3.9.11 Clutch controls. Clutch control shall be by means of a directional control valve or mechanical linkage. Valve or linkage shall be located as specified (see 6.2).

3.9.12 Engagement status. Clutch position shall be shown locally and remotely as approved by the contracting activity. Electro, mechanical, or proximity switch equipment as approved by the contracting activity may be used to show the clutch position.

3.10 Type VI positive drive overrunning clutch.

3.10.1 General. Positive drive overrunning clutches shall be constructed to engage driving and driven shafts under any speed between zero r/rein and maximum design engagement speed, at the instant that the speed of one shaft overtakes that of the other. The clutch shall be constructed to disengage driving and driven shafts so that either shaft may rotate freely relative to the other shaft.

3.10.2 Oil for actuation. Unless otherwise specified (see 6.2), oil used for the hydraulic servomechanism shall be the same as that used for lubricating the associated equipment.

3.10.3 Clutch controls. Clutch control shall be by means of a directional control valve, located and operated as specified (see 6.2).

3.10.4 Class A clutch. Class A clutches shall be constructed for automatic engagement and disengagement as specified in 3.10.1.

3.10.5 Class B clutch. Class B clutches shall incorporate a remotely controlled hydraulic or pneumatic servomechanism to provide the axial force required for engagement or disengagement as specified in 3.10.1.

3.10.6 Engagement. The driving and driven shafts shall be connected by means of a gear-type coupling constructed to transmit full power torque. A helical sliding spline shall provide for the movement of the clutch sleeve into engagement with the hub.

3.10.7 Flanges, hubs and sleeves. Flanges, hubs and sleeves shall be as specified in 3.4.7 through 3.4.7.13.

3.10.8 Sleeve position indicator. A visual indicator shall be provided to show the position of the clutch sleeve.

3.10.9 Synchronizing mechanism. A ratchet and pawl mechanism to sense the synchronous speed shall be incorporated as an integral part of the clutch. This mechanism shall not transmit any torque to the driven shaft at any time.

3.10.10 Ratchet and pawl mechanism. The ratchet and pawl mechanism shall be constructed for minimum wear and noise in the overrunning position. Pawls shall be located and confined by mechanical means. Spring actuation of pawls may be employed as required to assure clutch engagement or disengagement

3.10.11 Lockout device. When specified (see 6.2), a manual or servo-operated mechanism shall be provided to prevent clutch engagement. The actuated lockout device shall prevent the clutch from ratchetting as well as from engaging.

3.10.12 Lock- in device. When specified (see 6.2), a locking device shall be provided to lock the clutch into engagement when the output torque reduces or reverses. The lock-in mechanism shall prevent shuttling of the clutch sleeve under conditions of fluctuating torque. This device shall be capable of being actuated while the clutch is rotating and allow the clutch to transmit full power torque in both directions of rotation.

3.11 Environment requirements.

3.11.1 Trim, list, roll, and pitch, Clutches shall operate when the ship is operating in the condition shown in table IV or as specified (see 6.2). Trim and list or ***roll*** and pitch may occur simultaneously. Pitch and roll time cycle data shall be recorded when the pitch and roll angles specified exceed those listed in table IV.

TABLE IV. Trim, list, roll and pitch.

Condition	Surface ships (degrees)	Submarines (degrees)
Permanent trim, down bow or stern	5	30
Permanent list, port or starboard	15	15
Roll, port or starboard from even keel	45	60
Pitch, up or down from normal waterline	10	10

3.11.2 Lubricating oil temperature. Unless otherwise specified (see 6.2), oil inlet temperature to clutch under normal operating conditions shall be between 110 and 130 degrees Fahrenheit (°F). However, the clutch shall be constructed for start-up and unrestricted operation with oil inlet temperature as low as 90°F. Maximum rise between oil inlet and oil discharge temperatures from the clutch shall be not greater than 50°F.

3.11.3 Ambient temperature. Depending on the ship type, ambient engineering space temperature will range up to 150°F. Under emergency conditions (space abandoned) , temperature may rise above 200°F until heat producing equipment can be shut down. If clutch is housed by a guard or casing, ambient temperature is external to guard or casing.

3.11.4 Ambient pressure. The clutch shall be designed to operate in a specified ambient pressure range (see 6.2).

3.11.5 Atmospheric conditions. Clutches shall operate in an environment where the air will be salt laden (saltwater atmosphere) and humidity will be at or near the saturation point for long periods of time.

3.12 Special tools. Unless otherwise specified (see 6.2), special tools shall be provided to install or service the clutches. Special tools are defined es those 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)).

3.13 Workmanship. Parts shall be free of burrs, sharp edges, and damage that could make the part unsatisfactory for the purpose intended. Threaded parts and fasteners shall show no evidence of cross threading, mutilation, or burrs. Fasteners shall be torqued to prescribed limits (see 3.4.6.6).

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 (examinations and tests) 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 this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program (see 6.3) The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of the manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material. Nonconformance to requirements or defects that adversely affect operation or life shall be grounds for rejection.

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

(a) First article inspection (see 4.3).
(b) Quality conformance inspection (see 4.4).

4.3 First article inspection. First article inspection shall consist of the examinations and tests specified in table V.

TABLE V Examinations and tests.

Examination or test	Requirement	First article inspection	Quality conformance inspection
Workmanship	3.13	4.5,1	4.5.1
Material inspection	3.2 through 3.2.2.1	4.5.2	4.5.2
Welding, brazing, and allied processes	3 4.11	4.5.3	4.5.3
Castings	3.2.5	4.5.4	4.5.4
Critical fits	3.4.7.1, 34.76, 3.4.7.7	4.5.5	4.5.5
Tooth finish (types V and VI)	3.4.7.8	4.5.5.1	4.5.5.1
Weight	3 4.15	4.5.5.2	---
Surface defects	3.2.3	4.6.1 through 4.6.1.2	4.6.1 through 4.6.1.2
Tooth hardness (types V and VI)	3.4.7.13	4.6.1.3	4.6.1.3
Case depth and core hardness	3.2.4	4 6 1.4	---
Piping	3.4.12	4.6.3	4.6.3
Tooth contact (types V and VI)	3.4.7.11	4.6.2	4.6.2
Static	3.3.1.4	4.6.4	---
Shock	3.4.9	4.6.5	---
Dynamic balance	3.4.10	4.6.6 through 4.6.6.3	4.6.6 through .4.6.6.3
Special tools and lifting gear	3.4.14, 3.12	4.6.7	4.6.7
Special features	3.4.17	4.6.8	---

4.4 Quality conformance inspection. Quality conformance inspection shall be performed on all clutch assemblies or parts and shall consist of applicable examinations and tests specified in table V (see 6.3) Nonconformance of parts or procedures to quality conformance requirements shall be rejected.

4.5 Examinations.

4.5.1 General. Parts shall be examined to determine conformance to 3 13.

4.5.2 Materials inspection. Materials inspection shall consist of certification that the materials listed in tables I and II are in accordance with the applicable referenced specification (see 6.3)

4.5.3 **Welding, brazing, and allied processes.** Examinations and test procedures for welding, brazing, and allied processes shall conform to MIL-STD-278.

4.5.4 Castings. Castings shall be inspected in accordance with MIL-STD-278.

4.5.5 Measurement of critical fits. Critical fits shall be measured to assure satisfactory installation.

4.5.5.1 RHR. Hub and sleeve tooth surfaces shall be inspected in accordance with ANSI B46.1 to assure that they conform to the tooth finish specified.

4.5.5.2 Weight. The first article shall be weighed. Any change of weight or center of gravity which will result in more than a 5 percent increase in weight or change to the center of gravity during the design stage shall be reported as soon as it is known.

4.6 Tests.

4.6.1 Nondestructive tests of metals. Nondestructive tests shall conform to MIL-STD-271.

4.6.1.1 Ultrasonic and radiographic tests. Castings and forgings shall be ultrasonically or radiographically tested in accordance with MIL-STD-271. Ultrasonic testing shall be in both radial and longitudinal directions using either a shear or longitudinal wave, depending on the geometry of the item.

4.6.1.2 **Magnetic particle or liquid penetrant inspection.** Teeth of hubs, sleeves, and all shafts shall be subjected to inspection by the magnetic particle or liquid penetrant method in accordance with MIL-STD-271. Nonmagnetic material shall be subjected to inspection by the liquid penetrant method.

4.6.1.2.1 Residual magnetism. Residual magnetism of magnetic parts after finish machining and demagnetization following magnetic particle inspection shall not exceed 10 gauss.

4.6.1.3 Tooth hardness, surface hardened material. Tooth hardness shall be determined by the contractor's method in accordance with 4.6.1.4, but shall not cause damage to or upset metal in teeth.

4.6.1.4 Case depth, case and core hardness. Case depth and case hardness of surface hardened teeth shall be determined from a coupon piece or lug obtained from the same heat and lot as the actual clutch part. The coupon piece or lug shall have been processed together with the clutch part through the complete heat-treat cycle. Determination of surface hardness and case depth shall take account of effects of final machining or other processes used to achieve the final tooth profile in the case hardened regions. Core hardness shall be determined on the actual parts. Readings shall be taken by contractor's method but shall not damage or upset metal in clutch teeth. No measurements are to be taken on active surfaces of teeth.

4.6.2 Tooth contact check. Clutches which use dental type tooth connections shall be checked for tooth contact to determine conformance to 3 4.7.11.

4.6.3 Piping. Piping shall be inspected in accordance with the applicable material specifications and MIL-STD-278, except as follows:

(a) Small sections of low pressure piping (such as lube oil) shall not require hydrostatic tests. Magnaflux inspection of welds is acceptable.
(b) Piping which is furnished in sections which shall be fitted and welded to form final assembly by the shipbuilder and which will be hydrostatically tested by the shipbuilder shall not require hydrostatic tests by the manufacturer.

4.6.4 Static test. The first article of each type clutch design shall be statically tested at 200 percent of rated torque from the parent equipment for 1 minute to determine conformance to 3.3.1 4. For examination and failure to pass examination, see 4.6.4.1.

4.6 4.1 Examination after static test Clutches shall be examined for deformation, cracks, extrusion, loosening of fasteners, displacement of snap rings and other damage that is visible. Any of the foregoing or other defects which would adversely affect operation or life shall be cause for rejection.

4.6 5 Shock test Clutches shall be tested with parent equipment. Acceptance criteria shall be specified in accordance with MIL-S-901 (see 3.4.9).

4,6.5.1 Examination after shock test. Clutches shall be examined for deformation, cracks, extrusion, loosening of fasteners, displacement of snap rings and other damage that is visible. Any of the foregoing or other defects which would adversely affect operation or life shall be cause for rejection. Tooth and rubber elements shall be examined in accordance with 4.6.6.2.

4.6 6 Dynamic tests. Clutches shall be tested with the parent equipment Also, unless otherwise specified (see 6.2) each new clutch design shall successfully pass a 4000 cycle engagement/disengagement test under conditions simulating actual clutch operation.

4 6 6.1 Inspection during dynamic tests. During the dynamic tests, a check shall be made of the clutches for the following:

(a) Adequate lubrication.
(b) Quiet running.
(c) Freedom from vibration.
(d) Wearing of parts.
(e) Tightness of casing and piping connections.
(f) Adequacy of oil seals.

4.6.6.2 Examination after dynamic tests. Dental tooth type connections shall be examined for distress as specified in NAVSEA 0901-LP-420-0007, chapter 9420. Rubber elements shall be examined for deformation, cracks, and extrusion.

4.6 6.3 Failure to pass examination after dynamic tests. Evidence of probable unsatisfactory operation in service apparent on the dynamic tests shall be considered cause for rejection of the clutch.

4.6.7 Special tools and lifting gear. verification of suitability. Special tools and lifting gear provided for clutches shall be demonstrated on the first article to assure that they are satisfactory for their intended purpose.

4.6.8 Special feature demonstration. Clutch special features shall be demonstrated (for example, disconnect and reconnect features) during dynamic test period and under static conditions when applicable.

4.7 Acceptance trials. Clutches shall be examined during in-port period for defects (see 4.6.6.2) after completion of first or prototype ship full power and maneuvering acceptance trials or as specified (see 6.2). Failure to pass examination shall be as specified (see 4.6.6.3 and 6.2).

4.8 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 7.)

5.1 Preservation. packing. and marking.

5.1.1 **Equipment**. Clutches, stock components, and repair parts shall be preserved, packed, and marked as required by the parent equipment specifications (see 6.2). When such instructions are not otherwise provided, preservation and packing shall be in accordance with MIL-T-17286 to the following levels which are specified for the destination or intended use of the parts:

Destination	Preservation level	Packing level
On board	A	C
Stock	A	B
Immediate use	C	C

5.1.2 **Lifting gear and tools**. Unless used in sets, pairs, or quantities greater than one, or as specified in the contract or order (see 6.2) lifting gear and tools shall be individually preserved. When the unit is packaged as a set, assembly, or quantities greater than one, each item shall be wrapped or cushioned to prevent direct surfaces contact with surfaces of adjacent parts.

5.1.3 Talc or talcum. When used in the packaging process of items, talc or talcum shall be free of asbestos and asbestiform-like materials.

5.1.4 Marking. Marking for shipment and storage shall be in accordance with requirements of the parent equipment specification (see 6.2). When requirements are not otherwise provided, marking shall be in accordance with MIL-STD-129.

5.1.5 Depreservation. The contractor shall provide depreservation instructions in each container. These instructions shall also be provided when shipment is made.

5.1.6 Unpacking. Clutch containers shall be marked and unpacking instructions provided when normal unpacking procedures may damage the container contents. Instructions shall be placed in a sealed waterproof envelope prominently marked "UNPACKING INSTRUCTIONS" and the envelope shall be firmly affixed to the outside.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. This specification is intended to be applied to clutches for service on propulsion units for Navy ships. The intended arrangements and details are those of conventional design (similar units having been built previously and installed on board Navy ships or comparable commercial ships). When a departure from conventional design is contemplated, consideration should be given to applying this specification as a general guide for construction of a prototype. The prototype shall be tested and evaluated to assure that it is suitable for Navy use prior to the manufacture of production models.

6.2 Acquisition requirements. Acquisition documents must specify the following:

(a) Title, number, and date of this specification.
(b) Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2,1.1 and 2.2).
(c) Clutch required; type and class (when applicable) (see 1.2).
(d) If first article inspection is required (see 3.1).
(e) Clutch materials required, if other than those of tables I and II (see 3.2).
(f) Whether cast iron parts are permitted (see 3 2.1).
(g) Design torque load if other than 120 percent of full power torque and when clutch requirements are needed (see 3.3.1).
(h) Over torque number and frequency of occurrence (see 3.3.1.4).
(i) Misalignment requirements (see 3.3.1.4, 3.4.7.4 and 6.11).
(j) If retaining nuts are required for splined or shrunk shafts (see 3.4.3.1).
(k) When lube oil is not supplied from propulsion gear or parent equipment system (see 3.4.5 and 3.8.3).
(l) Tooth contact requirements, type V and VI (see 3.4.7.11).
(m) Percentage of full-power torque, if other than as specified (see 3.4.7.12).
(n) Allowable tooth stress limits if calculations are to be compared to allowable limits (see 3.4.7.12).
(o) Whether aluminum alloys are permitted for weight critical housing parts or guards (see 3.4.8).
(p) Shock design, test, and acceptance requirements if other than parent equipment requirements (see 3.4.9).
(q) Clutch special features (see 3.4.17).
(r) Ambient pressure range of the clutch environment (see 3.11.4).
(s) Type of rotor construction, type I (see 3.5.1).
(t) Oil filling method, oil filling and dumping time (see 3.5.1.1).
(u) Type of actuation, sliding scoop tubes (see 3.5.1.2).

(v) Percentage of slip if greater than 3 percent (see 3.5.1.2.1).
(w) Friction material, type II (see 3.6.1).
(x) If cast iron discs may be used, type III (see 3.7.1.1).
(Y) Whether clutches shall operate in oil, type III (see 3.7.1.1 and 3.7.1.2).
(z) Requirements for flanges, hubs, and sleeves if not as specified (see 3.8.4 and 3.9.4).
(aa) Synchronizing torque (see 3.9.7).
(bb) Actuation pressure and medium (see 3.9.9 and 3.10.5).
(cc) When hydraulically actuated and cooling oil is not the same as that used for lubricating the associated equipment (see 3.9.10 and 3.10.2).
(dd) Location and operation of directional control valve (see 3.9.11 and 3.10.3).
(ee) When a lockout mechanism (see 3.10.11) or a lock-in device (see 3.10.12) is to be provided and whether the method of actuation is manual or servo-operated.
(ff) Trim, list, roll, and pitch, if other than table IV (see 3.11.1).
(gg) Lubricating oil inlet temperature (see 3.11.2).
(hh) If special tools required for maintenance, operation or installation are not to be provided (see 3.12).
(ii) If anti-friction lining material is other than the material specified in table I (see 3.4.4.1).
(jj) If hub and sleeve material is other than the material specified in table I (see 3.4.7.3).
(kk) Parent equipment requirements apply for the following except when deleted or when substitute requirements are provided herein.

(1) Operating conditions (see 3.3.1 and 3.9.2).
(2) Operating speed range, r/rein (see 3.3.1.1(a)).
(3) Horsepower, r/rein, alignment (where applicable) and other requirements for clutch design (see 3.3.1.1, 3.3.1.2, 3.3.1.3, and 3.9.7).
(4) Life endurance in terms of operating hours and number of engagement and disengagement cycles expected at different power levels over the life of the clutch (see 3.3.1.3).
(5) Safety objectives (guards, casings, or shields) furnished by the shipbuilder or parent equipment contractor unless otherwise indicated (see 3.3.3.1).
(6) LOW noise, vibration or in situ balancing (see 3.4.10.2).
(7) If cyclic testing is not required (see 4.6.6).
(8) Examinations after ship trials (see 4.7).
(9) Level of presentation and packing (see 5.1.1 and 5.1.2)
(10) Marking for shipment and storage (see 5.1.4).
(11) Clutch control requirements and additional indicating lights (see 3.4.2).

6.3 Consideration of data requirements. The following data requirements should be considered when this specification is applied on a contract, The applicable Data Item Descriptions (DID's) should be reviewed in conjunction with the specific acquisition to ensure that only essential data are requested/provided and that the DID's are tailored to reflect the requirements of the specific

acquisition. To ensure correct contractual application of the data requirements, a Contract Data Requirements List (DD Form 1423) must be prepared to obtain the data, except where DoD FAR Supplement 27.475-1 exempts the requirement for a DD Form 1423.

Reference Paragraph	DID Number	DID Title	Suggested Tailoring
3.3.1 and appendix A	DI-GDRQ-80650	Design data and calculations	----
3.3.2.3	UDI-S-21202	Analysis data, maintenance engineering	----
3.3.2.3	UDI-R-23096	Report, reliability and maintainability data	----
3.3.3.2	DI-SAFT-80100	System safety program plan	----
3.4 and appendix B	DI-DRPR-80651	Engineering drawings	----
4.4	DI-T-5329	Inspection and test reports	----
4.5 2	DI-MISC-80678	Certification data/report	----

The above DID's were those cleared as of the date of this specification. The current issue of DoD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DID's are cited on the DD Form 1423.

6.4 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 that have been cleared and listed in DoD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL) must be listed on a separate Contract Data Requirements List (DD Form 1423), which is included as an exhibit to the contract. The technical manuals must be acquired under separate contract line item in the contract.

6.5 First article. When first article inspection is required, the contracting officer should provide specific guidance to offerors whether the item(s) should be a preproduction sample, a first article sample, a first production item, a sample selected from the first production items, a standard production item from the contractor's current inventory (see 3.1), and the number of items to be tested as specified in 4.3. The contracting officer should also include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results, and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract. Bidders should not submit alternate bids unless specifically requested to do so in the solicitation.

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

6.6.1 Spare parts. When ordering spare parts or repair parts for the equipment covered by this specification, the contract should state that such spare parts and their 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.

6.7 Sub-contracted material and marts. 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.

6.8 Definitions.

6.8.1 Positive drive clutch. A positive drive clutch is a clutch which transmits torque through dental teeth or toothed members without slip.

6.8.2 Nonpositive drive clutch. A nonpositive drive clutch is a clutch which transmits torque through synchronizing elements such as friction plates, drums, cones, spragues, wedging elements, or through a hydraulic fluid drive (type I).

6.8.3 Overrunning clutch. A nonpositive overrunning clutch (the IV) is a clutch whose output free wheels when turning faster than the clutch input, and which, upon accelerating the input up to output speed, will engage and transmit input torque, or one whose input shaft free wheels when turning faster than the output shaft, and engages and transmits input torque when the input shaft decelerates to the same speed as the output shaft.

6.8.4 Case depth. Case depth is defined as the depth at which:

(a) For carburized parts - case hardness is Rockwell C50 or 5 points less than the surface hardness, whichever is smaller.
(b) For nitrided parts - case hardness is 110 percent of core hardness

6.9 Cross reference of classification. The following is a cross reference of classification between the clutches of MIL-C-18087 and this revision:

MIL-C-18087	MIL-C-18087A
Type IV - Hydraulic (fluid drive)	Type I - Nonpositive drive hydraulic (fluid drive)
Type V - Friction (hydraulically or pneumatically actuated)	Type III - Nonpositive drive friction (disc, drum, or cone)
Type VI - Friction (pneumatically actuated)	Type II - Nonpositive drive friction (tire and tube)
Type VII - Positive drive	Type V - Positive drive forced synchronizing
No reference	Type IV - Nonpositive drive overrunning
No reference	Type VI - Positive drive overrunning

The coupling requirements covered by MIL-C-18087(SHIPS) dated 7 March 1955 are covered by MIL-C-23223.

6.10 **Substitute materials approval**. Contractors who anticipate bidding to this specification may obtain from the command or agency concerned "across-the-board" approval of commercial or contractor specification materials, including test and examination requirements, to be used in lieu of the Government specification requirements referred to herein. The approval of substitute material must represent no present or predicted cost increase to the contracting activity.

6.10.1 substitute materials when bidding. Contractors who anticipate using substitute materials should Indicate these materials as alternatives in the bid proposal. Prior approval should be indicated, where applicable, by citing approval letters. The material substitutions will be approved or not approved in whole or in part by the contracting activity. Such approval applies only to a specific purchase or contract.

6.11 Misalignment values. Misalignment values should be provided to the contracting activity and should contain the following information:

(a) Normal misalignment.
(b) Maximum continuous misalignment.
(c) Maximum transient misalignment.
(d) Expected axial movement.

6.12 Fastener installation torque. Installation torque limits and thread lubricant requirements should be specified in the technical manuals for all threaded fasteners.

6.13 Tooth hardness data. When requested by the Government inspector or contracting activity, test reports should include tooth hardness data for case hardened material.

6.14 Subject term (key word) listing.

Casings
Drums
Hubs
Pins
Pistons
Rotors
Shafts
Tube, scoop

6.15 **Changes from previous issue**. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Preparing activity:
Navy - SH
(Project 3010-N010)

APPENDIX A

DESIGN DATA AND CALCULATIONS TECHNICAL CONTENT REQUIREMENTS

10. SCOPE

10.1 Scope. This appendix covers the design data and calculations technical content requirements that should be included when required by the contract or order. This appendix is mandatory only when data item description DI-GDRQ-80650 is cited on the DD Form 1423.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. DESIGN DATA AND CALCULATIONS TECHNICAL CONTENT

30.1 When required by the contract or order, design data and calculations shall contains the following information:

(a) Allowable limits, when not specified in the specification or in the contract or order shall be proposed with supporting justification by the contractor for approval by the contracting activity.
(b) Calculations shall be provided in sufficient detail for review by the contracting activity.
(c) When crowned teeth are required, tooth crown radius shall be provided.

APPENDIX B

ENGINEERING DRAWINGS TECHNICAL CONTENT REQUIREMENTS

10. SCOPE

10.1 Scope. This appendix covers the technical content requirements that should be included on drawings when required by the contract or order. This appendix is mandatory only when data item description DI-DRPR-80651 is cited on the DD Form 1423.

20. APPLICABLE DOCUMENTS

20.1 Government documents.

20.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

SPECIFICATIONS

MILITARY

MIL-T-31000 - Drawings, Engineering and Associated Lists

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, BLDG. 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

30. DRAWINGS

30.1 Drawing desire information Drawings shall contain sufficient design information to permit shipbuilders to make a satisfactory installation onboard ship and to design supporting systems. This information shall include, but not be limited to, the following:

(a) Mass moments of inertia for the clutch rotating parts in operating condition about three mutually perpendicular axes with the origin at the center of gravity of the unit as mounted. Orientation of the axes shall be indicated with respect to the equipment and ship with one axis being the longitudinal axis of the clutch.
(b) Axial, lateral, and torsional stiffness of the clutch in operating condition.
(c) Interface dimensions and location.
(d) Lifting points and required loads.
(e) Outline drawings and assembly drawings as applicable shall contain the outline dimensions, weights, and center of gravity locations for the clutch and controller. A notation of any change in weight or location of center of gravity due to modifications listed in the revision columns of the drawing shall also be listed therein

and copies shall be forwarded to the purchaser. Components comprising the assembled equipment for the first clutch and controller supplied by the Vendor, when ready for shipment, shall be weighed and actual weights and correlated locations of the center of gravity shall be entered as a revision to the applicable outline or assembly drawing.

(f) Parts illustrations, with parts list and quantities required for makeup of component.

(g) Installation torque limits and thread lubricant requirements for all threaded fasteners.

(h) Wiring and piping diagrams where applicable.

(i) Maintenance and repair procedures. (Routine adjustments, including all disassembly/reassembly steps and related safety precautions, post repair tests, and alignments or calibration when applicable.)

(j) All component materials.

(k) Tooth harnesses when applicable.

(1) Permissible amount of unbalance in inch-ounces.

(m) Lubrication requirements for the clutch and control system for all operating modes and ambient conditions specified herein.

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document numb letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or c requirements on current contracts. Comments submitted on this form do not constitute or imply au waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER	2. DOCUMENT DATE (YYM

3. DOCUMENT TITLE

4. NATURE OF CHANGE (*Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as need*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle Initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (If applicable)	7. DATE (YYM

8. PREPARING ACTIVITY

a. NAME Technical Point of Contact (TPOC): Mr. Dennis Spirides (SEA 56X44) PLEASE ADDRESS ALL CORRESPONDENCE AS FOLLOWS:	b. TELEPHONE (Include Area Code) (1) Commercial (2) AUT TPOC: 703-602-9468 8-3
c. ADDRESS (Include Zip Code) Commander, Naval Sea Systems Command Department of the Navy (SEA 5523) Washington, DC 20362-5101	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAY Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA Telephone (703) 756-2340 AUTOVON 289-234