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An American National Standard

Standard Specification for Rotary Positive Displacement Distillate Fuel Pumps[1]

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1. Scope

1.1 This specification covers the requirements applicable to the design and construction of rotary positive displacement distillate fuel pumps for shipboard use.

1.2 Lineal dimensions and units of force in this specification are expressed as inches and pounds respectively. A companion metric standard is in the process of preparation.

2. Referenced Documents

2.1 *ASTM Standards:*

A 36/A 36M Specification for Carbon Structural Steel[2]

A 53/A 53M Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless[3]

A 106 Specification for Seamless Carbon Steel Pipe for High-Temperature Service[3]

A 193/A 193M Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service[3]

A 194/A 194M Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both[3]

A 240/A 240M Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels[4]

A 269 Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service[3]

A 276 Specification for Stainless Steel Bars and Shapes[4]

A 312/A 312M Specification for Seamless and Welded Austenitic Stainless Steel Pipes[3]

A 354 Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners[5]

A 434 Specification for Steel Bars, Alloy, Hot-Wrought or Cold-Finished, Quenched and Tempered[6]

A 449 Specification for Quenched and Tempered Steel Bolts and Studs[5]

A 563 Specification for Carbon and Alloy Steel Nuts[5]

A 564/A 564M Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes[4]

A 574 Specification for Alloy Steel Socket-Head Cap Screws[5]

A 582/A 582M Specification for Free-Machining Stainless Steel Bars[4]

A 743/A 743M Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application[7]

A 747/A 747M Specification for Steel Castings, Stainless, Precipitation Hardening[7]

B 148 Specification for Aluminum-Bronze Sand Castings[8]

B 150 Specification for Aluminum Bronze Rod, Bar, and Shapes[8]

B 209 Specification for Aluminum and Aluminum-Alloy Sheet and Plate[9]

B 221 Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes[9]

B 271 Specification for Copper-Base Alloy Centrifugal Castings[8]

B 505 Specification for Copper-Base Alloy Continuous Castings[8]

B 584 Specification for Copper Alloy Sand Castings for General Applications[8]

D 1418 Practice for Rubber and Rubber Lattices— Nomenclature[10]

D 2000 Classification System for Rubber Products in Automotive Applications[11]

D 3951 Practice for Commercial Packaging[12]

F 104 Classification System for Nonmetallic Gasket Materials[11]

F 467 Specification for Nonferrous Nuts for General Use[5]

F 468 Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use[5]

F 593 Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs[5]

F 594 Specification for Stainless Steel Nuts[5]

[1] This specification is under the jurisdiction of ASTM Committee F25 on Ships and Marine Technology and is the direct responsibility of Subcommittee F25.11 on Machinery.

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[2] *Annual Book of ASTM Standards*, Vol 01.04.

[3] *Annual Book of ASTM Standards*, Vol 01.01.

[4] *Annual Book of ASTM Standards*, Vol 01.03.

[5] *Annual Book of ASTM Standards*, Vol 15.08.

[6] *Annual Book of ASTM Standards*, Vol 01.05.

[7] *Annual Book of ASTM Standards*, Vol 01.02.

[8] *Annual Book of ASTM Standards*, Vol 02.01.

[9] *Annual Book of ASTM Standards*, Vol 02.02.

[10] *Annual Book of ASTM Standards*, Vol 09.01.

[11] *Annual Book of ASTM Standards*, Vol 09.02.

[12] *Annual Book of ASTM Standards*, Vol 15.09.

F 837 Specification for Stainless Steel Socket Head Cap Screws[5]
F 880 Specification for Stainless Steel Socket-Set Screws[5]
F 912 Specification for Alloy Steel Socket Set Screws[5]
F 1511 Specification for Mechanical Seals for Shipboard Pump Applications[13]
2.2 *ANSI Standard:*[14]
B16.24 Pipe Flanges and Flanged Fittings
2.3 *ANSI/HI Standard:*[14]
3.6 Rotary Pump Tests
2.4 *AMS Standards:*[15]
3215 Acrylonitrile Butadiene (NBR) Rubber Aromatic Fuel Resistant 65-75
4676 Bars and Forgings, Corrosion Resistant, Hot Finished, Precipitation Hardenable 66.5 Ni, 3.0 AL, 0.62 Ti, 28 Cu
4677 Bars and Forgings, Corrosion Resistant, Annealed 66.5 Ni, 2.9 AL, 30 Cu
5894 Bars, Sheet, and Plate, Alloy 60 Co, 28 Cr, 4.5 W, 1.15 C, Solution Heat Treated
2.5 *AFBMA Standards:*[16]
9 Load Ratings and Fatigue Life for Ball Bearings
11 Load Ratings and Fatigue Life for Roller Bearings
2.6 *AGMA Standard:*[17]
390.03 Gear Classification, Materials and Measuring Methods for Unassembled Gears
2.7 *Military Standards:*[18]
MIL-STD-167-1 (Ships) Mechanical Vibrations of Shipboard Equipment (Type 1—Environmental and Type 2—Internally Excited)
MIL-STD-740-1 (Ships) Airborne Sound Measurements and Acceptance Criteria of Shipboard Equipment
MIL-STD-740-2 (Ships) Structureborne Vibratory Acceleration Measurements and Acceptance Criteria of Shipboard Equipment
2.8 *Military Specifications:*[18]
MIL-N-25027 Nut, Self-Locking, 250°F, 450°F and 800°F, 125 KSI FTU, 60 KSI FTU and 30 KSI FTU
MIL-S-901 Shock Tests, HI (High Impact) Shipboard Machinery, Equipment and Systems, Requirements for Navy
MIL-R-83248 Rubber Fluorocarbon Elastomer, High Performance Fluid, and Compression Set Resistant
2.9 *International Standards Organization Standards:*[14]
ISO 9001 Quality Systems and Quality Assurance—Design/Development, Production, Installation, and Service
ISO 9066 Information Processing Systems—Text Communication—Reliable Transfer—Part 2: Protocol Specification

3. Terminology

3.1 *Definitions:*

3.1.1 *capacity*, *n*—the quantity of fluid actually delivered per unit of time at the rated speed, including both the liquid and dissolved or entrained gases, under stated operating conditions.

3.1.2 *Discussion*—In the absence of any gas or vapor entering or forming within the pump, the capacity is equal to the volume displaced per unit of time, less slip.

3.1.3 *capacity, maximum*, *n*—the quantity of fluid delivered that does not exceed the limit determined by the formula in 4.1.2.1.

3.1.4 *capacity, rated*, *n*—the minimum quantity of fluid delivered at the specified conditions of discharge pressure, inlet pressure and viscosity as shown in Table 1.

3.1.5 *displacement*, *n*—the volume displaced per revolution of the rotor(s).

3.1.6 *Discussion*—In pumps incorporating two or more rotors operating at different speeds, the displacement is the volume displaced per revolution of the driving rotor. Displacement depends only on the physical dimensions of the pumping elements.

3.1.7 *dry operation*, *n*—a brief run during priming or stripping with suction and discharge lines unrestricted and pump chamber wet with liquid but pumping only air or vapor available from the suction.

3.1.8 *efficiency, mechanical*, *n*—the ratio of the pump power output (hydraulic horsepower) to the pump power input (brake horsepower) expressed in percent.

3.1.9 *efficiency, volumetric*, *n*—the ratio of the pump's capacity to the product of the displacement and the speed expressed in percent.

3.1.10 *fuel, clean*, *n*—fuel purified for direct use.

3.1.11 *fuel, dirty*, *n*—fuel before purification that may contain water and some solids.

3.1.12 *net positive inlet pressure available (NPIPA)*, *n*—the total inlet pressure available from the system at the pump inlet connection at the rated flow, minus the vapor pressure of the liquid at the pumping temperature.

3.1.13 *net positive inlet pressure required (NPIPR)*, *n*—the net pressure above the liquid vapor pressure at rated flow and pumping temperature and at the pump inlet connection required to avoid performance impairment due to cavitation.

3.1.14 *pressure, cracking*, *n*—sometimes called set pressure, start-to-discharge pressure, or popping pressure; the pressure at which the relief valve just starts to open.

3.1.15 *Discussion*—This pressure cannot be determined readily in a relief valve that bypasses the liquid within the pump.

3.1.16 *pressure, differential*, *n*—the difference between discharge pressure and inlet pressure.

TABLE 1 Pump Sizes

Size	A	B	C	D	E	F	G	H
Rated capacity (gpm)	10	25	50	75	100	200	300	400
Maximum capacity (gpm)	13	30	59	86	114	221	328	433
Flange rating (lb)	150	150	150	150	150	150	150	150

[13] *Annual Book of ASTM Standards*, Vol 01.07.
[14] Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.
[15] Available from Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096.
[16] Available from Anti-Friction Bearing Manufacturers Association, 1101 Connecticut Ave., NW, Suite 700, Washington, DC 20036.
[17] Available from American Gear Manufacturers Association, Suite 1000, 1901 N. Fort Myer Dr., Arlington, VA 22209.
[18] Available from Standardization Documents Order Desk, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

3.1.17 *pressure, discharge*, *n*—the total pressure at the outlet of the pump; discharge pressure is sometimes called outlet pressure.

3.1.18 *pressure, inlet*, *n*—the total pressure at the inlet of the pump. Inlet pressure is sometimes called suction pressure.

3.1.19 *pressure, maximum allowable working*, *n*—the maximum continuous pressure for which the manufacturer has designed the equipment (or any part to which the term is referred) when handling the specified fluid at the specified temperature.

3.1.20 *Discussion*—This pressure should not be greater than two thirds of the hydrostatic test pressure of the pressure containing parts.

3.1.21 *rated condition*, *n*—defined by discharge pressure, inlet pressure, capacity, and viscosity.

3.1.22 *rotary pump*, *n*—a positive displacement pump consisting of a casing containing gears, screws, lobes, cams, vanes, shoes, or similar elements actuated by relative rotation between the drive shaft and the casing.

3.1.23 *Discussion*—There are no inlet and outlet valves. These pumps are characterized by their close running clearances.

3.1.24 *slip*, *n*—the quantity of fluid that leaks through the internal clearances of a rotary pump per unit of time.

3.1.25 *Discussion*—Slip depends on the internal clearances, the differential pressure, the characteristics of the fluid handled and in some cases, the speed.

3.1.26 *speed, maximum allowable*, *n—in revolutions per minute*, the highest speed at which the manufacturers' design will permit continuous operation.

3.1.27 *speed, minimum allowable*, *n—in revolutions per minute*, the lowest speed at which the manufacturers' design will permit continuous operation.

3.1.28 *speed, rated*, *n*—the number of revolutions per minute of the driving rotor required to meet the rated conditions.

3.1.29 *suction lift*, *n*—a term used to define a pump's capability to induce a partial vacuum at the pump inlet.

3.1.30 *temperature, maximum allowable*, *n*—the maximum continuous temperature for which the manufacturer has designed the equipment (or any part to which the term is referred) when handling the specified fluid at the specified pressure.

3.1.31 *unit, pump*, *n*—the pump and motor assembly; it also includes a gear box, base, couplings, guards, as required.

4. Classification

4.1 Pumps shall be classified as follows:

4.1.1 *Types*:

4.1.1.1 *Type II*—Screws with timing gears.

4.1.1.2 *Type III*—Screws without timing gears.

4.1.1.3 *Type IV*—Impellers with timing gears.

4.1.1.4 *Type V*—External gear (spur, helical, herringbone, lobe).

4.1.1.5 *Type VIII*—Internal gear, internal rotary lobe.

4.1.1.6 *Type X*—Vane (sliding).

4.1.1.7 *Type XI*—Sliding shoe.

4.1.2 *Sizes*:

4.1.2.1 Standard pump sizes shall be as shown in Table 1. Rated capacity shall be based on 150-psig discharge pressure, 10-psia inlet pressure and 32-SSU viscosity (1034-kPa gage, 69 kPa absolute, and 2 centistoke, respectively). Rated capacity equals the minimum capacity. The maximum capacity shall not exceed the amount determined by the following formula:

$$Q_{max} = Q\left[1 + \frac{1}{1 + Q^{0.4}}\right] \quad (1)$$

where:

Q = the rated capacity (minimum capacity) and

Q_{max} = maximum allowable capacity, at 32-SSU viscosity $Q_{\max}$ shall be rounded to nearest whole number.

5. Ordering Information

5.1 The ordering activity is to provide the following information to the potential bidders:

5.1.1 Title, number, and date of specification.

5.1.2 Type and size of each pump (see Section 4).

5.1.3 Quantity of each pump type and size (see Table 1).

5.1.4 Mounting configuration (vertical, horizontal).

5.1.5 Motor characteristics and specifications (see 7.6 and motor specification if applicable).

5.1.6 Discharge pressure.

5.1.7 System relief valve cracking pressure and full flow bypass pressure (see 7.6 and 7.15).

5.1.8 Preservation, packaging, packing, and boxing requirements (see Section 14).

5.1.9 Quantity of drawings (see 13.2).

5.1.10 Quantity of manuals (see 13.3).

5.1.11 Format and quantity of each type of test report (see 12.1.1.4 and S12.3.8).

5.1.12 Shock, noise, and vibration requirements, if applicable (see S12.3).

5.1.13 Types of certified data required (see 12.1.2).

5.1.14 Instruction plates and locations, if required.

5.1.15 Define shipbuilding specification, if applicable (see 13.1).

6. Materials

6.1 Pump component parts shall be constructed of the materials shown in Table 2.

7. General Requirements

7.1 Pumps shall be designed to pump distillate fuel and aviation turbine fuel with a viscosity range of 32 to 100 SSU (2 to 21 cSt).

7.2 Pumps shall be capable of sustained operation during inclinations up to 45° in any direction.

7.3 The pumps shall be capable of withstanding environmental vibration induced by shipboard machinery and equipment in the frequency range of 4 to 25 Hz.

7.4 The internally excited vibration levels of the pump shall not exceed 0.003-in. (0.076-mm) displacement peak to peak during rated operation when readings are measured on the pump case near the coupling perpendicular to the pump shaft.

7.5 At the conditions in 4.1.2, the airborne noise level of the pump unit shall meet the requirements in Table 3.

7.6 The pump shall be driven by an electric motor. The driver shall be sized for maximum flow at the relief valve full flow bypass pressure, at maximum viscosity.