



Designation: F1510 – 07 (Reapproved 2019)

An American National Standard

Standard Specification for Rotary Positive Displacement Pumps, Ships Use¹

This standard is issued under the fixed designation F1510; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification defines the requirements applicable to design and construction of rotary positive displacement pumps for shipboard use. The classes of service are shown in Section 4.

1.2 This specification will not include pumps for hydraulic service or cargo unloading applications.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

- A27/A27M Specification for Steel Castings, Carbon, for General Application
- A36/A36M Specification for Carbon Structural Steel
- A48/A48M Specification for Gray Iron Castings
- A53/A53M Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- A159 Specification for Automotive Gray Iron Castings
- A193/A193M Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications

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 and Piping Systems.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

- A194/A194M Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
- A322 Specification for Steel Bars, Alloy, Standard Grades
- A354 Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners
- A395/A395M Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
- A434 Specification for Steel Bars, Alloy, Hot-Wrought or Cold-Finished, Quenched and Tempered
- A449 Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
- A515/A515M Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
- A536 Specification for Ductile Iron Castings
- A563 Specification for Carbon and Alloy Steel Nuts
- A564/A564M Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes
- A574 Specification for Alloy Steel Socket-Head Cap Screws
- A582/A582M Specification for Free-Machining Stainless Steel Bars
- A743/A743M Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application
- B150M Specification for Aluminum Bronze, Rod, Bar, and Shapes [Metric] (Withdrawn 2002)³
- B584 Specification for Copper Alloy Sand Castings for General Applications
- D1418 Practice for Rubber and Rubber Latexes—Nomenclature
- D2000 Classification System for Rubber Products in Automotive Applications
- D3951 Practice for Commercial Packaging
- F104 Classification System for Nonmetallic Gasket Materials

³ The last approved version of this historical standard is referenced on www.astm.org.



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F912 Specification for Alloy Steel Socket Set Screws

F1511 Specification for Mechanical Seals for Shipboard
Pump Applications

iTeh Standards
(<https://standards.iteh.ai>)
Document Preview

[ASTM F1510-07\(2019\)](#)

<https://standards.iteh.ai/catalog/standards/sist/86802028-478d-4b75-ac90-b62a90944ecf/astm-f1510-072019>

2.2 ASME Standard:⁴

ASME B16.5 Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard

2.3 SAE Standards:⁵

SAE AS 568A Aerospace Size Standard for O-Rings

SAE J 429 Mechanical and Material Requirements for Externally Threaded Fasteners

2.4 AMS Standard:⁵

AMS 3215 Acrylonitrile Butadiene (NBR) Rubber Aromatic Fuel Resistant 65-75

2.5 ABMA Standards:⁶

ABMA 9 Load Ratings and Fatigue Life for Ball Bearings

ABMA 11 Load Ratings and Fatigue Life for Roller Bearings

2.6 AGMA Standard:⁷

AGMA 390.03 Gear Classification, Materials and Measuring Methods for Unassembled Gears

2.7 API Standard:⁸

API 676 Positive Displacement Pumps—Rotary

2.8 Military Standards:⁹

MIL-S-901

MIL-STD-167

MIL-STD-740

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

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

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

3.1.8 *fuel, dirty, n*—fuel before purification which may contain water and some solids.

3.1.9 *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.

3.1.10 *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.

3.1.11 *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. This pressure cannot be determined readily if the relief valve is internal to the pump and it bypasses the liquid within the pump.

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

3.1.13 *pressure, discharge, n*—the pressure at the outlet of the pump. Discharge pressure is sometimes called outlet pressure.

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

3.1.15 *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. This pressure should not be greater than $\frac{2}{3}$ of the hydrostatic test pressure of the pressure containing parts.

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

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

3.1.18 *slip, n*—the quantity of fluid that leaks through the internal clearances of a rotary pump per unit of time. Slip depends on the internal clearances, the differential pressure, the characteristics of the fluid handled and in some cases, the speed.

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

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

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. 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.

3.1.2 *capacity, maximum, n*—the quantity of fluid delivered that does not exceed the limit determined by the formula in 9.2.

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

3.1.4 *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.

⁴ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

⁵ Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096, <http://www.sae.org>.

⁶ Available from American Bearing Manufacturers Association (ABMA), 1001 N. Fairfax Street, Suite 500, Alexandria, VA 22314, <https://www.americanbearings.org>.

⁷ Available from American Gear Manufacturers Association (AGMA), 1001 N. Fairfax St., Suite 500, Alexandria, VA 22314-1587, <http://www.agma.org>.

⁸ Available from American Petroleum Institute (API), 1220 L. St., NW, Washington, DC 20005-4070, <http://www.api.org>.

⁹ Available from U.S. Government Printing Office, Superintendent of Documents, 732 N. Capitol St., NW, Washington, DC 20401-0001, <http://www.access.gpo.gov>.

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

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

3.1.23 *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.

4. Classification

4.1 Pumps will 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 *Classes*:

4.1.2.1 *Class A*—Aqueous film forming foam, AFFF.

4.1.2.2 *Class B*—Bromine.

4.1.2.3 *Class CD*—Clean distillate fuel, viscosity 32 to 100 SSU (2 to 21 centistokes) (for example, jet fuel, JP-5, fuel).

4.1.2.4 *Class CH*—Clean heavy fuel, viscosity 100 to 1500 SSU (21 to 325 centistokes) (propulsion fuel).

4.1.2.5 *Class DD*—Dirty distillate fuel, viscosity 32 to 100 SSU (2 to 21 centistokes) (for example, transfer, stripping, purifier feed, leak-off).

4.1.2.6 *Class DH*—Dirty heavy oil, viscosity 32 to 4000 SSU (2 to 863 centistokes) (for example, waste oil, transfer, stripping, purifier feed, drains).

4.1.2.7 *Class G*—Gasoline, aviation gasoline, gasohol.

4.1.2.8 *Class LM*—Lube oil, viscosity 130 to 4000 SSU (27 to 863 centistokes) (for example, propulsion, SSTG, control, L.O. service).

4.1.2.9 *Class LA*—Auxiliary L.O. 130 to 4000 SSU (27 to 863 centistokes) service and L.O. transfer.

4.1.2.10 *Class M*—Miscellaneous.

4.1.2.11 *Class W*—Heavily contaminated seawater, viscosity 32 to 4000 SSU (2 to 863 centistokes) (bilge stripping, oily waste transfer).

5. Ordering Data

5.1 The ordering activity shall provide manufacturers with all of the following information:

5.1.1 Title, number, and date of specification,

5.1.2 Type and classification, see Section 4,

5.1.3 Capacity in gallons per minute or litres per minute at rated discharge pressure,

5.1.4 Discharge pressure in pound-force per square inch gauge (psig) or kilopascal (kPa) gauge.

5.1.5 Airborne noise levels (if different than 7.5),

5.1.6 Viscosity (only if different than Section 4),

5.1.7 Mounting configuration (vertical, horizontal),

5.1.8 Driver type (motor, turbine, engine, attached),

5.1.9 Driver characteristics or specifications, or both,

5.1.10 Relief valve cracking pressure and full-flow bypass pressure,

5.1.11 Packaging and boxing requirements (immediate use, domestic; storage, domestic; overseas),

5.1.12 Quantity of pumps,

5.1.13 Quantity of drawings,

5.1.14 Quantity of technical manuals,

5.1.15 Quantity of test reports,

5.1.16 Performance test, if required,

5.1.17 Certified data required, and

5.1.18 Instruction plates and locations, if required.

6. Materials

6.1 Pump component parts shall be constructed of the materials shown in Table 1.

6.2 Materials other than shown in Table 1 are considered exceptions and are subject to approval by the purchaser before usage.

7. General Requirements

7.1 Pumps shall be designed for a 20-year service life.

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 from 4 to 25 Hz.

7.4 The internally excited vibration levels of the pump shall not exceed 0.003-in. (0.00762-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 normal operating conditions, the airborne noise level of the pump shall not exceed 85 dBA.

7.6 The pump driver (electric motor, air motor, turbine, hydraulic motor, diesel engine, attached) shall be as specified in the ordering data. The driver shall be sized for maximum flow at the relief valve full-flow bypass pressure, at maximum viscosity. If a two-speed motor is specified for high-viscosity Class LM applications, the motor size shall be based on power required at low speed, which is used during cold startup.

7.7 If a reduction gear is required between the driver and the pump, it shall be provided by the pump manufacturer. Reduction gears shall meet the requirements of AGMA 390.03. Gears shall be AGMA Class 7 or better, pinions shall be AGMA Class 8 or better, and bearings shall be designed for a L10 life of 15 000 h.

7.8 Horizontal pumps may be mounted on a common horizontal bedplate with the driving unit or mounted directly to the driver. Vertical pumps may be mounted with a bracket to the driving unit or mounted directly to the driver.

7.9 All pump units shall incorporate guards over couplings, belts, and other external rotating parts.

7.10 The mounting arrangement shall be sufficiently rigid to assure alignment is maintained between the pump and the driver in accordance with the conditions in 7.2, 7.3, and 8.1.