



UL 448C

STANDARD FOR SAFETY

Stationary, Rotary-Type, Positive-Displacement Pumps for Fire-Protection Service

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UL Standard for Safety for Stationary, Rotary-Type, Positive-Displacement Pumps for Fire-Protection Service, UL 448C

Second Edition, Dated January 4, 2023

Summary of Topics

This revision of UL 448C dated December 19, 2023 includes a pump marking update; [21.1\(g\)](#)

Text that has been changed in any manner or impacted by ULSE's electronic publishing system is marked with a vertical line in the margin.

The revised requirements are substantially in accordance with Proposal(s) on this subject dated November 17, 2023.

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UL 448C

Standard for Stationary, Rotary-Type, Positive-Displacement Pumps for Fire-Protection Service

Prior to the first edition, the requirements for the products covered by this standard were included in the Outline of Investigation for Stationary, Rotary-Type, Positive-Displacement Pumps for Fire-Protection Service, SU 448C.

First Edition – February, 2009

Second Edition

January 4, 2023

This ANSI/UL Standard for Safety consists of the Second Edition including revisions through December 19, 2023.

The most recent designation of ANSI/UL 448C as an American National Standard (ANSI) occurred on December 19, 2023. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

Comments or proposals for revisions on any part of the Standard may be submitted to ULSE at any time. Proposals should be submitted via a Proposal Request in the Collaborative Standards Development System (CSDS) at <https://csds.ul.com>.

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INTRODUCTION

1 Scope

1.1 These requirements cover stationary, rotary type, positive displacement pumps intended for supplying water or foam liquid concentrates to fire protection systems.

1.2 The pumps covered by these requirements are intended to be installed in accordance with the Standard for Installation of Stationary Pumps for Fire Protection, NFPA 20.

2 Components

2.1 A component of a product covered by this Standard shall:

- a) Comply with the requirements for that component as specified in this Standard;
- b) Be used in accordance with its rating(s) established for the intended conditions of use; and
- c) Be used within its established use limitations or conditions of acceptability.

2.2 A component of a product covered by this Standard is not required to comply with a specific component requirement that:

- a) Involves a feature or characteristic not required in the application of the component in the product;
- b) Is superseded by a requirement in this Standard; or
- c) Is separately investigated when forming part of another component, provided the component is used within its established ratings and limitations.

2.3 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

3 Units of Measurement

3.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

4 Referenced Publications

4.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

4.2 The following publications are referenced in this Standard:

ABMA 9, *Load Ratings and Fatigue Life for Ball Bearings*

ABMA 11, *Load Ratings and Fatigue Life for Roller Bearings*

ASME B1.20.1, *Pipe Threads, General Purpose, Inch*

ASME B16.1, *Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250*

AWWA C606, *Grooved and Shouldered Joints*

HI 3.6, *Rotary Pump Tests*

HI 14.6, *Rotodynamic Pumps for Hydraulic Performance Acceptance Tests*

NFPA 20, *Installation of Stationary Pumps for Fire Protection*

5 Glossary

5.1 For the purposes of this standard, the following definitions apply.

5.2 CORROSION-RESISTANT MATERIAL – A material having resistance to corrosion equivalent to or exceeding that of a brass or bronze alloy, or series 300 stainless steel.

5.3 FOAM LIQUID CONCENTRATES – Concentrated liquid film foaming agents and other additives intended to enhance the fire fighting effectiveness of the water.

5.4 PRESSURE, MAXIMUM WORKING – For performance tests specified in this standard, the sum of the maximum net pressure developed by the pump and the maximum positive suction pressure marked on the pump, under any condition of intended use including the relief valve discharging 100 % of the pump capacity with the valve set at its highest pressure setting. For production tests, this value may be lower, based on the conditions imposed by the particular installation for which the pump is constructed. Therefore, the values of maximum net pressure and maximum positive suction pressure that are marked on the pump are those that indicate the acceptability of a pump (the limiting pressures) for an installation.

5.5 PRESSURE, NET (TOTAL HEAD) – The algebraic difference in psi (kPa) between pressures measured at the discharge flange and at the suction flange, corrected to the pump centerline and corrected for differences in velocity head at the points of gauge attachment.

5.6 PUMP LOAD – The brake horsepower (kW input) required to drive a pump at rated speed, and at the capacity and net pressure (including the additional requirements associated with the operation of the relief valve) requiring maximum power for its intended use.

5.7 PUMP, ROTARY TYPE POSITIVE DISPLACEMENT – A pump characterized by the use of gears, screws, lobes, cams or similar elements to carry and displace liquid.

5.8 PUMP ROTOR – A gear or similar element used to carry and displace liquid.

5.9 RELIEF VALVE – A valve capable of automatically relieving 100 % of pump capacity at a pressure not exceeding 125 % of the valve set pressure.

5.10 SET PRESSURE – Internal pressure at which the relief valve is intended to start to allow the flow of water.

CONSTRUCTION

6 General

6.1 These requirements are intended to address rotary type, positive displacement pumps for fire protection systems. This is not intended to preclude the investigation of pumps having different design features as long as an equivalent level of performance is provided.

6.2 A casting shall be smooth and free from scale, lumps, cracks, blisters, sand holes, and defects of any nature that may affect the use for which it is intended. A casting shall not be plugged or filled, but may be impregnated to remove porosity.

6.3 A bolt, stud, cap screw, or gland swing bolt used to assemble parts subject to stress due to fluid pressure shall have a nominal diameter of not less than 1/4-inch (6.4 mm).

6.4 An interior bolt or screw that is exposed to pumped fluid shall be a corrosion-resistant material.

6.5 The maximum stress on any bolt of a pressure-holding structure shall not exceed one-fourth the elastic limit of the material as computed by using the stress area. The stress area is defined by the equation:

in which:

A_s is the stress area in square inches ($\text{m}^2 \times 1550$);

D is the nominal diameter of bolt in inches ($\text{mm} \times 0.04$); and

n is the number of threads per inch (25.4 mm).

6.6 The load on the bolts is to be computed on the basis of the internal fluid pressure equivalent to the maximum working pressure over the area out to the centerline of the bolts.

6.7 The maximum combined shear stress for a pump shaft shall not exceed 30 % of the elastic limit in tension or be more than 18 % of the ultimate tensile strength of the shafting steel used. Compliance with this requirement is to be verified by a review of manufacturers' stress calculations.

6.8 Flange dimensions and bolt layouts used in pipe connections shall comply with the requirements in ASME B16.1, or other national or international pipe flange standards.

6.9 A threaded opening used for pipe connection shall comply with the requirements in ASME B1.20.1, or other national or international pipe thread standards.

6.10 Grooved end connections shall comply with the requirements in AWWA C606, or other national or international grooved standards.

7 Pump Casings

7.1 The pump casing shall be constructed of a corrosion resistant material and designed to permit examination of rotors and other interior parts without disturbing suction or discharge piping.

7.2 The pump shall be provided with feet or provisions for accommodating feet or a fabricated base support, such as bolt holes and a bearing area for attaching the base to the pump.

7.3 A drain opening shall be provided so that all parts of the pump casing can be drained. The opening shall be threaded to receive a plug that is not smaller than 1/8-inch nominal pipe size.

8 Rotors and Other Internal Components

8.1 The rotor, wear ring liners, interior nuts, glands, sleeve bearings, drain plugs and other interior components shall be constructed of a corrosion-resistant material.

8.2 The rotors shall be secured in an axial direction on the pump shaft or hydraulically balanced, permitting no contact with the casing under operating conditions.

9 Ball and Roller Bearings

9.1 Ball and roller bearings shall have an L-10 rating of not less than 5000 hours at maximum pump load (maximum hydraulic load on the largest rotor operated at any point on its rated speed curve) in accordance with ABMA 9 and ABMA 11, respectively.

9.2 With reference to [9.1](#), the L-10 rating in hours is to be calculated from the L-10 rating in revolutions based on the following equation:

in which:

where:

L_h is the L-10 rating in hours;

L_{10} is the L-10 rating in millions of revolutions;

N is the rated speed in revolutions per minute;

C is the dynamic load rating of bearing in pounds-force;

P is the combined force on bearing in pounds;

X is the radial load factor of bearing;

F_r is the radial load on bearing in pounds-force;

Y is the axial load factor of bearing; and

F_a is the axial load on bearing in pounds-force.

9.3 The shaft bearing of the driver shall not carry the axial or radial forces of the pump rotor.

9.4 Grease lubricated bearing housings shall be equipped with a tapped opening, plug, grease fitting and a relief hole, or relief grease fitting.

Exception: Bearings constructed such that additional lubrication is not necessary shall not require a grease fitting or relief hole.

9.5 Bearings and their races shall be constructed of a case-hardened material or a material hardened throughout.

9.6 Bearings shall be securely fitted to prevent axial movement.

10 Sleeve Bearings

10.1 Sleeve bearings shall be constructed of a corrosion-resistant material and lubricated by the pumped liquid.

11 Shaft Seals

11.1 A pump shall be provided with a mechanical or lip seal.

11.2 The seals shall be used within the seal manufacturer's specifications for pressure, peripheral velocity (based upon shaft rotational speed), shaft or sleeve finish, maximum shaft deflection and alignment with shaft.

11.3 As specified by the seal manufacturer, the seal shall be suitable for vacuum as well as positive pressure conditions.

11.4 As specified by the seal manufacturer, the seal shall be constructed to provide for leak tightness during both operating and non-operating conditions.

11.5 Parts in contact with the liquid shall be corrosion resistant.

11.6 A lip seal shall be provided with a primary seal material constructed of polytetrafluoroethylene (PTFE) or another material that provides equivalent or better seal performance.

11.7 The mating surfaces of a mechanical seal shall be one of the following material combinations or a mating surface combination that provides seal performance at least equivalent to one of these material combinations:

- a) Silicon carbide to silicon carbide;
- b) Carbon to silicon carbide; or
- c) Carbon to tungsten carbide.

12 Relief Valve

12.1 The discharge side of the pump shall be provided with a relief valve capable of relieving 100 % of the pump capacity at an inlet pressure not exceeding 125 % of the set pressure.

12.2 The components of the relief valve that are in contact with the liquid shall be constructed of a corrosion-resistant material.

PERFORMANCE

13 Hydraulic Performance Test

13.1 When tested within the specified rated pressure and speed range, a positive displacement pump shall develop flows and pressures that are not less than the manufacturer's published pump performance curves, and show no evidence of the rotor contacting the casing that adversely impacts the long-term performance of the pump. Also, the mechanical or lip seal shall not leak or allow air to leak into the pump during this testing.

13.2 Representative pump samples, which are to include at least one sample of each pump series, shall be tested at the minimum and maximum rated speeds.

13.3 Correction calculations to rated speeds shall be in accordance with HI 3.6.

13.4 For the tests described in [13.5](#) – [13.6](#) the applicable Level 1U test tolerances as specified in HI 14.6 are to be utilized.

13.5 The pump shall be tested using water at the minimum net positive suction head (NPSH) specified by the manufacturer at the pump inlet and operated at various flows and pressures to generate data to compare with the manufacturer's performance curves. At least four different flow and pressure

measurements shall be taken at each tested speed. Also, the maximum power required to drive the pump with the relief valve discharging at the rated pump capacity shall be determined with a positive gauge pressure available at the inlet. The flow, suction pressure, discharge pressure, input power and speed shall be measured during each test. The test fluid temperature shall also be measured during testing.

13.6 In addition to the tests using water, a pump intended for use with foam liquid concentrates shall be tested as specified in [13.5](#) using a foam liquid concentrate having a viscosity at rest of not less than the maximum specified for the pump at the measured temperature during the testing. If the pump is intended to be used with a foam liquid concentrate having a viscosity lower than water, tests are also to be conducted with the lowest viscosity foam liquid concentrate intended for use with the pump.

14 Hydrostatic Strength Tests

14.1 The pressure retaining parts of a pump assembly including the relief valve shall withstand for 5 minutes without rupture, a hydrostatic pressure of twice the maximum working pressure (See [5.4](#)) or 400 psig, whichever is greater.

14.2 Representative pump samples shall be filled with water and vented of all entrapped air. The pressure is then to be gradually increased to twice the rated working pressure and held for 5 minutes. Observations shall be made for pump rupture.

15 Dry Operation and Self-Priming Tests

15.1 Representative pump samples, which are to include at least one sample of each pump series, shall demonstrate the ability to operate without liquid in the pipe for 10 minutes and to self-prime so as to evacuate all air from the pump.

Exception: A pump intended only for water mist systems is not required to operate without liquid in the pipe for 10 minutes.

15.2 The inlet and outlet of the pump is to be connected to dry piping that is not supplied with liquid. The pump shall be operated at the maximum rated speed for a minimum of 10 minutes without seizing or discontinuing to operate.

15.3 The pump inlet shall then be connected to a supply of foam liquid concentrate having a viscosity at rest of not less than the maximum specified for the pump with the liquid surface at least 2 feet (0.6 m) below the centerline of the pump. With the valves on the inlet and outlet piping in the open position, the pump is to be operated at the minimum rated speed. The test is then to be repeated at the maximum rated speed. At each speed, observations shall be made for self-priming and the evacuation of all air in the pump.

16 Endurance Test

16.1 Representative pump samples, which are to include at least one sample of each pump series, shall demonstrate the ability to operate for 24 hours at maximum speed and rated capacity without the rotor contacting the casing causing a reduction in performance below the manufacturer's published pump performance curves, overheating of the bearings, or physical damage.

16.2 A pump intended for use in horizontal and vertical installation orientations shall be subjected to the test described in [16.3](#) in both horizontal and vertical orientations.

16.3 The inlet and outlet of the pump shall be connected to a piping arrangement and operated at maximum speed for a minimum of 24 hours. The test fluid temperature shall be measured during testing. If the pump is intended for use with foam liquid concentrates, the test shall be conducted with a foam liquid