UL 448C

STANDARD FOR SAFETY

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

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

First Edition, Dated February 2, 2009

Summary of Topics

This revision of ANSI/UL 448C dated November 28, 2018 is issued to update the title page to reflect the most recent designation as a Reaffirmed American National Standard (ANS). No technical changes have been made.

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

The requirements are substantially in accordance with Proposal(s) on this subject dated September 21, 2018.

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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 2, 2009

This ANSI/UL Standard for Safety consists of the First Edition including revisions through November 28, 2018.

The most recent designation of ANSI/UL 448C as a Reaffirmed American National Standard (ANS) occurred on November 28, 2018. 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 UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line 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.

1.1 revised April 10, 2014

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.

1.2 effective February 2, 2011

2 Components

2.1 Except as indicated in 2.2, a component of a product covered by this standard shall comply with the requirements for that component.

2.1 effective February 2, 2011

2.2 A component is not required to comply with a specific requirement that:

a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard, or

b) Is superseded by a requirement in this standard.

2.2 effective February 2, 2011

2.3 A component shall be used in accordance with its rating established for the intended conditions of use.

2.3 effective February 2, 2011

2.4 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.

2.4 effective February 2, 2011

3 Units of Measurement

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

3.1 effective February 2, 2011

4 Undated References

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.

4.1 effective February 2, 2011

5 Glossary

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

5.1 effective February 2, 2011

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.

5.2 effective February 2, 2011

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

5.3 revised April 10, 2014

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 percent 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.

5.4 effective February 2, 2011

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.

5.5 effective February 2, 2011

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.

5.6 effective February 2, 2011

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.

5.7 effective February 2, 2011

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

5.8 effective February 2, 2011

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

5.9 effective February 2, 2011

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

5.10 effective February 2, 2011

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.

6.1 effective February 2, 2011

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.

6.2 effective February 2, 2011

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).

6.3 effective February 2, 2011

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

6.4 effective February 2, 2011

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:

$$A_s = 0.7854\left(D - \frac{0.9743}{n}\right)^2$$

in which:

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

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

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

6.5 effective February 2, 2011

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.

6.6 revised April 10, 2014

6.7 The maximum combined shear stress for a pump shaft shall not exceed 30 percent of the elastic limit in tension or be more than 18 percent 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

6.7 effective February 2, 2011

6.8 Flange dimensions and bolt layouts used in pipe connections shall comply with the requirements in the Standard for Cast Iron Pipe Flanges and Flanged Fittings, ANSI/ASME B16.1, or other national or international pipe flange standards.

6.8 effective February 2, 2011

6.9 A threaded opening used for pipe connection shall comply with the requirements in the Standard for Pipe Threads, General Purpose, ANSI/ASME B1.20.1, or other national or international pipe thread standards.

6.9 effective February 2, 2011

6.10 Grooved end connections shall comply with the requirements in the Standard for Grooved and Shouldered Joints, ANSI/AWWA C606, or other national or international grooved standards.

6.10 effective February 2, 2011

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.

7.1 effective February 2, 2011

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.

7.2 effective February 2, 2011

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.

7.3 effective February 2, 2011

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.

8.1 effective February 2, 2011

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.

8.2 effective February 2, 2011

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 the Standard for Load Ratings and Fatigue Life for Ball Bearings, ANSI/ABMA 9, and the Standard for Load Ratings and Fatigue Life for Roller Bearings, ANSI/ABMA 11, respectively.

9.1 effective February 2, 2011

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:

$$L_h = (L_{10} \times 10^6) / (N \times 60)$$

in which:

$$L_{10} = \frac{C^3}{P^3} = \frac{C^3}{(XF_r + YF_a)^3} \quad (Ball)$$

$$L_{10} = \frac{C^{10/3}}{P^{10/3}} = \frac{C^{10/3}}{(XF_r + YF_a)^{10/3}} \quad (Roller)$$

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.

9.2 effective February 2, 2011

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

9.3 effective February 2, 2011

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.

9.4 effective February 2, 2011

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

9.5 effective February 2, 2011

9.6 Bearings shall be securely fitted to prevent axial movement.

9.6 effective February 2, 2011

10 Sleeve Bearings

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

10.1 effective February 2, 2011

11 Shaft Seals

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

11.1 effective February 2, 2011

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.

11.2 effective February 2, 2011

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

11.3 effective February 2, 2011

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.

11.4 effective February 2, 2011

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

11.5 effective February 2, 2011

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

11.6 effective February 2, 2011

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.

11.7 effective February 2, 2011

12 Relief Valve

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

12.1 effective February 2, 2011

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

12.2 effective February 2, 2011

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.

13.1 effective February 2, 2011

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.

13.2 effective February 2, 2011

13.3 Correction calculations to rated speeds shall be in accordance with the Hydraulic Institute Standard 3.6 for Rotary Pump Tests.

13.3 effective February 2, 2011

13.4 For the tests described in 13.5 – 13.6 the applicable Level 1U test tolerances as specified in the American National Standard for Rotodynamic Pumps for Hydraulic Performance Acceptance Tests, ANSI/HI 14.6-2011 are to be utilized.

13.4 revised April 10, 2014

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.

13.5 effective February 2, 2011

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.

13.6 revised April 10, 2014

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.

14.1 effective February 2, 2011

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.

14.2 effective February 2, 2011

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.

15.1 effective February 2, 2011

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.

15.2 effective February 2, 2011

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.

Revised 15.3 effective April 10, 2014

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.

16.1 effective February 2, 2011

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.

16.2 effective February 2, 2011

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 concentrate having a viscosity at rest of not less than the maximum specified for the pump at the temperature measured during the test.

16.3 revised April 10, 2014