UL 448B

STANDARD FOR SAFETY

Residential Fire Pumps Intended for One- and Two-Family Dwellings and Manufactured Homes

UL Standard for Safety for Residential Fire Pumps Intended for One- and Two-Family Dwellings and Manufactured Homes, UL 448B

Second Edition, Dated January 4, 2023

Summary of Topics

This new edition of ANSI/UL 448B dated January 4, 2023 incorporates editorial changes including renumbering and reformatting to align with current style.

The requirements are substantially in accordance with Proposal(s) on this subject dated October 21, 2022.

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Standard for Residential Fire Pumps Intended for One- and Two-Family Dwellings and Manufactured Homes

Prior to the first edition, the requirements for the products covered by this standard were included in the Outline of Investigation for Residential Fire Pumps Intended for One- and Two-Family Dwellings and Manufactured Homes, SU 448B.

First Edition – December, 2008

Second Edition

January 4, 2023

This ANSI/UL Standard for Safety consists of the Second Edition.

The most recent designation of ANSI/UL 448B as an American National Standard (ANSI) occurred on January 4, 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 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 fire pumps intended for use in water-supply systems for one- and two-family dwellings and manufactured homes.

1.2 The pumps covered by these requirements are intended for installation and use in accordance with the Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes, NFPA 13D.

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*

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

ASME B16.42, *Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300*

ASME B36.10M, *Welded and Seamless Wrought Steel Pipe*

ASTM E145, *Standard Specification for Gravity-Convection and Forced-Ventilation Ovens*

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

ISO 21940-11, *Mechanical vibration – Rotor balancing – Part 11: Procedures and tolerances for rotors with rigid behaviour*

NFPA 13D, *Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes*

5 Glossary

5.1 For the purpose 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 PRESSURE, MAXIMUM WORKING – For performance tests specified in this standard, the maximum pressure developed at the pump discharge flange under any condition of intended use determined by the sum of the maximum net pressure developed by the pump and the allowed positive suction pressure. For production tests, this value may be lower, based on the conditions imposed by the particular installation for which the pump is constructed. The maximum positive suction pressure marked on the pump indicates the acceptability of a pump inlet pressures for an installation.

5.4 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 PRESSURE, SHUTOFF (CHURN) – The net head developed by a pump at rated speed with no water being delivered (discharge valve closed).

5.6 PRESSURE, MAXIMUM NET – The maximum net pressure developed by the pump at rated speed which typically occurs at or near shutoff pressure.

5.7 PUMP, END-SUCTION – A horizontal centrifugal pump characterized by having its suction nozzle on the pump centerline at the opposite side of the casing from the mechanical seal and having the face of the suction nozzle perpendicular to the longitudinal axis of the shaft. This type of pump is not intended to be used where a static suction lift is involved.

5.8 PUMP, IN-LINE – A centrifugal pump, the drive unit for which is supported solely by the pump, and that is characterized by suction and discharge connections having a common centerline that intersects the shaft axis. This type of pump is not intended to be used where a static suction lift is involved.

5.9 PUMP LOAD – The brake horsepower (kW input) required to drive a pump at rated speed and at the capacity requiring maximum power.

5.10 PUMP, RESIDENTIAL FIRE – A pump intended for installation in accordance with NFPA 13D.

5.11 PUMP, SPLIT-CASE – A centrifugal pump characterized by a housing that is split axial or radial to the shaft, and mounted in the horizontal or vertical position. This type of pump is not intended to be used where a static suction lift is involved.

CONSTRUCTION

6 General

6.1 These requirements are intended to address end-suction, in-line pump or split-case residential pumps. 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 residential fire pump shall have a rated capacity equal to a value specified in Table 6.1, or greater than 100 gallons per minute (379 liters per minute).

Table 6.1
Pump capacities

Gallons per minute	(Liters per minute)
20	(76)
25	(95)
30	(114)
35	(132)
40	(151)
45	(170)
50	(189)
55	(208)
60	(227)
65	(246)
70	(265)
75	(284)
80	(303)
90	(341)
100	(379)

6.3 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.

6.4 A bolt, stud, cap screw, or gland swing bolt used to assemble parts subject to stress due to water pressure shall not be less than 1/4 inch (6.4 mm) in diameter.

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

6.6 The maximum stress on any bolt of a pressure-holding casting 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 × 1550);

D is the nominal diameter of bolt in inches (mm × 0.04); and

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

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

6.8 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.

6.9 The impellers shall be dynamically balanced to the G6.3 balance quality grade in accordance with the requirements for pump impellers in ISO 21940-11.

Exception: The impellers may be statically balanced in accordance with ISO 21940-11 if the ratio of the maximum outside diameter to the width at the periphery (including the shroud but not including the back vane) is equal to or greater than 6.

6.10 Flange dimensions and bolt layouts used in pipe connections shall comply with the requirements of one of the following standards:

a) ASME B16.1;

b) ASME B16.42;

c) ASME B16.5, when steel is used; or

d) Other national pipe flange standards.

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

6.12 The minimum pipe sizes for the suction and discharge piping shall be as specified in Table 6.2. Pumps are not restricted from having threaded or flange sizes other than the pipe sizes specified in Table 6.2 when fitted with an increaser fitting for connection to the minimum pipe size.

Table 6.2
Size of openings for pumps

Pump capacity rating		Minimum nominal pipe size inches[a]	
Gallons per minute	(Liters per minute)	Suction	Discharge
20	(76)	1	3/4
25	(95)	1	3/4
30	(114)	1	1
35	(132)	1	1
40	(151)	1-1/4	1
45	(170)	1-1/4	1-1/4
50	(189)	1-1/4	1-1/4
55	(208)	1-1/4	1-1/4
60	(227)	1-1/4	1-1/4
65	(246)	1-1/2	1-1/4
70	(265)	1-1/2	1-1/2
75	(284)	1-1/2	1-1/2
80	(303)	1-1/2	1-1/2
90	(341)	2	1-1/2
100	(379)	2	2

[a] ASME B36.10M

6.13 The pump shall include the following as applicable:

a) Automatic air-release valve or vent tube (self-venting pumps excluded).

b) Circulation relief valve except when the pump does not develop temperatures exceeding 180 °F (82.2 °C) at the pump casing during operation at no flow conditions.

7 Pump Casings

7.1 The pump casing shall be constructed of metallic materials and designed to permit examination of impellers and other interior parts without disturbing suction or discharge piping.

7.2 The pump or attached motor shall be provided with feet or a fabricated base for support. The support means shall have structural strength and rigidity acceptable for the application.

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 Impellers, Rings, and Other Internal Components

8.1 Impeller, impeller wearing rings, case wearing rings, shaft sleeves, guide or diffusion vane rings, interior nuts, glands, gland nuts, and drain plugs shall be of corrosion-resistant material.

8.2 A diffusion vane casting may be protected against corrosion and sticking by bronze-tipping the portion most exposed.

8.3 The minimum internal dimensions of the passages at any point in the impeller shall not be less than 1/8 inch (3.2 mm).

8.4 The radial clearance between a stationary and moving part of a pump shall not be less than 0.005 inch (0.127 mm).

8.5 The impellers shall be secured in an axial direction, permitting no contact with the casing under operating conditions.

8.6 The impellers shall be of the closed type; that is, they shall incorporate shrouds or sidewalls that completely enclose the impeller waterways from the suction eye to the periphery.

8.7 Impellers made of a plastic material shall be of a one-piece construction.

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 load (maximum hydraulic load on the largest impeller 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:

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

in which:

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

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

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.

9.3 If a pump utilizes the shaft bearings of the driver to carry the axial and radial forces of the impellers, compliance with the requirements in 9.1 and 9.2 is to be verified by a review of bearing life calculations for the driver based on the maximum loads applied by the pump.

9.4 The bearing assembly on one end of a split-case-pump shaft shall be arranged to float axially. Two bearing assemblies shall be provided for an end-suction pump; one that is free to float within the frame to carry radial forces, and the other arranged to carry both radial and axial thrust. The bearings shall be lubricated with grease.

9.5 Bearings shall be constructed such that additional lubrication is not necessary.

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

9.7 Means, such as water slingers and dust caps, shall be provided to limit the entrance of water or foreign matter to the bearings.

10 Shaft Seals

10.1 The pump shall be provided with mechanical seals.

10.2 A mechanical seal 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.

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

10.4 The seal faces shall be mechanically loaded, such as the use of a spring, to provide for leak tightness when the pump is not operating.

10.5 Glands, drive holders, and parts in contact with the liquid shall be corrosion resistant.

10.6 The seal mating surfaces 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) Silicone carbide to silicone carbide;

b) Carbon to silicone carbide; or

c) Carbon to tungsten carbide.

PERFORMANCE

11 Operation Test

11.1 A pump shall have a rated capacity as specified in 6.2 and shall have rated net pressures of 20 psi (138 kPa) or higher. More than one capacity-pressure rating may be developed for any pump. For each rated capacity, a pump shall develop not less than the rated total head.

11.2 A pump shall develop not less than 65 % of rated total head when discharging at 1-1/2 times rated capacity.

11.3 The maximum net pressure for a fire pump shall not exceed 140 % of rated head.

11.4 The operation tests are to be conducted at rated speed or at a speed within ±10 % of the rated speed, and the performance curves for the exact rated speed determined by means of the affinity relationships.