JOINT CANADA-UNITED STATES
NATIONAL STANDARD

ANSI/CAN/UL 448:2020

STANDARD FOR SAFETY

Centrifugal Stationary Pumps for Fire-Protection Service

Approved American National Standard
ANSI
ANSI/UL 448-2020

Standards Council of Canada
Conseil canadien des normes

SCC FOREWORD

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UL Standard for Safety for Centrifugal Stationary Pumps for Fire-Protection Service, ANSI/CAN/UL 448

Twelfth Edition, Dated March 30, 2020

Summary of Topics

This Twelfth Edition of ANSI/CAN/UL 448, Standard for Safety for Centrifugal Stationary Pumps for Fire-Protection Service, has been issued to reflect the latest ANSI and SCC approval dates, and to incorporate the proposals dated September 13, 2019.

The new requirements are substantially in accordance with Proposal(s) on this subject dated September 13, 2019.

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Twelfth Edition

March 30, 2020

This ANSI/CAN/UL Safety Standard consists of the Twelfth Edition.

The most recent designation of ANSI/UL 448 as an American National Standard (ANSI) occurred on March 30, 2020. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, Preface or SCC Foreword.

This standard has been designated as a National Standard of Canada (NSC) on March 30, 2020.

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MARKINGS

Preface

This is the Twelfth Edition of ANSI/CAN/UL 448 Standard for Safety for Centrifugal Stationary Pumps for Fire-Protection Service.

UL is accredited by the American National Standards Institute (ANSI) and the Standards Council of Canada (SCC) as a Standards Development Organization (SDO).

This Standard has been developed in compliance with the requirements of ANSI and SCC for accreditation of a Standards Development Organization.

This ANSI/CAN/UL 448 Standard is under continuous maintenance, whereby each revision is approved in compliance with the requirements of ANSI and SCC for accreditation of a Standards Development Organization. In the event that no revisions are issued for a period of four years from the date of publication, action to revise, reaffirm, or withdraw the standard shall be initiated.

In Canada, there are two official languages, English and French. All safety warnings must be in French and English. Attention is drawn to the possibility that some Canadian authorities may require additional markings and/or installation instructions to be in both official languages.

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 http://csds.ul.com.

To purchase UL Standards, visit the UL Standards Sales Site at http://www.shopulstandards.com/HowToOrder.aspx or call tollfree 1-888-853-3503.

This Edition of the Standard has been formally approved by the UL Standards Technical Panel (STP) on Fire Pump Equipment, STP 448.

This list represents the STP 448 membership when the final text in this standard was balloted. Since that time, changes in the membership may have occurred.

STP 448 Membership

Name	Representing	Interest Category	Region
Bell, Kerry M.	UL LLC	Testing and Standards	USA
Black, Art	Carmel Fire Protection Associates	AHJ	USA
Brush, David	Flotronix Corporation	Supply Chain	USA
Buscher, Brian	Xylem AC Fire Pump	Producer	USA
Cummings, Brandon E.	Power and Energy Services Inc.	Commercial / Industrial User	USA
Current, Jay	Ministry of the Solicitor General	Government	Ontario, Canada

STP 448 Membership Continued on Next Page

STP 448 Membership Continued

Name	Representing	Interest Category	Region
Dadgardoust, Mohammad	LRI Engineering Inc.	General	Ontario, Canada
Dawson, Mike J.	Cummins Fire Power Engineering	Producer	USA
Dembkowski, Mike	Clarke Fire Protection Products, Inc.	Producer	USA
Edwards, Griff	Underwriters Laboratories Inc.	STP Project Manager - Non-voting	USA
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McCullough, Rick	self	General	Saskatchewan
Pasternack, Steven	Intertek	Testing and Standards	USA
Piltette, Maurice	Mechanical Designs Ltd.	General	USA
Ruggieri, James	General Machine Corp.	General	USA
Ryckman, Jason	Canadian Automatic Sprinkler Association	General	Ontario, Canada
Savage Sr., Michael	City of Rio Rancho	AHJ	USA
Scott, Kevin	KH Scott & Associates	AHJ	USA
Simone, Joseph	Naval Facilities Engineering Command	Government	USA
Stelter, William F.	Master Control Systems Inc.	Supply Chain	USA
Yung, Chuck	Electrical Apparatus Service Association	General	USA

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This Standard is intended to be used for conformity assessment.

The intended primary application of this standard is stated in its scope. It is important to note that it remains the responsibility of the user of the standard to judge its suitability for this particular application.

CETTE NORME NATIONALE DU CANADA EST DISPONIBLE EN VERSIONS FRANÇAISE ET ANGLAISE

INTRODUCTION

1 Scope

1.1 These requirements cover stationary centrifugal fire pumps intended for use in water-supply systems for fire-protection service.

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

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.

2.2 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.

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

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.

3 Units of Measurement

3.1 Where values of measurement are specified in both SI and U. S. Customary units, it is the responsibility of the user of this standard to determine the unit of measurement appropriate for the user's needs.

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.

5 Normative References

5.1 The following standards are referenced in this standard, and portions of these referenced standards may be essential for compliance.

American Bearing Manufacturers Association (ABMA) Standards

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

American Society of Mechanical Engineers (ASME) Standards

ANSI/ASME B16.1, *Standard for Cast Iron Pipe Flanges and Flanged Fittings*

ANSI/ASME B16.42, *Standard for Ductile Iron Pipe Flanges and Flanged Fittings*
ANSI/ASME B16.5, *Standard for Pipe Flanges and Flanged Fittings*
ANSI/ASME B1.20.1, *Standard for Pipe Threads, General Purpose, Inch*
ANSI/ASME B36.10, *Welded and Seamless Wrought Steel Pipe*

Hydraulic Institute (HI) Standards

ANSI/HI 14.6-2011, *American National Standard for Rotodynamic Pumps for Hydraulic Performance Acceptance Tests*

International Standards Organization (ISO) Standards

ISO 21940-11, *Mechanical Vibration – Rotor Balancing – Part 11: Procedures and Tolerances for Rotors with Rigid Behaviour*

National Fire Protection Association (NFPA) Codes and Standards

NFPA 20, *Stationary Pumps for Fire Protection*

6 Glossary

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

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

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

6.4 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 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.

6.5 PRESSURE, NET (TOTAL HEAD):

a) For a split-case, end-suction, in-line pump, multistage multiport, or a vertical-turbine pump in a suction vessel, 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.

b) For a vertical-turbine pump in a sump or well, the pressure measured by a pressure gauge attached just beyond the discharge head, corrected for the velocity head at the point of gauge attachment and for the vertical distance from the pumping water level to the center of the gauge.

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

6.7 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 stuffing box 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.

6.8 PUMP, FIRE– A pump for horizontal or vertical mounting, having rated capacities in accordance with the requirements in the Standard for the Installation of Stationary Pumps for Fire Protection, NFPA 20.

6.9 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.

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

6.11 PUMP, MULTISTAGE MULTIPORT – A centrifugal pump with multiple impellers operating in series where the discharge from each impeller, except for the last impeller, provides pressure to the subsequent stage and multiple discharge ports are provided at certain locations within the stages of the pump.

6.12 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.

6.13 PUMP, VERTICAL-TURBINE – A centrifugal pump with one or more impellers discharging into one or more bowls and a vertical eductor or column pipe used to connect the bowls to the discharge head on which the pump driver is mounted. The pump may also be provided with a suction vessel as an integral part. Vertical turbine pumps not provided with suction vessels are intended for installation in sumps or wells.

CONSTRUCTION

ALL PUMPS

7 General

7.1 An end-suction or in-line pump shall be of a single- or two-stage construction. A split-case pump may be of a single-stage or multistage construction. A multistage multiport pump shall be of a multistage construction with multiple outlets. A vertical-turbine pump may have any number of bowls and impellers.

7.2 A split-case, multistage multiport, vertical-turbine, end-suction, or in-line pump shall have a rated capacity equal to a value specified in Table 7.1, or greater than 5000 gallons per minute (18925 liters per minute) in 500 gallons per minute (1892 liters per minute) increments.

Table 7.1
Pump capacities

Gallons per minute	(Liters per minute)	Gallons per minute	(Liters per minute)
25	(95)	2000	(7570)
50	(189)	2500	(9462)
100	(379)	3000	(11355)
150	(568)	3500	(13247)

Table 7.1 Continued on Next Page

Table 7.1 Continued

Gallons per minute	(Liters per minute)	Gallons per minute	(Liters per minute)
200	(757)	4000	(15140)
250	(946)	4500	(17032)
300	(1136)	5000	(18925)
400	(1514)		
450	(1703)		
500	(1892)		
750	(2839)		
1000	(3785)		
1250	(4731)		
1500	(5677)		

7.3 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.

7.4 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 3/8 inch (9.5 mm) in diameter.

7.5 An interior bolt or screw that is exposed to pumped water shall be constructed of a corrosion-resistant material (see 6.2) or Series 400 stainless steel.

7.6 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).

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.

Exception: If an O-ring is used to provide a casing seal, the area inside the O-ring shall be permitted to be used to determine area for the bolt stress calculation.

7.7 The maximum combined shear stress for a pump shaft, based upon the minimum diameter at the root of threads or an undercut (not including undercutting for keys), 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. For shafts with keyways, the allowable stress limits shall be 75 percent of the stresses calculated using the minimum shaft diameter at the key location (not including the undercut). Compliance with this requirement is to be verified by a review of manufacturers' stress calculations.

7.8 The impellers shall be dynamically balanced to the G6.3 balance quality grade in accordance with the requirements for pump impellers in the Mechanical Vibration – Rotor Balancing – Part 11: Procedures and Tolerances for Rotors with Rigid Behaviour, ISO 21940-11.

Exception: The impellers may be statically (single plane) 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.

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

a) Standard for Cast Iron Pipe Flanges and Flanged Fittings, ANSI/ASME B16.1;

b) Standard for Ductile Iron Pipe Flanges and Flanged Fittings : Classes 150 and 300, ANSI/ASME B16.42; or

c) Standard for Pipe Flanges and Flanged Fittings: NPS 1/2 through 24, ANSI/ASME B16.5, when steel is used

Exception: A pump intended for use in installations where the connection piping has national pipe flange dimensions that are different from these standards shall be permitted to be constructed with flanges complying with the national pipe flange standard compatible with connection piping.

7.10 A threaded opening used for pipe connection shall comply with the requirements in the Standard for Pipe Threads, General Purpose, Inch, ANSI/ASME B1.20.1.

Exception: A pump intended for use in installations where the connected piping has national pipe threads that are different from ANSI/ASME B1.20.1 shall be permitted to be constructed with threads complying with the national pipe thread standard compatible with the connected piping.

7.11 A pump shall be provided with the following:

a) Automatic air-release valve (self-venting pumps excluded);

b) Circulation relief valve (except for engine driven pumps for which engine cooling water is taken from the pump discharge) and;

c) Pressure gauges.

7.12 The minimum internal dimensions of the passages at any point in the impeller shall not be less than:

a) 5/16 inch (7.9 mm) for a pump rated 500 gallons per minute (1892 L/min) or less; or

b) 1/2 inch (12.7 mm) for a pump rated more than 500 gallons per minute (1892 L/min).

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

SPLIT-CASE, END-SUCTION, IN-LINE, AND MULTISTAGE MULTIPORT PUMPS

8 Pump Casings

8.1 Except for multistage multiport pumps, a pump casing shall be constructed to permit examination of impellers and other interior parts without disturbing suction or discharge piping. The casing shall include

means to facilitate disassembly of the casing, and the stuffing box cover (if provided), without requiring the use of wedges or prying elements, such as by provision of tapped holes for jackscrews.

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

8.3 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:

a) Not smaller than 1/2 inch (12.7 mm) nominal pipe size for pumps having rated capacities equal to or greater than 100 gallons per minute and 1/4 inch (6.4 mm) nominal pipe size for pumps having rated capacities less than 100 gallons per minute (379 liters per minute); and

b) Formed of corrosion-resistant material.

9 Impellers, Rings, and Other Internal Components

9.1 A pump shall be provided with case wearing rings that are made of material that will not gall. The rings shall be secured to the case in a manner that does not permit rotational or axial movement. Impeller wearing rings need not be provided.

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

9.3 The radial clearance between a stationary and moving part of a pump shall not be less than 0.0075 inch (0.191 mm).

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

9.5 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.

10 Sleeve Bearings

10.1 The main shaft bearings shall be proportioned so that the stress on the projected area of any bearing will not be more than 20 psi (138 kPa).

10.2 Each bearing shall be of the removable-shell type. Each shell shall be lined throughout. The finished bearing shall not be less than 1/4 inch (6.4 mm) thick.

10.3 The removable shells shall be accurately machined to uniform cylindrical fits and shall be interchangeable.

10.4 Oil grooves that lubricate the entire bearing shall be provided.

10.5 Each bearing shall be provided with a ring or endless-chain oiler, its lower part running in an oil-filled chamber cast under the bearings. This chamber shall be provided with a 1/2 inch (12.7 mm) nominal pipe size drain hole fitted with a brass plug.

10.6 Each bearing cap shall be provided with a hinged lid large enough to permit application of oil and inspection of the bearing.

10.7 Water slingers of corrosion-resistant material shall be provided to seal the bearings at their inner ends. Dust caps shall be provided to seal the bearings at their outer ends.

11 Ball and Roller Bearings

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

11.2 With reference to 11.1, 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:

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

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

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.*

11.3 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 11.1 and 11.2 is to be verified by a review of bearing life calculations for the driver based on the maximum loads applied by the pump.

11.4 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.

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

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

11.6 Bearings and their races shall be hardened throughout. Case-hardened material is not acceptable.

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

12 Shaft Seals

12.1 The pump shall be provided with stuffing box(es) and packing. A stuffing box shall have a depth of at least five times the width of the packing ring plus lantern ring. A lantern ring shall be permitted to replace one ring of packing, but at least four packing rings shall be provided when a lantern ring is installed. The glands shall exert a uniform pressure on the packing. A stuffing box bottom ring, if used, shall be of a corrosion-resistant material. Shafts shall be provided with corrosion resistant sleeves.

12.2 Packing shall not be utilized as bearing supports for the shaft.

VERTICAL-TURBINE PUMPS

13 Pump Discharge Heads

13.1 The pump discharge head shall be either the aboveground-discharge or the underground-discharge type.

13.2 The discharge head shall be constructed to support and align the driver and the pump column. A separate combination pump-mounting plate and drive-support stand shall be furnished with the underground type.

14 Pump Columns

14.1 The column for a pump shall be:

a) Furnished in sections not exceeding a nominal length of 10 feet (3.05 m);

b) Of steel pipe complying with Table 14.1 or other pipe having equivalent strength and durability; and

c) Connected by threaded-sleeve type couplings or flanges. The ends of each section of threaded pipe shall be faced parallel and machined with threads to permit the ends to butt so as to form accurate alignment of the pump column. All column flange faces shall be parallel and machined for rabbet fit to permit accurate alignment.

Table 14.1
Pump column pipe weight

Nominal size (inside diameter) inches[a]	Outside diameter		Weight (plain ends)	
	inches	(mm)	pounds/foot	(kg/m)
6	6.625	(168.28)	18.97	(28.23)
8	8.625	(219.08)	24.70	(36.76)
9	9.625	(244.48)	28.33	(42.16)
10	10.750	(273.05)	31.20	(46.43)
12	12.750	(323.85)	43.77	(65.14)
14[b]	14.000	(355.60)	54.57	(81.21)

[a] ANSI B36 and B125 Series Specifications.

[b] Outside diameter.

15 Suction Vessels

15.1 The suction vessel shall have structural strength and rigidity acceptable for the application. The wall thickness shall not be less than that of:

a) Schedule 40 steel pipe or the equivalent if less than 8 inches (203 mm) in diameter; and

b) Schedule 30 steel pipe or the equivalent if 8 inches or more in diameter.

16 Bowl Assemblies

16.1 A pump bowl shall be provided with corrosion-resistant wearing rings that are made of material that will not gall. The rings shall be secured to the bowl in a manner that does not permit rotational or axial movement. Bowl bearings shall be made of rubber, bronze, or corrosion resistant material acceptable for the specific installation.

17 Impellers

17.1 An impeller shall be:

a) Made of corrosion-resistant material; and

b) Of the closed type.

17.2 An impeller shall be securely fastened to the impeller shaft.

18 Impeller Shafts

18.1 The impeller shafts shall be monel metal, stainless steel alloy (AISI Type 416 or the equivalent), or material having equivalent strength, rigidity, and resistance to corrosion.

19 Line Shafts

19.1 The line shaft of a water-lubricated type pump (open line shaft) shall be stainless steel alloy (AISI Type 416 or the equivalent) or of steel with corrosion-resistant shaft sleeves at bearings and at stuffing boxes.