UL 448A

STANDARD FOR SAFETY

Flexible Couplings and Connecting Shafts for Stationary Fire Pumps

UL Standard for Safety for Flexible Couplings and Connecting Shafts for Stationary Fire Pumps, UL 448A

Second Edition, Dated November 29, 2022

SUMMARY OF TOPICS

This new edition of ANSI/UL 448A dated November 29, 2022 is being issued to include editorial updates to Components, Section 2, and Referenced Publications, Section 4.

The revised requirements are substantially in accordance with Proposal(s) on this subject dated August 5, 2022 and October 14, 2022.

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Standard for Flexible Couplings and Connecting Shafts for Stationary Fire Pumps

First Edition – December, 2008

Second Edition

November 29, 2022

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

The most recent designation of ANSI/UL 448A as an American National Standard (ANSI) occurred on November 29, 2022. 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 flexible couplings and flexible connecting shafts intended to connect the shaft of a stationary fire pump to a fire pump driver.

1.2 Flexible couplings and flexible connecting shafts covered by this standard are intended for installation and use 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b) Is superseded by a requirement in this Standard; or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:

AGMA 922-A96, *Load Classification & Service Factors for Flexible Coupling*

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

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

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 FLEXIBLE CONNECTING SHAFT – A device that incorporates two flexible joints and a telescoping element that is used to connect a driver to a pump.

5.3 FLEXIBLE COUPLING – A device used to connect the shafts or other torque-transmitting components from a driver to the pump that permits minor angular and parallel misalignment.

5.4 MODEL (flexible coupling or flexible connecting shaft) – A designation, at minimum, defining the torque transmitting capacity of the product.

5.5 SERVICE FACTOR – A factor referenced in the manufacturer's installation that is intended to be applied to the calculated end use application torque based upon the type of pump and driver to be connected with the coupling or connecting shaft.

CONSTRUCTION

6 General

6.1 A flexible coupling or flexible connecting shaft shall comply with the applicable requirements of NFPA 20.

7 Sizes

7.1 A flexible coupling or flexible connecting shaft shall be constructed to be compatible with the sizes of fire pump and driver shafts specified in the installation instructions.

8 Hubs and Power Transmission Components

8.1 A flexible coupling or flexible connecting shaft shall be constructed in such a manner that the hub or power transmission component(s) of the driver shaft is mechanically attached to the hub or power transmission components of the pump shaft.

9 Drive Mechanisms

9.1 A flexible coupling incorporating a primary drive mechanism constructed of a polymeric material shall be provided with a secondary drive mechanism to operate the pump temporarily in the event that the primary drive mechanism discontinues to drive the pump shaft. See Section 13, Endurance and Starting Cycle.

10 Flexible Connecting Shaft Bearings

10.1 Flexible connecting shaft needle or roller bearings shall have a B-10 rating of not less than 5,000 hours for all speeds within a rated speed range based on the following equation unless the published bearing factor for the universal joint is intended to be utilized in different equation

$$L_h = [(1.5 \times 10^6) / (N \times A)] \times (B_f / T_r)^{10/3}$$

in which:

L_h is the B-10 rating in hours;

N is the speed associated with the torque rating in revolutions per minute;

A is the intended operating angle in degrees;

B_f is the bearing factor published for the universal joint in ft-lbs; and

T_r is the torque rating as tested in Section 13, Endurance and Starting Cycle in ft-lbs.

11 Fasteners

11.1 Fasteners supplied with the coupling shall be of a type that will withstand the anticipated forces during assembly and use.

PERFORMANCE

12 General

12.1 Representative samples of flexible couplings or flexible connecting shafts are to be subjected to the tests described in Section 13, Endurance and Starting Cycle, and Section 14, Aging Tests, Polymeric Materials.

13 Endurance and Starting Cycle

13.1 General

13.1.1 When tested as specified in 13.2.1 – 13.2.3, a flexible coupling or flexible connecting shaft shall:

a) Remain in the installed position;

b) Transmit the specified power from the driver;

c) Remain completely intact on the shafts; and

d) Not show excessive wear such that it becomes inoperable, causes risk of injury to persons, or causes damage to the coupling, connecting shaft, or shaft which affects the means of attachment that would impair the intended use.

13.1.2 Testing with diesel engines in accordance with 13.2.1 or 13.3.1 is considered representative of electric motor drivers. Testing in accordance with 13.2.1 or 13.3.1 shall be permitted to be conducted using a electric motor driver provided the end use of the flexible coupling or connecting shaft is limited to connecting fire pumps to electric drivers. A flexible coupling or connecting shaft intended for use with both engine and electric motor drivers shall be subjected to the starting tests described in 13.2.2 or 13.3.2, as applicable, using both an engine and electric driver. A flexible coupling or connecting shaft intended for use with an engine driver only or an electric motor only shall be permitted to be subjected to the starting tests described in 13.2.2 or 13.3.2, as applicable, using the type of driver referenced in the manufacturer's installation instructions.

13.1.3 For the purposes of the testing described in 13.2 and 13.3, the maximum rated speed is considered to be achieved when the measured speed for the test is at least 97 % of the rated speed referenced in the manufacturer's instructions.

13.2 Flexible coupling test method

13.2.1 A representative sample of each flexible coupling model is to be tested. A flexible coupling is to be installed to connect the shafts of a driver (see 13.1.2) and dynamometer or other similar torque-transmitting device in a manner, as specified in the flexible coupling manufacturer's instructions, to represent:

a) 200 % of the maximum permitted angular and parallel misalignment; and

b) The maximum gap between the shaft hubs.

The flexible coupling is to be operated continuously for no less than 24 hours while transmitting driver horsepower to provide for a shaft torque equivalent to the maximum torque rating of the flexible coupling and the maximum rated speed as specified in the coupling manufacturer's installation instructions for fire pump use. After the 24 hour test duration, the same flexible coupling sample shall be operated for no less than 8 hours while transmitting the engine horsepower to provide for a shaft torque equivalent to the minimum torque rating and the maximum rated speed specified in the coupling manufacturer's installation for fire pump use.

13.2.2 Before and after the endurance test specified in 13.2.1, the driver (see 13.1.2) is to be started and accelerated as quickly as possible to maximum rated speed at rated torque, operated at that speed for no less than 30 seconds, and then stopped. Starting tests conducted with an electric motor driver shall be conducted using an across-the-line starting arrangement. A test arrangement simulating the starting of an across-the-line motor shall be permitted to be used if it is demonstrated to be an equivalent or more challenging starting condition. For a diesel engine driver, the time to achieve the maximum rated speed at rated torque shall not exceed 20 seconds. A total of 40 starting cycles are to be conducted for each driver type intended for use with the flexible coupling. For each driver, twenty cycles are to be conducted before the endurance test, and twenty cycles after the endurance tests. All starting tests are to be conducted with the flexible coupling aligned as described in 13.2.1.

13.2.3 In addition to the tests specified in 13.2.1 and 13.2.2, a flexible coupling fitted with a primary drive mechanism constructed of a polymeric material shall be connected to a torque transmitting device to provide for the misalignment specified in 13.2.1. With the primary polymeric drive mechanism removed, the secondary drive mechanism shall be operated at the maximum and minimum rated shaft torques specified in 13.2.1 for two hours of operation each with the driver used during the testing described in 13.2.1. Observations shall be made for the transmission of the specified power during this test.

13.3 Flexible connecting shaft method

13.3.1 A representative sample of each flexible connecting shaft model is to be tested. A flexible connecting shaft is to be installed to connect the shafts of a driver (see 13.1.2) and dynamometer or other similar torque-transmitting device in a manner, as specified in the flexible connecting shaft manufacturer's instructions, to represent:

a) Angular and parallel misalignment which includes 200 % of the misalignment tolerances (e.g., a flexible connecting shaft with a specified parallel misalignment of 3° ±1° would be tested at 3° plus 2° = 5°) referenced in the manufacturer's installation instructions; and

b) The maximum length referenced for the flexible connecting shaft.

The flexible connecting shaft is to be operated continuously for no less than 24 hours while transmitting horsepower to provide for a shaft torque equivalent to the maximum torque rating of the flexible connecting shaft specified in the connecting shaft manufacturer's installation instructions for fire pump use. If the maximum torque rating is not at the maximum rated speed, the flexible connecting shaft shall be tested for