



Approval Standard for Flexible Fire Pump Couplings and Flexible Connecting Shafts for Fire Protection Service

Class Number 1336

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Foreword

The FM Approvals certification mark is intended to verify that the products and services described will meet FM Approvals' stated conditions of performance, safety and quality useful to the ends of property conservation. The purpose of Approval Standards is to present the criteria for FM Approval of various types of products and services, as guidance for FM Approvals personnel, manufacturers, users and authorities having jurisdiction.

Products submitted for certification by FM Approvals shall demonstrate that they meet the intent of the Approval Standard, and that quality control in manufacturing shall ensure a consistently uniform and reliable product. Approval Standards strive to be performance-oriented. They are intended to facilitate technological development.

For examining equipment, materials and services, Approval Standards:

- a) must be useful to the ends of property conservation by preventing, limiting or not causing damage under the conditions stated by the Approval listing; and
- b) must be readily identifiable.

Continuance of Approval and listing depends on compliance with the Approval Agreement, satisfactory performance in the field, on successful re-examinations of equipment, materials, and services as appropriate, and on surveillance audits of the manufacturing facility.

FM Approvals LLC reserves the right in its sole judgment to change or revise its standards, criteria, methods, or procedures.

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1. INTRODUCTION

1.1 Purpose

- 1.1.1 This standard states Approval criteria for flexible fire pump couplings and flexible connecting (drive) shafts which provide power transmission from diesel engines or electric motors to fire pumps that supply water to fire protection systems. These flexible fire pump couplings and flexible connecting shafts must have an extended service life, throughout which they must be capable of operating reliably at rated power and speeds during emergency fire incidents, despite being idle for extended periods. The purpose of the flexible coupling and flexible connecting shafts is to compensate for temperature changes and to permit end movement of the shafts without interference with each other while transmitting power from the driver to the pump.
- 1.1.2 Approval criteria include, but are not limited to, performance requirements, marking requirements, examination of manufacturing facility(ies), audit of quality assurance procedures, and a surveillance program.
- 1.1.3 Approval standards are intended to verify that the product described shall meet stated conditions of performance, safety, and quality useful to the ends of property conservation.

1.2 Scope

- 1.2.1 This standard encompasses the design and performance requirements for flexible fire pump couplings and flexible connecting shafts used in fire pump service that are designed and installed in accordance with FM Global Property Loss Prevention Data Sheets.
- 1.2.2 This standard encompasses flexible fire pump couplings and flexible connecting shafts for use with operating speeds at or below 3600 rpm.
- 1.2.3 This standard encompasses the design and performance requirements for flexible fire pump couplings of 30 hp through 1000 hp load rating, and for flexible connecting shaft diameters of up to 4 inch nominal size used in fire pump service.
- 1.2.4 Flexible couplings and flexible connecting shafts designed for other rated capacities shall be evaluated on a case-by-case basis.

1.3 Basis for Requirements

- 1.3.1 The requirements of this standard are based on experience, research and testing, and/or the standards of other organizations. The advice of manufacturers, users, trade associations, jurisdictions and/or loss control specialists was also considered.
- 1.3.2 The requirements of this standard reflect tests and practices used to examine characteristics of flexible fire pump couplings and flexible connecting shafts for the purpose of obtaining Approval. Flexible fire pump couplings and flexible connecting shafts having characteristics not anticipated by this standard may be FM Approved if performance equal, or superior, to that required by this standard is demonstrated, or if the intent of the standard is met. Alternatively, flexible fire pump couplings and flexible connecting shafts which meet all of the requirements identified in this standard may not be FM Approved if other conditions which adversely affect performance exist or if the intent of this standard is not met.

1.4 Basis for Approval

Approval is based upon satisfactory evaluation of the product and the manufacturer in the following major areas:

1.4.1 Examination and tests on production samples shall be performed to evaluate:

- The suitability of the product;
- The performance of the product as specified by the manufacturer and required by FM Approvals; and,
- As far as practical, the durability and reliability of the product.

1.4.2 An first audit shall be conducted to evaluate the manufacturer's ability to consistently produce the product that was examined and tested as part of the Approval project. The audit shall review the facility and in-place quality control procedures used in the manufacturing of the product. Typically, areas of review are incoming inspection, work in progress, production testing, final quality control, marking, calibration of equipment, shipping procedures, and document and drawing control. These examinations are repeated periodically as part of the FM Approvals' Surveillance Audit Program. (Refer to Section 5.2, Surveillance Audit Program.)

1.5 Basis for Continued Approval

Continued Approval is based upon:

- Production or availability of the product as currently FM Approved;
- The continued use of acceptable quality assurance procedures;
- Satisfactory field experience;
- Compliance with the terms stipulated in the Master Agreement;
- Satisfactory re-examination of production samples for continued conformity to requirements; and
- Satisfactory Surveillance Audits conducted as part of the FM Approvals' product follow-up program.

Also, as a condition of retaining Approval, manufacturers may not change a product or service without prior written authorization by FM Approvals. (Refer to Section 5.1.3 for further details regarding changes to FM Approved products.)

1.6 Effective Date

The effective date of an Approval standard mandates that all products tested for Approval after the effective date shall satisfy the requirements of that standard. Products FM Approved under a previous edition shall comply with the new version by the effective date or forfeit Approval.

The effective date of this standard is **September 30, 2011** for compliance with all requirements.

1.7 System of Units

Units of measurement used in this standard are United States (U.S.) customary units. These are followed by their arithmetic equivalents in International System (SI) units, enclosed in parentheses. The first value stated shall be regarded as the requirement. The converted equivalent value may be approximate. Appendix A lists the selected units and conversions to SI units for measures appearing in this standard. Conversion of U.S. customary units is in accordance with the Institute of Electrical and Electronics Engineers (IEEE)/ASTM International (ASTM) SI 10-2002, *American National Standard for Use of the International System of Units (SI): The Modern Metric System*.

1.8 Applicable Documents

The following standards, test methods, and practices are referenced in this standard or are beneficial in understanding this standard:

American Gear Manufacturers Association (AGMA) 922 (Edition A96), *Load classification and Service Factors for Flexible Couplings*
 ANSI/AGMA 9000 (Edition C90), *Flexible Couplings - Potential Unbalance Classification*
 ANSI/AGMA 9001 (Edition B97), *Flexible Couplings - Lubrication*
 ANSI/AGMA 9002 (Edition B04), *Bores and Keyways for Flexible Couplings (Inch Series)*
 ANSI/AGMA 9003, (Edition B08), *Flexible Couplings - Keyless Fits*
 ANSI/AGMA 9004, (Edition B08), *Flexible Couplings - Mass Elastic Properties and Other Characteristics*
 ANSI/AGMA 9008, (Edition B00), *Flexible Couplings - Gear Type, Flange Dimensions, Inch Series*
 ANSI/AGMA 9009-D02 (2002), *Flexible Coupling – Nomenclature for Flexible Couplings*
 ANSI/AGMA 9103-B08 *Flexible Couplings - Keyless Fits (Metric Edition)*
 ANSI/AGMA 9104-A06 *Flexible Couplings - Mass Elastic Properties and Other Characteristics (Metric Edition)*
 ANSI/AGMA 9112-A04 *Bores and Keyways for Flexible Couplings (Metric Series)*
 FM Approvals, Approval Standard 1321/1323-2007, *Fire Pump Controllers for Electric Motor and Diesel Engine Drivers*
 FM Approvals, Approval Standard 1333-2008, *Diesel Engine Fire Pump Drivers*
 FM Global Property Loss Prevention Data Sheet 3-7, April 2008, *Fire Protection Pumps*
 FM Global Property Loss Prevention Data Sheets
 IEEE/ASTM SI 10-2002, *American National Standard for Use of the International System of Units (SI): The Modern Metric System*
 International Organization for Standardization (ISO) 17025 (2005), *General Requirements for the Competence of Testing and Calibration Laboratories*
 ISO 1940-1, 2003, *Mechanical vibration -- Balance quality requirements for rotors in a constant (rigid) state -- Part 1: Specification and verification of balance tolerances*
 National Fire Protection Association (NFPA) 20-2007, *Standard for the Installation of Stationary Pumps for Fire Protection*

1.9 Definitions

For purposes of this standard, the following terms apply:

Accepted

This term refers to installations acceptable to the authority enforcing the applicable installation rules. When the authority is FM Global, such locations are termed “FM Global Accepted.” Acceptance is based upon an overall evaluation of the installation. Factors other than the use of FM Approved equipment impact upon the decision to accept, or not to accept. Acceptance is not a characteristic of a product. It is installation specific. A product accepted for one installation may not be acceptable elsewhere. (Contrast this definition with FM Approved.)

Angular Misalignment

Misalignment where the pump shaft and the driver shaft axes are not parallel.

Axial Misalignment

Misalignment caused when one shaft moves along its axis relative to the other shaft (end float).

Close-Coupling

Direct connection or “close-coupling” of the pump and driver is acceptable for electrically driven, in-line, vertically mounted, horizontal split case, and end-suction pumps.

Critical Speed

Any operating speed that corresponds to the natural period of vibration (natural frequency) of the rotating shafts.

Diesel Engine

An internal combustion engine in which the fuel is ignited entirely by the heat resulting from the compression of the air supplied for combustion.

Elastomeric Components

Any flexible non-metallic element that is a part of the coupling assembly. Usually, these components are used between two rigid end connections in the coupling assembly, to provide dampening and flexibility during operation. FM Approvals does not allow the only source of torque transmission to be an elastomeric or polymeric component.

Fire Pump Package

An assembled unit consisting of a fire pump, driver, controller, and accessories.

Flexible Connecting Shaft

A flexible mechanical device used to connect the shafts or other torque-transmitting components from a driver to the pump, used for transmitting torque and rotation.

Flexible Drive Coupling

A device used to connect the shafts or other torque-transmitting components from a driver to the pump. The device shall not rely on an elastomeric or polymeric element as a sole means of torque transmission. All FM Approved flexible drive couplings must have metal-to-metal contact of components to drive the pump in case of elastomeric or polymeric element failure. The coupling assembly shall permit minor angular and parallel misalignment as restricted by both the pump, driver and coupling manufacturers. Examples of recommended couplings are: pin and bushing, jaw, disc, drive shaft, or steel-grid-type couplings where the drive components are metallic.

FM Approvals Certification Marks

The FM Approvals Certification Marks are detailed in Appendix B. Their use is mandatory on all units of FM Approved flexible fire pump couplings and flexible connecting shafts. These registered marks cannot be used except as authorized by FM Approvals via the granting of Approval to a specific product.

FM Approved

This term refers to products FM Approved by FM Approvals. Such products are listed in the Approval Guide, an online resource of FM Approvals. All products so listed have been successfully examined by FM Approvals, and their manufacturers have signed and returned a Master Agreement to FM Approvals. The Master Agreement obligates the manufacturer to allow re-examination of the product and surveillance audits at FM Approval's discretion. It further requires the manufacturer not to deviate from the as-FM Approved configuration of the product without review by and agreement of FM Approvals. Approval is product specific.

Hollow Shaft

This pertains to the hollow vertical drive shaft of electric motors or right angle gear drives used to drive vertical turbine pumps. The hollow drive shaft is designed to accept the solid line shaft of the pump. The design facilitates impeller adjustment within the bowl assembly and the installation of a non-reverse ratchet into the motor or gear drive.

Line Shaft

A shaft which transmits the power from the driver to the pump shaft.

Misalignment

A situation created by two shafts whose axes are not in the same straight line.

Non-Reverse Ratchet

A mechanism installed as an integral part of the hollow shaft electric motor or hollow shaft right angle gear drive to prevent reverse rotation of the pump-driver assembly.