



Member of the FM Global Group

Examination Standard for Centrifugal Fire Pumps (In-Line Type)

Class Number 1371

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Foreword

This standard is intended to verify that the products and services described will meet stated conditions of performance, safety and quality useful to the ends of property conservation. The purpose of this standards is to present the criteria for examination of various types of products and services.

Examination in accordance with this standard shall demonstrate compliance and verify that quality control in manufacturing shall ensure a consistent and reliable product.

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1. INTRODUCTION

1.1 Purpose

- 1.1.1 This standard states testing and certification requirements for in-line, single stage type centrifugal fire pumps which supply water to fire protection systems. These pumps must have an extended service life, throughout which they must be capable of operating reliably at rated capacities and pressures during emergency fire incidents, despite being idle for extended periods.
- 1.1.2 Testing and certification criteria may include, but are not limited to, performance requirements, marking requirements, examination of manufacturing facility(ies), audit of quality assurance procedures, and a surveillance program.

1.2 Scope

- 1.2.1 This standard encompasses the design and performance requirements for in-line type, centrifugal fire pumps for use in fire protection systems. Certification is limited to single stage, in-line type, centrifugal fire pumps that have a minimum rated discharge pressure of at least 40 psi (275 kPa). In cases where metric sized in-line type, centrifugal fire pumps are to be examined for certification, test criteria comparable to the United States equivalent size shall be used.
- 1.2.2 Requirements for other types of centrifugal fire pumps are detailed in the following examination standards:

<i>Class</i>	<i>Centrifugal Fire Pump Type</i>
1310	Multi Stage, Multi Outlet
1311	Split-Case Type, (Axial or Radial)
1312	Vertical Shaft Turbine Type
1319	Horizontal, End-Suction Type
1370	Vertical Turbine Barrel Type

- 1.2.3 Requirements for other major components in the pump package are detailed in the following examination standards:

<i>Class</i>	<i>Equipment</i>
1046	Fire Pump Flowmeter Systems
1321/1323	Controllers for Electric Motor Driven and Diesel Engine Driven Fire Pumps
1333	Diesel Engine Fire Pump Drivers
1336	Fire Pump Couplings and Flexible Connecting Shafts for Fire Protection Service
1359	Trim Water Pressure Relief Valves
2311	Pressure Gauges for Fire Protection Systems

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 single stage, in-line type, centrifugal fire pumps for the purpose of obtaining certification.

1.4 Basis for Certification

Certification 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 for certification; and as far as practical,
- the durability and reliability of the product.

1.4.2 An examination of the manufacturing facilities and audit of quality control procedures shall be made to evaluate the manufacturer's ability to consistently produce the product which is examined and tested, and the marking procedures used to identify the product. Subsequent surveillance may be required by the certification agency in accordance with the certification scheme to ensure ongoing compliance.

1.5 Basis for Continued Certification

1.5.1 The basis for continual certification may include, but is not limited to, the following based upon the certification scheme and requirements of the certification agency:

- production or availability of the product as currently certified;
- the continued use of acceptable quality assurance procedures;
- compliance with the terms stipulated by the certification;
- satisfactory re-examination of production samples for continued conformity to requirements; and
- satisfactory surveillance audits conducted as part of the certification agency's product surveillance program.

1.6 Effective Date

The effective date of this certification standard mandates that all products tested for certification after the effective date shall satisfy the requirements of this standard.

The effective date of this standard is eighteen (18) months after the publication date of the standard 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. Conversion of U.S. customary units is in accordance with ANSI/IEEE/ASTM SI 10. Two units of measurement (liter and bar), outside of but recognized by SI, are commonly used in international fire protection and are used in this standard.

1.8 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the cited edition applies.

ANSI/IEEE/ASTM SI 10, *American National Standard for Metric Practice*
ANSI/AWWA E103, *Horizontal and Vertical Line-Shaft Pumps*
API Standard 682, *Pumps—Shaft Sealing Systems for Centrifugal and Rotary Pumps*
IEC 60034-1, *Rotating electrical machines - Part 1: Rating and performance*
NEMA MG 1, *Motors and Generators*

1.9 Terms and 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. Acceptance is based upon an overall evaluation of the installation. Acceptance is not a characteristic of a product. It is installation specific. A product accepted for one installation may not be acceptable elsewhere.

Characteristic Curve

Graphic representation of the variation of the pump's total head, efficiency and brake horsepower versus the pump's capacity at a constant speed.

Closed-Coupled Pump

A pump having its impeller fastened directly to the electric motor shaft, without the use of extension shafts and couplings.

Corrosion Resistant

Having resistance to corrosion equal to or exceeding that of bronze alloy having a minimum copper content of 80 percent, or being of Series 300 Stainless Steel construction.

Design Working Pressure

The maximum pressure for which a pump component is designed. This pressure is equal to or greater than the maximum pressure developed by the pump at shut off or churn conditions with the largest impeller available, and at maximum speed plus the maximum suction pressure for the pump.

Dynamic Shaft Deflection

Dynamic condition where the axial centerline of the shaft does not coincide with the axial centerline of the bearings, measured at the gland end of the stuffing box.

Efficiency

The ratio of the energy delivered by the pump to the energy supplied to the pump shaft (liquid power divided by applied power).

Enclosed Impeller

An impeller in which the pumped liquid is confined by the sidewalls (shrouds) and vanes of the impeller. All impellers supplied in accordance with this certification standard shall be of this type.

Fire Pump Alternate Manufacturing Location

A location that manufactures a complete pump to the design requirements of the Fire Pump Manufacturer (OEM) or modifies (i.e. trimming of a pump impeller) an OEM supplied (bare-shafted) fire pump.

The Fire Pump Alternate Manufacturing Location may be an alternate facility owned and operated by the OEM or a facility owned by others that performs the complete, or partial, manufacturing of the complete fire pump and/or package under direct control of the OEM.

Fire Pump Manufacturer

The manufacturer of the certified fire pump is also referred to as the Original Equipment Manufacturer (OEM) of the fire pump.

Fire Pump Package

An assembled fire pump, driver, controller and components, see Appendix D, necessary to provide a complete pump installation.

Fire Pump Packager

The Fire Pump Manufacturer can delegate, through a legal agreement, the function of assembling the fire pump package to a third party known as the fire pump packager. Alternatively, or in addition to, a Fire Pump Packager may package or just distribute complete private labeled fire pump packages.

The Fire Pump Packager may be a facility owned and operated by the Fire Pump Manufacturer or a facility owned by others that performs the assembly of the complete fire pump package under direct control of the OEM.

Fire Pump Private Labeler

A company, other than the Fire Pump Manufacturer (OEM), that has a legal agreement with the OEM whereby the pump is manufactured and labeled by the OEM in the name of the Private Labeler.

In order to enter into a Fire Pump Private Label agreement, a Fire Pump Private Labeler must be one of the following entities:

- Fire Pump Manufacturer
- Fire Pump Alternate Manufacturer
- Fire Pump Packager

In-Line Pump

Single stage pump having its electric motor driving unit supported exclusively by the pump and having its suction and discharge nozzles on a common centerline which intersects the shaft axis at a 90° angle. The impeller is fastened to the end of the shaft of the electric motor, either directly or on a separate shaft attached to the motor shaft by means of a rigid, spacer coupling.

Maximum Load

Maximum radial hydraulic load on the impeller at any point on the performance curve based on a specific gravity of 1.0. This usually occurs at the point of maximum total discharge head.

Maximum Power

The greatest speed-corrected power required to drive the pump at rated speed and at any point along its characteristic curve, and through the pumps total run out condition. This is determined under conditions of increasing positive suction head.

Mechanical Seals

A sealing device which forms a running seal between the rotating and stationary components. They may be used in place of compression (soft) packing. All mechanical seals are constructed of three basic sets of parts:

- A set of primary seal faces: one rotary and one stationary
- A set of secondary seals known as shaft packings and insert mountings such as O-rings, wedges and V-rings
- Mechanical seal hardware including gland rings, collars, compression rings, pins, springs and bellows

The primary seal is achieved by two very flat, lapped faces perpendicular to the shaft. The rubbing contact between these two flat mating surfaces minimizes leakage. One face is held stationary in a housing and the other face is fixed to, and rotates with, the shaft. Dissimilar materials are usually used for the stationary insert and the rotating seal ring face in order to prevent adhesion of the two faces.

Cartridge Seal Type

This type of mechanical seal is a completely self-contained unit (including stationary and rotating seal faces, gland sleeve, mating ring, etc.) which is pre-assembled and preset before installation. The cartridge mechanical seal is a complete seal assembly which is manufactured, assembled and calibrated by the mechanical seal manufacturer.

Component Type

This type of mechanical seal is assembled from the individual components directly onto the shaft. The components usually consist of a rotating unit with a mating face which is in contact with a stationary unit. The rotating unit seals in two places, at the interface between the rotating face and the stationary face and between the shaft and the seal body. The stationary unit seals against the pump body.

Split Seal Type

This type of mechanical seal has its primary sealing elements and other components split. The seal can be mounted on a pump without removing the impeller.

Rated Capacity

Rate at which water is delivered, in gal./min. (L/min), at rated pressure and rated speed.

Rated Pressure

Pressure in pounds per square inch - psi (kilopascals -kPa) developed by the pump when operating at rated capacity.

Shaft Runout

Static condition where the axial centerline of the shaft does not coincide with the axial centerline of the bearings, as measured at the junction of the motor shaft and impeller.

Shutoff or Churn Pressure

The net pressure in psi (kPa) developed by the pump at rated speed with zero flow.

Single Stage Pump

A pump in which the total head is developed by one impeller.

Off-Site Test Facilities

The location where testing will be performed that is not operated by the certification agency and which provides all of the following:

- a.) All required test and data collection equipment.
- b.) A formal calibration system with traceability to nationally recognized standards by an ISO 17025 accredited calibration service.
- c.) Test personnel who possess a thorough understanding of, and the ability to conduct, the required tests.

Total Discharge Head

The gauge reading in psi (kPa) at the discharge of the pump, referred to the pump centerline, plus the velocity head at the point of gauge attachment.

Total Suction Head

The condition when the suction pressure is above atmospheric. The total suction head is the algebraic sum of the gauge reading in psi (kPa) at the pump suction nozzle, referred to the pump centerline, plus the velocity head at the point of gauge attachment. Also called "positive suction pressure".

Total Suction Lift

The condition when suction pressure is below atmospheric. The total suction lift is the algebraic sum of the gauge reading in psi (kPa) at the suction nozzle of the pump, referred to the pump centerline, minus the velocity head at the point of gauge attachment.

Total Head

The algebraic difference between the total discharge head and the total suction head. Where suction head exists, total head equals total discharge head minus total suction head. Where suction lift exists, total head equals total discharge head plus total suction lift.

2. GENERAL INFORMATION

2.1 Product Information

- 2.1.1 Pumps covered by this standard include those designed for one of the following capacities: 25, 50, 100, 150, 200, 250, 300, 400, 450, 500, 750, 1000, 1250, 1500, 2000, 2500, 3000, 3500, 4000, 4500, and 5000 gal./min. (95, 190, 380, 570, 755, 945, 1135, 1515, 1705, 1895, 2840, 3785, 4730, 5680, 7570, 9465, 11 355, 13 250, 15 140, 17 035, and 18 925 L/min) or larger.
- 2.1.2 Pumps shall have a minimum rated discharge pressure of at least 40 psi (275 kPa).
- 2.1.3 In order to meet the intent of this standard, single stage, in-line type, centrifugal fire pumps must be examined on a model-by-model, type-by-type, manufacturer-by-manufacturer, and plant-by-plant basis. This is predicated on the basis that identical designs, fabricated in identical materials by different manufacturers or, even by different plants of the same manufacturer, have been seen to perform differently in testing. Sample fire pumps, selected in conformance to this criterion, shall satisfy all of the requirements of this standard.

2.2 Certification Application Requirements

The manufacturer shall provide the following preliminary information with any request for certification consideration:

- A complete list of all models, types, sizes, and options for the products or services being submitted for certification consideration;
- Anticipated pump performance, including total head, power requirements, and efficiency versus flow characteristics. If different impellers or a range of impellers are used to obtain the rated head range for the pump being examined, complete details shall be provided concerning the range of performance specifications to be evaluated, including maximum and minimum characteristic curves for each rated speed;
- The pump manufacturer shall, for each model pump, conduct performance tests prior to the certification program on minimum and maximum impeller diameters. Suction pressure shall be sufficient to determine maximum power requirements. The maximum horsepower measured shall be used to size the electric motor(s) for certification tests and, ultimately, for site installation. Performance curves of the total head and power versus flow shall be drawn from the data from these tests and submitted to the certification agency prior to scheduling the witnessed certification tests.
- Motor specifications for each motor used, including power rating, speed, frame size, radial thrust capacity, shaft deflection versus radial thrust, minimum shaft fatigue lift, maximum shaft runout, and minimum bearing life;
- Calculations to determine maximum radial thrust, shaft size, shaft runout, stuffing box runout, shaft stress and shaft deflection, coupling stress (when extension shafts and spacer couplings are used), casing bolt size, strength of impeller holding bolt and anti-friction bearing life;
- If mechanical seals are provided, all sizing and design information shall be submitted for evaluation, (See Section 3.2.6)
- General assembly drawings (showing the pump and attachments), one complete set of manufacturing drawings, materials list(s) and physical property specifications (such as ASTM A48 CL 40 - Cast Iron), anticipated marking format, brochures, sales literature, specification sheets, installation, operation and maintenance procedures;
- The number and location of manufacturing facilities; and,
- All documents shall identify the manufacturer's name, document number or other form of reference, title, date of last revision, and revision level. All foreign language documents shall be provided with English translation.

2.3 Requirements for Samples for Examination

- 2.3.1 Following authorization of a certification examination, the manufacturer shall submit samples for examination and testing based on the following:
- Sample requirements are to be determined by the certification agency.
- 2.3.2 Requirements for samples may vary depending on design features, results of prior or similar testing, and results of the foregoing tests.