

Approval Standard for Fire Hose Assemblies and Fire Hose Couplings

Class Number 2111, 2131

October 2014

©2014 FM Approvals LLC. All rights reserved.

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 periodic follow-up 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.

TABLE OF CONTENTS

1. INTRODUCTION	1
1.1 Purpose	1
1.2 Scope	1
1.3 Basis for Requirements	2
1.4 Basis for Approval	2
1.5 Basis for Continued Approval	2
1.6 Effective Date	3
1.7 System of Units	3
1.8 Applicable Documents	3
1.9 Definitions	3
2. GENERAL INFORMATION	6
2.1 Product Information	6
2.2 Approval Application Requirements	6
2.3 Requirements for Samples for Examination	7
3. GENERAL REQUIREMENTS	7
3.1 Review of Documentation	7
3.2 Physical or Structural Features	7
3.3 Fire Hose Assemblies	8
3.4 Materials	8
3.5 Markings	9
3.6 Calibration	9
4. PERFORMANCE REQUIREMENTS	10
4.1 Performance Testing for Fire Hose Assemblies	10
4.1.1 Examination	10
4.1.2 Hydrostatic Proof-Pressure Tests	10
4.1.3 Kink Test	11
4.1.4 Hydrostatic Minimum Burst-Pressure Test	11
4.1.5 Lining Adhesion	12
4.1.6 Tensile Strength and Ultimate Elongation – Linings and Covers	13
4.1.7 Heat Resistance	14
4.1.8 Cold Resistance (Not Required for Occupant-Use Hose)	14
4.1.9 Abrasion Test (Not Required for Occupant-Use Hose)	15
4.1.10 Friction Loss (Not Required for Occupant-Use Hose)	15
4.1.11 Alternating Pressure Test (Not Required for Occupant-Use Hose)	16

4.1.12	Moisture Resistance.....	16
4.1.13	Repeated Bending Test.....	16
4.1.14	Fold Resistance	17
4.1.15	Accelerated Aging of Jacket Threads	17
4.1.16	Water Absorption Test of Lining Material	17
4.2	Performance Testing for Fire Hose Couplings	18
4.2.1	Hydrostatic Strength Test	18
4.2.2	Tensile Strength Test	18
4.2.3	Rough Usage Test.....	18
4.2.4	Torque Test	19
4.2.5	High Temperature Performance	19
4.2.6	Low Temperature Performance	19
4.2.7	Corrosion – Salt Spray	19
4.2.8	Corrosion – Stress Cracking	20
4.2.9	Tensile Strength and Ultimate Elongation – Coupling Gaskets.....	21
4.2.10	Compression Set – Coupling Gaskets	21
4.2.11	Low Temperature Resistance – Coupling Gaskets	22
4.3	Additional Tests.....	22
5.	OPERATIONS REQUIREMENTS.....	23
5.1	Demonstrated Quality Control Program	23
5.2	Surveillance Audits	23
5.3	Manufacturer’s Responsibilities	24
5.4	Manufacturing and Production Tests.....	24
	APPENDIX A: Units of Measurement	26
	APPENDIX B: Tolerances.....	27
	APPENDIX C: FM Approvals Certification Marks	28

1. INTRODUCTION

1.1 Purpose

1.1.1 This standard states Approval requirements for:

- Single-jacket and multiple-jacket lined fire hose assemblies in trade sizes of 1½, 1¾, 2, 2½, 3, 3½, 4, 4½, 5, and 6 in. (25, 38, 44, 51, 65, 76, 90, 100, 113, 125, and 150 mm).
- Single-jacket occupant-use fire hose assemblies in trade sizes of 1, 1½, and 2½ in. (25, 38 and 65 mm).
- Couplings for use with fire hose assemblies described above.

1.1.2 Approval criteria may include, but are not limited to, performance requirements, marking requirements, examination of manufacturing facility(ies), audit of quality assurance procedures, and a follow-up program.

1.2 Scope

1.2.1 This standard sets performance requirements for the following product categories and associated class numbers:

Class Number	Product Category
2111	Fire Hose Assemblies
2131	Fire Hose Couplings

1.2.2 This standard is applicable to:

- Single-jacket and multiple-jacket hose assemblies designed for municipal and industrial fire protection services.
- Single-jacket occupant-use hose assemblies designed to be used by occupants of a building to fight incipient fires prior to the arrival of trained fire fighters or fire brigade members. Occupant-use hose is expected to see infrequent service and is intended to be used for interior fire-fighting purposes only.
- Couplings attached to both ends of single- or multiple-jacket fire hose to allow for connection to additional lengths of hose, water sources, and/or discharge devices.

1.2.3 Single-jacket, uncovered hose is designed for use on standpipes, fire hydrants, and other such applications. They are not intended for rugged use nor in areas where they may be subject to chafing or being dragged over rough or sharp surfaces.

1.2.4 Multiple-jacket and covered hose is designed for use on pumpers or other areas where the extra protection afforded by the outer jacket or cover is desired.

1.2.5 While in service, fire hose tested and Approved to this Standard should be maintained and tested periodically to a nationally recognized standard, such as NFPA 1962, *Standard for the Care, Use, Inspection, Service Testing, and Replacement of Fire Hose, Couplings, Nozzles, and Fire Hose Appliances*.

1.2.6 Fire hose of unusual design may be subjected to special tests to determine its suitability.

- 1.2.7 FM Approvals Standards are intended to verify that the product described will meet stated conditions of performance, safety, and quality useful to the ends of property conservation.

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 national and international 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 fire hose and fire hose couplings for the purpose of obtaining Approval. These requirements are intended primarily as guides, and strict conformity is not always mandatory. Fire hose 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, fire hose which does 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 examination of the manufacturing facility(ies) and audit of quality control procedures shall be made to evaluate the manufacturer's ability to produce the product as examined and tested, and the marking procedures used to identify the product. These examinations are repeated as part of FM Approvals' product follow-up 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 Approval Agreement;
- satisfactory re-examination of production samples for continued conformity to requirements;
- satisfactory Surveillance Audits conducted as part of FM Approvals' product follow-up program.

Also, as a condition of retaining Approval, manufacturers may not change a product or service without prior authorization by FM Approvals.

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 12 months from the issue date for full 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 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)/American Society for Testing Materials (ASTM) SI10-2010, “*American National Standard for Metric Practice.*”

1.8 Applicable Documents

The latest versions of the following standards, test methods, and practices are referenced in this standard:

ASTM B117, *Standard Practice for Operating Salt Spray (Fog) Apparatus.*

ASTM D395, *Standard Test Methods for Rubber Property – Compression Set*

ASTM D412, *Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension.*

ASTM D471, *Standard Test Method for Rubber Property – Effect of Liquids.*

ASTM D573, *Standard Test Method for Rubber - Deterioration in an Air Oven.*

ANSI/IEEE/ASTM SI 10 2010, American National Standard for Metric Practice.

FM Global property loss prevention data sheets.

National Fire Protection Association (NFPA) 1961, *Standard on Fire Hose*

National Fire Protection Association (NFPA) 1962, *Standard for the Care, Use, Inspection, Service Testing, and Replacement of Fire Hose, Couplings, Nozzles, and Fire Hose Appliances*

National Fire Protection Association (NFPA) 1963, *Standard for Fire Hose Connections*

1.9 Definitions

For purposes of this standard, the following terms apply:

Burst Pressure

The hydrostatic pressure at which a hose is expected to burst. The burst pressure shall not be less than three times the service test pressure.

Coupling Assembly

A complete coupling including its gaskets and the expansion rings or collar pieces used in attaching the coupling to a fire hose.

Coupling Bowl

The section of the coupling that the hose is attached to. The bowl has distinct ridges to lock the hose in place once the expansion ring is expanded against it.

Coupling Slippage

Any permanent movement of the hose out of a coupling bowl, of an external coupling collar, or of the hose under an external coupling collar.

Cover

An additional layer on the outside of a hose consisting of a continuous synthetic rubber or plastic to provide extra protection for the outer jacket (i.e., UV resistant).

Denier

A unit of measure for the linear mass density of fibers or yarns, defined as the mass in grams per 9000 meters (29,500 ft).

Elongation

The percent a section of hose increases in length from an initial measurement with the hose pressurized at 10 psi (6.9 kPa) to a final measurement with the hose pressurized at its proof test pressure.

Expansion Ring

A ring that is expanded to hold the hose tightly to the coupling bowl while sealing against the tail gasket.

FM Approvals Certification Mark

The FM Approvals certification mark is detailed in Appendix C. Its use is mandatory on all lengths of FM Approved fire hose and fire hose couplings. 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. 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 an Approval Agreement to FM Approvals. This form obligates the manufacturer to allow re-examination of the product and audit of facilities and procedures at FM Approvals 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.

Hose Assembly

Fire hose with couplings attached to both ends.

Hose Size (Trade Size)

The nominal internal diameter of the hose, typically expressed in inches.

Jacket

The structural support for fire hose that is often in the form of a woven yarn. A hose may consist of two or more jacket layers (multiple-jacket) to allow for rougher use and higher operating pressures.

NH Thread

An American National Fire Hose Connection Screw Thread, as specified in NFPA 1963, *Standard for Fire Hose Connections*.

Nonthreaded Coupling

A coupling in which the mating is achieved with locks or cams but without the use of screw threads.

Proof Pressure

The hydrostatic pressure to which a sample of new production hose is tested to indicate its acceptability for a specific normal maximum operating pressure. The proof pressure shall not be less than two times the service test pressure.

Rise

The maximum distance between the bottom of the hose and the test surface when the hose is pressurized to its proof test pressure. If the hose rises in several places along its length, the greatest measurement will be considered the rise.

Screw Thread Coupling

A coupling in which the mating is achieved with the use of threads.

Service Test Pressure

The hydrostatic test pressure marked on the hose that determines the pressure the hose is service tested to, as required by NFPA 1962, *Standard for the Care, Use, Inspection, Service Testing, and Replacement of Fire Hose, Couplings, Nozzles, and Fire Hose Appliances*. The service test pressure shall be at least 10 percent greater than the normal highest operating pressure.

Tail Gasket

A gasket in the bowl of a coupling designed to provide a watertight seal between the coupling and the hose. Also known as bowl gasket.

Thread Gasket

A gasket that is inserted into the internally threaded coupling swivel designed to provide a watertight seal when connected to an externally threaded coupling or fitting.

Twist

The number of revolutions the free end of a 50 ft (15 m) hose rotates when it is pressurized from an initial pressure of 10 psi (6.9 kPa) to its proof test pressure. One end is held stationary and the other end is allowed to move freely.

Warp

The maximum distance any portion of a hose deviates from a straight line running from the center of the fitting at one end to a point on the center of the hose 50 ft (15 m) from that fitting, with the hose pressurized to its proof test pressure.

Warp Thread

The threads or yarns of a hose jacket that run lengthwise.

Weft Thread

The threads or yarns of a hose jacket that are helically wound throughout the length of the hose at approximately right angles to the warp thread. Also known as filler thread.

2. GENERAL INFORMATION

2.1 Product Information

- 2.1.1 Present standard nominal sizes of fire hose and fire hose couplings for fire protection service are: 1, 1½, 1¾, 2, 2½, 3, 3½, 4, 4½, 5, and 6 inches (25, 38, 44, 51, 65, 76, 90, 100, 113, 125, and 150 mm).
- 2.1.2 In order to meet the intent of this standard, fire hose and couplings 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 hose and couplings, selected in conformance to this criterion, shall satisfy all of the requirements of this Standard.

2.2 Approval Application Requirements

To apply for an Approval examination, the manufacturer or its authorized representative should submit a request to:

Manager of Fire Protection
FM Approvals Hydraulics Laboratory
743A Reynolds Road
West Glocester, RI 02814
U.S.A.

The fire hose or coupling manufacturer shall provide the following preliminary information with any request for Approval consideration:

- a complete list of all trade names or designations, and sizes for the products or services being submitted for Approval consideration, and
- the number and location(s) of manufacturing facilities.

The fire hose manufacturer shall also provide:

- jacket weave and lining specifications, anticipated marking format, brochures, sales literature, and installation, operation and maintenance procedures, and
- coupling manufacturer and model designation

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

Following set-up and authorization of an Approval examination, the manufacturer shall submit samples for examination and testing. Sample requirements are to be determined by FM Approvals following review of the preliminary information. Sample requirements may vary depending on design features, results of prior testing, and results of the foregoing tests. It is the manufacturer's responsibility to submit samples representative of production. Any decision to use data generated utilizing prototypes is at the discretion of FM Approvals. The manufacturer shall provide any special test fixtures that may be required to evaluate the fire hose.

3. GENERAL REQUIREMENTS

3.1 Review of Documentation

During the initial investigation and prior to physical testing, the manufacturer's specifications, technical data sheets, and design details shall be reviewed to assess the ease and practicality of installation and use. The product shall be capable of being used within the limits of the Approval investigation.

3.2 Physical or Structural Features

3.2.1 Service Test Pressure: A single jacket fire hose is intended for service test pressures of 150, 200, or 250 psi (1030, 1380, or 1720 kPa). A multiple jacket fire hose is intended for service test pressure of 200, 300, or 400 psi (1380, 2070, or 2760 kPa).

3.2.2 Diameter: The internal diameter of the unpressurized hose shall not be less than the trade size of the hose.

3.2.3 Jacket

3.2.3.1 Jackets shall be evenly and firmly woven, and as free from defects, dirt, knots, lumps, and irregularities as is consistent with good manufacturing practice and which would not impair its intended use. The threads shall be continuous and all knots in the filler threads shall be tucked under the warp threads.

3.2.3.2 Each jacket shall be seamless and shall have the filler woven around the hose throughout its length. The warp shall be interwoven with and substantially cover the filler.

3.2.4 Linings and Covers

3.2.4.1 All fire hose shall be lined.

3.2.4.2 Linings and covers, if provided, shall be manufactured from one of the following materials:

- Rubber compound
- Thermoplastic material
- Blends of rubber compounds and thermoplastic material
- Natural rubber-latex-coated fabric