FM Approvals

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Examination Standard for Fire Hose Assemblies and Fire Hose Couplings

Class Number 2111, 2131

September 2024

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 standard 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:

- 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. Testing and certification criteria may include 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 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 certified 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.

1.3. 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 fire hose and fire hose couplings 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,
- the durability and reliability of the product.

1.4.2. An examination of the manufacturing facilities and audit of quality control procedures may be conducted 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

The basis for continual certification may include 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 in the certification agreement;
- satisfactory re-examination of production samples for continued conformity to requirements;
- satisfactory surveillance audits conducted as part of the certification agency’s product surveillance program.

1.6. Effective Date

The effective date of this examination 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.

1.8. Normative References

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

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

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

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

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

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

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

NFPA 1961, *Standard on Fire Hose*

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

NFPA) 1963, *Standard for Fire Hose Connections*

1.9. Terms and 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.

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, 4 ½, 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. 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;
- general assembly drawings, complete set of manufacturing drawings, materials list, anticipated marking format, piping and electrical schematics, nameplate format, brochures, sales literature, spec. sheets, installation, operation and maintenance procedures, etc. ; and
- the number and location of manufacturing facilities.

All documents shall identify the manufacturer's name, document number or other form of reference, title, date of last revision, and revision level. All 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 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 any foregoing tests.

2.3.3. The manufacturer shall submit samples representative of production.

2.3.4. It is the manufacturer's responsibility to provide any necessary test fixtures, such as those which may be required to evaluate the 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 certification examination results may further define the limits of the final certification.

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

3.2.4.3. Linings and covers shall be of uniform thickness and free from pitting, blisters, or other imperfections that may impair its intended use.

3.2.5. Couplings

3.2.5.1. The coupling assembly shall have no sharp edges or projections that may abrade the hose.

3.2.5.2. Couplings shall be manufactured of corrosion resistant material of sufficient strength and hardness to withstand normal wear and abuse.

3.2.5.3. All edges shall be chamfered and free from burrs, including those on the coupling expansion ring.

3.2.5.4. The swivel mechanism on an internally threaded coupling assembly shall turn freely by hand. Couplings in nominal sizes of 2 ½" (65 mm) or greater shall be provided with lugs or grips to allow for tightening with a suitable wrench.

3.2.5.5. Externally and internally threaded couplings, when connected hand-tight, shall not gall in mildly corrosive environments.

3.2.5.6. All gaskets used in a coupling assembly shall have uniform dimensions and shall not protrude into the waterway.

3.2.5.7. Coupling screw threads shall be as specified by nationally, internationally, or municipal recognized standards. At minimum, all fire hose shall be supplied with NH threaded couplings, as specified in NFPA 1963, *Standard for Fire Hose Connections*.

3.3. Fire Hose Assemblies

3.3.1. Fire hose shall be certified as a hose assembly complete with attached couplings. Both the hose and couplings shall satisfy the requirements in this Standard. Couplings may carry standalone certification or may be tested as a component of the fire hose assembly. In the latter case, the coupling manufacturer shall be considered as a sub-contractor to the fire hose manufacturer and may be subject to follow-up audit inspections. A method of design control shall be established to ensure that the certification agency is notified of any design changes to the couplings.

3.3.2. Specifications: The manufacturer of a fire hose shall submit a hose specification sheet which details the following construction characteristics:

- jacket weave specifications including warp thread material, warp thread size, number of warp ends, warp denier, filler thread material, filler picks/in. (mm), and filler denier;
- lining material and thickness;
- cover material and thickness (if provided);
- coupling manufacturer and model designation;
- service test pressure, proof test pressure, and burst pressure.

The hose specification sheet shall be a controlled document including a revision level or date. This document shall be updated, and the certification agency be notified, if any changes are made to the specifications listed above.

3.4. Materials

All materials shall be suitable for the intended application. Any materials used in these products shall have physical properties necessary to render them suitable for their intended use. When unusual materials are used, special tests may be necessary to verify their suitability.

3.5. Markings

3.5.1. The following information shall be stenciled on each length of fire hose in 1 in. (25 mm) high letters beginning approximately 3 ft (1 m) from each end:

- manufacturer’s name or identifying symbol;
- trade name or designation;
- month and year of manufacture;
- service Test Pressure in local and customary units;
- the words “occupant-use only” (if certified as occupant-use hose);
- the certification agency’s mark of conformity.

3.5.2. The following information shall be stamped or cast on each certified fire hose coupling in letters not less than .100 in. (2.5 mm) high:

- manufacturer's name or identifying symbol,
- trade name or designation,
- thread size and type, and
- the certification agency's mark of conformity.

3.5.3. The trade name or designation shall correspond with the manufacturer's catalog designation and shall uniquely identify the product as certified. The manufacturer shall not place this model or type identification on any other product unless covered by a separate agreement.

3.5.4. The certification agency's mark of conformity shall be displayed visibly and permanently on the product and/or packaging as appropriate and in accordance with the requirements of the certification agency. The manufacturer shall exercise control of this mark as specified by the certification agency and the certification scheme.

3.5.5. All markings shall be legible and durable.

3.6. Manufacturer's Installation and Operation Instructions

3.6.1. The manufacturer shall:

- prepare instructions for the installation, maintenance, and operation of the product;
- provide facilities for repair of the product and supply replacement parts, if applicable; and
- provide services to ensure proper installation, inspection, or maintenance for the product where it is not reasonable to expect the average user to be able to provide the installation, inspection, or maintenance.

3.7. Calibration

3.7.1. Each piece of equipment used to verify the test parameters shall be calibrated within an interval determined on the basis of stability, purpose, and usage. A copy of the calibration certificate for each piece of test equipment is required. The certificate shall indicate that the calibration was performed against working standards whose calibration is certified and traceable to an acceptable reference standard and certified by an ISO/IEC 17025 accredited calibration laboratory. The test equipment shall be clearly identified by label or sticker showing the last date of the calibration and the next due date. A copy of the service provider's accreditation certificate as an ISO/IEC 17025 accredited calibration laboratory should be available.

3.7.2. When the inspection equipment and/or environment is not suitable for labels or stickers, other methods such as etching of control numbers on the measuring device are allowed, provided documentation is maintained on the calibration status of this equipment.

4 PERFORMANCE REQUIREMENTS

4.1. Performance Testing for Fire Hose Assemblies

4.1.1. Examination

4.1.1.1. Requirements

The fire hose shall conform to the manufacturer's specifications and to the certification requirements.

4.1.1.2. Test/Verification

Samples shall be examined and compared to the specifications. It shall be verified that the sample conforms to the physical and structural requirements described in Section 3, General Requirements.

4.1.2. Hydrostatic Proof-Pressure Tests

4.1.2.1. Requirements

A. The percent elongation shall not exceed the values shown in Table 4.1.2, when tested in accordance with Section 4.1.2.2.

B. The number of degrees of twist per foot shall not exceed the values shown in Table 4.2.1, when tested in accordance with Section 4.1.2.2.

C. The amount of warp per 50 ft (15 m) length shall not exceed the values shown in Table 4.2.1, when tested in accordance with Section 4.1.2.2.

D. The hose shall not rise above the test surface more than the values specified in Table 4.2.1., when tested accordance with Section 4.1.2.2.

Table 4.1.2 – Proof-Pressure Test Requirements

Test	*Number of Jackets*	*Trade Size*		*Service Test Pressure*		*Maximum Allowable Requirements*
		in.	*(mm)*	*psi*	*(kPa)*	
Elongation	Single	1 - 6	(25 – 150)	150 – 250	(1030 – 1720)	10 percent
	Multiple	1 - 2 ½	(25 – 65)	200 – 400	(1380 – 2760)	8 percent
	Multiple	3	(76)	200 – 400	(1380 – 2760)	10 percent
	Multiple	3 ½ - 6	(90 – 150)	200 - 400	(1380 – 2760)	13 percent
Twist	Single	1 - 2	(25 – 51)	150	(1030)	7 ½ turns/50 ft (15.2 m)
	Single	2 ½ - 6	(65 – 150)	150	(1030)	3 ¾ turns/50 ft (15.2 m)
	Single	1 - 2	(25 – 51)	200, 250	(1380, 1720)	10 turns/50 ft (15.2 m)
	Single	2 ½ - 6	(65 – 150)	200, 250	(1380, 1720)	5 turns/50 ft (15.2 m)
	Multiple	1 - 2	(25 – 51)	200 - 400	(1380 – 2760)	4 ¼ turns/50 ft (15.2 m)
	Multiple	2 ½ - 6	(65 – 150)	200 - 400	(1380 – 2760)	1 ¾ turns/50 ft (15.2 m)
Warp	Single & Multiple	1 - 6	(25 – 150)	150 - 400	(1030 – 2760)	20 in./50 ft (510 mm/15.2 m)
Rise	Single	1 - 2	(25 – 51)	150 – 250	(1030 – 1720)	7 in. (180 mm)
	Single	2 ½ - 3	(65 – 76)	150 – 250	(1030 – 1720)	4 in. (100 mm)
	Single	3 ½ - 6	(89 – 150)	150 – 250	(1030 – 1720)	0 in. (0 mm)
	Multiple	1 - 6	(25 – 150)	200 – 400	(1380 – 2760)	0 in. (0 mm)

4.1.2.2. Test/Verification

The sample length shall be approximately 50 ft (15 m). The hose assembly shall be marked prior to the tests by suitable means at a point immediately adjacent to each coupling. One end of the sample shall be connected to the source of water supply and the other end shall be free to move and shall be plugged by a fitting provided with a petcock to allow for the escape of air while the sample is being filled. The connection between the end of the sample and the source of water supply is to be rigid.

The sample shall be stretched out on the test surface so as to lie straight and without twist. To facilitate the complete removal of air from the sample, the surface on which the sample rests shall be inclined so that the supply end is lower than the relief end. With the petcock open, water shall be admitted through the sample gradually until all air has been expelled and the sample is completely filled with water. The petcock shall then be closed and the pressure raised to 10 psi (70 kPa).

While at that pressure, the initial length measurement shall be taken as the distance between the markings immediately adjacent to each coupling, to the nearest inch. The sample shall be straightened out in order to obtain an accurate measurement. The jacket construction and workmanship in weaving, particularly knots, loose ends, and skips in warp threads shall be noted and recorded at this time. The position of the sample with regard to twist shall also be noted. From this point on, neither the sample nor the fittings shall be touched, moved, or interfered with in any way until all measurements and observations have been completed at the final test pressure.

Following measurement of the length at 10 psi (70 kPa), the pressure shall be increased at a rate of 300 -1000 psi (2070 - 6900 kPa) per minute until the required proof pressure is reached. While the pressure is being increased, the sample shall be examined for leakage and other defects. The proof pressure shall be maintained for at least 15 seconds, but not more than 1 minute. During this time, observations and measurements for elongation, twist, warp, and rise shall be completed.

4.1.3. Kink Test

4.1.3.1. Requirements

A hose assembly, while kinked, shall withstand a hydrostatic pressure of 1½ times the service test pressure without leakage, rupturing, or breaking of any threads in the jacket.

4.1.3.2. Tests/Verification

The sample shall be a minimum of 3 ft (0.9 m) in length. One end shall be connected to the water supply and the other end shall be plugged by a fitting provided with a petcock to allow escape of air while being filled. With the petcock open, the sample shall be filled until all air has been expelled. The petcock shall then be closed and the sample pressurized to 10 psi (70 kPa). The sample shall then be kinked approximately 18 in. (455 mm) from the free end by tying the hose back against itself as close to the free end as possible. The pressure shall be increased at a rate of 300 to 1000 psi (2070 to 6900 kPa) per minute until 1 ½ times the service test pressure is reached, and then immediately released.

4.1.4. Hydrostatic Minimum Burst-Pressure Test

4.1.4.1. Requirements

Two sample hose assemblies shall withstand a hydrostatic test pressure of three times the marked service test pressure without rupturing or breaking of any thread in the jacket. One sample shall be tested while lying straight and the other while curved around a surface with a 27 in (0.7 m) radius.

4.1.4.2. Test/Verification

The sample shall be a minimum of 3 ft (0.9 m) in length and placed inside a protective enclosure. One end of the sample shall be connected to the water supply and the other end shall be plugged by a fitting provided with a petcock to allow escape of air while being filled. With the petcock open, the sample shall be filled until all air has been expelled. The petcock shall then be closed and the sample pressurized to three times the service test pressure, at a rate of 300 to 1000 psi (2070 to 6900 kPa) per minute, and then immediately released. Observations of rupturing or breaking of any threads in the jacket shall be made.

4.1.5. Lining Adhesion

4.1.5.1. Requirements

A. The rate of separation of a 1½ in. (38 mm) lining strip from the jacket shall not exceed 1 in. (25 mm) per minute when a weight of 12 lbs. (5.5 kg) is applied.

B. If a rubber backing is used between the liner and jacket, the adhesion between the lining and the jacket, and the lining and the backing, shall be such that the rate of separation of a 1½ in. (38 mm) strip is not greater than 1 in. (25 mm) per minute when a weight of 12 lbs. (5.5 kg) is applied.

C. The requirements of 4.1.5.1. A and B are not intended to exclude a construction that provides no adhesion between the jacket and the lining along the fold, provided the surface over which there is no adhesion does not exceed 35 percent of the total surface.

D. If the hose is provided with a cover, the adhesion between the cover and the woven jacket shall be such that the rate of separation of a 1½ in. (40 mm) strip of the cover from the jacket shall not be greater than 1 in. (25 mm) per minute with a weight of 10 lbs. (4.5 kg).

4.1.5.2. Tests/Verification

The apparatus required for this test shall consist of a supporting frame, clamps, weights, weight holders, and a timer. The supporting frame shall be of such design that specimens, with weights attached, may be suspended vertically and hang freely during the progress of the test.

The specimen for the adhesion test shall be cut transversely to the length of the hose. The specimen shall be 2 in. (50 mm) wide and shall be cut around the full circumference of the hose. A strip of lining, or cover if provided, 1½ in. (40 mm) wide shall be cut out accurately, the cut extending through the rubber but not entirely through the woven jacket. This strip shall be separated at one end to the extent of about 1½ in. (40 mm), and a reference mark shall be placed on the jacket at the juncture of the jacket and lining or cover. The free end of the woven jacket and the free end of the strip of rubber shall be secured in suitable clamps.

With the separated jacket gripped in a stationary clamp, the separated liner or cover shall be gripped in a freely suspended clamp hanging vertically, to which the prescribed weight shall be attached with suitable provision for supporting and releasing it slowly without jerking. The distance through which separation takes place shall be noted for a period of 10 minutes, or until complete separation occurs. The adhesion to the jacket shall be taken as the rate obtained by dividing the total distance separated by inches (millimeters), to the nearest 0.1 in. (2.5 mm), by the elapsed time in minutes.

If a rubber backing is used between the lining and the jacket, the adhesion between the lining and the backing, and the adhesion between the backing and the jacket shall be determined using the methods specified in this section. If the adhesion cannot be determined because the backing has a tendency to tear during the test, the rate of separation between the separating members shall be considered the adhesion.

4.1.6. Tensile Strength and Ultimate Elongation – Linings and Covers

4.1.6.1. Requirements

The tensile strength and ultimate elongation of specimens taken from the lining and cover, if provided, shall not be less than as specified in Table 4.1.6. when tested as specified in Section 4.1.6.2.

The tensile strength and ultimate elongation values of specimens subjected to the air-oven aging test shall not be less than 80 percent of the tensile strength and 50 percent of the ultimate elongation of the unconditioned specimens .

Table 4.1.6 – Tensile Strength and Ultimate Elongation Requirements

Material Type	*Minimum Tensile Strength*		*Minimum Elongation, %*
	psi	*(kPa)*	
Natural and Synthetic Rubber	1200	(8300)	400
Latex Rubber	1800	(12400)	700
Thermoplastic	2000	(13800)	400
Other	1200	(8300)	400

4.1.6.2. Tests/Verification

For standard elastomers, the material manufacturer's certificates of compliance verifying the conformance to the performance requirements listed in Section 4.1.6.1 shall be considered acceptable. The test certificates shall demonstrate that the tests were conducted by an ISO 9000 certified facility, and that the test equipment was calibrated by an ISO 17025 (*General Requirements for the Competence of Testing and Calibration Laboratories*) certified agency. Where such certifications are not available, tests of the elastomer shall be conducted.

Tensile strength and elongation shall be determined in accordance with the test methods specified in ASTM D 412, *Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension, Method A.* Three dumbbell specimens shall be cut with a Type A or C die transversely from the sample. Samples shall be buffed prior to cutting with the die. If the nature or thickness of the lining is such that buffing cannot be accomplished without damaging the lining, unbuffed specimens may be used for the tensile strength and elongation tests.

Three measurements for thickness shall be made in the constricted portion of each specimen. The minimum value obtained shall be used as the thickness of the specimen in calculating the tensile strength. Two benchmarks 1 in. (25 mm) apart shall be stamped centrally on the constricted portion of each specimen. A tensile test machine shall be used to pull the dumbbell specimens to the point of rupture. The average tensile strength and elongation of the three specimens shall be considered the tensile strength and ultimate elongation of the rubber lining or cover. If a dumbbell test specimen breaks outside the benchmarks, or if the result of either tensile strength or elongation based on the average of three specimens is not acceptable, another set of three specimens shall be tested, and the results from this set shall be considered final. Results of tests of specimens that break in the curved portion just outside the benchmarks may be accepted if within the minimum requirements.

Three additional dumbbell specimens shall be prepared as described above. The specimens shall be conditioned in an oven for 96 hours at 158°F±3.6°F (70°C±2°C) following the procedures described in ASTM D 573, *Standard Test Method for Rubber - Deterioration in an Air Oven*. The specimens shall then be tested for tensile strength and ultimate elongation as described above, and the values shall be compared to those obtained on the unconditioned specimens.

4.1.7. Heat Resistance

4.1.7.1. Requirements

An 18 in. (455 mm) length hose assembly shall be subjected to a hydrostatic pressure of three times the service test pressure, without leakage or other damage, after exposure to a heated steel block.

4.1.7.2. Tests/Verification

The hose sample shall be filled with water, evacuated of all air, capped at both ends, and conditioned at room temperature for 24 hours. A 2½ ×1½ ×8 in. (65 ×40 ×205 mm) steel block shall be conditioned in an oven maintained at 500°F (260°C) for a minimum of 16 hours. Within 5 seconds of removal from the oven, the steel block shall be placed on the hose so that the longitudinal axis of the block is perpendicular to the longitudinal axis of the hose. The contact area shall be the midpoint of the 2 ½ in. (65 mm) side of the block and the midpoint of the hose. A metal knife edge shall be used as a support near one end of the block to obtain maximum force on the hose. The block shall be removed after 60 seconds. The hose shall then be allowed to cool and shall be hydrostatically pressurized to three times the service test pressure.

4.1.8. Cold Resistance (Not Required for Occupant-Use Hose)

4.1.8.1. Requirements

A 3 ft (1 m) length hose assembly shall be conditioned as detailed in Section 4.1.8.2. The hose shall be subjected to a hydrostatic test to the proof pressure for 5 minutes without leakage or other damage.

After a 50 ft (15 m) length hose assembly is conditioned as detailed in Section 4.1.8.2, it shall be possible for one operator to uncoil and lay out the hose immediately upon removal from the conditioning chamber.

4.1.8.2. Tests/Verification

A 3 ft (1 m) length of hose shall be immersed in a water bath at room temperature for 24 hours. The sample shall then be removed from the bath and conditioned at room temperature for 15 minutes. The hose shall then be conditioned at -30°F (-34°C) for 24 hours. Immediately upon removal from the conditioning chamber the hose shall be bent double on itself, 180 degrees, first one way then the other. The sample shall then be allowed to thaw at room temperature for 24 hours, after which it shall be subjected to the proof pressure.

A 50 ft (15 m) length of dry hose shall be firmly coiled and conditioned at -30°F (-34°C) for 24 hours. Immediately upon removal from the conditioning chamber one operator shall uncoil and lay out the full length of hose.

4.1.9. Abrasion Test (Not Required for Occupant-Use Hose)

4.1.9.1. Requirements

A hose assembly shall not leak or burst at the service test pressure after 3000 cycles by an abrasion wheel.

4.1.9.2. Tests/Verification

The hose test sample shall have a minimum length of 3 ft (1 m). It shall be hydrostatically pressurized to 125 psi (860 kPa) and firmly anchored horizontally on a test table. A Norton standard 5×2×½ in. (130×50×15 mm) nominal size abrasion wheel with designation

37C36-KVK shall be moved back and forth for 3000 cycles along the crown of the hose. The frequency of the cycles shall not exceed 30 per minute. The wheel shall be prevented from rotating and shall exert on the hose its full weight plus half of the 1 lb (0.5 kg) weight of the moving arm. The contact surface of the portion of the abrasion wheel utilized shall be unused at the start of the test.

4.1.10. Friction Loss (Not Required for Occupant-Use Hose)

4.1.10.1. Requirements

For hose assemblies having nominal diameters of 3 ½ in. (89 mm) or less, the friction loss per 50 ft (15 m) of coupled hose shall comply with the requirements shown in Table 4.1.10.

Table 4.1.10 – Friction Loss Requirements

Trade Size		*Flow*		*Maximum Friction Loss*	
in.	*(mm)*	*gal/min*	*(L/min)*	*psi*	*(kPa)*
1 ½	(38)	100	(380)	18	(125)
1 ¾	(44)	135	(510)	15	(105)
2	(51)	155	(590)	10	(70)
2 ½	(65)	250	(950)	8	(55)
3	(76)	400	(1510)	8	(55)
3 ½	(89)	600	(2270)	8	(55)

The above results were derived using the Hazen-Williams formula as follows:

$$f = \left(\frac{18.73 \cdot Q}{C}\right)^{1.85} \cdot \left(\frac{1}{D}\right)^{4.87}$$

Where:

f = friction loss, psi
Q = flow, gal/min
D = internal diameter of hose, in.
C = Hazen-Williams constant, 135

4.1.10.2. Tests/Verification

The sample length shall be approximately 50 ft (15 m), but shall be measured prior to performing this test. The sample shall be pressurized to 10 psi (69 kPa) and the length shall be recorded as the distance between the points immediately adjacent to each coupling. After the length measurement has been taken, both ends of the sample shall be connected to a piezometer pipe of the proper length (minimum of 10 times the inside diameter) and a nominal diameter equal to that of the hose being tested. The flow in gal/min (L/min), as per Table 4.1.10 shall be established. A differential pressure gauge shall be used to measure the pressure loss between the piezometer fittings and hose. The hose sample shall then be removed and the pressure loss between the piezometer pipes measured. The total pressure loss of the hose shall be calculated by subtracting the loss between the piezometer pipes from the loss between the piezometer pipes and hose.

4.1.11. Alternating Pressure Test (Not Required for Occupant-Use Hose)

4.1.11.1. Requirements

A hose assembly shall have the ability to withstand 2000 cycles of alternating pressure between 0 psi (0 kPa) and the service test pressure of the hose without any leakage or damage. Subsequently, there shall be no leakage or damage when the hose is subjected to it's proof-pressure.

4.1.11.2. Tests/Verification

One end of a 12 ft (3.7 m) length hose assembly shall be connected to the water supply and the other end shall be plugged and held stationary. The sample shall be filled, evacuated of all air, and hydrostatically pressurized to the service test pressure of the hose. The pressure within the sample shall then be relieved back down to 0 psi (0 kPa). This shall be considered 1 cycle. After 2000 cycles of alternating pressure, the hose assembly shall be hydrostatically pressurized to the proof pressure. Any leakage or damage to the hose shall be observed.

4.1.12. Moisture Resistance

4.1.12.1. Requirements

A hose assembly shall be resistant to degradation from moisture when soaked in water for 48 hours.

4.1.12.2. Tests/Verification

A 3 ft (0.9 m) length hose sample shall be immersed in tap water at room temperature for 48 hours. The sample shall then be removed and hydrostatically pressurized to three times the service test pressure. Any leakage or damage to the hose shall be observed.

4.1.13. Repeated Bending Test

4.1.13.1. Requirements

Hose assemblies having nominal diameters of 3 ½ in. (89 mm) or less shall have the ability to withstand 100,000 cycles of repeated bending (10,000 cycles for occupant-use hose) without any leakage or damage.

4.1.13.2. Tests/Verification

A 6 ft length hose sample shall be filled with water and capped on both ends. One end of the hose shall be secured to a linear actuator mechanism designed to pull the sample back and forth horizontally. The free end shall be passed over a wheel, with a given radius, and allowed to hang freely in the vertically downward direction. The bending radius shall be 8 in. (203 mm) for 1 ½ and 1 ¾ in. (38 and 44 mm) size hose and 14 in. (356 mm) for sizes 2 in. (51 mm) or greater. The pull distance over the wheel shall be a total of 2 ft (.6 m). After 50,000 cycles of bending (5,000 for occupant-use hose), the sample shall be flipped so that the remaining cycles are completed in the opposite direction of bending. After 100,000 cycles of bending (10,000 for occupant-use hose), the sample shall then be hydrostatically pressurized to three times the service test pressure. Any leakage or damage to the hose shall be observed.

4.1.14. Fold Resistance

4.1.14.1. Requirements

A hose assembly shall be resistant to damage after being conditioned to 140°F (60°C) while folded and clamped.

4.1.14.2. Tests/Verification

A 3 ft length hose assembly shall be folded at the center and held tightly with a clamp provided with calibrated springs so that a total force of 120 lbs (534 N) is exerted on the fold. The sample shall then be conditioned to 140°F (60°C) for 30 days. At the end of the conditioning period, the clamp shall be removed and the sample shall be laid out straight. The sample shall then be hydrostatically pressurized to three times the service test pressure. Any leakage or damage to the hose shall be observed. If the hose lining adheres to itself after the clamp has been removed, it shall free itself before the service test pressure of the hose is reached.

4.1.15. Accelerated Aging of Jacket Threads

4.1.15.1. Requirements

The tensile strength of the warp and filler threads that have been conditioned to 330°F (166°C) shall not be less than 40% of the tensile strength of unconditioned threads.

4.1.15.2. Tests/Verification

Three, 8 in. (203 mm) long warp threads and three, 8 in. (203 mm) long filler threads shall be conditioned to 330°F (166°C) for 7 days (168 hours) in an air-circulating oven. Subsequently, the threads shall be conditioned at 70°F (21°C) for a minimum of 24 hours. After the conditioning, a tensile test machine shall be used to measure the tensile strength of the threads. The jaw separation rate shall be 2 in. (51 mm) per minute. The average of each of the three samples shall be considered the tensile strength of the thread. Three additional unconditioned warp and filler threads shall be tested and the tensile strength shall be compared for compliance to the requirement.

4.1.16. Water Absorption Test of Lining Material

4.1.16.1. Requirements

Vulcanized lining materials shall be resistant to absorption after being immersed in distilled water at 212°F (100°C). The change in thickness or weight shall not exceed 1.5% of the original values.

4.1.16.2. Tests/Verification

A specimen of vulcanized lining material shall be prepared and tested in accordance with ASTM D 471, *Standard Test Method for Rubber Property – Effect of Liquids*. The specimen shall be maintained in distilled water at a temperature of 212°F (100°C) for 6 hours. Thickness and weight measurements shall be recorded prior to and subsequent to the conditioning period and shall be compared for compliance to the requirement.

4.2. Performance Testing for Fire Hose Couplings

4.2.1. Hydrostatic Strength Test

4.2.1.1. Requirements

Couplings shall be capable of withstanding hydrostatic pressures equal to two times the service test pressure without slippage or leakage and three times the service test pressure without separation or damage.

4.2.1.2. Tests/Verification

Each coupling shall be tested with a fire hose having the maximum service test pressure for which it is intended to be used on. The sample shall be a minimum of 3 ft (0.9 m) in length and placed inside a protective enclosure. Markings shall be made on the hose at points immediately adjacent to each coupling. One end of the sample shall be connected to the water supply and the other end shall be plugged by a fitting provided with a petcock to allow escape of air while being filled. With the petcock open, the sample shall be filled until all air has been expelled. The petcock shall then be closed and the sample pressurized to two times the service test pressure of the hose. The pressure shall be maintained for 10 minutes. Observations of any coupling slippage or leakage shall be made. The pressure shall then be increased to three times the service test pressure and maintained for a minimum of 15 seconds. The couplings shall not separate from the hose or show any signs of damage or distortion.

4.2.2. Tensile Strength Test

4.2.2.1. Requirements

Couplings shall have a tensile strength of at least 1200 psi (8270 kPa) times the nominal diameter in inches. After the tensile test, the couplings shall operate freely. There shall be no damage to the threaded or swivel connections or separation from the hose. Following the tensile strength test, there shall be no leakage of the coupling or the attachment to the hose at the service test pressure.

4.2.2.2. Tests/Verification

Each coupling shall be tested with a fire hose having the maximum service test pressure for which it is intended to be used on. A 1 ft (0.3 m) length hose assembly shall have the externally and internally threaded couplings connected to adapters. The adapters shall then be installed in a tensile test machine such that the tension will be on the couplings. The tensile load shall be applied at a rate no greater than 0.1 in. (2.5 mm) per minute until the required load has been reached. After the tensile load has been applied, the samples shall be inspected for damage to the threaded or swivel connections or to the attachment of the hose. A hydrostatic pressure test shall be conducted on the hose assembly at the service test pressure. The pressure shall be maintained for a minimum of 5 minutes.

4.2.3. Rough Usage Test

4.2.3.1. Requirements

Couplings shall be capable of being dropped up to 6 ft (1.8 m) onto a concrete surface without deformation or other damage that would impair function. After drop testing, the couplings shall operate freely with no binding.

4.2.3.2. Tests/Verification

The couplings on each end of a 10 ft (3 m) length hose assembly shall be connected together to form a loop. The assembly shall then be dropped from a height of 6 ft (1.8 m) onto a

concrete surface so as to land as squarely as possible onto the swivel ring. A total of 3 drops shall be performed. Subsequently, the couplings shall operate freely and have the ability to disconnect and reconnect without any binding. Additionally, any deformation or damage shall be observed.

4.2.4. Torque Test

4.2.4.1. Requirements

Couplings equipped with lugs shall be capable of withstanding an applied torque of 200 ft·lb (271 N·m) without distortion or breaking.

4.2.4.2. Tests/Verification

An internally threaded coupling assembly shall be connected to an externally threaded coupling assembly and tightened until a total torque of 200 ft·lb (271 N·m) is applied on the lug(s). Observations of any distortion or breaking shall be made.

4.2.5. High Temperature Performance

4.2.5.1. Requirements

A coupling assembly with gaskets installed shall operate freely with no binding after being subjected to temperatures up to 275°F (135°C).

4.2.5.2. Tests/Verification

A dry externally threaded and internally threaded coupling assembly shall be placed in an air-circulating oven and conditioned at 275°F (135°C) for a period of 4 hours. Immediately upon removal, the couplings shall be connected and disconnected and shall operate freely with no binding.

4.2.6. Low Temperature Performance

4.2.6.1. Requirements

A coupling assembly with gaskets installed shall operate freely with no binding after being subjected to temperatures as low as -30°F (-34°C).

4.2.6.2. Tests/Verification

A dry externally threaded and internally threaded coupling assembly shall be conditioned at -30°F (-34°C) for a period of 24 hours. Immediately upon removal from the conditioning chamber, the couplings shall be connected and disconnected and shall operate freely with no binding.

4.2.7. Corrosion – Salt Spray

4.2.7.1. Requirements

Coupling assemblies shall withstand a 240 hour exposure to the processes described in 4.2.6.2 without incurring damage that would impair function.

4.2.7.2. Tests/Verification

An externally threaded and internally threaded coupling assembly shall be connected and hand tightened. The couplings shall be exposed to salt spray (fog) as specified in ASTM B

117, *Standard Practice for Operating Salt Spray (Fog) Apparatus*. The salt solution shall consist of 20 percent (by weight) of common salt (NaCl) dissolved in deionized water with a pH between 6.5 and 7.2 and a specific gravity between 1.126 and 1.157.

Following the exposure period, the couplings shall be rinsed in tap water and shall be able to be disconnected freely with no binding.

4.2.8. Corrosion – Stress Cracking

4.2.8.1. Requirements

Couplings manufactured of copper alloys with a zinc content exceeding 15 percent shall be resistant to stress corrosion cracking resulting from exposure to the processes described in 4.2.8.2. Following the exposure period, the sample shall not show evidence of cracking, delamination, or degradation.

4.2.8.2. Tests/Verification

An externally threaded and internally threaded coupling assembly shall be connected together and hand tightened. The couplings shall then be filled with deionized water, and sealed with a non-reactive material so as to prevent the introduction of ammonia atmosphere to the interior of the coupling. The coupling assembly to be tested shall be free from any non-permanent protective coating and, if necessary, shall be degreased. If a permanent coating is an inherent part of the design, such coating shall be subjected to tests as deemed necessary by the certification agency to evaluate its protective integrity.

The samples shall be exposed to a moist ammonia-air mixture maintained in a glass chamber with a volume of 0.73 ± 0.34 ft^3 (0.02 ± 0.01 m^3). There shall be provisions in the test chamber to prevent droplets of condensation from falling from the top of the enclosure directly onto the samples. Such a shield or other means shall be constructed of glass or other non-reactive materials.

Aqueous ammonia having a density of 5.86 x 10^{-5} lb/ft^3 (0.94 g/cm^3) shall be maintained in the bottom of the chamber, approximately 1.5 in. (40 mm) below the bottom of the sample. The volume of ammonia to be used shall be determined by multiplying the enclosure volume in ft^3 (L) by 0.075 gal/ft^3 (10 L/m^3). This will result in approximately the following atmospheric concentrations: 35 percent ammonia, 5 percent water vapor, and 60 percent air. Prior to beginning the exposure, the chamber shall be conditioned to a temperature of 93°F ± 4°F (34°C ± 2°C) for a period of not less than one hour, and shall be maintained at this temperature throughout the exposure period. The moist ammonia-air mixture shall be maintained at essentially atmospheric pressure. Provisions shall be made for venting the chamber, such as by the use of a capillary tube, to avoid buildup of pressure.

Following exposure to the moist ammonia environment for a period of 10 days, the samples shall be removed, rinsed in potable water, and air dried. Following a minimum two-day drying period, visual examination of the samples shall be made.

4.2.9. Tensile Strength and Ultimate Elongation – Coupling Gaskets

4.2.9.1. Requirements

Each material used for coupling gaskets shall have a tensile strength of not less than 500 psi (3450 kPa) and an ultimate elongation of not less than 100 percent.

The tensile strength and ultimate elongation values of specimens subjected to the air-oven aging test shall not be less than 80 percent of the tensile strength and 50 percent of the ultimate elongation of the unconditioned specimens .

4.2.9.2. Tests/Verification

For standard elastomers, the material manufacturer's certificates of compliance verifying the conformance to the performance requirements listed in Section 4.1.6.1 shall be considered acceptable. The test certificates shall demonstrate that the tests were conducted by an ISO 9000 certified facility, and that the test equipment was calibrated by an ISO 17025 (*General Requirements for the Competence of Testing and Calibration Laboratories*) certified agency. Where such certifications are not available, tests of the elastomer shall be conducted.

Tensile strength and elongation shall be determined in accordance with the test methods specified in ASTM D 412, *Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension.* Material sheets shall be obtained for each type of elastomer used in the coupling gaskets. Three dumbbell specimens shall be cut with a Type A or C die transversely from the sample. Samples shall be buffed prior to cutting with the die. If the nature or thickness of the material is such that buffing cannot be accomplished without damaging the lining, unbuffed specimens may be used for the tensile strength and elongation tests.

Three measurements for thickness shall be made in the constricted portion of each specimen. The minimum value obtained shall be used as the thickness of the specimen in calculating the tensile strength. Two benchmarks 1 in. (25 mm) apart shall be stamped centrally on the constricted portion of each specimen. A tensile test machine shall be used to pull the dumbbell specimens to the point of rupture. The average tensile strength and elongation of the three specimens shall be considered the tensile strength and ultimate elongation of the rubber lining or cover. If a dumbbell test specimen breaks outside the benchmarks, or if the result of either tensile strength or elongation based on the average of three specimens is not acceptable, another set of three specimens shall be tested, and the results from this set shall be considered final. Results of tests of specimens that break in the curved portion just outside the benchmarks may be accepted if within the minimum requirements.

Three additional dumbbell specimens shall be prepared as described above. The specimens shall be conditioned in an oven for 96 hours at 158°F±3.6°F (70°C±2°C) following the procedures described in ASTM D 573, *Standard Test Method for Rubber - Deterioration in an Air Oven*. The specimens shall then be tested for tensile strength and ultimate elongation as described above, and the values shall be compared to those obtained on the unconditioned specimens.

4.2.10. Compression Set – Coupling Gaskets

4.2.10.1. Requirements

Each material used for coupling gaskets shall have a compression set of not more than 15 percent.

4.2.10.2. Tests/Verification

Testing shall be conducted in accordance with ASTM D 395, *Standard Test Methods for Rubber Property - Compression Set,* Method B. Type I specimens of each material shall be prepared and then exposed for 22 hours at 70°F ± 2°F (21°C ± 1°C).

4.2.11. Low Temperature Resistance – Coupling Gaskets

4.2.11.1. Requirements

Coupling gaskets shall not crack when squeezed after being conditioned as detailed in Section 4.2.10.2.

4.2.11.2. Tests/Verification

Coupling gaskets shall be conditioned at 0°F (-18°C) for a period of 24 hours and then at -25°F (-32°C) for a period of 2 hours. Immediately upon removal from the conditioning chamber, the gasket is to be squeezed from any two opposite points into a "figure 8" configuration. Observations of any cracking or fracturing shall be made.

5 MANUFACTURER'S REQUIREMENTS

5.1. Demonstrated Quality Control Program

5.1.1. A quality assurance program is required to assure that subsequent products produced by the manufacturer shall present the same quality and reliability as the specific products examined. Design quality, conformance to design, and performance are the areas of primary concern.

- Design quality is determined during the examination and tests and may be documented in the certification report.
- Continued conformance to this standard is verified by the certifier's surveillance program.
- Quality of performance is determined by field performance and by periodic re-examination and testing.

5.1.2. The manufacturer shall demonstrate a quality assurance program which specifies controls for at least the following areas:

- existence of corporate quality assurance guidelines;
- incoming quality assurance, including testing;
- in-process quality assurance, including testing;
- final inspection and tests;
- equipment calibration;
- drawing and change control;
- packaging and shipping; and
- handling and disposition of non-conforming materials.

5.1.3. Documentation/Manual

There should be an authoritative collection of procedures/policies. It should provide an accurate description of the quality management system while serving as a permanent reference for implementation and maintenance of that system. The system should require that sufficient records are maintained to demonstrate achievement of the required quality and verify operation of the quality system.

5.1.4. Records

To assure adequate traceability of materials and products, the manufacturer shall maintain a record of all quality assurance tests performed, for a minimum period of two years from the date of manufacture.

5.1.5. Drawing and Change Control

- The manufacturer shall establish a system of product configuration control that shall allow no unauthorized changes to the product. Changes to critical documents, identified in the certification report, may be required to be reported to, and authorized by the certification agency prior to implementation for production.
- Records of all revisions to all certified products shall be maintained.

5.2. Surveillance Audit

5.2.1. An audit of the manufacturing facility may be part of the certification agency's surveillance requirements to verify implementation of the quality assurance program. Its purpose is to determine that the manufacturer's equipment, procedures, and quality program are maintained to ensure a uniform product consistent with that which was tested and certified.

5.2.2. Certified products or services shall be produced or provided at, or provided from, location(s) disclosed as part of the certification examination. Manufacture of products bearing a certification mark is not permitted at any other location prior to disclosure to the certification agency.

5.3. Product Modifications

5.3.1. The manufacturer shall notify the certification agency of changes in product construction, components, raw materials, physical characteristics, coatings, component formulation or quality assurance procedures prior to implementation.

5.4. Manufacturing and Production Tests

5.4.1. Test Requirement No. 1 — Internal Diameter

The manufacturer shall perform measurements of the internal diameter every 2500 ft (760 m) or less to ensure the fire hose being produced is still within specifications.

5.4.2. Test Requirement No. 2 — Thickness of Lining

The manufacturer shall perform measurements of the lining thickness every 2500 ft (760 m) or less to ensure the fire hose being produced is still within specifications.

5.4.3. Test Requirement No. 3 — Thickness of Cover

The manufacturer shall perform measurements of the cover thickness every 2500 ft (760 m) or less to ensure the fire hose being produced is still within specifications.

5.4.4. Test Requirement No. 4 — Adhesion Lining to Jacket

The manufacturer shall perform testing of the adhesion of the lining to the jacket every 2500 ft (760 m) or less to ensure compliance with the requirements of this Standard.

5.4.5. Test Requirement No. 5 — Adhesion Cover to Jacket

The manufacturer shall perform testing of the adhesion of the cover to the jacket every 2500 ft (760 m) or less to ensure compliance with the requirements of this Standard.

5.4.6. Test Requirement No. 6 — Physical Tests of Lining

The manufacturer shall perform physical testing of the lining every 2500 ft (760 m) or less to ensure compliance with the requirements of this Standard. If the material is manufactured at a third party location and certificates of compliance are provided for each batch, testing on a monthly-basis is considered acceptable.

5.4.7. Test Requirement No. 7 — Physical Tests of Cover

The manufacturer shall perform physical testing of the cover every 2500 ft (760 m) or less to ensure compliance with the requirements of this Standard. If the material is manufactured at a third party location and certificates of compliance are provided for each batch, testing on a monthly-basis is considered acceptable.

5.4.8. Test Requirement No. 8 — Kink Test

The manufacturer shall kink test production fire hose every 2500 ft (760 m) or less, as per Section 4.3. Hose, while kinked, shall withstand a hydrostatic pressure of 1½ times the service test pressure without leakage, rupturing, or breaking any yarns in the jacket or reinforcement.

5.4.9. Test Requirement No. 9 — Burst Test

The manufacturer shall burst test production fire hose every 5000 ft (1525 m) or less, as per Section 4.4. Sample hose shall withstand a hydrostatic test pressure of three times the marked service test pressure without rupturing or breaking of any yarn in the jacket or cover.

5.4.10. Test Requirement No. 10 — Proof Pressure Test

The manufacturer shall proof pressure test every length of production fire hose, as per Section 4.2. The percent elongation, number of degrees of twist per foot, amount of warp per 50 ft (15 m) length, and rise above the test surface shall not exceed the values shown in Table 4.2.1.

5.4.11. Test Requirement No. 11 – Coupling Retention

The manufacturer shall test 100% of fire hose assemblies for coupling retention. All couplings shall be capable of withstanding hydrostatic pressures equal to two times the service test pressure without slippage or leakage and three times the service test pressure without separation or damage.

6 BIBLIOGRAPHY

ISO/IEC 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*.

APPENDIX A: Tolerances

Unless otherwise stated, the following tolerances shall apply:

Angle:	± 2°
Flow:	± 3% of value
Frequency (Hz):	± 5% of value
Length:	± 2% of value
Volume:	± 5% of value
Force:	± 2% of value
Torque:	± 2% of value
Rotation:	± 1 RPM
Pressure:	± 5% of value
Temperature:	± 5% of value
Time:	+ 5/-0 seconds + 0.1/-0 minutes + 0.1/-0 hours + 0.25/-0 days

Unless stated otherwise, all tests shall be carried out at a room (ambient) temperature of 68°F ± 18°F (20°C ± 10°C).