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# NFPA 1961 Fire Hose 1992 Edition

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The Board of Directors reaffirms that the National Fire Protection Association recognizes that the toxicity of the products of combustion is an important factor in the loss of life from fire. NFPA has dealt with that subject in its technical committee documents for many years.

There is a concern that the growing use of synthetic materials may produce more or additional toxic products of combustion in a fire environment. The Board has, therefore, asked all NFPA technical committees to review the documents for which they are responsible to be sure that the documents respond to this current concern. To assist the committees in meeting this request, the Board has appointed an advisory committee to provide specific guidance to the technical committees on questions relating to assessing the hazards of the products of combustion.

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# NFPA 1961

## Standard on

# Fire Hose

## 1992 Edition

This edition of NFPA 1961, *Standard on Fire Hose*, was prepared by the Technical Committee on Fire Hose and acted on by the National Fire Protection Association, Inc. at its Fall Meeting held November 18-20, 1991, in Montréal, Québec, Canada. It was issued by the Standards Council on January 17, 1992, with an effective date of February 10, 1992, and supersedes all previous editions.

The 1992 edition of this document has been approved by the American National Standards Institute.

Changes other than editorial are indicated by a vertical rule in the margin of the pages on which they appear. These lines are included as an aid to the user in identifying changes from the previous edition.

## Origin and Development of NFPA 1961

Standards on fire hose for both mill use and for fire department use were among the earliest standards issued by the NFPA with the first standard issued in 1898. NFPA 196 was issued in 1934 as *Standard Specification for Cotton Rubber-Lined Fire Hose for Public and Private Fire Department Use*. This standard remained in existence until 1958 when the Fire Hose Committee was again constituted to update the requirements. A tentative standard was issued in 1958, and the official standard was issued in 1960 recognizing the newer synthetic materials that were being used in the manufacture of fire hose. This standard covered hose in the 1 in., 1½ in., 2 in., and 2½ in. sizes for single or multiple jacket hose and 3 in. and 3½ in. sizes for multiple jacket hose.

In the 1972 edition, the concept of single jacket relay supply hose in the trade sizes of 3½ in., 4 in., 4½ in., 5 in., and 6 in. was introduced. In 1979 the standard was renumbered from NFPA 196 to NFPA 1961 to coincide with a general renumbering of the fire service standards.

This edition is a general editorial updating of the 1987 edition. The term "rack and reel hose" has been changed to "occupant use hose." The requirements for forestry hose were updated, and requirements for suction hose were added to the standard.

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## Contents

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NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates explanatory material on that paragraph in Appendix A.

Information on referenced publications can be found in Chapter 6 and Appendix B.

## Chapter 1 Administration

**1-1 Scope.** The requirements of this standard shall apply to design and design verification testing of new fire hose, specified as attack hose, occupant use hose, forestry hose, and supply hose.

**1-2 Purpose.**

**1-2.1** The purpose of this standard is to specify minimum requirements for hose manufacturers and for those responsible for preparing purchase specifications for hose.

**1-2.2** This standard may be referenced in purchase specifications. The standard is not intended to serve as a detailed manufacturing specification.

**1-2.3** The test requirements specified in this standard are intended to be performed under controlled laboratory conditions by the hose manufacturers or testing laboratories and are not intended to be performed by users in uncontrolled, nonlaboratory situations.

**1-2.4** The provisions of this standard reflect conditions and expert opinion prevalent at the time the standard was issued.

It is not intended that the provisions of this standard be applied to facilities, equipment, structures, or installations prior to the effective date of this standard.

*Exception: Where specific requirements for existing facilities, equipment, structures, or installations are contained in this standard, or where the authority having jurisdiction rules that the existing situation presents a distinct hazard to life or property.*

**1-3 Definitions.**

**Approved.*** Acceptable to the "authority having jurisdiction."

**Attack Hose.** Hose designed to be used by trained fire fighters and fire brigade members to combat fires beyond the incipient stage. It is designed to convey water to handline nozzles, distributor nozzles, master stream appliances, portable hydrants, manifolds, standpipe and sprinkler systems, and pumps used by the fire department.

**Authority Having Jurisdiction.*** The "authority having jurisdiction" is the organization, office or individual responsible for "approving" equipment, an installation or a procedure.

**Coating.** A jacket in which the yarn is impregnated or saturated with the protective materials or coated with the protective materials so the outside of the jacket is relatively smooth.

**Covered (other than rubber-covered).** Jacket covered and lined with a continuous synthetic rubber or plastic, this cover usually being thicker than that of a coating.

**Fire Hose.** A flexible conduit constructed with a woven jacket and an approved nonpermeable lining.

**Forestry Fire Hose.** A hose designed to meet specialized requirements for fighting wildland fires.

**Hard Suction Hose.** A hose used for drafting water from static supplies (lakes, rivers, wells, etc.). It may also be used for supplying pumpers from a hydrant if designed for that purpose. The hose contains a semi-rigid or rigid reinforcement designed to prevent collapse of the hose under vacuum.

**Labeled.** Equipment or materials to which has been attached a label, symbol or other identifying mark of an organization acceptable to the "authority having jurisdiction" and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

**Large-Diameter Hose.** A hose of 3½-in. (90-mm) size or larger. Supply hose is designed to be used at operating pressures not exceeding 185 psi (1275 kPa). Attack hose is designed for use at operating pressures of at least 275 psi (1895 kPa).

**Listed.*** Equipment or materials included in a list published by an organization acceptable to the "authority having jurisdiction" and concerned with product evaluation, that maintains periodic inspection of production of listed equipment or materials and whose listing states either that the equipment or material meets appropriate standards or has been tested and found suitable for use in a specified manner.

**May.** This term is used to state a permissive use or an alternative method to a specified requirement.

**Occupant Use Hose.** Fire hose designed to be used by the building's occupants to fight incipient fires prior to the arrival of trained fire fighters or fire brigade members.

**Shall.** This term indicates a mandatory requirement.

**Should.** Indicates a recommendation or that which is advised but not required.

**1-4 Units.** In this standard, values for measurement are followed by an equivalent in SI units, but only the first stated value shall be regarded as the requirement. Equivalent values in SI units shall not be considered as the requirement as these values may be approximate.

Table 1-4 SI conversions

| Quantity | US Unit/ Symbol | SI Unit/ Symbol | Conversion Factor |
|---|---|---|---|
| Length | inch/in. | millimeter/mm | 1 in. = 25 mm |
| | foot/ft | meter/m | 1 ft = 0.305 m |
| Volume | gallon/gal | liter/L | 1 gal = 3.785 L |
| Flow Rate | gallon per minute/gpm | liter per minute/L/m | 1 gpm = 3.785 L/m |
| Pressure | pounds per square inch/psi | kilopascal/kPa | 1 psi = 6.895 kPa |
| Mass | pounds/lb | kilograms/kg | 1 lb = .454 kg |

## Chapter 2 Design Requirements

### 2-1 Requirements for All Hose.

**2-1.1** The purchaser shall specify the service test pressure for the hose, but in any case the service test pressure shall not be less than as specified in this chapter for each type of hose. The purchaser shall specify a service test pressure of at least 10 percent greater than the normal highest operating pressure at which the hose is expected to be used.

**2-1.2** The proof test pressure shall not be less than 2 times the specified service test pressure.

**2-1.3** The burst test pressure shall not be less than 3 times the specified service test pressure.

**2-1.4** The kink test pressure shall not be less than 1½ times the specified service test pressure.

### 2-2 Requirements for Attack Hose.

**2-2.1** The minimum trade size for attack hose shall be 1½ in. (38 mm).

**2-2.2*** Attack hose shall have a minimum design service test pressure of 300 psi (2070 kPa). For design service test pressures greater than 300 psi (2070 kPa), the proof test pressure, burst test pressure, and kink test pressure shall be calculated as specified in Section 2-1.

**2-2.3** For the minimum design service test pressure of 300 psi (2070 kPa), the minimum pressure for the proof test pressure shall be 600 psi (4140 kPa) when tested as specified in Section 4-2. The hose shall withstand the test pressure without movement of couplings, leakage, or breaking of any thread in the jacket(s).

**2-2.4** For the minimum design service test pressure of 300 psi (2070 kPa), the minimum burst test pressure shall be 900 psi (6205 kPa) when tested as specified in Section 4-5. The test sample shall withstand the test pressure without failure.

**2-2.5** For the minimum design service test pressure of 300 psi (2070 kPa), the minimum kink test pressure shall be 450 psi (3100 kPa) when tested as specified in Section 4-4. The full length of hose, while kinked, shall withstand the test pressure without breaking any thread in the jacket.

**2-2.6** The maximum elongation shall not exceed 8 percent for 1½- through 2½-in. (38- through 65-mm) size hose, 10 percent for 3-in. (76-mm) size hose, and 13 percent for 3½-in. (89-mm) or larger size hose when tested as specified in Section 4-3.

**2-2.7** The maximum twist in turns per 50 ft (15 m) shall not exceed 4¼ for 1½- through 2-in. (38- through 51-mm) size hose, and 1¾ for 2½-in. (65-mm) or larger size hose. The final twist shall be in a direction that shall tighten the couplings when tested as specified in Section 4-3.

**2-2.8** The maximum warp shall not exceed 20 in. (508 mm) when tested as specified in Section 4-3.

**2-2.9** There shall be no rise permitted when tested as specified in Section 4-3.

### 2-3 Requirements for Large-Diameter Supply Hose.

**2-3.1** The minimum trade size for large-diameter hose shall be 3½ in. (89 mm).

**2-3.2*** Supply hose shall have a minimum design service test pressure of 200 psi (1380 kPa). For design service test pressures greater than 200 psi (1380 kPa), the proof test pressure, burst test pressure, and kink test pressure shall be calculated as specified in Section 2-1.

**2-3.3** For the minimum design service test pressure of 200 psi (1380 kPa), the minimum pressure for the proof test pressure shall be 400 psi (2760 kPa) when tested as specified in Section 4-2. The hose shall withstand the test pressure without movement of couplings, leakage, or breakage of any thread in the jacket(s).

**2-3.4** For the minimum design service test pressure of 200 psi (1380 kPa), the minimum burst test pressure shall be 600 psi (4140 kPa) when tested as specified in Section 4-5. The test sample shall withstand the test pressure without failure.

**2-3.5** For the minimum design service test pressure of 200 psi (1380 kPa), the minimum kink test pressure shall be 300 psi (2070 kPa) when tested as specified in Section 4-4. The full length of hose, while kinked, shall withstand the test pressure without breaking any thread in the jacket.

**2-3.6** The maximum elongation shall not exceed 10 percent when tested as specified in Section 4-3.

**2-3.7** The maximum twist in turns per 50 ft (15 m) shall not exceed 1¾. The final twist shall be in a direction that shall tighten the couplings when tested as specified in Section 4-3.

**2-3.8** The maximum warp shall not exceed 20 in. (508 mm) when tested as specified in Section 4-3.

**2-3.9** There shall be no rise permitted when tested as specified in Section 4-3.

### 2-4 Requirements for Occupant Use Hose.

**2-4.1** The minimum trade size for occupant use hose shall be 1½ in. (38 mm).

**2-4.2*** Occupant use hose shall have a minimum design service test pressure of 150 psi (1034 kPa). For design service test pressures greater than 150 psi (1034 kPa), the proof test pressure, burst test pressure, and kink test pressure shall be calculated as specified in Section 2-1.

**2-4.3** For the minimum design service test pressure of 150 psi (1034 kPa), the minimum proof test pressure shall be 300 psi (2070 kPa) when tested as specified in Section 4-2. The hose shall withstand the test pressure without movement of couplings, leakage, or breakage of any thread in the jacket(s).

**2-4.4** For the minimum design service test pressure of 150 psi (1034 kPa), the minimum burst test pressure shall be 450 psi (3100 kPa) when tested as specified in Section 4-5. The test sample shall withstand the test pressure without failure.

**2-4.5** For the minimum design service test pressure of 150 psi (1034 kPa), the minimum kink test pressure shall be 225 psi (1550 kPa) when tested as specified in Section 4-4. The full length of hose, while kinked, shall withstand the test pressure without breaking any thread in the jacket.

**2-4.6** The maximum elongation shall not exceed 10 percent when tested as specified in Section 4-3.

**2-4.7** The maximum twist in turns per 50 ft (15 m) shall not exceed 7½. The final twist shall be in a direction that shall tighten the couplings when tested as specified in Section 4-3.

**2-4.8** The maximum warp shall not exceed 20 in. (508 mm) when tested as specified in Section 4-3.

**2-4.9** There shall be no rise greater than 7-in. (178-mm) permitted when tested as specified in Section 4-3.

**2-5 Requirements for Forestry Hose.**

**2-5.1** The trade sizes for forestry hose shall be 1 in. (25 mm) and 1½ in. (38 mm).

**2-5.1.1** The maximum weight per 50 ft (15 m) of lined, cotton-synthetic jacketed forestry fire hose shall be 10 lb (4.5 kg) for 1-in. (25-mm) hose, and the maximum weight shall be 13 lb (6 kg) for 1½-in. (38-mm) hose as required in U.S.D.A. Forest Service Specification 5100-186, *Lined, Cotton-Synthetic Jacketed Fire Hose.*

**2-5.1.2** The maximum weight per 50 ft (15 m) of lined, synthetic woven jacket forestry fire hose shall be 5 lb (2.3 kg) for 1-in. (25-mm) hose, and the maximum weight shall be 8 lb (3.6 kg) for 1½-in. (38-mm) hose as required in U.S.D.A. Forest Service Specification 5100-187, *Lined, Synthetic Woven Jacket Fire Hose.*

**2-5.2*** Forestry hose shall have a minimum design service test pressure of 300 psi (2070 kPa). For design service test pressures greater than 300 psi (2070 kPa), the proof test pressure, burst test pressure, and kink test pressure shall be calculated as specified in Section 2-1.

**2-5.3** For the minimum design service test pressure of 300 psi (2070 kPa), the minimum pressure for the proof test pressure shall be 600 psi (4140 kPa) when tested as specified in Section 4-2. The hose shall withstand the test pressure without movement of couplings, leakage, or breakage of any thread in the jacket(s).

**2-5.4** For the minimum design service test pressure of 300 psi (2070 kPa), the minimum pressure for the burst test pressure shall be 900 psi (6205 kPa) when tested as specified in Section 4-5. The test sample shall withstand the test pressure without failure.

**2-5.5** For the minimum design service test pressure of 300 psi (2070 kPa), the minimum kink test pressure shall be 450 psi (3100 kPa) when tested as specified in Section 4-4. The full length of hose, while kinked, shall withstand the test pressure without breaking any thread in the jacket.

**2-5.6** The maximum elongation shall not exceed 10 percent when tested as specified in Section 4-3.

**2-5.7** The maximum twist in turns per 50 ft (15 m) shall not exceed 12 turns. The final twist shall be in a direction that shall tighten the couplings when tested as specified in Section 4-3.

**2-5.8** The maximum warp shall not exceed 25 in. (635 mm) when tested as specified in Section 4-3.

**2-5.9** There shall be no rise greater than 8 in. (203 mm) permitted when tested as specified in Section 4-3.

**2-5.10 Flexibility and Compressibility Testing.**

**2-5.10.1** For flexibility and compressibility the maximum applied load for lined, cotton-synthetic jacketed fire hose shall not exceed 100 lb (45.4 kg) for 1-in. (25-mm) hose and 125 lb (56.75 kg) for 1½-in. (38-mm) hose when tested in accordance with U.S.D.A. Forest Service Specification 5100-186, *Lined, Cotton-Synthetic Jacketed Fire Hose.*

**2-5.10.2** For flexibility and compressibility the maximum applied load for lined, synthetic woven jacket fire hose shall not exceed 100 lb (45.4 kg) for 1-in. (25-mm) hose and 125 lb (56.75 kg) for 1½-in. (38-mm) hose when tested in accordance with U.S.D.A. Forest Service Specification 5100-187, *Lined, Synthetic Woven Jacket Fire Hose.*

**2-6 Requirements for Suction Hose.** The requirements of Chapters 3, 4, and 5 shall not apply to suction hose except as specified herein.

**2-6.1** All suction hose shall meet the requirements of 2-6.2 through 2-6.13. If the suction hose is intended for use under positive pressure, it shall also meet the requirements of 2-6.14.

**2-6.2** The minimum trade size for suction hose shall be 1½ in. (38 mm).

**2-6.3** The internal diameter of the hose shall comply with 3-1.1.

**2-6.4** The internal surface shall be smooth and free of corrugations.

**2-6.5** Linings and covers, if provided, shall be made from one of the following materials, and the material shall be approved:

(a) Rubber compound;

(b) Thermoplastic compound;

(c) Blends of rubber and thermoplastic compounds.

**2-6.6** If a lining is provided, it shall meet the requirements of 3-3.6.1.

**2-6.7** If a cover is provided, it shall meet the requirements of 3-3.7.

**2-6.8** The suction hose shall be constructed to withstand an internal vacuum of at least 23 in. Hg (78 kPa) without failure, including collapse of the liner or the cuffed (soft) ends, when applicable in the coupling bowl area.

**2-6.9** The hose shall be designed for use in ambient conditions ranging from -30°F to 140°F (-34°C to 60°C).

**2-6.9.1** The tensile strength of the tube, and cover if provided, shall not decrease by more than 20 percent of the original value, and the elongation shall not decrease by more than 50 percent when tested in accordance with Section 4-7.

**2-6.9.2** The material used for the tube, and cover if provided, shall pass the Low-Temperature Test on Tube and Cover of ASTM D380, *Standard Test Methods for Rubber Hose*, when subjected to the cold chamber for 5 hr at -30°F (-34°C).

**2-6.10** The tensile strength and ultimate elongation shall meet the requirements of 3-3.8.1, 3-3.8.2, and 3-3.8.4.

**2-6.11** The linings and covers of the suction hose, if provided, shall show no visible signs of cracking when subjected to the ozone test specified in Section 4-9.

**2-6.12 Marking.**

**2-6.12.1** If the suction hose is designed for use under vacuum only, it shall be indelibly marked at 5 ft (1.5 m) intervals in letters at least 2 in. (51 mm) high with the words "FOR VACUUM USE ONLY." Each length shall also be indelibly marked in letters at least 1 in. (25 mm) high with the words "SERVICE TEST TO 22 IN. HG VACUUM PER NFPA 1962."

**2-6.12.2** If the suction hose is designed for use under positive pressure, each length shall be indelibly marked in letters at least 1 in. (25 mm) high with the words "SERVICE TEST TO (the service test pressure the hose is designed to) AND 22 IN. HG VACUUM PER NFPA 1962."

**2-6.13** After the hose has been coupled, it shall be subjected to a vacuum of 23 in. Hg (78 kPa). Once the vacuum has been established, the hose shall maintain that vacuum for 5 min with no loss of vacuum. The vacuum pump shall not be used to maintain the vacuum during the 5-min period. After the test has been completed, the lining shall be visually inspected for any sign of collapse or failure.

**2-6.14 Positive Pressure Requirements for Suction Hose.**

**2-6.14.1*** Suction hose shall have a minimum design service test pressure of 165 psi (1138 kPa).

**2-6.14.2** For design service test pressures greater than 165 psi (1138 kPa), the proof test and burst test pressures shall be calculated as defined in Section 2-1.

**2-6.14.3** For the minimum design service test pressure of 165 psi (1138 kPa), the minimum pressure for the proof test pressure shall be 330 psi (2275 kPa) when tested as specified in Section 4-2. The hose shall withstand the test pressure without movement of couplings, leakage, breakage, or showing any signs of deformity.

**2-6.14.4** For the minimum design service test pressure of 165 psi (1138 kPa), the minimum burst test pressure shall be 495 psi (3413 kPa) when tested as specified in Section 4-5. The test sample shall withstand the test pressure without failure.

## Chapter 3 Construction Requirements

**3-1 Size.**

**3-1.1* Diameter.** The hose shall have an internal diameter of not less than the trade size of the hose; however, the internal diameter for 2½-in. (65-mm) hose shall be at least 2 9/16 in. (65 mm).

**3-1.2 Length.**

**3-1.2.1** The hose shall be in lengths averaging not less than 50 ft (15 m) unless the purchaser specifies 75 ft (22.5 m) or 100 ft (30 m) and shall not include the length from which the burst test sample is taken.

Supply hose or attack hose used to connect a pumper to a hydrant may be in lengths of not less than 10 ft (3.05 m).

**3-1.2.2** No nominal 50-ft (15-m) length shall be less than 48 ft (14.6 m), other than the length from which a burst test sample was taken, which shall not be less than 47 ft (14.3 m).

**3-1.2.3** No nominal 75-ft (22.5-m) length shall be less than 73 ft (22.3 m), other than the length from which a burst test sample was taken, which shall not be less than 72 ft (22 m). The hose shall be in lengths averaging not less than 75 ft (22.5 m).

**3-1.2.4** No nominal 100-ft (30-m) length shall be less than 98 ft (29.9 m), other than the length from which a burst test sample was taken, which shall not be less than 97 ft (29.6 m). The hose shall be in lengths averaging not less than 100 ft (30 m).

**3-1.2.5** Each length shall be measured as specified in 4-2.1 of this standard.

**3-2 Jackets.**

**3-2.1*** Jackets shall be made from one of the following materials, and the material shall be approved:

(a) Natural thread;

(b) Synthetic thread;

(c) Combination of natural and synthetic thread.

**3-2.2** Samples of hose made from the threads selected as specified in 3-2.1 shall have been submitted to an approved testing laboratory, and shall be determined by the testing laboratory to be suitable as jackets for fire hose.

**3-2.3** Jackets shall be well, evenly, and firmly woven, and as free from unsightly defects, dirt, knots, lumps, and irregularities of twist as is consistent with good manufacturing practice.

**3-2.4** All knots shall be tucked under the warp threads.

**3-2.5*** Each jacket shall be seamless and shall have the filling woven around the hose throughout its length and the warps interwoven with and substantially covering the filling.

**3-2.6** When mildew treatment for the jacket is specified by the purchaser, the hose manufacturer shall certify that the mildew treatment meets the requirements of U.S.D.A. Forest Service Specification 5100-186, *Lined, Cotton-Synthetic Jacketed Fire Hose.*

**3-3 Linings and Cover.**

**3-3.1*** All fire hose shall be lined.

**3-3.2** Liners, and covers if provided, shall be made from one of the following materials, and the material shall be approved:

(a) Rubber compound;

(b) Thermoplastic material;

(c) Blends of rubber compounds and thermoplastic material;

(d) Natural rubber-latex-coated fabric.

**3-3.3** Samples of hose with liners, and covers if provided, made from the materials selected as specified in 3-3.2 shall be submitted to an approved testing laboratory. The testing laboratory shall determine whether the material and thickness are suitable for specified types of fire hose.

**3-3.4** The lining shall be of uniform thickness of standard commercial quality.

**3-3.5** The waterway surface of the lining shall be free from pitting, irregularities, or other imperfections.

**3-3.6 Lining Adhesion.**

**3-3.6.1** The adhesion between the lining and the jacket shall be such that the rate of separation of a 1½-in. (38-mm) strip of the lining from the jacket shall not be greater than 1 in. (25 mm) per minute with a weight of 12 lb (5.4 kg), when tested in accordance with 4-6.1, 4-6.2, 4-6.3, and 4-6.4. If a rubber backing is used between the lining and the jacket, the adhesion between the lining and the backing and between the backing and the jacket shall be such that the rate of separation of a 1½-in. (38-mm) strip shall not be greater than 1 in. (25 mm) per minute with a weight of 12 lb (5.4 kg), as specified in 4-6.5.

**3-3.6.2** The requirement of 3-3.6.1 shall not exclude a construction that provides no adhesion between the jacket and lining along the fold if the surface over which there is no adhesion is not greater than 35 percent of the total surface.

**3-3.7 Cover Adhesion.** The adhesion between the cover and the woven jacket shall be such that the rate of separation of a 1½-in. (38-mm) strip of the cover from the jacket shall not be greater than 1 in. (25 mm) per minute with a weight of 10 lb (4.5 kg).

**3-3.8 Tensile Strength and Ultimate Elongation.**

**3-3.8.1** 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 3-3.8 when tested as specified in Section 4-7.

**Table 3-3.8**

| Material | Tensile Strength (psi) | Tensile Strength (kPa) | Ultimate Elongation (%) |
|---|---|---|---|
| Natural and Synthetic Rubber | 1200 | 8275 | 400 |
| Latex Rubber | 1800 | 12410 | 700 |
| Thermoplastic | 2000 | 13790 | 400 |
| All | 1200 | 8275 | 400 |

**3-3.8.2** If oil-resistant liners or covers are required, the ultimate elongation shall not be less than 250% provided that the tensile strength and ultimate elongation do not decrease more than 50% when tested in accordance with Section 4-11.

**3-3.8.3** The tensile strength of liners for forestry hose shall not be less than 1800 psi (12410 kPa).

**3-3.8.4** The tensile strength and ultimate elongation of specimens subjected to the oven aging test, as specified in Section 4-8, shall not be less than 75 percent of specimens not subjected to this test.

**3-3.9** For hose marked as ozone-resistant, the hose linings, and covers if provided, shall show no visible signs of cracking when subjected to the ozone test specified in Section 4-9.

**3-3.10 Cold Resistance Test.**

**3-3.10.1** Hose marked by the manufacturer for use down to −65°F (−54°C) shall show no apparent damage to the jacket or lining when subjected to the cold bending test specified in Section 4-10. Following the cold bending test as specified in Section 4-10, the hose shall not leak nor show breakage of any thread in the jacket when subjected to the proof test pressure as specified in Section 4-2.

**3-3.10.2** It shall be possible for one person to uncoil and lay out a 50-ft (15-m) length of hose immediately after it has been subjected to the cold test as specified in 4-10.2.

**3-4 Marking.**

**3-4.1** Each length of fire hose shall be indelibly marked in letters and figures at least 1 in. (25 mm) high with the manufacturer's identification, the month and the year of manufacture, and the words "SERVICE TEST TO (the service test pressure specified in Section 2-1 of this standard) PSI PER NFPA 1962."

These markings shall be in two places on each length of hose, beginning 5 ft (1.52 m) ± 6 in. (152 mm) from the ends of the hose.

**3-4.2* Large-Diameter Hose.**

**3-4.2.1** Each length of large-diameter supply hose meeting the requirements of Section 2-3 shall be indelibly marked lengthwise in letters at least 2 in. (51 mm) high with the words "SUPPLY HOSE."

**3-4.2.2** Each length of large-diameter attack hose meeting the requirements of Section 2-2 shall be indelibly marked lengthwise in letters at least 2 in. (51 mm) high with the words "ATTACK HOSE."

**3-4.2.3** The marking shall be centered in the first 5 ft (1.52 m) ± 6 in. (152 mm) from each end of the hose and shall be marked in two places, 180 degrees apart.

**3-4.3** No markings referring to pressure other than the service test pressure specified in 3-4.1 shall appear on the hose.

## Chapter 4 Test Methods for Manufacturers' Hose Certification

**4-1 Hydrostatic Tests.**

**4-1.1** Tests shall be conducted by the hose manufacturer or at an approved testing facility designated by the manufacturer.

**4-1.2** All nondestructive hydrostatic tests shall be conducted on hose equipped with couplings to be delivered.

**4-2 Proof Test Pressure.**

**4-2.1** The test shall be conducted on a test table that shall have a clear space of at least 20 in. (508 mm) on each side of a line drawn through the center of the supply connection parallel to the edges of the test table. To facilitate the complete removal of air from the hose, the surface of the test table shall be inclined with the supply at the low end. The hose shall be filled with water until all air has been exhausted. The valve shall be closed and the pressure adjusted to 10 psi (69 kPa). While at 10 psi (69 kPa) the hose shall be straightened out, and the length of the hose between couplings shall be measured and recorded to the nearest inch (25 mm). The pressure in the hose shall be increased at a rate of not less than 300 psi (2070 kPa) nor more than 1000 psi (6895 kPa) per minute until the required test pressure is reached. Proof test pressure shall be held for at least 15 seconds and not more than 1 minute.

**4-2.2** The hose shall be marked behind the coupling before the proof test pressure and examined for movement after the test.

**4-3 Elongation, Twist, Warp, and Rise Test Methods.**

**4-3.1** The elongation of the hose shall be calculated from the initial measurement of 10 psi (69 kPa) and final measurement taken at the proof test pressure.

**4-3.2** The amount of twist shall be measured by following the color line or by noting, in the period during which the pressure is being applied, the turns of the fitting at the free end of the hose. The amount of twist shall be recorded to the nearest one-eighth turn or 45 degrees.

The direction of twist shall be reported as right or left. A right twist shall be in the direction that would tend to tighten couplings.

**4-3.3*** When the hose warps to any appreciable extent and particularly when the allowable limit of elongation is approached, the length at final pressure shall be measured by following the contour of the hose. For hose that does not warp to any extent, the measurement may be taken parallel to the edge of the test table. All measurements shall be taken from the inside edges of the fittings.

**4-3.4** For hose having nominal length of 50 ft (15 m), the amount of warping shall be the maximum deviation of any portion of the hose from a straight line drawn from center to center of the fittings. For hose having nominal length greater than 50 ft (15 m) and up to 100 ft (30 m), the amount of warping shall be the maximum deviation of any 50-ft (15-m) portion of the hose from an initial straight line drawn from the center of the fittings at each end of the hose.

**4-3.5** The warp shall be measured as the distance from the referenced straight line to the center line of the hose at the point of maximum deviation. If the first measurement of warping is excessive, the position of the hose relative to the water supply may be reversed, end for end, and the test for warping repeated.

**4-3.6** Rise shall be measured to the nearest inch (25 mm) and is that distance that the hose rises above the test table when subjected to the proof test pressure specified in this chapter.

**4-4 Kink Test.**

**4-4.1** The test shall be conducted on a test table that shall have a clear space of at least 20 in. (508 mm) on each side of a line drawn through the center of the supply connection parallel to the edges of the test table. To facilitate the complete removal of air from the hose, the surface of the test table shall be inclined with the supply at the low end. The hose shall be filled with water until all air has been exhausted. The valve shall be closed and the pressure adjusted to 10 psi (69 kPa).

**4-4.2** The hose shall be sharply kinked 18 in. (457 mm) from the free end by tying the hose back against itself as close to the fittings as practicable. The pressure shall be raised as described in Section 4-2 to the test pressure and immediately released.

**4-5* Burst Test.** One 3-ft (0.9-m) sample shall be cut from the end of two lengths of hose and submitted for testing before the hose is subjected to the proof pressure test. One of the samples shall be tested while lying straight and the other while lying curved on a surface having a radius of 27 in. (685 mm). A protective enclosure shall be used.

The 3-ft (0.9-m) samples shall be connected to the water supply, the air expelled, and the pressure raised until the specified burst pressure is reached.

**4-6 Adhesion Test.**

**4-6.1** 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.

**4-6.2** The specimen for the adhesion test shall be cut transversely.

**4-6.3** The specimen shall be 2 in. (51 mm) wide and shall be cut through so as to give a rectangular sample 2 in. (51 mm) wide and the full circumference of the hose in length. A strip of lining, or cover if provided, 1½ in. (38 mm) wide shall be cut out accurately, the cut extending through the rubber but not entirely through the woven jacket. This strip shall be started at one end to the extent of about 1½ in. (38 mm), and a reference mark shall be placed on the jacket at the juncture of the jacket and the lining. The free end of the woven jacket and the free end of the strip of rubber shall be secured in suitable clamps.

**4-6.4** With the separated jacket gripped in a stationary clamp, the separated rubber 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 (mm), to the nearest 0.1 in. (2.54 mm), by the elapsed time in minutes.

**4-6.5** 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 between the lining and the backing or between the backing and the jacket 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.

**4-7 Tensile Strength and Elongation.**

**4-7.1** Tensile strength and elongation shall be determined in accordance with the test methods specified in ASTM D 412, *Test Method for Rubber Properties in Tension*, Method A.

**4-7.2** Three dumbbell specimens shall be die cut and have a constricted portion 0.250 in. (6.4 mm) wide and 1.30 in. (33 mm) long. The enlarged ends shall be 1 in. (25 mm) wide.

**4-7.3** The constricted portion of each specimen may be buffed to remove fabric impressions or other surface irregularities. 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.

**4-7.4** The specimens shall be cut transversely from the sample.

**4-7.5** 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. The average tensile strength of the three specimens shall be considered the tensile strength of the rubber lining or cover.

**4-7.6** Two benchmarks 1 in. (25 mm) apart shall be stamped centrally on the constricted portion of each specimen.

**4-7.7** 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 is to 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.

**4-8 Oven Aging Test.** Three specimens shall be prepared as described in 4-7.2 through 4-7.5. The specimens shall be conditioned in an oven for 96 hr at 70°C ± 2°C (158°F ± 3.6°F) following the procedures described in ASTM D 573, *Test Method for Rubber Deterioration in an Air Oven*. Two benchmarks 1 in. (25 mm) apart shall be stamped centrally on the constricted portion of each specimen after the conditioning. The specimens shall then be tested in accordance with ASTM D 412, *Test Method for Rubber Properties in Tension*, Method A.

**4-9 Ozone Resistance.** Three specimens, 3¾-in. (85-mm) long by 1-in. (25-mm) wide (or as close to 1-in. wide as possible from small-diameter hose) shall be cut longitudinally from the liner, and cover if provided, of the sample and mounted in the specimen holder in a looped position in accordance with the procedures outlined in ASTM D 518, *Test Method for Rubber Deterioration — Surface Cracking*, Procedure B. The ozone test chamber shall be regulated to give an ozone concentration of 100 ppm and a temperature of 40°C ± 1°C (104°F ± 1.8°F). When constant test conditions have been obtained in the ozone test chamber, and after the mounted specimens have remained in an ozone-free atmosphere for 24 hr, the mounted specimens shall be placed in the test chamber and allowed to remain for 70 hr. After the test exposure the specimens shall be removed from the test chamber and examined with a 7-power magnifying glass.

**4-10 Test for Cold Resistance.**

**4-10.1** A cold box capable of maintaining a temperature of −54°C ± 2°C (−65°F ± 3.6°F) and of sufficient capacity to accommodate the test specimens shall be used.

**4-10.2** A 3-ft (0.9-m) sample of the hose, provided with the test fittings, shall be immersed in the water bath at room temperature for 24 hr. Then the hose shall be removed from the water bath, exposed to room atmosphere for 15 min, and then placed in the cold box maintained at −54°C ± 2°C (−65°F ± 3.6°F). After 24 hr in the cold box, the hose shall be removed from the box and immediately bent double on itself, 180 degrees, first one way and then the other. The hose shall then be allowed to thaw at room temperature for 24 hr, and then subjected to the proof test pressure as specified in Section 4-2.

**4-10.3** A 50-ft (15-m) length of dry hose shall be firmly coiled and placed in the cold box at −54°C ± 2°C (−65°F ± 3.6°F) for 24 hr. Immediately after removing the hose from the cold box, an attempt shall be made by one operator to uncoil and lay out the hose.

**4-11 Oil Immersion Test.**

**4-11.1** A sample of the liner shall be immersed in a petroleum-base oil at 121°C ± 1°C (250°F ± 1.8°F) for 18 hr and the tensile strength and elongation determined as specified in Section 4-7.

**4-11.2** The oil used in this test shall be a medium-swelling petroleum-base oil with a viscosity of 100 ± 5 Saybolt Universal seconds at 98.9°C (210°F), an aniline point of 93°C ± 3°C (199.4°F ± 5.4°F), and an open cup flash point of 246.1°C ± 5.6°C (475°F ± 10°F).

## Chapter 5 Sampling, Inspection, and Tests

**5-1 General Inspection and Tests.**

**5-1.1** The manufacturer shall be responsible for performing all inspection requirements. Manufacturers may utilize their own facilities or any approved laboratory.

**5-1.2** Records of inspection and tests shall be kept complete and available to the purchaser.

**5-1.3** In case of factory inspections, the manufacturer shall furnish the inspector all reasonable facilities for performing the work. During any inspection, the inspector may take from the lot one or more samples and submit them to an independent laboratory for inspection and tests.

**5-1.4** The purchaser reserves the right to perform any test deemed necessary to verify that the product offered meets all the requirements of this standard.

**5-1.5** All hoses of similar diameter and length presented together in one delivery shall be considered one lot for the purpose of inspection.

**5-1.6** Samples of the hoses ready for acceptance shall be selected from each lot for inspection of visual and dimensional characteristics.

**5-1.7** All hoses offered in a lot shall be subjected to elongation, twist, warp, rise, and proof tests performed in accordance with Sections 4-2 and 4-3.

**5-1.8** Samples shall be taken from the lot for kink, burst, jacket adhesion, and tensile strength and elongation tests.

**5-1.9** The purchaser shall specify if any of the other tests specified in Sections 4-8 through 4-12 are required.

**5-1.10** When requested, the manufacturer shall provide the purchaser a certification that the hose furnished has been tested and is in compliance with the provisions as outlined in this standard.

## Chapter 6 Referenced Publications

**6-1** The following documents or portions thereof are referenced within this standard and shall be considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

**6-1.1 ASTM Publications.** American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM D 380-1987, *Standard Test Methods for Rubber Hose*

ASTM D 412-1987, *Standard Test Method for Rubber Properties in Tension*

ASTM D 518-1986, *Standard Test Method for Rubber Deterioration — Surface Cracking*

ASTM D 573-1988, *Standard Test Method for Rubber Deterioration in an Air Oven*

**6-1.2 U.S.D.A. Publications.** U.S. Forest Service, San Dimias Technology and Development Center, San Dimias, CA 91773.

U.S.D.A. Forest Service Specification 5100-186, *Lined, Cotton-Synthetic Jacketed Fire Hose*

U.S.D.A. Forest Service Specification 5100-187, *Lined, Synthetic Woven Jacket Fire Hose*

## Appendix A

*This Appendix is not a part of the requirements of this NFPA document, but is included for information purposes only.*

**A-1-3 Approved.** The National Fire Protection Association does not approve, inspect or certify any installations, procedures, equipment, or materials nor does it approve or evaluate testing laboratories. In determining the acceptability of installations or procedures, equipment or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization concerned with product evaluations which is in a position to determine compliance with appropriate standards for the current production of listed items.

**A-1-3 Authority Having Jurisdiction.** The phrase "authority having jurisdiction" is used in NFPA documents in a broad manner since jurisdictions and "approval" agencies vary as do their responsibilities. Where public safety is primary, the "authority having jurisdiction" may be a federal, state, local or other regional department or individual such as a fire chief, fire marshal, chief of a fire prevention bureau, labor department, health department, building official, electrical inspector, or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the "authority having jurisdiction." In many circumstances the property owner or his designated agent assumes the role of the "authority having jurisdiction"; at government installations, the commanding officer or departmental official may be the "authority having jurisdiction."

**A-1-3 Listed.** The means for identifying listed equipment may vary for each organization concerned with product evaluation, some of which do not recognize equipment as listed unless it is also labeled. The "authority having jurisdiction" should utilize the system employed by the listing organization to identify a listed product.

**A-2-2.2** A minimum design service test pressure of 300 psi (2070 kPa) for attack hose provides a normal highest operating pressure of 275 psi (1895 kPa). If a higher operating pressure is needed, see 2-1.1 for determining the required design service test pressure.

**A-2-3.2** Whenever large-diameter supply hose is being used to supply attack lines, master stream appliances, portable hydrants, manifolds, and standpipe and sprinkler systems, a pressure relief device with a maximum setting of 200 psi (1380 kPa) should be used.

A minimum design service test pressure of 200 psi (1380 kPa) for supply hose provides a normal highest operating pressure of 185 psi (1275 kPa). If a higher operating pressure is needed, see 2-1.1 for determining the required design service test pressure.

**A-2-4.2** A minimum design service test pressure of 150 psi (1034 kPa) for occupant use hose provides a normal highest operating pressure of 135 psi (930 kPa). If a higher operating pressure is needed, see 2-1.1 for determining the required design service test pressure.

**A-2-5.2** A minimum design service test pressure of 300 psi (2070 kPa) for forestry hose provides a normal highest operating pressure of 250 psi (1723 kPa). If a higher operating pressure is needed, see 2-1.1 for determining the required design service test pressure.

**A-2-6.14.1** A minimum design service test pressure of 165 psi (1138 kPa) for suction hose provides a normal highest operating pressure of 150 psi (1034 kPa). If a higher operating pressure is needed, see 2-1.1 for determining the required design service test pressure.

**A-3-1.1** The friction loss characteristics of fire hoses are not included in this Standard but are an important consideration in the selection of hose. Friction loss varies considerably depending on the construction and design of the hose, the roughness of the lining, and its internal diameter, which may be different for different grades of hose. The type of couplings can also affect the friction loss.

Where friction loss is important, side-by-side comparisons are recommended. The following test is recommended.

All comparative tests should use 300 ft (92 m) of each type of hose to be tested laid side-by-side on a level surface. Commercially available line pressure gauges should be installed at the inlet and the outlet of the first 300 ft (92 m) of hose to be tested.

A smooth bore nozzle of the recommended size is to be used for the tests. Pressurize the test hose while the nozzle is fully open until the inlet line gauge reads 150 psi (1034 kPa). Read the pressure shown on the outlet line gauge. Subtract the outlet pressure from the inlet pressure and divide by 3 to determine the friction loss per 100 ft (31 m) of hose. Repeat the test for the next type hose to be tested. The hose with the lowest friction loss will flow the most amount of water for a given inlet pressure.

| Recommended Hose Size (inches) | Smooth Bore Nozzle Size (inches) |
|---|---|
| 1½" | ⅝" |
| 1¾" | ⅝" |
| 2" | ¾" |
| 2½" | 1" |
| 3" | 1¼" |
| 3½" | 1½" |
| 4" | 2" |
| 4½" | 2" |
| 5" | 2¼" |
| 6" | 2¼" |

**A-3-2.1** Hose with a jacket of all-synthetic threads is much lighter in weight than the all-cotton jacket hose and is considerably more flexible; therefore, a greater amount can be carried on apparatus or at standpipes.

**A-3-2.5** The abrasion characteristics of fire hose are not included in this standard but should be an important consideration in the selection of fire hose. In areas where the hose could be subjected to rough usage, double-jacketed or rubber-covered hose should be considered.

**A-3-3.1** Fire hose should not be used for the conveyance of potable water. There are hoses specifically designed for this purpose such as hoses designed to Federal Specifications ZZ-H-451, *Hose, Fire, Woven-Jacketed Rubber — or Latex or Rubber Coated Fabric-Lined, with Couplings*; MIL-H-24606, *Hose Assemblies, Chlorosulfonated Polyethylene Impregnated, Double Synthetic Jacket, with Couplings, Fire Fighting and Other Water Service*; and MIL-H-53027, *Hose Assembly, Rubber: Lightweight Collapsible, 6-inch for Drinking (Potable) Water.*

Linings for these hoses should be approved to NSF 14, *Plastic Piping Components and Related Materials*, or Title 21 (Food and Drug Administration) Part 177.2600, Chapter 1 of the *Code of Federal Regulations.*

**A-3-4.2** Hose manufactured before 1987 will not have the service test pressure stencilled on the hose. Users wishing to mark their existing hose should contact the hose manufacturer for the correct designation prior to marking their hose.

**A-4-3.3** For this purpose, an edge of the table should be marked off in feet and inches (m, and cm or mm). Warping in hose tests is the deviation from a straight line drawn from fitting to fitting in a plane parallel to the surface on which the hose rests.

**A-4-5** CAUTION: Hose meeting the requirements of this standard may be supplied with a coupling that will not be capable of complying with the burst test requirements of the hose. The purchaser should request information on the failure point of couplings supplied with the hose.

## Appendix B Referenced Publications

**B-1** The following documents or portions thereof are referenced within this standard for informational purposes only and thus should not be considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

**B-1.1 Code of Federal Regulations.** Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

21 CFR 177.2600 Rubber Articles Intended for Repeated Use

**B-1.2 Military and Federal Specifications.** Naval Publications and Forms Center, 5801 Tabor Ave., Attn: NPODS, Philadelphia, PA 19120-5094.

MIL-H-24606, *Hose Assemblies, Chlorosulfonated Polyethylene Impregnated, Double Synthetic Jacket, with Couplings, Fire Fighting and Other Water Service*, December 6, 1985

MIL-H-53027, *Hose Assembly, Rubber: Lightweight Collapsible, 6-inch for Drinking (Potable) Water*, December 18, 1990

ZZ-H-451, *Hose, Fire, Woven-Jacketed Rubber — or Latex or Rubber Coated Fabric-Lined, with Couplings*, January 13, 1984

**B-1.3 NSF Publication.** National Sanitation Foundation, 3475 Plymouth Rd, P.O. Box 1468, Ann Arbor, MI 48106.

NSF 14-1990, *Plastic Piping Components and Related Materials*

## Index

# SUBMITTING PROPOSALS ON NFPA TECHNICAL COMMITTEE DOCUMENTS

**Contact NFPA Standards Administration for final date for receipt of proposals on a specific document.**

Note: All proposals must be received by 5:00 p.m. E.S.T./E.D.S.T. on the published proposal closing date.

## INSTRUCTIONS

Use a separate proposal form for submitting each proposed amendment.

1. Type or print legibly in black ink.

2. Indicate the number, edition year, and title of the document. Also indicate the specific section or paragraph that the proposed amendment applies to.

3. Check the appropriate box to indicate whether this proposal recommends adding new text, revising existing text, or deleting text.

4. In the space identified as "Proposal" indicate the exact wording you propose as new or revised text, or the text you propose be deleted.

5. In the space titled "Statement of Problem and Substantiation for Proposal" state the problem which will be resolved by your recommendation and give the specific reason for your proposal. Include copies of test results, research papers, fire experience, or other materials that substantiate your recommendation.

6. Check the appropriate box to indicate whether or not this proposal is original material, and if it is not, indicate the source of the material.

7. Sign the proposal.

If supplementary material (photographs, diagrams, reports, etc.) is included, you may be required to submit sufficient copies for all members and alternates of the technical committee. The technical committee is authorized to abstract the "Statement of Problem and Substantiation for Proposal" if it exceeds 200 words for publication in the Technical Committee Reports.

NOTE: The NFPA Regulations Governing Committee Projects in Paragraph 10-10 state: Each proposal shall be submitted to the Council Secretary and shall include:

(a) identification of the submitter and his affiliation (Committee, organization, company) where appropriate, and

(b) identification of the document, paragraph of the document to which the proposal is directed, and

(c) a statement of the problem and substantiation for the proposal, and

(d) proposed text of proposal, including the wording to be added, revised (and how revised), or deleted.