

Specification 5100-186c
October 1996
Superseding
Specification 5100-186b
January 1978

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
SPECIFICATION FOR
FIRE HOSE, COTTON-SYNTHETIC,
LINED, WOVEN JACKET, 1 INCH AND 1-1/2 INCH

1. SCOPE.

1.1. Scope. The fire hose described in this specification is a cotton-synthetic, jacketed hose, with an elastomer lining designed for use in wildland firefighting. The coupling thread series designations are 1 inch 11-1/2 NPSH and 1-1/2 inch 9 NH. Working pressure is up to 450 psig (3102 kPag).

2. APPLICABLE DOCUMENTS.

2.1. Government Documents. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issue of these documents are those in effect on the date of the invitation for bids or request for proposals (see 6.2).

USDA Forest Service Standard

5100-190 - Threads, Gaskets, Rocker Lugs, Connections and Fittings, Fire Hose

USDA Forest Service Specification

5100-108 - Couplings, Lightweight, Fire and Suction Hose

Federal Standards and Test Methods

FED-STD-191 - Textile Test Method

Method 5100 - Strength and Elongation, Breaking of Woven Cloth; Grab Method

FED-STD-601 - Rubber: Sampling and Testing

Method 1111 - Buffing

Beneficial comments, recommendations, additions, deletions and any pertinent data that may be used in improving this document should be addressed to: USDA Forest Service, San Dimas Technology and Development Center, 444 East Bonita Avenue, San Dimas, CA 91773-3198 by using the Specification Comment Sheet at the end of this document or by letter.

Method 2011 - Thickness, Micrometer, Flat Foot

Method 2341 - Circumference, Inner, Mandrel

Method 4111 - Tensile Strength

Method 4121 - Elongation, Ultimate

Method 8011 - Friction, Machine Method

Copies of federal standards and associated test methods are available from General Services Administration, Federal Supply Service Bureau, Specification Section, Suite 200, 470 East L'Enfant Plaza SW, Washington DC 20407.

Copies of USDA Forest Service Specifications and Standards are available from USDA Forest Service, San Dimas Technology and Development Center, 444 East Bonita Avenue, San Dimas, CA 91773-3198.

2.2. Non-Government Publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those in effect on the date of the invitation for bids or request for proposals.

American National Standards Institute (ANSI)/American Society for Quality Control (ASQC)

Z 1.4 - Sampling Procedures and Tables for Inspection by Attributes

Address requests for copies to the American National Standards Institute Inc., 11 West 42nd Street, New York, NY 10036.

American Society for Testing and Materials (ASTM)

D 297 - Test Methods for Rubber Products - Chemical Analysis

D 412 - Test Methods for Rubber Properties in Tension

D 518 - Test Method for Rubber Deterioration - Surface Cracking

D 573 - Test Method for Rubber - Deterioration in an Air Oven

D 1149 - Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber

E 380 - Practice for Use of the International System of Units

Address requests for copies to American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

2.3. Order of Precedence. In the event of conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS.

3.1. Qualified Products List Number. The bidder shall possess a currently valid notice of qualification with associated Qualified Products List (QPL) number obtained in accordance with 4.1. The date of issue on the QPL number shall precede the date on the invitation for bids.

3.2. Construction.

3.2.1. Woven Jacket. The woven fire hose jacket shall be seamless. The jacket shall have filler yarn woven around the hose throughout its length. Warp yarn shall be interwoven with the filler yarn to enhance abrasion resistance. The jacket shall be even and firm in texture, flexible and free from dirt, knots, lumps, irregularity of twist, or other defects that may affect the appearance or serviceability of the hose.

3.2.2. Liner. The fire hose liner shall be lamination from flat stock, extrusion, or a coated reinforced construction using a thin cambric or other reinforcing material. When a lap joint is used it shall be as small and smooth as practicable. The liner shall extend the full length of the hose providing a smooth waterway with no ribs, ripples, indentations, overlapping material or any uneven surface.

3.2.3. Couplings. 1 inch (25.4 mm) diameter hose shall be supplied with 1 inch 11-1/2 NPSH couplings, and 1-1/2 inch (38.1 mm) hose shall be supplied with 1-1/2 inch 9 NH couplings. One end of the hose shall be equipped with a coupling female section and the other end with a coupling male section. The couplings shall be properly installed. The couplings shall be lightweight, USDA Forest Service qualified in accordance with the minimum requirements of Specification 5100-108.

3.3. Materials. Where more than one type of material is used in various components, there shall be no incompatibility between materials which may cause corrosion.

3.3.1. Jacket Material. The jacket material shall be woven of high quality cotton synthetic yarn.

3.3.2. Lining Material. The lining material shall be made of an elastomer material of natural or synthetic rubber.

3.3.3. Mildew Treatment. The cotton synthetic hose jacket shall be treated to be resistant to mildew. The fungicide or compound shall be applied by thoroughly impregnating the material and shall be non-toxic, insoluble in water and shall not cause deterioration of the material when exposed to water or the atmosphere.

3.3.4. Recoverable Materials. The contractor is encouraged to use recovered materials to the maximum extent practicable, in accordance with paragraph 23.403 of the Federal Acquisition Regulation (FAR), provided all performance requirements of this specification are met.

3.4. Hose Conditioning. Hose shall be conditioned in a controlled environment of 70 ± 2 °F (21.1 ± 1.1 °C) and $65 \pm 5\%$ relative humidity for at least 12 hours before testing or inspection.

3.5. Dimensions and Weights. After the hose has been cured in accordance with 3.4, the hose shall conform to the sizes and weights as indicated in Table 1. The hose length shall be 100 foot (+0/-2 ft) (30.48 m +0/- 0.61 m) as measured from back to back of the couplings with the hose at a hydrostatic pressure of 10 psig (68.9 kPag). If the acquisition document specifies 50 foot, it shall be 50 foot (+0/- 2 ft) (15.24 m +0/- 0.61 m) long. The hose weight shall be determined after the mildew treatment has been applied to the hose.

Table1. Hose Size and Weight

Thread Series Designation	External Diameter at 10 psig (69 kPag)	Maximum Weight Dry Hose with Couplings	
	Minimum to Maximum inch (mm)	50 ft (15.24 m) lb (kg)	100 ft (30.48 m) lb (kg)
1 inch 11-1/2 NPSH	1.19 to 1.31 (30.23 to 33.27)	10.76 (4.88)	20.38 (9.24)
1-1/2 inch 9 NH	1.69 to 1.81 (42.93 to 45.97)	14.76 (6.70)	26.88 (12.19)

3.5.1. Internal Diameter Measurement. When tested in accordance with 4.7.4, the internal diameter shall be not less than 1.0 inch (25.4 mm) for the 1 inch 11-1/2 NPSH and not less than 1.5 inch (38.1 mm) for the 1-1/2 inch 9 NH fire hose.

3.5.2. Recoupled Hose. Hoses that have had sections removed for testing (see 4.4.1.1) may be recoupled and designated as short lengths. Short lengths will not meet the length and weight requirements in 3.5. These recoupled hoses shall, however, conform to the thread series designation and external diameter dimension requirements in Table 1.

3.5.3. Dimensional Tolerance. Unless otherwise noted, the following tolerances apply: one place (x.x) +/- 0.1 inch (2.5 mm); two places (x.xx) +/- 0.01 inch (0.25 mm) and three places (x.xxx) +/- 0.010 inch (0.254 mm).

3.6. Workmanship. Workmanship shall be equal to the best commercial practices consistent with the highest engineering standards in the industry and shall be free from any defect which may impair serviceability or detract from the product's appearance.

3.6.1. Symmetry. All metal part sections shall be symmetrical and concentric to 0.030 inch (0.762 mm).

3.6.2. Extruded Components. Extruded sections shall be free from laps, sharp die marks, cracks and other defects.

3.6.3. Cast Components. Cast parts shall be fine-grained, free from blowholes, pinholes, pits, porosity, hard spots, shrinkage, cracks or other defects.

3.6.4. Laminated Components. There shall be no blisters, pinholes, pits, sink marks, crazing, wrinkles, voids, foreign material or cracks.

3.7. Threads, Waterways, Gaskets, Gasket Recesses and Rocker Lugs. All threads, waterways, gaskets, gasket recesses and rocker lugs shall be in accordance with USDA Forest Service Standard 5100-190.

3.8. Marking. Coupling markings shall be in accordance with USDA Forest Service Standard 5100-190. Markings on each length of hose shall be with permanent indelible paint or ink. The type paint or ink shall not damage the hose. All letters and numerals shall be at least 0.75 inch (19.05 mm) high. Markings shall start at 2 foot (0.61 m) from the back of the female coupling. Hose markings shall include "FSS"; "450 WP"; the manufacturer's name, trademark or other identification; and the year of manufacture.

3.9. Surface Finish. The finish for all coupling surfaces, to include threaded surfaces, shall be in accordance with USDA Forest Service Standard 5100-190.

3.10. Performance.

3.10.1. Hose Coupling Slippage Measurement. When marked in accordance with 4.7.2.2, and evaluated in accordance with 4.7.2.6, the marks placed on the hose at the back of the couplings shall be observed for coupling slippage. There shall be no coupling slippage observed.

3.10.2. Hose Elongation. When tested in accordance with 4.7.2.5, hose elongation and external diameter expansion shall not be more than 10 percent over the baseline dimensions determined in 4.7.2.3. There shall be no circumferential contraction.

3.10.3. Twist, Warp, and Rise at Working Pressure of Hose. When tested in accordance with 4.7.2.4, at a hydrostatic pressure of 450 psig (3102 kPag), the twist of the hose shall not be more than 12 turns in any 50 ft (15.24 m) length. Any twist shall be in the direction that will tighten the couplings. The hose shall not warp more than 25 inches (0.64 m) from a reference line and the hose shall not rise more than 8 inches (0.20 m) from its original position on a flat smooth surface. In addition, there shall be no leaking or sweating of the hose or coupling.

3.10.4. Kink Pressure. When tested in accordance with 4.7.2.7, the hose shall not burst when a hydrostatic pressure of 400 psig (2758 kPag) is applied with the hose in a kinked position.

3.10.5. Burst Pressure. When tested in accordance with 4.7.3, the hose shall not burst when hydrostatic pressure of 900 psig (6205 kPag) is applied.

3.10.6. Flexibility and Compressibility. When tested in accordance with 4.7.5, the applied load shall not exceed 40 pounds (18.1 kg) for 1 inch 11-1/2 NPSH hose and 55 pounds (24.9 kg) for 1-1/2 inch 9 NH hose when the hose is compressed to 0.5 inch (12.7 mm).

3.10.7. Lining to Jacket Adhesion. When tested in accordance with 4.7.6, the force required to separate the lining and jacket shall not be less than 12 pounds (5.4 kg).

3.10.8. Lining. When tested in accordance with 4.7.7, hose lining shall meet the following requirements for tensile strength and elongation, before and after oven aging and ozone resistance. In addition, if the lining consists of a natural rubber compound, then the hose lining shall meet the following requirement for free sulfur.

3.10.8.1. Tensile Strength and Elongation of Lining. When tested in accordance with 4.7.7.1, the lining shall be capable of withstanding a cross-sectional tensile load of 1800 psig (12.41 MPag) and an ultimate elongation of 400 percent.

3.10.8.2. Tensile Strength and Elongation of Lining After Oven Aging. When tested in accordance with 4.7.7.2, after oven aging, the lining average tensile strength shall not be less than 65 percent of the original strength as determined in 4.7.7.1. The maximum set in elongation shall not exceed 25 percent after an elongation of 300 percent for a period of 10 minutes, and 10 minutes at rest.

3.10.8.3. Lining Resistance to Ozone. When tested in accordance with 4.7.7.3, specimens shall exhibit no signs of cracking or crazing when viewed under 7X magnification.

3.10.8.4. Rubber Lining Sulfur Content. When tested in accordance with 4.7.7.4, a lining consisting of a natural rubber compound shall not contain more than 1 percent free sulfur by weight.

3.11. Mildew Treatment for Jacket. When tested in accordance with 4.7.8, the jacket shall retain at least 80 percent of its original breaking strength. The viability controls shall show an abundant growth of *Chaetomium globosum*.

3.12. Metric Products. Metric dimensions are provided for information only, inch-pound units shall be the required units of measure for this specification. Thread series designations are indicated as 1 inch 11-1/2 NPSH and 1-1/2 inch 9 NH. Since these are thread series designations, not an indication of a specific dimension, the metric equivalent is not given. Products manufactured to metric dimensions will be considered on an equal basis with those manufactured using inch-pounds units, provided they fall within the tolerances specified using conversion tables contained in the latest revision of ASTM E380, and all other requirements of this standard are met.

4. SAMPLING, INSPECTION AND TEST PROCEDURES.

4.1. Qualification Testing.

4.1.1. Manufacturer Submission for Qualification Tests. The prospective contractor shall provide, without cost to the Government:

- a. Five complete sets or one reproducible set of detailed dimensional drawings and specifications.
- b. One coupled, 100 foot length of fire hose.
- c. One uncoupled, 100 foot length of fire hose.
- d. One set of male and female couplings.
- e. An estimated test fee. Contact the Water Handling Project Leader at the USDA Forest Service, San Dimas Technology and Development Center (SDTDC), 444 East Bonita Avenue, San Dimas, CA 91773.
- f. A signed collection agreement. Contact the SDTDC Water Handling Project Leader for a copy of the form.
- g. All of the above items shall be delivered to SDTDC to the attention of the Water Handling Project Leader. The Government shall not be responsible for the submitted test samples.

4.1.2. Qualification Test. Qualification inspection and tests shall be conducted by the Government and at the expense of the contractor at a fee to be determined by the Government. If requested by the contractor, the Government will inform the contractor of date and place of inspection and tests. The contractor may send a representative (who has been designated in writing) to be present and observe the inspection and tests, but they will not be permitted to be a participant. Upon completion of tests, the sample will be retained by the Government. Qualification testing shall stop upon a single failure and the test sample rejected. The contractor will be informed as to the nature of the failure. The Government shall not be obligated to continue testing a defective item once it is known to be defective, or when it is considered to be in the best interest of the Government.

4.1.3. Notice of Qualification. Notice of Qualification shall be issued to the contractor upon the successful completion of qualification tests. Copies of qualification notices shall be provided to the General Services Administration. A copy shall be retained in the SDTDC file.

4.1.4. Notice of Failure to Qualify. The contractor shall be notified by letter of a failure to qualify, if the submitted fire hose does not meet the requirements of this specification.

4.1.5. Re-qualification. After qualification, if any changes are made in the product or where it is manufactured, the contractor shall notify SDTDC immediately in writing. The need for re-qualification shall be determined by the Government when there are changes to the product or this specification.

4.2. General Inspection and Tests. Unless otherwise specified in the contract or purchase order, the contractor is responsible for performance of all inspection requirements prior to submission for Government acceptance inspection and tests. The contractor may utilize their own facilities or any commercial laboratory acceptable to the Government. Inspection records of the examination and tests shall be kept complete and available to the Government.

4.2.1. Inspection and Test Sites. The Government shall conduct lot acceptance inspection and tests to determine compliance with the specification. If lot acceptance and tests are conducted at locations other than the manufacturing facilities, the contracting officer will specify location and arrangements. In the case of on-site inspections at the contractor's facility, the contractor shall furnish the inspector all reasonable facilities for their work. During any inspection, the inspector may take from the lot one or more samples and submit them to an independent test laboratory approved by the Government or to a Government test facility for inspection and tests.

4.2.2. Testing With Referenced Documents. The contractor is responsible for insuring that components and materials used were manufactured, examined and tested in accordance with referenced specifications and standards. The Government reserves the right to perform any of the inspections or tests set forth in this section where such action is deemed necessary to assure supplies and services conform to prescribed requirements. All inspection or testing of a sample shall stop upon a single failure and the sample rejected. The contractor will be informed as to the nature of the failure. The Government shall not be obligated to continue testing a defective item once it is known to be defective or when it is considered to be in the best interest of the Government.

4.3. Responsibility for Compliance. All items shall meet all requirements of sections 3 and 4. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in this specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.4. Sampling for Inspection. When inspection is performed, sampling shall be in accordance with ANSI/ASQC Z 1.4.

4.4.1. Lot. All fire hose of one size, presented together in one delivery shall be considered a lot for the purpose of inspection. A sample unit shall be one length of coupled fire hose.

4.4.1.1. Recoupled Hoses. All hose lengths that have been cut or have had specimens taken from them will be tagged as short lengths and will be accepted if the lot is accepted. The contractor shall recouple the cut lengths without additional cost to the Government. The maximum amount of recoupled hose lengths shall not exceed the amount of samples cut for testing, as indicated in 4.4.3.1 in the sampling.

4.4.2. Sampling for Visual and Dimensional Examination. Sampling for visual and dimensional examination shall be S-3, with an Acceptable Quality Level (AQL) of 2.5 percent defective.

4.4.3. Sampling for Lot Acceptance Tests. Sampling for lot acceptance testing shall be S-3 with an AQL of 2.5 percent defective.

4.4.3.1. Special Sampling for Hydrostatic Testing for Lot Acceptance. A special sampling for elongation, twist, warp, rise, kink, working pressure and burst testing for lot acceptance shall be S-3 with an AQL of 1.5 percent defective.

4.5. Inspection and Tests. As required by 3.4, hose shall be conditioned before testing or inspection.

4.5.1. Visual and Dimensional Examination. When selected in accordance with 4.4.2, each sample fire hose shall be visually and dimensionally examined to determine conformance with this specification. Visual or dimensional defects shall be classified as major or minor. A defect not listed in Table 2 shall be classified as a minor defect. If the number of defects in any sample exceeds the indicated AQL, the lot shall be rejected.

Table 2. Major and Minor Defects

Defect	Classification	
	Major	Minor
1. Construction of hose not as required.	X	
2. Jacket material not as required.	X	
3. Lining not as required.	X	
4. Hose dimensions and weight not as required.	X	
5. Coupling and expansion ring loose or damaged.	X	
6. Interior of lining not smooth.		X
7. Uneven surface of lining.		X
8. Irregularity in jacket.		X
9. Excessive ridge on lining lap joint.		X
10. Coupling overexpanded.		X
11. Markings not as required.		X

4.5.2. Lot Acceptance Tests. Each of the samples selected in accordance with 4.4.3, shall be tested in accordance with 4.7, to determine conformance with requirements of this specification.

4.5.3. Quality Conformance Inspection. Unless otherwise specified, sampling for inspection shall be performed in accordance with ANSI/ASQC Z 1.4. The inspection level and AQL shall be as specified in 4.4.3.

4.6. Certificate of Conformance. A Certificate of Conformance shall meet the requirements of USDA Forest Service Standard 5100-190. Where certificates of conformance are required, the Government reserves the right to verify test any such items to determine the validity of certification. These certificates shall be based on the testing of component materials and may be performed by the component material supplier. The contractor shall provide certificates of conformance for 3.2.3, 3.10.8.1, 3.10.8.2, 3.10.8.3, 3.10.8.4 and 3.11 (see 4.6.2, 4.6.3, 4.6.4, 4.6.5 and 4.6.6).

- 4.6.1. Certificates of Conformance in Lieu of Testing. Unless otherwise specified, certificates of conformance may be acceptable in lieu of testing end items.
- 4.6.2. Couplings. As required by 3.2.3, fire hose shall be equipped with pre-qualified USDA Forest Service Specification 5100-108 lightweight couplings.
- 4.6.3. Tensile Strength and Elongation of Lining Before and After Oven Aging. As required by 3.10.8.1 and 3.10.10.2, the lining shall meet the indicated physical property requirements when tested to the defined test methods.
- 4.6.4. Lining Resistance to Ozone. As required by 3.10.8.3, the lining shall meet the indicated physical property requirements when tested to the defined test methods.
- 4.6.5. Rubber Lining Sulfur Content. As required by 3.10.8.4, the lining shall meet the indicated physical property requirement when tested to the defined test method.
- 4.6.6. Mildew Treatment. As required by 3.11, the jacket shall meet the indicated physical property requirement when tested to the defined test method.
- 4.7. Performance Testing. Samples shall be subjected to the following tests to determine if the samples meet the requirements of the specification.
- 4.7.1. Fluid Medium. All testing requiring the use of a fluid medium shall be performed using municipally supplied potable water; this shall include, but is not limited to, all hydrostatic testing and burst pressure testing. If the contractor does not have access to a municipal water supply, the testing shall be performed using any clear fresh water normally available for firefighting. Testing performed by the Government will be conducted using municipally supplied potable water.
- 4.7.2. Hydrostatic Tests.
- 4.7.2.1. Test Apparatus. Hydrostatic testing shall be conducted on a clean stainless steel table, at least 112 foot (34.1 m) long. A reference line shall be indicated on the test table as a straight line between the axial centers of the hose couplings, with the female coupling attached to a water pressure source. Test equipment shall include a pump capable of providing a hydrostatic pressure of 450 psig (3102 kPag). The rate for applying hydrostatic pressure for the following tests shall not be less than 300 psig (2068 kPag) per minute and not more than 600 psig (4137 kPag) per minute, i.e., at a uniform rate over a 45 to 90 second time interval.
- 4.7.2.2. Preparation of Test Specimens. As required by 3.4, the hose test sample shall be cured before testing or inspection. The test hose shall be marked at the back of each coupling in order to determine any coupling hose slippage during hydrostatic testing. Connect the female coupling to a water pressure source and position the hose over the reference line on the test table. Attach a petcock to the male coupling. Charge the line by applying water pressure with the male coupling positioned at a height of 10 to 12 inches (0.25 to 0.31 m) as pressure is applied. Close the petcock when all air has been exhausted out of the hose. Hold the water pressure at 10 psig (69 kPag).

4.7.2.3. Baseline Measurement at 10 psig (69 kPag). As required by 3.10.2, length and external diameter measurements at 10 psig (69 kPag) shall be obtained. These values shall be used to determine the change in elongation, expansion and circumferential contraction. Apply a hydrostatic pressure of 10 psig (69 kPa) and hold. The total length of the hose shall be measured from the inside of one coupling to the inside of the other coupling. The length shall meet the requirements of 3.5. The external diameter of the hose shall be measured at the center of the hose and at 3 feet (0.91 m) from each of the couplings and shall meet the requirements of 3.5. See Table 1.

4.7.2.4. Twist, Warp, Rise and Working Pressure Test. As required by 3.10.3, the hose shall be tested for twist, warp, rise and working pressure. Increase the hydrostatic pressure to 450 psig (3102 kPag). Count the number of twists in any 50 foot (15.2 m) length. Evaluate the direction of twist in relation to the coupling. Measure warp as the greatest distance of the centerline of the hose from the reference line. Measure the rise as the greatest vertical distance of the hose from the test table. The coupled hose shall be examined for leaking or sweating.

4.7.2.5. Elongation Measurement at 450 psig (3102 kPag). As required by 3.10.2, with the hydrostatic pressure at 450 psig (3102 kPag) the hose shall be tested for elongation, external diameter expansion and circumferential contraction. The total length of the hose shall be measured, followed by measuring the external diameter at the same three locations identified in 4.7.2.3. The percentage elongation, external diameter expansion and circumferential contraction shall be calculated.

4.7.2.6. Hose Coupling Slippage Determination. As required by 3.10.1, the marks placed on the hose at the back of the couplings shall be observed for coupling slippage.

4.7.2.7. Kink Pressure Test. As required by 3.10.4, the hose shall be tested for kink pressure. The hydrostatic pressure shall be reduced to 10 psig (69 kPag) and held. The hose shall be kinked, or bent over on itself, at its center, and securely tied at a point approximately 1.5 foot (0.46 m) from the kink. The hydrostatic pressure shall be increased to 400 psig (2758 kPag), i.e. at a uniform rate over a 40 to 80 second time interval, and held for 5 seconds.

4.7.3. Burst Pressure Test. As required by 3.10.5, the hose shall be tested for burst pressure. Obtain a test sample for the burst test from the uncoupled hose submitted by the manufacturer. Begin the sample 3 to 4 inches (76 to 102 mm) into the coil diameter from the outside edge. The specimen shall be 40 inches \pm 0.13 inch (1.02 m \pm 3.3 mm) in length. The hose shall be coupled and a hydrostatic pressure of 900 psig (6205 kPag) applied. The hose shall be positioned straight or curved in a radius of not less than 27 inches (0.69 m).

4.7.4. Internal Diameter Test. As required by 3.5.1, the hose internal diameter shall be measured in accordance with Test Method 2341 of Federal Standard 601, using a mandrel.

4.7.5. Flexibility and Compressibility Tests. As required by 3.10.6, the hose shall be tested for flexibility and compressibility.

4.7.5.1. Test Apparatus. The flexibility and compression test apparatus shall consist of a compression tester with plates of nominal 6 inches (152 mm) in length and 4 inches (102 mm) in width. The compression tester shall be an accepted laboratory instrument having a rate of travel of approximately 0.25 inch (6.35 mm) per minute. See Figure 1.

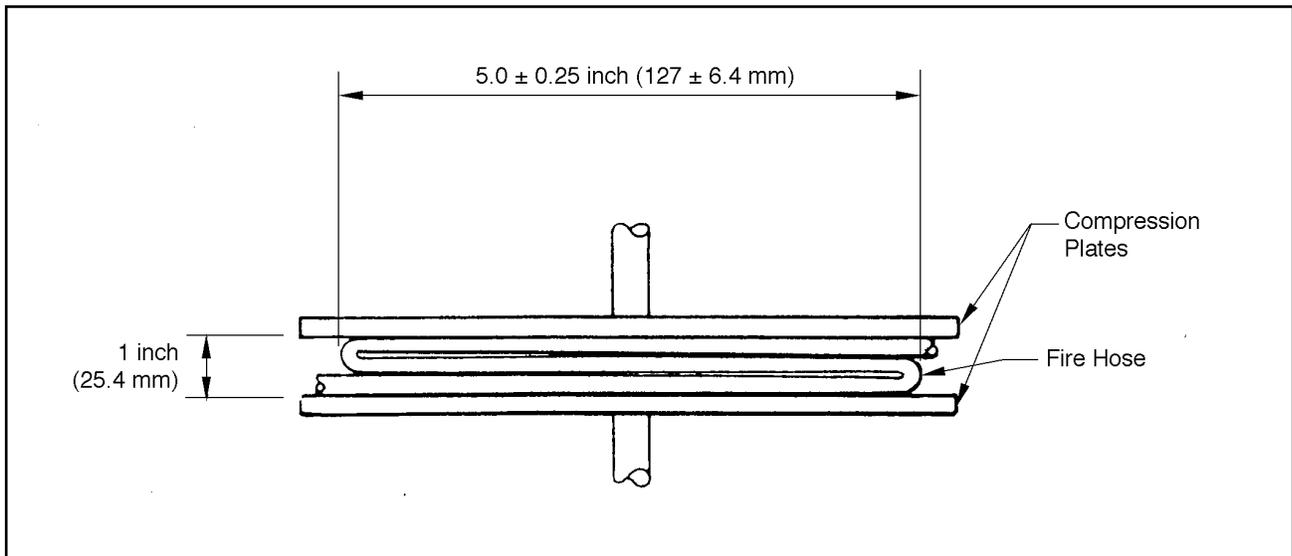


Figure 1. Compression and Flexibility Test Apparatus.

4.7.5.2. Preparation of Test Specimens. Two 20 inch (0.51 m) lengths of hose shall be obtained from the uncoupled hose coil, using the hose following the sample taken for the burst pressure test in 4.7.3. Each 20 inch (0.51 m) sample will be folded in an “S” shape and flattened manually so that the overall dimension of the “S” loop is as shown in Figure 1.

4.7.5.3. Flexibility and Compressibility Test Method. The hose test sample shall be placed between compression plates of the tester, parallel to the 6 inch (152 mm) axis, and shall be compressed until there is a distance of 0.50 inch (12.70 mm) between the plates. See Figure 1. The amount of load required to achieve this compression shall be recorded.

4.7.6. Lining and Jacket Adhesion. As required by 3.10.7, the hose shall be tested for adhesion of the jacket to the lining. A tension force at 1 inch (25.4 mm) per minute for a period of one minute shall be applied to the hose, in accordance with Test Method 8011 of Federal Standard 601. The tension force at which the jacket separates from the lining shall be recorded.

4.7.7. Lining Tests.

4.7.7.1. Tensile Strength and Elongation of Lining Tests. As required by 3.10.8.1, the lining shall be subject to a tensile strength and elongation tests. Three sample linings shall be taken from the hose. The dimensions shall be suitable for the test apparatus. The jacket shall be removed, and the lining buffed lightly to remove the jacket material. Reinforced linings shall be buffed until all the fabric material is removed. The lining shall be prepared in accordance with Test Method 1111 and measured in accordance with Test Method 2011 of Federal Standard 601. The lining shall be cut into the shape of a dumbbell along the longitudinal axis of the hose. Specimens shall be capable of withstanding 1800 psig (12.41 MPag) cross-sectional tensile load when tested in accordance with Test Method 4111 of Federal Standard 601. The specimen shall be capable of withstanding an ultimate elongation of 400 percent when tested in accordance with Test Method 4121 of Federal Standard 601.

4.7.7.2. Tensile Strength and Elongation of Lining After Oven Aging Tests. As required by 3.10.8.2, the lining shall be subjected to oven aging and then the maximum set in elongation and the average value in tensile strength shall be determined. Three sample linings shall be prepared in the same method defined in 4.7.9.1. Oven aging shall be conducted in accordance with ASTM D 573. The specimen lining shall be subjected to a temperature of 158 ± 2 °F (70 ± 1.1 °C) for 96 hours, cooled to room temperature on a flat surface and allowed to rest for 16 to 48 hours. The average value of tensile strength shall be determined in accordance with Test Method 4111 of Federal Standard 601. The maximum set in elongation shall be determined in accordance with ASTM D 412. The lining average tensile strength shall not be less than 65 percent of the original strength. The maximum set in elongation shall not exceed 25 percent after an elongation of 300 percent for a period of 10 minutes, and 10 minutes at rest.

4.7.7.3. Lining Resistance to Ozone Test. As required by 3.10.8.3, the lining shall be tested for ozone resistance. A sample lining shall be taken from the hose with the backing material intact. The jacket shall be removed, then the lining buffed lightly to remove the jacket material. Reinforced linings shall be buffed until all the fabric material is removed. The lining shall be prepared in accordance with Test Method 1111 and measured in accordance with Test Method 2011 of Federal Standard 601. The lining shall be shaped to the dimensions defined in ASTM D 518, Procedure C, Exposure of Tapered Specimens. The lining thickness shall be as produced by the manufacturer. The specimen lining will be stretched and mounted with an overall elongation of 15 percent, on suitable wooden frames with the lining backing toward the wood. The specimen lining shall be tested in accordance with ASTM D 1149. The specimen shall be subjected an ozone concentration of 150 ± 5 parts per hundred million, for 120 hours at 122 ± 1.8 °F (50 ± 1.0 °C). When examined under 7X magnification, there shall be no signs of cracking or crazing.

4.7.7.4. Rubber Lining Sulfur Content Test. As required by 3.10.8.4, a lining consisting of a natural rubber compound shall be tested for sulfur content, in accordance with ASTM D 297.

4.7.8. Mildew Treatment Test. As required by 3.11, the jacket material shall be tested for breaking strength before and after the mildew treatment.

4.7.8.1. Preparation of Test Specimens. Two sets of test specimens shall be obtained from sample lengths of hose.

4.7.8.1.1. Breaking Strength Control Test Specimens. The first set of 10 test specimens shall be prepared as controls for breaking strength on the jacket material before mildew treatment. This set of specimens shall have the elastomer lining peeled from the specimens before cutting. Peeling must be done in such a manner that the fabric of the specimens shall not be affected. The test specimens shall be cut 1.50 inches (38.10 mm) in width and 6 inches (152.4 mm) in length; and raveled to 1 inch (25.4 mm) in width.

4.7.8.1.2. Leaching, Sterilization, Inoculation, and Incubation Test Specimens. The second set of 10 specimens shall be prepared for leaching, sterilization, inoculation and incubation. The elastomer lining shall be left intact on these specimens until after the mildew treatment. Following incubation, washing, and drying, these specimens shall be prepared for breaking strength tests by carefully peeling off the elastomer lining. Peeling must be done in such a manner that at least 6 inches (152.4 mm) of fabric of the specimens shall not be affected. After peeling, the specimen shall be cut 1.50 inches (38.10 mm) in width and 6 inches (152.4 mm) in length; and raveled to 1 inch (25.4 mm) in width.

4.7.8.2. Leaching Treatment. Ten specimens shall be leached in a container(s) of suitable size at a temperature of 75 ± 5 °F (23.88 ± 2.78 °C) for 24 hours. Specimens having different treatments, either different amounts of the same fungistatic compound or different kinds of compounds shall not be leached together in the same container. During the course of the leaching, the material must be submerged at all times. The ratio of fabric to water (pH approximately 7.0) in the container shall not be less than 1 to 300 by weight and the flow of water shall be so regulated that there are 15 complete changes of water per hour. After leaching, the samples shall be air dried.

4.7.8.3. Sterilization by Steam Treatment. After leaching and air drying, specimens shall be placed in 16 ounce (0.47 L) screw-cap bottles, such as are used for culture chambers. The specimens shall be saturated by filling the bottles with water. The water shall be poured off and drained as completely as possible. The bottles shall be capped loosely and sterilized in an autoclave at 15 psig (103 kPag) and 250 °F (121 °C) exhaust temperature for 1 hour. Since a microbiological test is to follow sterilization, the caps shall be tightened when the bottles are removed from the autoclave.

4.7.8.4. Inoculation. Sterilized specimens shall be inoculated with the organism *Chaetomium globosum*, culture USDA 1042.4, ATCC-6205.

4.7.8.4.1. Culture Medium. The culture medium shall have composition indicated in Table 3. Culture medium pH shall be adjusted to 6.8 with hydrochloric acid or sodium hydroxide. The culture medium shall be melted in an autoclave and poured into 16 ounce (0.47 L) bottles, approximately 40 milliliters per bottle. Petri dishes may be used. The bottles shall be sterilized in an autoclave at 15 psig (103 kPag) and 250 °F (121 °C) exhaust temperature for 20 minutes, after which they are placed on their sides to allow culture medium to harden.

Table 3. Culture Medium Composition

Medium Composition	Weight
Sodium nitrate (2.8 g of ammonium nitrate may substituted)	3.0 g
Dipotassium hydrogen phosphate	1.0 g
Magnesium sulfate	0.25 g
Potassium chloride	0.25 g
Agar	10.0 g
Distilled water	1000.0 mL

4.7.8.4.2. Inoculum. Scrapings from a 100 mm petri dish (or equivalent surface) of a ripe fruiting culture of *Chaetomium globosum*, which has been incubated 2 to 4 weeks, shall be added to a flask of 100 milliliters of sterile water. The transfer shall be made with a sterile loop made from nichrome, platinum or tungsten wire. The black spore clusters shall be squeezed against the sides of the flask with a sterile pipette until the tiny spores can be seen to be in suspension.

4.7.8.4.3. Inoculation and Incubation. Leached specimens and viability controls shall be sterilized and allowed to return to ambient temperature. One specimen shall be placed in contact with the agar medium in each bottle under aseptic conditions. Two milliliters of the inoculum shall be distributed evenly along each specimen by means of a sterile pipette. The inoculated specimens shall be incubated at a temperature of 82 to 86 °F (27.7 to 29.9 °C). The specimens shall be removed from the containers at the end of 240 hours, gently washed to remove any growth of mildew and dried.

4.7.8.4.4. Report of Results. If the viability controls do not show an abundant growth of *Chaetomium globosum*, the test shall be considered inconclusive and shall be repeated.

4.7.8.5. Breaking Strength Specimens. The specimens shall be conditioned not less than 48 hours in an atmosphere of 73.5 ± 2 °F (23.0 ± 1.1 °C) and 50 ± 4 percent relative humidity. The breaking strength of both sets of specimens shall be determined as specified in Test Method 5100 of Federal Standard 191.

4.7.8.5.1. Report of Results. A report of the results shall indicate the average breaking strength of the specimens before and after exposure and the percentage strength retained.

5. PACKAGING, PACKING AND MARKING.

5.1. Packaging, Packing and Marking. Each section of hose shall be rolled into a compact roll with the male coupling in the center. Additional requirements regarding packaging, packing and marking shall be as specified in the contract or order.

6. NOTES.

6.1. Intended Use. The fire hose described in this specification is cotton-synthetic, jacketed hose, with an elastomer lining designed for use in wildland firefighting. The coupling thread series designations are 1 inch 11-1/2 NPSH and 1-1/2 inch 9 NH. Working pressure is up to 450 psig (3102 kPag).

6.2. Acquisition Requirements. Acquisition documents should specify the following:

- a. Title, number and date of the specification.
- b. Thread series designation of fire hose required.
- c. If certificates of conformance are acceptable in lieu of lot by lot testing (see 4.5.2 and 4.6)
- d. Packaging, packing and marking (see 5.1).

6.3. Qualification. The contracting officer should verify that the bidder possesses a currently valid notice of qualification with associated Qualified Products List (QPL) number obtained in accordance with 4.1. This QPL shall have already been obtained with a date of issue prior to the closing date of invitation for bids.

6.4. Notice. When Government drawings, documents, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever.

6.5. Preparing Activity. USDA Forest Service, San Dimas Technology and Development Center, 444 East Bonita Avenue, San Dimas, CA 91773-3198.

United States Department of Agriculture, Forest Service
Standardization Document Improvement Proposal

Instructions: This form is provided to solicit beneficial comments which may improve this document and enhance its use. Contractors, government activities, manufacturers, vendors, or other prospective users of this document are invited to submit comments to the USDA Forest Service, San Dimas Technology and Development Center, 444 East Bonita Avenue, San Dimas, California 91773-3198. Attach any pertinent data which may be of use in improving this document. If there is additional documentation, attach it to the form and place both in an envelope addressed to the preparing activity. A response will be provided when a name and address are included.

Note: This form shall not be used to submit request for waivers, deviation, or for clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

Standard Number and Title: **Specification 5100-186c, Fire Hose, Cotton-synthetic, Lined, Woven Jacket, 1 inch and 1-1/2 inch.**

Name of Organization and Address:

_____ Vendor _____ User _____ Manufacturer

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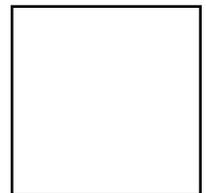
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