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SUPERSEDING
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FEDERAL SPECIFICATION

HOSE, FIRE, WOVEN-JACKETED
RUBBER-OR LATEX OR RUBBER-COATED
FABRIC-LINED, WITH COUPLINGS

This specification was approved by the Assistant Administrator, Office of Federal Supply and Services, General Services Administration, for the use of all Federal agencies.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers woven-jacketed, rubber-or latex or rubber-coated, fabric-lined fire hose with couplings.

1.2 Classification.

1.2.1 Types, classes, and sizes. Fire hose shall be of the following types, classes, and sizes, as specified (see 6.2):

Type I - Cotton jacket
Type II - Cotton-polyester jacket
Type III - Polyester jacket

Class A - Double jacketed
Class B - Single jacket

Size 1-1/2 - 1-1/2 inch minimum inside diameter (id)
Size 2 - 2-inch minimum id (type III, class B only)
Size 2-1/2 - 2-9/16 inch minimum id
Size 3 - 3-inch minimum id (types I, II, and III, class A)
Size 3-1/2 - 3-1/2 inch minimum id (types I, II, and III, class A)
Size 4 - 4-inch minimum id (type I and II, classes A and B)
Size 4-1/2 - 4-1/2 inch minimum id (type I, class A, and type III, classes A and B)
Size 6 - 6-inch minimum id (type III, class A only)

2. APPLICABLE DOCUMENTS

2.1 Government publications. The following documents, of the issues in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

Federal Specifications:

WW-C-621 - Coupling Assembly, Hose, (Fire, Woven-Jacketed Rubber or Cambric-lined and Unlined Linen)

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Federal Standards:

FED-STD-H28 - Screw Threads for Federal Services
FED-STD-123 - Marking for Shipment (Civil Agencies)
FED-STD-162 - Hose, Rubber, Visual Inspection Guide for
FED Test Method STD-191 - Textile Test Methods
FED Test Method STD-601 - Rubber: Sampling and Testing

(Activities outside the Federal Government may obtain copies of Federal specifications, standards, and commercial item descriptions as outlined under General Information in the Index of Federal Specifications, Standards, and Commercial Item Descriptions. The Index, which includes cumulative bimonthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

(Single copies of this specification and other Federal specifications and commercial item descriptions required by activities outside the Federal Government for bidding purposes are available without charge from General Services Administration Business Service Centers in Boston, MA; New York, NY; Philadelphia, PA; Washington, DC; Atlanta, GA; Chicago, IL; Kansas City, MO; Fort Worth, TX; Houston, TX; Denver, CO; San Francisco, CA; Los Angeles, CA; and Seattle, WA.

(Federal Government activities may obtain copies of Federal standardization documents, and the Index of Federal Specifications, Standards, and Commercial Item Descriptions from established distribution points in their agencies.)

Military Specifications:

MIL-P-775 - Packaging of Hose, Hose Assemblies; Rubber, Plastic, Fabric or Metal (Including Tubing) and Fittings, Nozzles and Strainers
MIL-E-52798 - Enamel, Alkyd, Camouflage

Military Standards:

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-129 - Marking for Shipment and Storage

(Copies of military specifications and standards required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

Federal regulations:

21CFR 177.2600 - Federal Food, Drug, and Cosmetics Act; Food Additives

(The Code of Federal Regulations and Federal Register are for sale on a subscription basis by the Superintendent of Documents, US Government Printing Office, Washington, DC 20402. When indicated, reprints of certain regulations may be obtained from the Federal agency responsible for issuance thereof.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless a specific issue is identified, the issue in effect on date of invitation for bids or request for proposal shall apply.

American Society for Testing and Materials (ASTR):

- D297 - Rubber Products-Chemical Analysis
- D380 - Rubber Hose, Methods of Testing
- D412 - Rubber Properties in Tension
- D573 - Rubber-Deterioration in an Air Oven
- D792 - Specific Gravity and Density of Plastics by Displacement
- D1053 - Measuring Rubber Property-Stiffening at Low Temperature Using a Torsional Wire Apparatus
- D2240 - Indentation Hardness of Rubber and Plastics by Means of a Durometer

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

Underwriters' Laboratories, Inc. (UL)

UL-19 - Standard for Woven-Jacketed Rubber-Lined Fire Hose

(Application for copies should be addressed to the Underwriters' Laboratories, Inc., 333 Pfingsten Road, Northbrook, IL 60062.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 First article. When specified (see 6.2), the contractor shall furnish one fire hose for first article inspection and approval (see 4.2.1 and 6.5).

3.2 Labeling of hose. When specified (see 6.2), the hose shall be approved and labeled by a nationally recognized testing agency or laboratory (see 6.4), adequately equipped, and competent to perform testing of fire hose. This requirement is mandatory for Navy procurements.

3.3 Materials. Materials used shall be free from defects which would adversely affect the performance or maintainability of individual components or of the overall assembly. Materials not specified herein shall be of the same quality used for the intended purpose in commercial practice. Unless otherwise specified herein, all equipment, material, and articles incorporated in the work covered by this specification are to be new and fabricated using materials produced from recovered materials to the maximum extent possible without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of used or rebuilt products are allowed under this specification unless otherwise specified. The hose shall have been manufactured not more than one year prior to date of delivery.

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3.3.1 Rubber. The rubber or latex used in the lining shall be compounded from natural rubber, synthetic rubber, or a mixture of the two.

3.3.2 Jacket yarns. The yarns used in the jacket shall be cotton or polyester yarns, or a mixture thereof as required.

3.4 Construction. The hose shall consist of a lining with or without rubber backing completely covered with a woven jacket or jackets. The contour at the fold line of the finished hose shall be a smooth continuous curve and shall show no evidence of crease.

3.4.1 Hose lining. The lining for types I and II hose shall consist of a solid rubber compound or a fine count fabric coated with latex or rubber. Type III hose lining shall consist of a solid rubber compound.

3.4.1.1 Rubber lining. The rubber lining shall be uniform in thickness and shall be made from a single ply extruded tube or from calendered sheets of not less than three plies, lap-jointed and vulcanized in the round into one solid body. Unless otherwise specified (see 6.2) the thickness of rubber lining, exclusive of the rubber backing, shall be as shown in table I. The thickness shall be determined in accordance with 4.5.2. When specified (see 3.8.6.1, 4.5.8, and 6.2), the rubber liner shall be so compounded as to insure its conformance with the requirements of Federal Food, Drug, and Cosmetic Act, 21CFR 177.2600. The supplier shall submit a certificate attesting that the compound conforms to the above stated regulations.

TABLE I. Thickness of rubber lining (exclusive of backing)

Size of hose	Thickness minimum (inch)
1-1/2, 2, 2-1/2	0.040
3	0.050
3-1/2, 4	0.060
4-1/2, 6	0.070

3.4.1.2 Coated fabric lining (types I and II). The fine count fabric shall conform to the following:

Thickness of fabric -	0.007-inch minimum.
Thickness of fabric with rubber -	0.015-inch minimum.
Weight of fabric -	2.75 ounce/square yard minimum.

The inner waterway latex tube thickness shall be a minimum of 0.010 inch after removal from the fabric and measured in accordance with 4.5.2.

3.4.1.3 Surface. The waterway surface of the lining shall be free from corrugations, pitting, and other imperfections as determined by visual examination.

3.4.1.3.1 Surface corrugations. When corrugations cannot be satisfactorily determined by visual examination, hose may be subjected to the friction or head loss test of 4.5.7. If the hose meets the requirements of 3.12, the liner waterway smoothness shall be considered as meeting the requirements of this specification.

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3.4.2 Rubber backing. The rubber backing shall be uniform in thickness and the thickness shall be not more than 0.028 inch measured from the bottom of the impressions of the jacket.

3.4.3 Jacket. The jackets shall be seamless and shall have the fillers woven around the lining throughout its length. Class A jackets may be separate or interwoven. At no point shall the liner or the backing show through the outer jacket, nor shall the filler yarn protrude through the warp yarn. The jackets shall be evenly and firmly loomed and shall be free from knots, lumps, and irregularities in weave.

3.4.3.1 Type I. The jackets of type I hose shall be woven from cotton yarns in both the warp and filling direction.

3.4.3.2 Type II. The jackets for type II hose shall be woven from cotton yarns in the warp and polyester fiber yarns in the filling directions.

3.4.3.3 Type III. The jackets for type III hose shall be woven from polyester fiber yarns in both the warp and the filling directions.

3.4.3.3.1 Type III, class B. The jacket of type III, class B hose shall be made of polyester fiber and shall be seamless and circular woven. The finished jacket for 1-1/2 inch, 2-inch, and 2-1/2 inch hose shall have a minimum twist of one turn per inch in the S-direction. The warp yarn shall be spun from a suitable denier per filament and staple length of first quality polyester staple fiber, and shall have a minimum ply twist of two turns per inch. The jacket construction shall also meet the requirements of table II.

TABLE II. Type II, class B jacket construction

Hose size (inch)	Warp denier per 1/ fabric cross section (minimum)	Filler yarn denier (minimum)	Count of warp 2/ single yarn (maximum)	No. of warp plys (minimum)
1-1/2	1,080,000	16,000	8	7
1-1/2	1,080,000	16,000	10	9
1-1/2	1,080,000	16,000	12	11
2	1,872,000	16,000	8	13
2	1,872,000	16,000	10	16
2	1,872,000	16,000	12	19
2-1/2	2,340,000	16,000	8	13
2-1/2	2,340,000	16,000	10	16
2-1/2	2,340,000	16,000	12	19

1/ The warp denier per fabric cross section = (No. of warp ends) (denier per warp end).

2/ The count of 840 yards per pound is a numerical value which represents the smallest acceptable yarn.

3.4.3.4 Jacket impregnation. When specified (see 6.2), the outer jacket shall be impregnated with synthetic rubber.

3.4.3.5 Type I, class B. If color other than white is required for camouflage purposes, it shall be specified (see 6.2), and shall conform to camouflage colors earth brown, forest green, and desert sand of MIL-E-52798.

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3.4.4 Inside diameter. The id of the hose shall be not less than the nominal specified size except that the 2-1/2 inch size shall have an id of at least 2-9/16 inches.

3.4.5 Outside diameter. Unless otherwise specified (see 6.2), the outside diameter (od) of the hose shall be at the option of the manufacturer.

3.4.6 Length. Hose shall be furnished in the length specified (see 6.2), and shall conform to table III when the hose is measured in accordance with 4.4.2.1.

TABLE III. Length of hose

Size inch	Average length per lot (minimum feet)	Before sampling each length (minimum feet)	After sampling individual length (minimum feet)
1-1/2, 2, 2-1/2, 3, 3-1/2, 4	50	48	47
1-1/2, 2, 2-1/2	25	24	22
3-1/2, 4, 4-1/2	14	13-1/2	13
6	20	19-1/2	19

3.5 Couplings and gaskets. Unless otherwise specified (see 6.2), each length of hose shall be fitted with a set, one male and one female, of couplings conforming to WW-C-621. When specified (see 6.2), both couplings shall be either male or female. Unless otherwise specified (see 3.5.1, through 3.5.3, and 6.2.1), couplings shall be type A, style 1 or type C and have National Fire Hose (NH) threads, except size 2 inch which shall have two 11-1/2 National Hose Coupling (NPSH) threads. When specified (see 6.2), size 1-1/2 inch shall have 11-1/2 NPSH threads and size 4 inch shall have 4-6 NH (special) threads. Coupling threads shall conform to type NH or NPSH of FED-STD-H28 as specified (see 6.2). Each set of type A, style 1 couplings shall be provided with three rubber gaskets having the same temperature characteristics as the lining of the type of hose with which it is used. One gasket shall accurately fit the internally threaded swivel of the coupling, and one not less than 3/16 inch in thickness, shall be placed under the end of each expansion ring. When coupling is made up snugly as in service, the gasket shall not be compressed to the extent that it projects beyond the inside surface of the coupling and into the waterway. Each set of type C couplings shall be provided with one gasket which shall accurately fit the swivel of the coupling. Polyvinyl chloride gaskets may be used in lieu of rubber gaskets for types I and II.

3.5.1 Type I, class A, 4-1/2 inch size. Unless otherwise specified (see 6.2), 4-1/2 inch size, type I, class A hose lengths shall be fitted with a set (one male and one female) of couplings having NH threads, the male conforming to type A, style 1 and the female conforming to type A, style 3, of WW-C-621, except that the couplings shall be capable of withstanding the test pressures specified in table IV.

TABLE IV. Pressure to be applied to hose in burst test

Type	Class	Size	Burst Pressure psig
I and II	A	1-1/2, 2-1/2, 3, 3-1/2	600
I	A	4, 4-1/2	500 1/
II	A	4	600
III	A	1-1/2, 2-1/2, 3, 3-1/2	900
III	A	4-1/2, 6	600
I and II	B	1-1/2, 2-1/2	500
I and II	B	4	300
III	B	1-1/2, 2, 2-1/2	600
III	B	4-1/2	200

1/ Hose lying straight only.

3.5.2 Types I, II, and III, class-A, 3-inch size. Unless otherwise specified (see 6.2) types I, II, and III, class A, 3-inch size hose lengths shall be fitted with a set (one male and one female) of couplings having 2-1/2 to 7-1/2 NH threads (2-1/2 x 3- 3 part reducing coupling) and conforming to type A, style 1, of WW-C-621.

3.5.3 Type III, class A, 6-inch size. Unless otherwise specified (see 6.2) type III, class A, 6-inch size hose lengths shall be fitted with two long handled swivel female couplings conforming to type A, style 3 of WW-C-621, one end shall have 4-1/2 x 4 NH threads (4-1/2 x 6 reducing female coupling) and the other end shall have 6-4 NH threads.

3.6 Bursting strength. The hose shall not burst at pressures less than those shown in table IV for the respective type, class, and size of hose when tested as described in 4.5. The pressure shall be applied to the hose when it is lying straight and when it is held in a circular arc of 27-inch radius.

3.7 Hydrostatic properties. The hose, complete with couplings shall not leak, sweat, or show leakage at the couplings, and shall not show breakage of jacket yarns when it is subjected to the applicable hydrostatic pressures specified in table V and tested for elongation, expansion, twist, warp, and rise as described in 4.5 and 4.5.1.1. If desired, the manufacturer may humidify the hose for the hydrostatic test. Upon passing these tests, the hose shall be marked (see 3.13), to indicate compliance with the hydrostatic test requirements. The hose shall also meet table V requirements for the kink test as described in 4.5.

3.7.1 Coupling retention properties. Unless otherwise specified (see 6.2), hose assemblies shall pass the coupling retention test specified in 4.5.1.2. Any slippage of couplings shall be cause for rejection of the hose length.

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3.8 Physical properties of the lining.

3.8.1 Tensile strength. The tensile strength of the lining across the fold shall be not less than 1,200 pounds-force per square inch (psi), (see 4.5).

3.8.2 Ultimate elongation. The ultimate elongation of the lining across the fold of types I, II, and III hose shall be not less than 400 percent, tested in accordance with 4.5, except that the low temperature stock in type III, class B hose shall have an elongation of not less than 300 percent.

3.8.3 Set. The set of the lining shall not exceed 25 percent after being stretched to an elongation of 300 percent for types I, II, and III hose and 250 percent for type III, class B hose (see 4.5).

3.8.4 Strength of lap.

3.8.4.1 Rubber lining. The strength of the lap in the calendered rubber lining shall be not less than 75 pounds per inch of width (see 4.5).

3.8.4.2 Latex or rubber-coated fabric. The strength of the latex or rubber-coated lap shall be such that the break will occur in the fabric unless the stress is greater than 75 pounds. A parting of the lap, by the shearing of the latex from the fabric without breaking the fabric, at a value under 75 pounds shall constitute a failure. The test shall be made as described in 4.5.

3.8.4.3 Hardness (type III, class B hose). When tested as described in 4.5, the hardness of the lining of type III, class B hose, after having been aged as described in 4.5.3, shall not show a Shore A Durometer reading change exceeding 10 points in comparison to the Shore A Durometer reading of the unaged lining.

3.8.4.4 Specific gravity (type III, class B hose). The specific gravity of material used for lining type III, class B hose shall not exceed 1.4 when tested as described in 4.5.

3.8.5 Accelerated aging. The tensile strength and elongation of the rubber lining after having been aged as described in 4.5.3 shall be not less than 70 percent of the tensile strength and elongation before aging.

3.8.6 Resistance to water (types I, II, and III hose).

3.8.6.1 Extraction of rubber lining. When specified (see 3.4.1.1 and 6.2), the extractable nonvolatile matter of the rubber liner of types I, II, and III hose shall not exceed 21 milligrams per square inch when tested as specified in 4.5.8.

3.8.7 Torsional stiffness and cold-tension recovery (type III, class B hose). Unless otherwise specified (see 6.2), type III, class B hose shall be subjected to the torsional stiffness and cold-tension recovery test. After low-temperature conditioning (94 hours at -55 degree Celsius (deg C)), the torsional stiffness ratio of the rubber lining shall not exceed 10 (see 4.5.5.1 through 4.5.5.2.4) and the cold-tension recovery of the lining at -55 C shall be not less than 20 percent (see 4.5.5.3 through 4.5.5.3.3).

3.9 Low temperature flexibility (type III, class B). Unless otherwise specified (see 6.2), type III, class B hose shall not show damage to the jacket or liner, and shall not leak when hydrostatically tested, after being subjected to the low temperature flexibility test (see 4.5.4).

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3.10 Resistance to fungus type I and II). When specified (see 6.2), types I and II hose jackets, and rubber-coated fabric lining if used, shall be treated for resistance to fungus. The hose will be tested for fungus treatment in accordance with 4.5.6. The rubber-coated fabric lining and types I and II hose jackets shall retain at least 80 percent of their original breaking strength in either direction after being subjected to the test conditions specified in 4.5.6.5. The fungus treatment shall have no detrimental effect on the physical properties of the jacket or lining.

3.11 Adhesion. The adhesion between the backing and jacket, between the backing and lining, and between lining and jacket of types I, II, and III hose shall be not less than 12 pounds per each 1-1/2 inch of width (see table VII). This requirement is not intended to bar the construction of hose having no adhesion between the jacket and the lining along the fold provided that the surface over which there is no adhesion is not greater than 35 percent of the total surface for class A hose. Class B hose shall have the tube fully attached around the entire surface.

3.12 Friction or head loss. The first article sample shall meet the friction or head loss maximum requirements of table VI when tested in accordance with 4.5.7.

TABLE VI. Maximum allowable friction loss, psi per 50 feet

Size of hose, (inches)	Flow rate gals per min	Nozzle size (inches)	Allowable loss per 50 ft (psi)	Approx nozzle pressure (psi)
1-1/2	100	7/8	17	19.3
2	150	1	9	26
2-1/2	250	1-1/4	8	29
3	308	1-3/8	8-1/2	30
3-1/2	298	1-1/2	4	20

3.13 Marking. Each length of hose shall be indelibly stenciled at the ends in letters at least 1 inch high with the manufacturer's name, the month, and year of manufacture, the words "Tested to psi," and the contract number. (The applicable hydrostatic pressure specified for the size of the hose listed in table V as final pressure for elongation expansion, twist, warp, and rise psi.) The lettering shall begin approximately 4 feet from the coupling if a manufacturer produces hose at more than one factory, each length of hose shall have a distinctive marking, which may be in code, by which it may be identified as the product of a particular factory. Hose having rubber lining meeting the FDA requirements shall have the following additional marking "FOR USE WITH POTABLE WATER."

3.14 Workmanship. The finished hose shall be free from jacket abrasion, knot filler, missing picks, skip warps, snags, twisted jackets, improper location of markings, or any other defect affecting appearance or serviceability. Hose shall be flexible and easily coiled.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified

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in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Component and material inspection. Components and materials shall be inspected in accordance with all the requirements specified herein and in applicable referenced documents.

4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. First article inspection (see 4.2.1)
- b. Quality conformance inspection (see 4.2.2)

4.2.1 First article inspection. The first article inspection shall be performed on one hose when a first article is required (see 3.1, 6.2 and 6.5). This inspection shall include the examination of 4.4 and the tests of 4.5. The first article may be either a first production item or a standard production item from the supplier's current inventory provided the item meets the requirements of the specification and is representative of the design, construction, and manufacturing technique applicable to the remaining items to be furnished under the contract.

4.2.2 Quality conformance inspection. The quality conformance inspection shall include the examination of 4.4, the tests of 4.5, and the packaging inspection of 4.6. This inspection shall be performed on the samples selected in accordance with 4.3.

4.3 Sampling. Sampling and inspection procedures shall be in accordance with MIL-STD-105. All hose lengths with couplings of the same type, class, and size with the same construction materials, produced under essentially the same conditions offered for delivery at one time shall be considered a lot for the purpose of inspection. If an inspection lot is rejected, the contractor may rework it to correct the defects, or screen out the defective units, and resubmit for a complete reinspection. Resubmitted lots shall be reinspected using tightened inspection. If the rejected lot was screened, reinspection shall be limited to the defect causing rejection. If the lot was reprocessed, reinspection shall be performed for all defects. Rejected lots shall be separate from new lots, and shall be clearly identified as reinspected lots.

4.3.1 Sampling for examination. Each hose length or assembly shall receive the visual examination of 4.4.1 and the length dimensional examination of 4.4.2. The id dimensional examination shall only be performed on samples selected for the applicable tests cited in 4.4.2.2.

4.3.2 Sampling for tests.

4.3.2.1 Sampling for hydrostatic pressure test. Each hose length or assembly shall receive the hydrostatic pressure test by 4.5.1.

4.3.2.2 Sampling for burst test, straight and curved. The test shall be based on inspection level S-1. From each sample selected, a 3-foot section shall be removed and tested by the applicable test methods described in table VII. Test of the sample selections shall alternate between bursting the straight sample and the curved sample. The Acceptable Quality Level (AQL) shall be based on 2.5 percent defective units.

4.3.2.3 Sampling for construction, accelerated aging, tensile strength, percent set, strength of lap adhesion, water resistance, hardness, specific gravity, torsion stiffness ratio test, cold-tension recovery, and inside diameter. Samples for the jacket construction, and for accelerated aging tensile strength, ultimate elongation, percent set, strength of lap adhesion, hardness, specific gravity, torsional stiffness ratio, and cold-tension recovery of the lining may be taken from the samples used in the burst test. In the event that insufficient samples can be obtained from the burst test samples, a random sample of hose lengths shall be selected from each lot in accordance with MIL-STD-105 at inspection level S-1. The AQL shall be 2.5 percent defective. From the hoses sampled, 3-foot sections shall be cut and tested, as specified in 4.5.2 through 4.5.5.2 (except 4.5.4).

4.3.2.4 Sampling for low temperature flexibility (type III, class B hose only). When specified (see 6.2), the test shall be based on inspection level S-1 and an AQL of 2.5 percent defective.

4.3.2.5 Sampling for fungus resistance test. When fungus resistance is specified (see 6.2), an 8-foot section shall be taken from the manufacturer's assembled hose run in each contract for the fungus resistance requirement specified in 3.10 and as tested in 4.5.6. The test shall be repeated if any change in material occurs.

4.4 Examination.

4.4.1 Visual examination. Each length of hose shall be examined for the defects listed in FED-STD-162. In addition to the defects listed in FED-STD-162, type III hose shall be examined to determine if the liner shows through the jacket, and if the filler yarn protrudes through the warp yarn. Any hose assembly evidencing one or more defects shall be rejected.

4.4.2 Dimensions.

4.4.2.1 Length. The distance between the inside edges of the couplings shall be determined as described in ASTM D380 except that the measurement shall be made while a hydrostatic pressure of 10 psi is applied to the specimen as described in ASTM D380. The lengths of all hose in the lot shall be added and averaged. The average length per lot and the individual lengths shall not be less than the corresponding lengths shown in table III.

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TABLE VII. Requirement test for physical properties

Property	Requirement paragraph	Method in FED Test Method STD No. 601, or ATSM	Reference paragraph or footnote
Hydrostatic pressure properties	3.7 & table V	ASTM D380	4.5.1
Kink under pressure	3.7 & table V	ASTM D380	-
Elongation under pressure	3.7 & table V	ASTM D380	-
Expansion under pressure	3.7 & table V	ASTM D380	-
Twist, degree per foot	3.7 & table V	ASTM D380	-
Warp	3.7 & table V	ASTM D380	-
Rise	3.7 & table V	ASTM D380	-
Construction	3.4	-	4.5.2
Bursting strength straight & curved	3.6 & table IV	ASTM D380	-
Accelerated aging	3.8.5	ASTM D412	1/
Tensile Strength of rubber liner	3.8.1	ASTM D412	1/
Ultimate elongation of rubber lining	3.8.2	ASTM D412	1/
Set of rubber lining	3.8.3	ASTM D412	1/
Strength of lap	3.8.4	4311	2/
Adhesion	3.11	ASTM D380	
Resistance to fungus	3.10	-	4.5.6
Friction or head loss	3.12	-	4.5.7
Resistance to water extraction	3.8.6	-	4.5.8

Additional tests for type III, class B hose only

Hardness	3.8.4.3	ASTM D2240	-
Specific gravity	3.8.4.4	ASTM D792	-
Tortional stiffness and cold-tension recovery	3.8.7	-	4.5.5
Low temperature flexibility	3.9	-	4.5.4

1/ For rubber lining, die A in ASTM D412 shall be used for cutting the specimen; for the latex or rubber-coated lining, the coating on the passageway side (opposite side next to jacket) shall be carefully stripped from the fabric and die C in ASTM D412 shall be used. The specimen shall be cut transversly across the fold so that the fold is approximately midway between the ends of the constructed portion of the specimen.

2/ When testing latex or rubber-coated lining, the lap (splice) shall be a section that includes the fabric.

4.4.2.2 Inside diameter. The id shall be determined as described in ASTM D380 except that not less than two measurements shall be made on the unit or test unit. The measurements of hose with couplings shall be made when the 3-foot length is taken for the burst test, the 3-foot length for low temperature flexibility, or the 8-foot length for resistance to fungus.

4.5 Tests. Hose samples selected shall be subjected to the applicable tests specified in table VII.

4.5.1 Hydrostatic pressure test and coupling retention.

4.5.1.1 Hydrostatic pressure test. Each length of types I, II, and III hose in the lot with coupling attached, or length of hose remaining after removal of portions on which couplings have been attached by the manufacturer for use in other tests, shall be subjected to hydrostatic pressure test and to the tests specified in table VII. The hose assembly shall be held for a minimum of 1 minute at the test pressure. The pressure applied to the hose length shall be as specified in table V. Each length of types I, II, and III hose assemblies shall be index-marked with a pencil or other suitable device at a point immediately adjacent to the back side of each coupling. No slippage or leakage at the couplings or hose shall occur when the pressure specified in table V is applied to the length.

4.5.1.2 Coupling retention test. Unless otherwise specified (see 6.2), one hose assembly in the lot shall be index-marked with a pencil or other suitable device at a point immediately adjacent to back side of each coupling. The hose assembly shall be subjected to half the hydrostatic test pressure specified in table V for 5 minutes. The pressure shall then be raised to the normal hydrostatic test pressure for 5 seconds. No slippage or leakage shall occur at the couplings during the test. If hose assembly fails the test, the remaining hose assemblies in the lot shall be tested for 5 minutes. Failure of hose assembly to pass the test shall be cause for rejection.

4.5.2 Construction and physical property tests. The thickness of the lining and backing shall be determined as described in UL-19. The fabric and yarns of the hose jacket (see 3.3.2 and 3.4.3 through 3.4.3.3), and the latex or rubber-coated fabric (see 3.4.1.1 and 3.4.1.2) if used in the lining shall be taken from a 3-foot hose section (see 4.3.2.3), and shall be measured and tested in accordance with FED Test Method STD-191 for the following characteristics:

Method	Characteristic
5041	Weight (see 3.4.1.2)
5050	Construction (see 3.4.1.2 and 3.4.3.3)
5030	Thickness (see 3.4.1.1 and 3.4.1.2)
4050 & 4052	Twist (see 3.4.3.3)
4010	Length-weight relation for determination of denier filler yarn and counts of the single yarn (see 3.4.3.3)

After removal of the specimens used in tests of the lining and backing as applicable, the remaining specimens of type III hose jacket, and the fabric used in cambric lining if used, shall be unraveled as necessary and tested for consistency. In addition to the above test, the yarns from the sample of type III, class B hose jacket used in test method 5050.1 shall be unraveled and counted to determine that the number of warp plies specified in 3.4.3.3 is correct.

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4.5.3 Accelerated aging. The resistance of the lining to accelerated aging shall be determined as described in ASTM D573 except that the specimens shall be exposed for 166 +/-2 hours at 70 +/-2 deg C for types I and II hose, and 46 +/-1/4 deg hours at 100 +/-2 deg C for type III hose. The deterioration shall be measured by change in tensile strength, elongation, and hardness. Die I in method 4111 shall be used for cutting specimens (see 4.3.2.3) for tensile strength and elongation, and the specimens shall be cut transversely across the fold so that the fold is approximately midway between the ends of the constructed portion of the specimen.

4.5.4 Low temperature flexibility test, type III class B. Unless otherwise specified (see 6.2), a 3-foot section of hose shall be removed from each of the hose samples selected in accordance with 4.3.2.4 and shall be exposed to a temperature of -55 +/-2 deg C for a period of 24 hours. At the end of the exposure period and while maintained at the -55 +/-2 deg C exposure temperature, the hose shall be rapidly bent 180 double on itself, first one way and then the other. The hose shall then be examined for evidence of cracking or breaking of the jacket and liner. The hose shall then be allowed to thaw for 24 hours at room temperature after which it shall be subjected to the applicable hydrostatic proof pressure. Leakage shall be cause for rejection (see 3.9).

4.5.5 Torsional stiffness ratio-and cold recovery test.

4.5.5.1 Specimens. Unless otherwise specified (see 6.2), six test specimens (see 4.3.2.3) shall be buffed to uniform thickness, 0.080-inch wide by 1-1/2 inches long with a 1/4-inch square stub at each end, and tested for torsional stiffness ratio and cold tension recovery.

4.5.5.2 Torsional stiffness ratio.

4.5.5.2.1 Conditioning of specimens and test apparatus. Specimens shall be conditioned for not less than 94 hours in a chamber maintained at -55 +/-2 deg C. Test apparatus shall be conditioned for not less than 2 hours at -55 +2 C.

4.5.5.2.2 Test apparatus. The test apparatus shall be a torsional tester conforming to ASTM D1053, except that only the torsion apparatus, the stand, and a suitable bracket to hold the lower clamp are required. Torsion wire of appropriate torsion constant shall be used.

4.5.5.2.3 Test procedures. The test procedure shall be as follows:

- a. With the specimen and the test apparatus at 23 +/-2 deg C, the lower end of the specimen shall be secured in the rigidly mounted clamp of the test apparatus and the upper end shall be secured in the upper pinch clamp attached to the lower end of the torsional wire.
- b. The pointer shall be adjusted to the zero position by rotating the protractor scale. The torsional head shall be turned 180 and the pointer reading shall be recorded after a period of 10 seconds.
- c. After the above mentioned test has been conducted, the specimen and test apparatus shall be conditioned (see 4.5.5.2.1). After conditioning is complete, the test shall be repeated on the conditioned specimen and tests shall be conducted at -55 +/-2 deg C.

4.5.5.2.4 Calculations. The test shall be conducted on three specimens and the results averaged. If the torsional stiffness ratio for any one specimen is greater than 10, the ratio for each of the three specimens shall be within 20 percent of the average values of the three specimens. The torsional stiffness ratio at -55 +/-2 deg C shall be calculated as follows:

$$\text{Torsional stiffness ratio at } -55 \text{ C} = \frac{\text{Torsional stiffness factor at } -55 \text{ deg C}}{\text{Torsional stiffness factor at } +23 \text{ deg C}}$$

where:

$$\text{Torsional stiffness factor} = \frac{180 \text{ deg} - \text{angle of twist of specimen}}{\text{angle twist of specimen}}$$

4.5.5.3 Cold-tension recovery test.

4.5.5.3.1 Test apparatus. The test instrument shall consist of a measuring board, similar to that illustrated in figure 1, on which several stretching devices can be mounted. Each stretching device shall have one movable clamp and one fixed clamp. The board shall have lines engraved at intervals corresponding to each 10 percent stretch, based on the length of the specimen between the 1/4- by 1/4-inch square stubs.

4.5.5.3.2 Test procedure. The test procedure shall be as follows:

- a. The measuring board shall be conditioned for not less than 2 hours at -55 +/-2 deg C. Three specimens, cut from the sample (see 4.3.2.3), at 23 to 26 C, shall be clamped in the stretching devices along the edges of stubs, adjacent to the liner part, of the specimen and laid on the board. The moveable clamp shall be pulled back until the 1-1/2 inch long portion of the specimen has been stretched 100 percent elongation and fixed in that position.
- b. The stretching devices and the specimens shall be conditioned in low-temperature chamber for 7 days at -55 +/-2 deg C.
- c. With the test instrument and specimens still in the low-temperature chamber, the moveable clamp shall be released from its fixed position, and the assembly shall be conditioned for an additional period of 30 minutes at -55 +/-2 deg C.
- d. The final length of the specimen shall be determined with the board, stretching devices, and specimens held at an angle of 15 deg from the vertical. The cold-tension recovery percentages for the three specimens shall be calculated and averaged. The average value shall be used to determine compliance with 3.8.7. If the cold-tension recovery percentage for any one specimen is less than 20, the percentage for each of the three specimens shall be within 10 percent of the average for the three specimens. A cold-tension recovery not within 10 percent of the average for the three specimens shall constitute failure of the test.

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4.5.5.3.3 Calculation. The percentage of cold-tension recovery shall be computed from the formula:

$$\text{Percentage cold-tension recovery} = \frac{(L_s - L_f) \times 100}{L_s - L_o}$$

where:

L_s = stretched length of specimen.

L_f = final length of specimen.

L_o = initial length of specimen.

4.5.6 Fungus resistance (type I and II hoses). When specified (see 6.2), the jacket material shall be tested for resistance to fungus. Test procedures 4.5.6.1 through 4.5.6.5 shall be followed in determining compliance with the requirements of 3.10.

4.5.6.1 Preparation of test specimens. From the sample lengths of hose furnished (see 4.3.2.3) prepare 2 sets of 10 specimens each; 1 set for breaking strength controls and one set for leaching, sterilization, inoculation, and incubation. The rubber lining shall be peeled from the specimens for breaking strength controls before cutting. Peeling must be done in such a manner that the fabric of the specimens will not be injured. Control specimens will be cut 1-1/2 inches wide and 6 inches long and raveled to 1 inch in width. Specimens to be subjected to leaching, sterilization, inoculation, and incubation shall be cut not less than 1-1/4 inches wide and 8 inches long. The rubber lining shall be left intact on these specimens until breaking strength tests are made. Following incubation, washing and drying, these specimens are to be prepared for breaking strength tests by carefully peeling off the rubber lining in such a manner that at least 6 inches of the length of each specimen shall be undamaged. After peeling, the specimen shall be cut to 6 inches in length and raveled to 1 inch in width.

4.5.6.2 Leach treatment. Ten specimens shall be leached in containers of suitable size at a temperature of 24 +/-2 C for 24 hours. Specimens having different treatments, either different amounts of the same fungi-static compounds, shall not be leached together in the same vessel. During the course of the leaching, the material must be at all time submerged. The ratio of fabric to water (approximately pH 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 sample shall be air-dried and prepared for inoculation.

4.5.6.3 Steam sterilization. After leaching, specimens shall be placed in 16-ounce screw-cap bottles, such as are used for the 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 a gage pressure of 15 psi at 121 C exhaust temperature for 1 hour. If a microbiological test is to follow sterilization, the caps should be tightened when the bottles are removed from the autoclave.

4.5.6.4 Direct inoculation. Sterilized specimen method. Organism-*Chaetomium globosum*, culture USDA 1042.4 or ATCC-6205. The culture medium shall have the following composition:

Sodium nitrate (2.8 grams (g) of ammonium nitrate may be 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 milliliters (ml).

If necessary, the pH shall be adjusted to 6.8 with hydrochloric acid or sodium hydroxide. The culture medium shall be melted in an autoclave and shall be poured into 16-ounce bottles, about 40 ml per bottle. Petri dishes may be used. The bottles shall be sterilized in an autoclave at a gage pressure of 15 psi and 121 C exhaust temperature for 20 minutes, after which they are placed on their sides to allow culture medium to harden.

Inoculum, inoculation, incubation, and results shall be as follows:

a. Inoculum. Scrapings from a 10-centimeters (cm) 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 ml 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.

b. Inoculation and incubation. Leached specimens and viability controls shall be sterilized. When cold, one specimen shall be placed in contact with the agar medium in each bottle under aseptic conditions. Two ml 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 28 to 30 C. The specimens shall be removed from the containers at the end of the 240-hour period, gently washed to remove any growth of mildew, and dried.

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

4.5.6.5 Breaking strength of specimens. The breaking strength of specimens subjected to culture treatment as described above and those not subjected to culture treatment shall be determined as specified in method Number 5100 of FED Test Method STD-191, Textile Test Methods. The specimens shall be conditioned not less than 48 hours in an atmosphere of 23 +/-2 deg C and 50 +/-4 percent relative humidity for breaking tests. The report shall show the average breaking strength of the specimens before and after exposure, and the percentage strength retained to the nearest whole percent.

4.5.7 Friction or head loss. The friction or head loss test shall be made with the coupling gaskets in place. Two or more lengths shall be coupled

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together. Friction or head loss from hose inlet to outlet shall be measured With calibrated gages or a manometer or through the use of a gage and a calibrated flow meter. The pressure at the base of the standard tapered nozzle, which will produce the desired flow, shall be calculated by the following formula:

$$P = \frac{1 - d}{D} \times \frac{Q}{29.83 Kd}$$

where:

- p = nozzle pressure in psi
- Q = flow in gallons per minute
- d = diameter of nozzle opening in inches
- D = id of hose in inches
- K = discharge coefficient of nozzle (0.97 unless accurately determined)

The maximum allowable head loss shall be no greater than the values shown in table VI.

4.5.8 Extraction of inner hose liner. When specified (see 3.4.1.1, 3.8.6, and 6.2), the inner tube liner surface of one hose sample, selected in accordance with 4.4.2.2, shall be extracted in distilled water at reflux temperature in accordance with the following procedure:

- a. Remove a 1-inch ring of rubber inner liner and strip, cut, or buff away the outer fabric from the latex or rubber coat until the surface is smooth.
- b. Cut sufficient length of inner rubber liner to obtain approximately 10.
- c. Subject sample to distilled water, at reflux temperature, for 7 hours in an extraction apparatus as shown in figure 1 of ASTM D297.
- d. Filter the solution through Number 40 Whatman filter paper or equivalent and collect the extract in a tared container.
- e. Extract tie rubber sample in an additional 50-75 cubic cm of distilled water at a reflux temperature for 2 more hours and repeat step (d). Combine the extract solutions and evaporate to dryness. The container and residue shall be dried in an oven at 105 +/-2 deg C for 1 hour, cooled in a desiccator and weighed. The weight of the residue shall be recorded. A blank shall be run using the same amount of distilled water. After making allowance for the blank, the weight of the residue shall be recorded to the nearest milligram.
- f. Report the amount of matter extracted from the rubber in mg per square inch of surface, determined as follows:
 - Length (inches) x width (inches) x 2 - total surface area (square inches)
 - Milligrams per square inch = weight of extract/total surface area

4.6 Preparation for delivery inspection. An examination shall be made to determine compliance with the requirements of section 5. The sample unit shall be one unit prepared for shipment. Sampling shall be in accordance with MIL-STD-105. The inspection level shall be S-2 with an AQL of 4.0 percent defective.

5. PREPARATION FOR DELIVERY

5.1 Preservation and packing. Preservation and packing shall be in accordance with the requirements of MIL-P-775 with the level of preservation and the level of packing as specified (see 6.2).

5.2 Marking. Marking shall include the date of manufacture or date vulcanized.

5.2.1 Military agencies. Shipments to military agencies shall be marked in accordance with MIL-STD-129.

5.2.2 Civil agencies. Shipments to civil agencies shall be marked in accordance with FED-STD-123.

6. NOTES

6.1 Intended use. Class A hose is intended for use on pumping engines and in places where service conditions require the additional protection against wear by the extra jacket. Types I and II, class B hose is intended for use as fire hydrants, stand-pipes, reels, and places where abrasion of the jacket is not considered severe. Type III class B hose is intended for general use and for use on fire fighting equipment.

6.1.1 Special use. Hoses covered by this specification may be used for water purification equipment and for the conveying of potable water when the Federal Food, Drug, and Cosmetic Act requirements have been met, (see 6.2).

6.2 Ordering data. Purchasers should select the preferred options permitted herein and include the following information in procurement documents:

- a. Title, number, and date of this specification.
- b. Type, class, size, and length required (see 1.2.1 and 3.4.6).
- c. If first article is not required (see 3.1, 4.2.1, and 6.5).
- d. If testing by an independent laboratory is required (see 3.2 and 6.4).
- e. If different thickness of rubber lining is required (see 3.4.1.1).
- f. If inner rubber liner is required to conform to Federal Food, Drug, and Cosmetic Act (see 3.4.1.1, 3.8.6.1, 4.5.8, and 6.1.1).
- g. If synthetic rubber impregnation of outer jacket is required (see 3.4.3.4).
- h. When color required is other than white (3.4.3.5).
- i. If a particular od of hose is required (see 3.4.5).
- j. If a particular length of hose is required (see 3.4.6).
- k. If couplings are other than as specified and whether both couplings shall be male or female (see 3.5 through 3.5.3).
- l. When coupling thread shall be NPSH or NH (special) (see 3.5).
- m. If different or no coupling retention tests are required (see 3.7.1 and 4.5.1.2).
- n. If torsional stiffness test is not required for type III hose (see 3.8.7 and 4.5.5.1).

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- o. If low temperature flexibility test is not required for type III hose (see 3.9, 4.3.2.4, and 4.5.4).
- p. If fungus resistance treatment is required (see 3.10, 4.3.2.5, and 4.5.6).
- q. Location and conditions for first article testing (see 4.2.1, and 6.5).
- r. Level of preservation and packaging, and level of packing required (see 5.1).

6.3 Contract data requirements. When this specification is used in an acquisition which incorporates a DD Form 1423 Contract Data Requirements List (CDRL) and invokes the provisions of paragraph 7-104.9(n) of the Defense Acquisition Regulations (DAR), the data requirements will be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved CDRL (DD Form 1423) incorporated into the contract. When the provisions of DAR 7-104.9(n) are not invoked, the data shall be delivered in accordance with the contract requirements.

6.4 Recognized testing agency or laboratory. The testing agency or laboratory should be one which is regularly engaged in the examination, testing, and evaluation of fire hose, which has an established factory inspection, listing, and labeling program; and which has published standards for listing and labeling that are nationally recognized (see 3.2 and 6.2). For example, the Underwriter' Laboratories, Inc., 207 East Ohio Street, Chicago, IL 60611 and the Factory Mutual Engineering Division, 1151 Boston Providence Turnpike, Norwood, MA 02062 are considered recognized testing agencies.

6.4.1 Certification. It should be noted that all applicable requirements of this specification should be verified in accordance with section 4. However, hose bearing the label of a recognized testing agency or laboratory will require additional testing only for those requirements, as applicable, which have not been performed or confirmed by the agency label service.

6.5 First article. When a first article inspection is required, the item will be tested and should be a first production item or it may be a standard production item from the contractor's current inventory as specified in 4.2.1. The first article should consist of one hose assembly. The contracting officer should include specific instructions in procurement documents regarding arrangements for examination, test, and approval of the first article.

MILITARY INTERESTS:

Custodians

Army - ME
Navy - YD
Air Force - 99

CIVIL AGENCY COORDINATING ACTIVITIES :

GSA-FSS
DC GOVT - DCG
HHS-FEC
USDA-AFS

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Review activities

DLA-CS
Navy - SH

User activity

Navy - MC, CG

PREPARING ACTIVITY:

Navy - YD

Project No. 4210-0322

Orders for this publication are to be placed with General Services Administration, acting as an agent for the Superintendent of Documents. See section 2 of this specification to obtain extra copies and other documents referenced herein.