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Standard Test Methods for Rubber Hose[1]

This standard is issued under the fixed designation D380; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense. These methods have been approved for use by agencies of the Department of Defense to replace Methods 7431, 7421, 10011, 10021, 10211, 10221, 10311, 10341, 10351, and 10361 of Federal Test Method Standard No. 601 and for listing in the DoD Index of Specifications and Standards.

1. Scope

1.1 These test methods cover procedures for inspection and test of all types and constructions of rubber hose.[2]

1.2 In case of conflict between provisions of these test methods and those of detailed specifications or test methods for a particular hose, the latter shall take precedence.

1.3 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[3]

D412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
D413 Test Methods for Rubber Property—Adhesion to Flexible Substrate
D471 Test Method for Rubber Property—Effect of Liquids
D572 Test Method for Rubber—Deterioration by Heat and Oxygen
D573 Test Method for Rubber—Deterioration in an Air Oven
D865 Test Method for Rubber—Deterioration by Heating in Air (Test Tube Enclosure)
D1149 Test Methods for Rubber Deterioration—Cracking in an Ozone Controlled Environment
D1415 Test Method for Rubber Property—International Hardness
D2240 Test Method for Rubber Property—Durometer Hardness
D3183 Practice for Rubber—Preparation of Pieces for Test Purposes from Products
D3767 Practice for Rubber—Measurement of Dimensions
D4483 Practice for Evaluating Precision for Test Method Standards in the Rubber and Carbon Black Manufacturing Industries
E4 Practices for Force Verification of Testing Machines

3. General Test Methods

3.1 Except as otherwise specified in these test methods for rubber hose, the following test methods, applicable in general to vulcanized rubber, shall be complied with as required and are hereby made a part of these test methods:

3.1.1 *General Physical Test Requirements*—Practice D3183.

3.1.2 *Tension Test*—Test Methods D412.

3.1.3 *Aging Test*—Test Method D572, Test Method D573, and Test Method D865.

3.1.4 *Adhesion Test*—Test Methods D413.

3.1.5 *Immersion Test*—Test Method D471.

3.1.6 *Hardness Test*—Test Method D2240.

3.1.7 *Hardness Test*—Test Method D1415.

4. Significance and Use

4.1 These test methods provide uniform methods for inspection and test of rubber hoses that can be referenced in hose specifications for various applications.

4.2 Uniform test methods make quality comparisons of hose easier and more meaningful, and are more economical particularly when the same rubber vulcanizates are used in different types, constructions, or sizes of hose.

[1] These test methods are under the jurisdiction of ASTM Committee D11 on Rubber and are the direct responsibility of Subcommittee D11.31 on Rubber Hose and Belting.

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[2] For specifications covering hose used in automotive, construction, and industrial equipment applications, reference should be made to SAE Standards for Coolant System Hoses (SAE J20e), Fuel and Oil Hoses (SAE J30b), Power Steering Pressure Hose—High Volumetric Expansion (SAE J188), Power Steering Return Hose (SAE 189), Power Steering Pressure Hose—Low Volumetric Expansion (SAE J191), Power Steering Pressure Hose—Wire Braid (SAE J190), Windshield Wiper Hose (SAE J50a), Emission Control Hose (SAE J1010), Windshield Washer Tubing (SAE J1037), Tests and Procedures for SAE 100R Series Hydraulic Hose and Hose Assemblies (SAE J343c), and for Tests and Procedures for High-Temperature Transmission Oil Hose, Lubricating Oil Hose, and Hose Assemblies (SAE J1019).

[3] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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5. Sampling

5.1 A sample of sufficient length for proper performance of the required tests shall be cut from the hose when possible without impairing its use and the pieces of hose from which samples have thus been cut shall be accepted by the purchaser as full length, provided the hose meets the specified requirements. The length of samples required depends on the tests which are required. The following will show the minimum length required for the various tests:

5.1.1 *Thickness of Tube, Cover, and Rubber Elements; Tensile Strength and Elongation (Original); Adhesion*:

Nominal Bore Diameter, mm (in.)	Sample Length, mm (in.)
below 19 (0.75)	900 (36)
19 to 31.5 (0.75 to 1.25)	750 (30)
over 31.5 (1.25)	600 (24)

5.1.2 *Volumetric Expansion*—For all sizes 450 mm (18 in.).

5.1.3 *Straight Burst*— For hose nominal 76 mm (3 in.) and smaller, 450 mm (18 in.); for hose over 76 mm in inside diameter 600 mm (24 in.) but not exceeding 900 mm (36 in.). Use 900 mm for all sizes of jacketed rubberlined fire hose.

NOTE 1—Volumetric samples can be used for burst tests when hose is nominal 76 mm (3 in.) inside diameter and smaller.

5.1.4 *Curved Burst*—For all bore diameters of hose, 900 mm (36 in.).

5.1.5 *Hold Test*—For hose 76 mm (3 in.) and smaller, 450 mm (18 in.); for hose over 76 mm in inside diameter, 600 mm (24 in.) but not exceeding 900 mm.

5.1.6 *Immersion Test—Volume Change and Strength Deterioration*:

Nominal Bore Diameter, mm (in.)	Sample Length, mm (in.)
below 19 (0.75)	450 (18)
19 to 31.5 (0.75 to 1.25)	300 (12)
over 31.5 (1.25)	150 (6)

5.1.7 *Low-Temperature Test*:

Nominal Bore Diameter, mm (in.)	Sample Length, mm (in.)
below 31.5 (1.25)	500 (20)
31.5 to 50 (1.25 to 2)	700 (28)
over 50 (2)	1 000 (40)

5.2 Where the construction of the hose does not permit the cutting of samples as described in 5.1 without impairment of use, as in wire inserted hose, dredging sleeves, etc., a separate length having the same specifications shall be provided, either as an additional length or as a prolongation built onto the hose. Wire shall be omitted from the prolongation or sample length unless the detailed physical tests include requirements that measure the effect of the wire or metal elements in the construction. Additional length taken for purpose of tests shall be paid for by the purchaser, provided they conform to the specified requirements.

5.3 The sampling of woven-jacketed rubber-lined hose shall be in accordance with detailed specifications for this material.

6. Measurement of Hose

6.1 *Length*—Determine the length by means of a steel tape or calibrated measuring device. It shall not include the length of fittings except when specifically so requested and recorded. In the case of woven-jacketed rubber-lined hose, or hose with a helical wire reinforcement, determine the length under a 70-kPa (10-psi) internal pressure.

6.2 *Outside Diameter and Reinforcement Diameter*—Measure the circumference with a flexible tape and determine the diameter by calculation. Use of a pi (π) tape graduated to read the diameter directly is acceptable. On diameters of 25 mm (1 in.) or less, caliper measurements are acceptable when at least two measurements are made approximately 90° apart and the measurements averaged. The measuring device shall be capable of measuring in increments of 0.25 mm (0.01 in.) or less. All diameter measurements shall be made at least 25 mm (1 in.) distance back from the ends of the hose.

6.3 *Inside Diameter*—On hose up to and including nominal inside diameter of 75 mm (3 in.) suitable expanding ball gauges, telescoping gauges, or cylindrical-plug gauges shall be used.

6.3.1 The measuring devices shall have the following minimum precision:

Nominal Bore Diameter, mm (in.)	Plug gauges, mm (in.)	Calipers, mm (in.)	Scales, mm (in.)
25 (1) or less	0.25 (0.01)		
over 25 to 50 (1 to 2)	0.50 (0.02)		
over 50 to 75 (2 to 3)	0.75 (0.03)		
over 75 (3)		0.25 (0.01)	
150 (6) or more		0.50 (0.02)	0.50 (0.02)

6.3.1.1 Plug gates shall have the maximum increments in diameter as given above and a minimum step length of 9.5 mm (0.37 in.).

6.3.1.2 Ball gauges and telescopic gauges shall be capable of measuring increments of 0.50 mm (0.02 in.) or less.

6.3.2 On hose 150 mm (6 in.) or larger in nominal inside diameter, in addition to inside calipers, a graduated steel scale can be used. On hose 150 mm (6 in.) or larger the measuring device shall be capable of measuring 0.50 mm (0.02 in.) or less. With the exception of cylindrical plug gauges, at least two measurements shall be made approximately 90° apart and these measurements averaged. For hose that has a visual inside diameter variation at the end of the hose, for example, the flared or necked down end on wire braid reinforced hose, measurements shall be made at least 25 mm (1 in.) distance back from the end of the hose.

6.4 *Wall Thickness*—Determine the wall thickness at least 12 mm from the end of the hose to avoid flare. Use a micrometer with a rounded anvil in contact with the inside of the hose. Contact surface of the anvil should be about 8 mm long. Support for the anvil should be smaller in diameter than the anvil to avoid inward flare. Care is needed to be sure that the anvil and the foot are square to the surface of the hose. Sufficient force shall be applied to obtain firm contact with, but not indent, hose surface.

6.4.1 The minimum wall thickness shall be the minimum measurement obtained from a series of measurements taken around the circumference of the hose but concentrated in the area visually suspected of being thin.

6.4.2 The maximum wall thickness shall be the maximum measurement obtained from a series of measurements taken around the circumference of the hose but concentrated in the area visually suspected of being thick.

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6.4.3 The average wall thickness shall be the average of at least four measurements taken equidistant around the circumference of the hose.

6.5 *Wall Concentricity*—The difference between the minimum and maximum wall thickness determined in 6.4.1 and 6.4.2.

7. Thickness of Tube, Cover or Other Rubber Elements

7.1 Determine the thickness of a rubber element from any type of hose in accordance with Method A of Practice D3767.

7.2 Take the thickness of a rubber element adjoining a braid- or helical-wound reinforcing member of any material as the average between two measurements of thickness, one of which shall be obtained using the unbuffed specimen and the other using a specimen that is buffed just sufficiently to remove the braid or helical corrugations.

7.3 Take the thickness of a rubber element adjoining a seamless woven jacket of any material on a specimen that is buffed just sufficiently to remove the corrugations caused by the woven jacket. Where backing is used on a rubber element, remove the backing before measuring thickness.

7.4 Determine the thickness of a rubber element adjoining flexible metal convoluted lining at the valleys formed by the tops of the metal convolutions. Prepare the opposite side of the rubber element, adjacent to other reinforcing members, for thickness measurement as specified in the other paragraphs of this section, depending on the type of reinforcing member.

7.5 Determine the thickness of a rubber element adjoining reinforcing fabric woven prior to assembly in the hose on a specimen that is unbuffed.

8. Test Conditions

8.1 The temperature of the testing room shall be between 21 and 32°C (70 and 90°F). The samples to be tested shall be kept in this room for at least 30 min previous to the time of testing. In case of arbitration a test atmosphere of 50 ± 5 % relative humidity at a temperature of 23 ± 2°C (73.4 ± 3.6°F) shall be used.

NOTE 2—These special test conditions shall be confined to tension and immersion testing only.

9. Number of Tests

9.1 When test value limits are established, test one specimen for each physical characteristic required in the detailed specifications for a particular hose, except in the immersion tests given in Sections 19-23 inclusive. If the results do not meet the specified requirements, prepare two additional specimens from the original sample and test. Should the results of either of these tests be below the specified requirements, consider the sample to have failed to meet the specifications.

9.2 If test value limits are not established, test at least three specimens and take the median.

10. Separation of Rubber Parts

10.1 Cut a sufficient length from the hose sample to provide longitudinal tension test specimens from hose 76 mm (3 in.) and under in nominal diameter and transverse test specimens on larger sizes. Separate the rubber parts to be tested from the balance of the hose. Perform the separation without the use of a solvent, if practicable, and without excessive stretching of the rubber. Make the separation a little at a time while the rubber is gripped near the point of separation. If it is necessary to use a solvent in the separating operation use commercial *iso*octane. If *iso*octane is used, place the rubber so as to permit free evaporation of the solvent from all parts of its surface, and allow it to rest at least 1 h before being tested.

TENSILE STRENGTH AND ELONGATION OF RUBBER

11. Procedure

11.1 Test in accordance with Test Methods D412. When specimen thickness is less than 1.5 mm (0.06 in.) after preparation a greater variation in test values can be anticipated. At times acceptable test specimens cannot be obtained or true values do not result from dumbbells prepared from the hose. In such cases substitution of sheet material in accordance with the section on pieces from Practice D3183 is recommended.

ADHESION TESTS

12. Test Specimens

12.1 From woven-jacketed rubber-lined hose, cut adhesion test specimens all transversely from the samples in rings 50 mm (2 in.) in width. Then open these rings and lay them out flat so as to give rectangular specimens of length equal to the full circumference of the hose. Accurately cut on each specimen a central strip of lining 38 mm (1.5 in.) in width, the cut extending through the lining but not entirely through the woven jacket. Separate these strips from the jacket at one end for a distance of about 38 mm.

12.2 From other types of hose, cut the adhesion test specimens transversely from the samples in rings 25 mm (1 in.) in width using a sharp tool that will leave clean edges. On hose 6.5 to 100 mm (0.25 to 4 in.), inclusive, in inside diameter test the specimens in ring form and refer to them as "ring specimens." For hose over 100 mm in inside diameter cut the rings through at the point where the outside ply of fabric ends, and open them to form strips that shall be referred to as "strip specimens."

12.3 Cut adhesion specimens from hose less than 6.5 mm in inside diameter longitudinally from the hose (Note 3). Since the width of these specimens will be less than 25 mm (1 in.), determine the adhesion on the contact width of the test specimen.

NOTE 3—Adhesion tests on hose smaller than 6.5 mm (0.25 in.) are not recommended, due to the size of the specimen available.

12.4 In hose constructions having braided wire reinforcing members, it is impractical to prepare adhesion test specimens.

12.5 On hose 19 mm (0.75 in.) to 100 mm (4 in.), inclusive, in inside diameter, having a woven wire filler reinforcement, prepare specimens for the adhesion test as follows: Cut the hose to form a longitudinal specimen 150 mm (6 in.) long and 50 mm (2 in.) wide. Flatten the specimen thus prepared and draw two parallel lines 25 mm (1 in.) apart along the tube and cover and cut through to the woven carcass. Separate from the

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