Designation: D 622 – 99

Standard Test Methods for Rubber Hose for Automotive Air and Vacuum Brake System[1]

This standard is issued under the fixed designation D 622; 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 test methods were prepared jointly by the Society of Automotive Engineers and the American Society for Testing and Materials.

1. Scope

1.1 These test methods are intended for use in testing the conventional types of hose employed for the operation of air brake and vacuum brake systems,[2] either on a single motor vehicle or as connecting or transmission lines in a combination of vehicles. The hose may be assembled with suitable metal couplings or may be as fabricated for use with detachable fittings. The term "rubber" as used in these test methods includes synthetic compounds as well as compounds of natural rubber.

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

1.3 *This standard does not purport to address all of the safety problems, 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:*

D 380 Test Methods for Rubber Hose[3]

D 413 Test Methods for Rubber Property—Adhesion to Flexible Substrate[4]

D 471 Test Method for Rubber Property—Effect of Liquids[4]

D 573 Test Method for Rubber—Deterioration in an Air Oven[4]

D 1149 Test Method for Rubber Deterioration—Surface Ozone Cracking in a Chamber[4]

D 2240 Test Method for Rubber Property—Durometer Hardness[4]

E 4 Practices for Force Verification of Testing Machines[5]

2.2 *SAE Standards:*

J1402 Automotive Air Brake Hose and Hose Assemblies[2]

J1403 Vacuum Brake Hose[2]

3. Significance and Use

3.1 The purpose of these test methods are to provide nationally recognized test methods for air brake and vacuum brake hose, in particular the hose specifications SAE J1402 and SAE J1403, and to provide producers, distributors, and users with a basis for evaluating the characteristics of these hose products.

4. General Methods

4.1 The special tests described in these test methods shall be applied as required in order to comply with the detailed specifications for these types of hose. Otherwise, the general methods in Test Methods D 380 shall be used and are hereby made a part of these test methods.

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

5. Sampling

5.1 One representative sample of each lot to be tested shall be taken. The total length of hose required for all tests is as follows:

Air brake hose	approximately 3 m (9 ft)
Vacuum brake hose	appro ximately 5 m (15 ft)

5.2 Each test specimen shall be prepared from the original sample without having been subjected to any previous test.

5.3 In the interest of safety, any hose remaining intact after these tests shall be destroyed.

6. Test Conditions

6.1 The temperature of the testing room shall be maintained at 23 ± 5°C (73 ± 9°F). The temperature of the test samples shall be stabilized at the testing room temperature prior to testing.

---

[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.

Current edition approved May 10, 1999. Published June 1999. Originally published as D 622 – 41 T. Last previous edition D 622 – 86 (Reapproved 1991)$^{\epsilon 1}$.

[2] For specifications covering hose of these types, reference should be made to the Air Brake Hose (SAE J1402) and for Vacuum Brake Hose (SAE J1403) of the Society of Automotive Engineers, SAE Handbook.

[3] *Annual Book of ASTM Standards*, Vol 09.02.

[4] *Annual Book of ASTM Standards*, Vol 09.01.

[5] *Annual Book of ASTM Standards*, Vol 03.01.

TESTS APPLICABLE TO BOTH AIR BRAKE AND VACUUM BRAKE HOSE

7. Hydrostatic Bursting Test

7.1 Conduct the hydrostatic bursting test in accordance with Test Methods D 380.

8. Adhesion Test

8.1 *Fiber Reinforced Hose*—Conduct the adhesion test between component parts of fiber reinforced hose in accordance with Test Methods D 413, Machine Method.

8.2 *Wire Reinforced Hose*—Conduct the adhesion test on specimens with a minimum length of 380 mm (15 in.) prepared from the original sample without having been subject to previous tests.

8.2.1 *Procedure*—Place a steel ball of the size specified in Table 1 in the bore of the hose. Completely close one end against air leakage and connect the other end to a vacuum pump. Subject the bore of the hose to a reduced pressure (vacuum) of 85 kPa (25 in. Hg) for a period of 5 min while in an essentially straight position. At the end of this period and while still under the reduced pressure, bend the hose 3.14 rad (180°) to the minimum radius specified in Table 2 in each of two directions 3.14 rad (180°) apart.

8.2.1.1 After bending and returning to an essentially straight position and while still under reduced pressure, the ball shall be rolled from end to end of the hose. Failure of the ball to pass freely from end to end shall be an indication of separation of the tube from the carcass due to inadequate adhesion. Report any separation.

9. Ozone Resistance Test

9.1 Bend a specimen of hose of full circumference around a mandrel and tie the ends together where they cross one another with tie wire. The mandrel shall be a diameter twice the minimum bend radius specified in Table 2 for air brake hose and 8 times the nominal outside diameter for vacuum brake hose. The specimen length shall be about 250 mm (10 in.) longer than the mandrel circumference. Seal the ends of the hose with plugs on caps in such a manner that the reinforcement and inner tube will not be exposed to ozone.

9.2 Condition the hose for 24 ± ½ h in air at room temperature and while still on the mandrel place in an exposure chamber in accordance with Test Method D 1149, containing air mixed with ozone, with ozone at a partial pressure of 50 ± 5 mPa (formerly expressed as pphm, see Test Method D 1149 for explanation). The ambient air temperature in the chamber during the test shall be 40 ± 2°C (104 ± 3.6°F). Expose the specimen to the ozone and air mixture for a period of 70 ± 2 h. To determine conformance to this requirement, examine the cover of the specimen under 7× magnification, ignoring areas immediately adjacent to or within the area covered by the tie wire.

9.3 Report any cracks.

10. Oil Immersion Test

10.1 When required by the detailed specification, determine the changes in volume, tensile strength, ultimate elongation, and hardness of the tube and cover in accordance with Test Method D 471, using IRM 903 oil[6] at a temperature of 100 ± 2°C (212± 3.6°F) and an immersion period of 70 ± 2 h. Prepare the test specimen from samples taken from the hose. They shall be as near the size specified in Test Method D 471 as can be obtained from the hose being tested.

TESTS APPLICABLE TO AIR BRAKE HOSE

11. Proof Pressure Test

11.1 Assemble a specimen of hose 450 mm (18 in.) in length, with service couplings and connect to a source of air or nitrogen pressure. Submerge the hose and couplings entirely in water such that visual observation of the assembly is permitted, apply an internal pressure of 2070 ± 70 kPa (300 ± 10 psi) and maintain for 5 min. Report any evidence of leakage from the hose or couplings. Initial appearance of bubbles may be indications of air entrapped in hose wall. Agitate the hose after two min to break air bubbles from surface. Following this, a persistent stream of bubbles from any location shall be considered failure to meet test.

12. Assembly Tension Test

12.1 *Apparatus*—A tension testing machine conforming to the requirements of Practices E 4 and provided with an indicating device to give the total force in newtons (or pounds-force) at the conclusion of the test.

12.2 Assemble a specimen of hose 450 mm (18 in.) in length, with service couplings. Hold the assembly in the testing machine so that the hose and couplings will have a straight center line corresponding to the direction of the machine pull. Apply a steady tension force to the hose assembly at a speed such that the moving head travels at the rate of 0.4 ± 0.04 mm/s (1.0 ± 0.1 in./min) until failure occurs, either by separation of the hose from the couplings or by rupture of the hose structure. Report force to cause failure and the type of failure.

13. Length Change

13.1 Lay out the hose in a straight, horizontal position with one end connected to a source of hydrostatic pressure such as a hand- or power-driven hydraulic pump and the other end plugged or capped. Apply a pressure of 70 kPa (10 psi) and measure the original length between bench marks placed on the hose or the hose "free length" between the couplings. Then increase the pressure to 1400 kPa (200 psi) without releasing the original pressure of 70 kPa (10 psi) and make a final length

TABLE 1 Ball Size for Testing Adhesion of Wire Reinforced Hose

Hose Inside Diameter									
	mm	4.8	6.4	7.9	9.5	10.3	11.1	12.7	15.9
	in.	3/16	1/4	5/16	3/8	13/32	7/16	1/2	5/8
Ball Size	mm	3.6	4.8	6.0	7.1	7.5	8.3	9.5	11.9
	in.	9/64	3/16	15/64	9/32	19/64	21/64	3/8	15/32

TABLE 2 Minimum Bend Radius

Hose Inside Diameter	mm	4.8	6.4	7.9	9.5	10.3	11.1	12.7	15.9
	in.	3/16	1/4	5/16	3/8	13/32	7/16	1/2	5/8
Minimum Bend Radius	mm	51	64	76	89	89	102	102	114
	in.	2	2½	3	3½	3½	4	4	4½

[A] Minimum bend radius is measured to the inside of the bend .

measurement within 1 min. Report an increase in the final length from the original length as elongation, and report a decrease in final length from the original length as contraction. Calculate the percent change in length as follows:

$$\% \text{ Change} = \frac{(\text{final length} - \text{original length}) \times 100}{\text{original length}} \quad (1)$$

(+ %) change = elongation
(− %) change = contraction

14. High-Temperature Resistance Test

14.1 Bend a specimen of hose around a form of the dimensions specified in Table 3 and hold in place by a band or cord (see Fig. 1). Place the assembly, for a period of 70 ± 2 h at a temperature of 100 ± 2°C (212 ± 3.6°F), in an air oven conforming to that described in Test Method D 573. After removal from the oven, allow the hose to cool to room temperature and then remove from the form. Open the hose out to a straight length as shown in Fig. 2 and examine externally for cracks and disintegration. Cut the hose lengthwise and examine the inner tube for signs of cracking.

14.2 Report any cracks.

15. Low-Temperature Resistance Test

15.1 Condition the hose in a cold box in a straight position at − 40± 2°C (−40 ± 3.6°F) for 70 ± 2 h. After conditioning and without removal from the cold box, bend the hose 180° in 3 to 5 s around a form having the radius specified in Table 2. Examine externally for cracks. Cut the hose lengthwise and examine the inner tube for signs of cracking.

15.2 Report any cracks.

TESTS APPLICABLE TO VACUUM BRAKE HOSE

16. Aged Adhesion

16.1 Fill a hose 300 mm (12 in.) in length with Reference Fuel B[6] enclosed by means of suitable plugs or caps to prevent loss by evaporation or leakage. Allow the filled hose to stand at room temperature for 48 h.

16.2 After conditioning, drain the Reference Fuel B from the hose and conduct the adhesion test between component parts of fiber reinforced hose in accordance with Test Methods D 413, Machine Method.

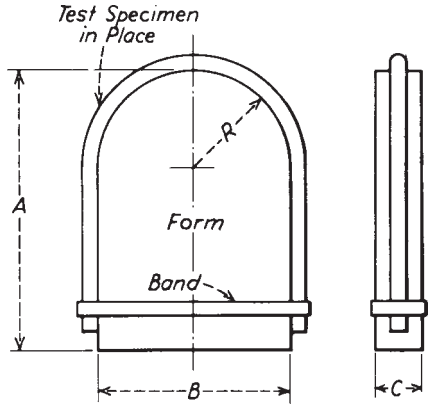

FIG. 1 Test Specimen on Form (see Table 3 and 4)

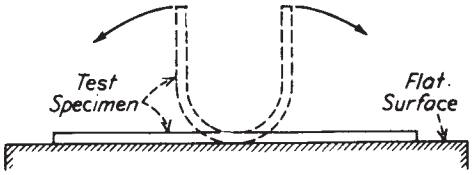

FIG. 2 Aged Specimen Being Staightened

17. Aging Test

17.1 Bend a specimen of hose around a form of the dimensions specified in Table 4 and hold in place by a band or

[6] Reference Fuel B is described in Test Method D 471.

TABLE 3 Dimensions of Test Specimens and Form for High-Temperature Resistance Test

Inside Diameter of Hose		Length of Specimen		Dimensions of Form (see Fig. 1)							
				A		B		R		C (min)	
mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.
4.8	3/16	229	9	114	4½	50	2	25	1	13	½
6.4	1/4	229	9	114	4½	76	3	38	1½	13	½
7.9	5/16	254	10	121	4¾	90	3½	45	1¾	19	¾
9.5	3/8	254	10	121	4¾	90	3½	45	1¾	19	¾
10.3	13/32	254	10	121	4¾	96	3¾	48	1⅞	19	¾
11.1	7/16	279	11	127	5	102	4	51	2	19	¾
12.7	½	279	11	127	5	102	4	51	2	19	¾
15.9	5/8	356	14	152	6	128	5	64	2½	25	1

TABLE 4 Dimensions of Test Specimens and Form for Aging Test

Inside Diameter of Hose		Type	Length of Specimen		Dimensions of Form (see Fig. 1)							
					A		*B*		*R*		*C* (min)	
mm	in.		mm	in.	mm	in.	mm	in.	mm	in.	mm	in.
5.6	7/32	Light Wall	203	8	114	4½	76	3	38	1½	13	½
6.4	¼	Heavy Wall	229	9	114	4½	76	3	38	1½	13	½
8.7	11/32	Light Wall	229	9	121	4¾	90	3½	45	1¾	19	¾
9.5	⅜	Heavy Wall	254	10	121	4¾	90	3½	45	1¾	19	¾
1.9	15/32	Light Wall	279	11	127	5	102	4	51	2	19	¾
2.7	½	Heavy Wall	279	11	127	5	102	4	51	2	19	¾
5.9	⅝	Heavy Wall	305	12	140	5½	114	4½	57	2¼	22	⅞
9.1	¾	Heavy Wall	356	14	152	6	128	5	64	2½	25	1
5.4	1	Heavy Wall	406	16	178	7	166	6½	83	3¼	35	1⅜

cord (see Fig. 1). Place the assembly for a period of 70 ± 2 h at a temperature of 100 ± 1°C (212 ± 1.8°F) in an air oven conforming to that described in Test Method D 573. After removal from the oven, allow hose to cool to room temperature and then remove from the form. Open the hose out to a straight length, as shown in Fig. 2, and examine externally for cracks and disintegration.

17.2 Subject the hose to a hydrostatic proof pressure as specified by the detailed specification.

17.3 Cut the hose lengthwise and examine the inner tube for signs of cracking.

17.4 Report any cracks externally and in the inner tube.

18. Cold Test

18.1 Condition the hose in a cold box in a straight position at − 40± 2°C (−40 ± 3.6°F) for 70 ± 2 h. After conditioning and without removal from the cold box, bend the hose 180° in 3 to 5 s around a mandrel having a diameter ten times the nominal outside diameter of the hose. Examine externally for cracking or breaking.

18.2 Subject the hose to a hydrostatic proof pressure as specified by the detailed specification.

18.3 Cut the hose lengthwise and examine the inner tube for signs of cracking and breaking.

18.4 Report any cracks externally and in the inner tube.

19. Collapse Resistance (Vacuum) Test

19.1 Assemble a hose specimen 300 mm (12 in.) in length with suitable end fittings such that one end may be completely closed against air leakage and the other end connected to a vacuum pump. Measure the outside diameter of the test specimen. Subject the bore of the hose to a reduced pressure (vacuum) of 88 kPa (26 in. Hg) for a period of 5 min. Connect a suitable manometer or vacuum gage in the system to indicate the degree of reduced pressure actually maintained. At the end of the 5-min. period, while the hose is still under reduced pressure, again measure the outside diameter of the test specimen so as to determine the minimum diameter at any cross section. Make the measurement with calipers graduated to a maximum of 1 mm (or 1/32in.). The difference between this measurement and the original outside diameter shall be considered the collapse of the hose outside diameter under reduced pressure.

20. Bend Test

20.1 Bend a hose specimen of the length prescribed in Table 5, in the direction of its normal curvature until its ends just touch as shown in Fig. 3. Measure the outside diameter of the specimen at the middle section *A* in the plane of the center line before and after bending, using calipers graduated to a maximum of 1 mm (or 1/32 in.). The difference between the two measurements shall be considered the collapse of the hose outside diameter on bending.

21. Fuel Immersion Tests

21.1 Conduct the immersion tests on tube material to determine the changes in tensile strength, ultimate elongation, and volume in accordance with Methods D 380 using Reference Fuel B[6] for 48 ± 0.5 h at room temperature.

22. Oven Aging Test

22.1 Conduct physical property tests to determine the changes in tensile strength, ultimate elongation, and hardness when test specimens of the tube and cover are subjected to air-oven aging at 100 ± 2°C (212 ± 3.6°F) for 70 ± 0.5 h in accordance with Test Methods D 573 and D 2240.

23. Report

23.1 The report shall include the following:

23.1.1 Description of the sample including type and size of hose and type of couplings, if any,

23.1.2 Statement of the methods used together with the results obtained,

23.1.3 All observed and recorded data, and

23.1.4 Date of test and temperatures of test room.

24. Precision and Bias

24.1 No statement is made about either the precision or the

TABLE 5 Dimensions of Bend Test Specimen of Vacuum Brake Hose

Inside Diameter of Hose		Length of Specimen			
		Heavy Duty		Light Duty	
mm	in.	mm	in.	mm	in.
5.6	7/32	...	...	178	7
6.4	¼	203	8	...	...
8.7	11/32	...	...	279	11
9.5	⅜	305	12	...	...
11.9	15/32	...	...	356	14
12.7	½	406	16	...	...
15.9	⅝	559	22	...	...
19.1	¾	711	28	...	...
25.4	1	914	36	...	...

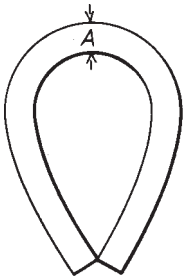

FIG. 3 Bend Test of Vacuum Brake Hose

bias of these test methods for measuring the test results since these results merely state whether there is conformance to the criteria for success specified in the procedure.

25. Keywords

25.1 automotive air brake hose; automotive vacuum brake hose