SURFACE VEHICLE STANDARD

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Vacuum Brake Hose

RATIONALE

The technical report covers technology, products, or processes which are mature and not likely to change in the foreseeable future.

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1. Scope

The vacuum brake hose is intended for use in the power braking systems of vehicles or as connections on vacuum lines of vehicles or systems thereof. For the purposes of clearly identifying hose classification and for specification simplification, vacuum brake hose is divided into two types: heavy-wall Type H, and light-wall Type L.

1.1 Rationale

This SAE document is a reaffirmation of the vehicle standard for vacuum brake hoses. Minor editorial changes were made to clarify some sections without affecting the standard's intent.

2. References

2.1 Related Publications

The following publications are provided for information purposes only and are not a required part of this document.

2.1.1 ASTM PUBLICATIONS

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM D 471—Rubber Property—Effect of Liquids
ASTM D 622—Rubber Hose for Automotive Air and Vauum Brake System
ASTM D 1149—Rubber Deterioration—Surface Ozone Cracking in a Chamber (Flat Specimen)

3. Performance Tests

3.1 Fuel Resistance Test

3.1.1 Fill a specimen of vacuum brake hose 300 mm ± 6 (11.8 in ± 0.2) long with ASTM Reference Fuel B.

3.1.2 Maintain the reference fuel in the hose at atmospheric pressure and room temperature for 48 h ± 1.0.

3.1.3 Drain the hose and within 5 min determine that every inside diameter of any section of hose is not less than 75% of the nominal inside diameter of the hose for heavy-wall and not less than 70% of the nominal inside diameter of the hose for light-wall hose. This determination can be performed by passage, end-to-end, of a ball having a diameter equal to or greater than the 75%, 70% of nominal I.D.

3.1.4 Within 10 min of fuel removal, subject the specimen to a vacuum of 88 + 0, -7 kPa (26 + 0, -2 in Hg) for 10 min ± 1.

3.1.5 Conduct the adhesion test for reinforced hose per 3.5.

3.2 Pressure Test

Subject a 450 mm ± 6 (18 in ± 0.2) length of hose to a hydrostatic pressure of 2.41 MPa ± 0.07 (350 psi ± 10) for 1 min + 10, -0 s.

3.3 High Temperature Exposure Test

3.3.1 Using calipers, measure the outside diameter of a 300 mm ± 6 (11.8 in ± 0.2) straight length of hose.

3.3.2 Subject the hose to an internal vacuum of 88 + 0, -7 kPa (26 + 0, -2 in Hg) at a temperature of 125 °C ± 2 (257 °F ± 3.6) for 96 h ± 2.0.

3.3.3 Within 5 min after completion of the hot vacuum aging period, measure the outside diameter at the point of greatest collapse using calipers.

3.3.4 Cool the hose for 4 h ± 0.25, and then condition the hose for 30 min ± 5 at room temperature.

3.3.5 Bend the hose around a mandrel having a diameter five times the nominal outside diameter of the hose.

3.3.6 Examine the hose for evidence of external and internal embrittlement or other evidence of degradation.

3.3.7 Subject the hose to a proof test pressure of 1.21 MPa ± 0.07 (175 psi ± 10) for 1 min + 10, -0 s.

3.4 Bend Test

3.4.1 Using calipers, measure the outside diameter of a specimen of vacuum brake hose of the length described in Table 1 at the middle section in the plane of the centerline.

TABLE 1—DIMENSIONS OF BEND TEST SPECIMEN AND MAXIMUM COLLAPSE OF O.D. OF VACUUM BRAKE HOSE

Inside Diameter of Hose		Length of Specimen				Maximum Collapse of O.D. (% of O.D.)	
		Heavy-Wall		Light-Wall		Heavy-Wall	Light-Wall
mm	in	mm	in	mm	in		
5.56	7/32	—	—	180	7	—	40%
6.35	1/4	205	8	—	—	20%	—
8.73	11/32	—	—	280	11	—	30%
9.53	3/8	305	12	—	—	20%	—
11.91	15/32	—	—	355	14	—	30%
12.70	1/2	405	16	—	—	20%	—
15.88	5/8	560	22	—	—	20%	—
19.05	3/4	710	28	—	—	20%	—
25.4	1	915	36	—	—	20%	—

3.4.2 Bend the specimen in the direction of its normal curvature until its ends just touch as shown in Figure 1.

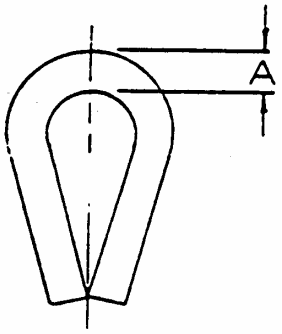

FIGURE 1—BEND TEST OF VACUUM BRAKE HOSE

3.4.3 When the specimen is in bent configuration, again measure the outside diameter of the hose at the same middle section "A" in the plane of the centerline.

3.4.4 The difference between the two measurements shall be considered the collapse of the hose outside diameter on bending.

3.5 Adhesion Test

3.5.1 SPECIMEN PREPARATION

3.5.1.1 From the hose to be tested, cut a test specimen of length 25.0 + 3.0, -0 mm (1.00 + 0.12, -0 in).

3.5.1.2 Cut the layer to be tested of the test specimen longitudinally along its entire length of contact with the adjacent layer.

3.5.1.3 Peel the layer to be tested from the adjacent layer to create a flap large enough to permit attachment of a clamp.

3.5.1.4 Mount the test specimen on a freely rotating form with the separated layer attached to a clamp.

3.5.2 TEST APPARATUS

Utilize an appropriate tensile testing machine such that:

3.5.2.1 The recording head includes a freely rotating form with an outside diameter substantially the same as the inside diameter of the hose specimen to be placed on it.

3.5.2.2 The freely rotating form is mounted so that its axis of rotation is in the plane of the ply being separated from the specimen, and so that the applied force is perpendicular to the tangent of the specimen circumference at the line of separation.

3.5.2.3 The preferred rate of travel of the grip is 25 mm/min ± 3 (1.0 in/min ± 0.1), and the capacity of the machine is such that the maximum applied tension during the test is not more than 85% nor less than 15% of the machine's rated capacity.

3.5.2.4 The machine operates with no device for maintaining maximum load indication, and in a pendulum type machine, the weight lever swings as a free pendulum without engagement of pawls.

3.5.2.5 The machine produces a chart with length separation as one coordinate and applied tension as the other. The preferred chart speed is the same as the crosshead speed.

3.5.2.6 The adhesion value shall be the minimum force recorded on the portion of the chart corresponding to the actual separation of the part being tested.

3.6 Low Temperature Test

3.6.1 Condition the hose in a cold box in a straight position at -40 °C ± 1 (-40 °F ± 1.8) for 70 to 72 h. After conditioning, and while still at this temperature, bend the hose at least 180 deg around the mandrel at a steady rate in a period of 3 to 5 s.

3.6.2 Examine the cover of the hose with naked eye for cracks or breaks.

3.6.3 To qualify the fact that no breaks occurred in the tube, the hose shall be allowed to return to room temperature, after which it shall show no leaks when subjected to a proof pressure of 1.21 MPa ± 0.07 (175 psi ± 10) for 1 min + 10, -0 s.

3.6.4 TEST APPARATUS

The mandrel diameter shall be that shown in Table 2.

TABLE 2—DIMENSIONS OF LOW TEMPERATURE RESISTANCE TEST SPECIMEN LENGTH AND MANDREL DIAMETER

Nominal I.D. of Hose		Length of Specimen		Mandrel Diameter	
mm	in	mm	in	mm	in
5.56	7/32	444.5	17-1/2	76.2	3
6.35	1/4	444.5	17-1/2	76.2	3
8.73	11/32	482.6	19	88.9	3-1/2
9.53	3/8	482.6	19	88.9	3-1/2
11.91	15/32	520.7	20-1/2	101.6	4
12.70	1/2	520.7	20-1/2	101.6	4
15.88	5/8	558.8	22	114.3	4-1/2
19.05	3/4	609.6	24	127.0	5
25.4	1	723.9	28-1/2	165.1	6-1/2

3.7 Ozone Test

3.7.1 Bend around the full circumference of the mandrel a specimen of hose approximately 250 mm (10 in) longer than the circumference of the required mandrel. Bind with tape or twine where the ends cross one another. If collapse of the hose occurs when bent around the mandrel, provide for internal support of the hose.

3.7.2 Condition the hose, on the mandrel, for 24.0 h ± 0.5 at room temperature.

3.7.3 While still on the mandrel, place the specimen in an exposure chamber containing air mixed with ozone at the ozone partial pressure of 100 mPa ± 5 (100 parts of ozone/100 million parts of air by volume ± 5) for 70 to 72 h. Ambient air temperature in chamber during test shall be 40 °C ± 3 (104 °F ± 5).

3.7.4 Examine the outside surface of the specimen for cracks under 7X magnification, ignoring the areas immediately adjacent to or within the area covered by the binding.

3.7.5 TEST APPARATUS

The mandrel diameter shall be eight times the nominal outside diameter of the hose being tested.

4. Performance Requirements

4.1 Fuel Resistance Test

4.1.1 The inside diameter of any section of hose shall not be less than 75% of the nominal I.D. for heavy-wall hose and not less than 70% of the nominal I.D. for light-wall hose.

4.1.2 The hose shall withstand a 10 min vacuum application without leakage or separation of inner tube from the fabric, if present.

4.1.3 The minimum load required to separate the tube from the plies and the cover from the plies shall be 10.5 N/cm (6 lb/in) of width.

4.2 Pressure Test

4.2.1 There shall be no leakage or burst of the hose during a 1 min pressure hold.

4.3 High Temperature Exposure

4.3.1 The collapse of the outside diameter shall not exceed 10% of original O.D. for heavy-wall hose and 15% of original O.D. for light-wall hose.

4.3.2 There shall be no external nor internal embrittlement or degradation.

4.3.3 There shall be no leakage during a 1 min pressure hold.

4.4 Bend Test

4.4.1 The collapse of the hose outside diameter on bending shall not exceed the values given in Table 1. This requirement does not apply to preformed hoses molded to configurations that fit specific applications without further bending.

4.5 Adhesion Test

4.5.1 The minimum load required to separate the tube from the plies and the cover from the plies shall be 14 N/cm (8 lb/in) of width.

4.6 Low Temperature Test

4.6.1 The hose tube and cover shall not crack or break.

4.7 Ozone Test

4.7.1 The outside surface of the hose shall show no cracking when examined under 7X magnification.