SURFACE VEHICLE STANDARD

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Refrigerant 12 Automotive Air-Conditioning Hose

RATIONALE

This document has been determined to contain basic and stable technology which is not dynamic in nature.

STABILIZED NOTICE

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1. Scope

This SAE Standard covers reinforced hose, or hose assemblies, intended for conducting liquid and gaseous dichlorodifluoromethane (refrigerant 12) in automotive air-conditioning systems. The hose shall be designed to minimize permeation of refrigerant 12 and contamination of the system and to be serviceable over a temperature range of –30 to 120 °C (–22 to 248 °F). Specific construction details are to be agreed upon between user and supplier.[1]

NOTE—R12 refrigerant has been placed on a banned substance list due to its ozone depletion characteristics. SAE J51 specification will be phased out as new automotive A/C systems are using R134a. SAE J2064 is the Standard for refrigerant 134a hose. For refrigerant 134a use, refer to SAE J2064.

2. References

2.1 Applicable Publications

The following publications form a part of this specification to the extent specified herein. Unless otherwise specified, the latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATION

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J343 JUN87—Tests and Procedures for SAE 100R Series Hydraulic Hose and Hose Assemblies
SAE J2064—R134a Refrigerant Automotive Air-Conditioning Hose

2.1.2 ASTM PUBLICATION

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

ASTM D 380—Methods of Testing Rubber Hose

[1] Tests referenced in this specification are laboratory tests, utilized to establish a performance standard.

3. Manufacture

The following is a list of common constructions and standard sizes of R12 hose, but is not meant to exclude other sizes and constructions.

3.1 Size

Standard dimensions are given in Tables 1A and 1B.

TABLE 1A—REFRIGERANT 12 AUTOMOTIVE AIR-CONDITIONING HOSE DIMENSIONS[1][2][3]—INSIDE DIAMETER

Size mm	Size in	Type A1, A2, B1 Max mm	Type A1, A2, B1 Max in	Type A1, A2, BA Min mm	Type A1, A2, B1 Min in	Type C Max mm	Type C Max in	Type C Min mm	Type C Min in	Type B2, D[4] Max mm	Type B2, D[4] Max in	Type B2, D[4] Min mm	Type B2, D[4] Min in
4.8	3/16					5.1	0.202	4.6	0.182	5.4	0.214	4.8	0.188
6.4	1/4	7.0	0.275	6.2	0.245	6.7	0.265	6.1	0.240				
8	5/16	8.6	0.337	7.8	0.307	8.3	0.327	7.6	0.300	8.7	0.343	8.0	0.313
9.5	3/8					9.9	0.390	9.1	0.360				
10	13/32	11.1	0.436	10.2	0.401	10.7	0.423	9.9	0.389	11.1	0.437	10.3	0.406
13	1/2	13.6	0.535	12.4	0.490	13.2	0.520	12.2	0.480	13.7	0.539	12.7	0.500
16	5/8	16.8	0.660	15.6	0.615	16.5	0.650	15.2	0.600	16.9	0.667	15.9	0.625
22	7/8									23.3	0.917	22.2	0.825
29	1-1/8									29.8	1.172	28.6	1.125

1. Fitting compatibility-fittings for thermoplastic hose may not necessarily be interchangeable. Therefore, it is recommended that fittings for hose be properly matched. Fittings and/or hose manufacturers' recommendations should be followed.
2. Concentricity based on total indicator reading between inside bore of hose and outer surface of hose shall not exceed the following values:
   - Types A1, A2, B1, B2, and D:
     - Sizes 6.4 mm (1/4 in) and under — 0.8 mm (0.030 in)
     - Sizes over 6.4 mm to 22 mm (1/4 to 7/8 in) — 1.0 mm (0.040 in)
     - Sizes over 22 mm (7/8 in) — 1.3 mm (0.050 in)
   - Type C
     - Sizes 6.4 mm (1/4 in) and under — 0.5 mm (0.020 in)
     - Sizes over 6.4 mm to 13 mm (1/4 to 1/2 in) — 0.6 mm (0.025 in)
     - Sizes over 13 mm (1/2 in) — 0.8 mm (0.030 in)
3. These are common hose sizes, but are not meant to exclude other sizes.
4. Dimensions for 3/16 in size apply only to Type B2 hose.

TABLE 1B—REFRIGERANT 12 AUTOMOTIVE AIR-CONDITIONING HOSE DIMENSIONS[1][2]—OUTSIDE DIAMETER

Size mm	Size in	Type A1 Max mm	Type A1 Max in	Type A1 Min mm	Type A1 Min in	Type A2 Max mm	Type A2 Max in	Type A2 Min mm	Type A2 Min in	Type B1 Max mm	Type B1 Max in	Type B1 Min mm	Type B1 Min in	Type C[2] Max mm	Type C[2] Max in	Type B2, D[3] Max mm	Type B2, D[3] Max in	Type B2, D[3] Min mm	Type B2, D[3] Min in
4.8	3/16													8.3	0.328	13.7	0.539	12.7	0.500
6.4	1/4	15.1	0.594	13.5	0.532					16.5	0.648	15.3	0.602	11.4	0.450				
8	5/16	19.1	0.750	17.5	0.688	19.8	0.781	18.3	0.719	18.8	0.742	17.7	0.696	13.5	0.530	17.6	0.695	16.7	0.656
9.5	3/8													15.2	0.600				
10	13/32	23.0	0.906	21.4	0.844	23.8	0.937	22.2	0.875	21.2	0.835	20.0	0.789	16.1	0.635	20.0	0.789	18.9	0.743
13	1/2	25.4	1.000	23.8	0.937	26.2	1.031	24.6	0.969	23.8	0.937	22.2	0.875	18.8	0.740	24.0	0.945	22.8	0.899
16	5/8	28.5	1.124	27.8	1.062	29.4	1.156	27.8	1.094	27.0	1.062	25.4	1.080	23.4	0.920	28.0	1.101	26.8	1.055
22	7/8															32.2	1.266	30.6	1.203
29	1-1/8															38.9	1.531	37.3	1.469

1. Fitting compatability-fittings for thermoplastic hose may not necessarily be interchangeable. Therefore, it is recommended that fittings for hose be properly matched. Fittings and/or hose manufacturers' recommendations should be followed.
2. Concentricity based on total indicator reading between inside bore of hose and outer surface of hose shall not exceed the following values:
   - Types A1, A2, B1, B2, and D:
     - Sizes 6.4 mm (1/4 in) and under — 0.8 mm (0.030 in)
     - Sizes over 6.4 mm to 22 mm (1/4 to 7/8 in) — 1.0 mm (0.040 in)
     - Sizes over 22 mm (7/8 in) — 1.3 mm (0.050 in)
   - Type C
     - Sizes 6.4 mm (1/4 in) and under — 0.5 mm (0.020 in)
     - Sizes over 6.4 mm to 13 mm (1/4 to 1/2 in) — 0.6 mm (0.025 in)
     - Sizes over 13 mm (1/2 in) — 0.8 mm (0.030 in)
3. Dimensions for 3/16 in size apply only to Type B2 hose.

3.2 Type A1 and A2—Rubber, Textile Reinforced

The hose shall be built having a seamless oil-resistant synthetic rubber tube. The reinforcement shall consist of textile yarn, cord, or fabric adhered to the tube and cover. The outer cover shall be heat and ozone-resistant synthetic rubber. It is recommended that the cover be pinpricked.

NOTE—Commercial product normally offered for Type A1 hose has been a one braid reinforcement of textile yarn with a smaller OD than Type A2 hoses. Type A2 hose has been a two braid hose. Hose fittings for Type A1 and A2 hoses are not normally interchangeable.

3.3 Type B1 and B2—Rubber, Wire Reinforced

The hose shall be built having a seamless oil-resistant synthetic rubber tube. The reinforcement shall consist of steel wire adhered to the rubber tube. The cover shall consist of a heat-resistant textile yarn impregnated with a synthetic rubber cement.

NOTE—Type B1 hose is currently not being manufactured. Commercial product normally offered for Type B1 hose has been a one-braid reinforcement of wire with unique ID and OD dimensions. Type B2 hose has been a one-braid reinforcement of wire with unique ID and OD dimensions conforming to those specified in SAE 100R5 hose and compatible with SAE 100R5 hose fittings. Hose fittings for Type B1 and Type B2 are not normally interchangeable.

3.4 Type C—Thermoplastic, Textile Reinforced

The hose shall have a thermoplastic tube. The reinforcement shall consist of suitable textile yarn. The outer cover shall be heat and ozone resistant. It is recommended that the cover be pin-pricked.

3.5 Type D—Thermoplastic, Textile Reinforced, Rubber Covered

The hose shall consist of textile yarn, cord, or fabric adhered to the tube and cover. It is recommended that the cover be pin-pricked.

4. Hose Identification

The hose shall be identified with the SAE number, type, and size of the inside diameter in metric mm equivalents or fraction of inches or both, and hose manufacturer's code marking. This marking shall appear on the outer cover of the hose at intervals not greater than 380 mm (15 in).

5. Testing

The test procedures described in the current issue of ASTM D 380 shall be followed whenever applicable. Tests referenced in this specification are laboratory tests intended to establish a performance standard.

5.1 Test Conditions

The temperature of testing room shall be maintained at 23 °C ± 2 °C (73 °F ± 3.6 °F). The temperature of the test hose or hose assemblies shall be stabilized for 24 h at the testing room temperature prior to testing.

5.2 Permeation Tests

Hose and hose assemblies shall not permit effusion of refrigerant 12 at a rate greater than that listed in Table 2 when tested at the specified temperature. Hose and hose assemblies intended for high-pressure side service (discharge and liquid line applications) shall be tested at 100 °C ± 2 °C (212 °F ± 3.6 °F). Hose and hose assemblies intended for low-pressure side service (suction line applications) shall be tested at 80 °C ± 2 °C (176 °F ± 3.6 °F).

The permeation test is designed to measure, by loss of mass, the rate of effusion of refrigerant 12 through the hose wall. The apparatus required consists of canisters with internal volumes of 475 to 525 cm^3 (29 to 32 in^3) and a 21 MPa (3000 psi) minimum burst pressure with appropriate fittings to connect to the hose assemblies, halogen detector, circulation air oven capable of maintaining uniform test temperature throughout the test periods, and a weighing scale capable of mass measurements of 0.1 g accuracy.

5.2.1 PROCEDURE

Four hose assemblies, having a free hose length of 1 m are required. Three of the hose assemblies shall be used for determining the loss of refrigerant and the fourth assembly shall be run as an empty plugged blank to be used as a means of determining the mass loss of the hose body alone.

Measure the free length of hose in each assembly at zero gage pressure to the nearest 1 mm (0.04 in). Connect each of the four hose assemblies to a canister and obtain the total mass of each test unit including end plugs to the nearest 0.1g.

TABLE 2—ALLOWABLE PERMEATION RATE(1)

Test Temperature °C	Test Temperature °F	Reference Pressure MPa	Reference Pressure psig	Maximum Allowable Loss of Refrigerant 12 kg/m^2year(1) Types B2, A1, A2, B1	Maximum Allowable Loss of Refrigerant 12 kg/m^2year(1) Types C, D	Maximum Allowable Loss of Refrigerant 12 lb/ft^2year(1) Types B2, A1, A2, B1	Maximum Allowable Loss of Refrigerant 12 lb/ft^2year(1) Types C, D
100	212	3.24	470	46.5	13.2	10	3
80	176	2.21	320	29	9.7	6	1.98

1. These rates reflect specific temperature and pressure conditions and do not reflect normal life permeation rates.

Load three of the test units with 0.6 mg of liquid refrigerant 12 per mm^3 of each test unit's volume to a total variance of ±5 g. Check the loaded test units with a halogen detector at a sensitivity of 11 g/year (1lb/40 years) to be sure that they do not leak. Any suitable method for safely loading may be used.

Two suggested methods are as follows:

5.2.1.1 Method 1

Hose assemblies may be conveniently loaded by conditioning the hose assemblies, connected canisters, and refrigerant 12 cylinder in a cold box for 4 h minimum at a temperature below the boiling point of the refrigerant 12. Using the density of the refrigerant 12 at the conditioning temperature, the proper load weight may be calculated in terms of volume at the temperature, they may be loaded by measuring the calculated volume of liquid refrigerant 12 with a graduate. The filled hose assemblies and connected canisters should be capped while still at the conditioning temperature, but may be removed from the cold box to complete the tightening to ensure proper seal.

5.2.1.2 Method II

The hose assemblies and connected canisters may be loaded at room temperature by transferring the refrigerant 12 under pressure through suitable valves and connections. A suitable apparatus consists of a refrigerant 12 cylinder, liquid accumulator, piston pump, and controls for metering the required charge.

Place the three loaded and one blank test units in the air oven at the specified test temperature for a period of 30 min ± 5 min to drive off surface moisture. Do not bend the hose in a curve with a diameter smaller than 20 times the outside diameter of the hose while in the oven. Check the loaded test units for leakage and weigh all test units not less than 15 min or more than 30 min after removal from the oven. Record the mass obtained as the original mass.

Place the test units back in the oven at the specified temperature for 24 h. At the end of the 24-h period, remove the test units; weigh in the same manner as previously specified, and return to the oven. If a loss of 20 g or more occurs, discontinue the test, check for leaks, and repeat test procedure.

Consider the first 24-h period as the preconditioning period. Disregard the mass loss during this period in final calculations. 72 h after the preconditioning weighing, weigh in the same manner as previously described. Calculate the 72-h mass loss. Determine the effusion rate by subtracting the corresponding mass loss of the blank from that of the loaded test unit. Express the effusion rate in kg/m^2/year or lb/ft^2/year. Calculate the rate of loss of refrigerant 12 mass for the loaded test units as follows in Equation 1:

$$R = \left[\frac{(A - B)}{L_1} - \frac{(C - E)}{L_2} \right] \bullet \frac{K}{D} \qquad \text{(Eq. 1)}$$

where:

A = Initial mass after preconditioning period of loaded test unit, g
B = Final mass after 72-h period of loaded test unit, g
C = Initial mass after preconditioning period of blank test unit, g
D = Nominal hose inside diameter, mm
E = Final mass after 72-h period of blank test unit, g
K = 39.7
R = Rate of refrigerant 12 mass loss, kilograms per square meter per year
L_1 = Free hose length of loaded test unit, m
L_2 = Free hose length of blank test unit, m

or where:

D = Nominal hose inside diameter, in
K = 12.3
R = Rate of refrigerant 12 mass loss, pounds per square foot per year
L_1 = Free hose length of loaded test unit, in
L_2 = Free hose length of blank test unit, in

At the conclusion of the test, the refrigerant charge in each specimen should be exhausted to a suitable reclamation container.

5.3 Integrity test

The hose shall show no signs of tube splitting causing rupture when tested at 107 °C ± 2 °C (225 °F ± 3.6 °F) for 24 h when loaded with refrigerant 12 as described in the Permeation Test. Three test units are required.[2] This test may be conducted as a separate test or as part of the Permeation Test by running the 24-h preconditioning period at 107 °C ± 2 °C (225 °F ± 3.6°F).

At the conclusion of the test, the refrigerant charge in each specimen should be exhausted to a suitable reclamation container.

5.4 Aging Test

The hose shall show no cracks or other disintegration when tested as specified after aging at 120 °C ± 2 °C (248 °F ± 3.6 °F) for 168 h. The mandrel used shall have a diameter eight times the nominal OD for Types A1, A2, B1, B2, and D, and shall have a diameter twice the minimum bend radius shown in Table 3 for Type C. The test unit shall have free hose length not less than 300 mm (12 in) or more than 1000 mm (39 in).

TABLE 3—MINIMUM BEND RADIUS FOR TYPE C HOSE

Size mm	Size in	Minimum Bend Radius mm	Minimum Bend Radius in
4.8	3/16	51	2.0
6.4	1/4	76	3.0
8	5/16	89	3.5
9.5	3/8	102	4.0
10	13/32	114	4.5
13	1/2	127	5.0
16	5/8	165	6.5

5.4.1 PROCEDURE

Coil the uncapped hose assembly around the mandrel of the designated size. Place in a circulating air oven for the time and at the temperature specified. After removal from the oven, allow the hose assembly to cool to room temperature, then open the hose assembly to a straight length and examine the hose externally for cracks or other disintegration. Place the hose assembly under an internal hydrostatic pressure of 2.4 MPa (350 psi) for a period of 5 min. Report any leakage through the hose as evidence of cracking.

[2] Failure of this test by a weight loss exceeding 20% of the original refrigerant 12 mass.