The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

SURFACE VEHICLE STANDARD

SAE J2196

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Submitted for recognition as an American National Standard

SERVICE HOSE FOR AUTOMOTIVE AIR CONDITIONING

1. Scope—This SAE Standard covers reinforced rubber, reinforced thermoplastic, or otherwise constructed hose, or hose assemblies, intended for conducting liquid and gaseous refrigerants for service connections from mobile air-conditioning systems to service equipment such as a manifold gauge set and vacuum pumps or for use internally, in charging stations or service equipment intended for use in servicing mobile air-conditioning systems.

1.1 The hose shall be designed to minimize permeation of refrigerants and contamination of refrigerant passing there through and to be serviceable over a temperature range of –30 to 95 °C. Hose working pressure shall be at least 3.4 MPa and the minimum burst pressure shall be at least 5 times.

2. References

2.1 Applicable Documents

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

SAE J51—Automotive Air-Conditioning Hose

SAE J513—Refrigerant Flare Fittings

SAE J639—Safety Practices for Mechanical Vapor Compression Refrigeration Equipment or System used to Cool Passenger Compartments of Motor Vehicles

SAE J2197—Service Hose Fittings

SAE J2210—HFC-134a Recycling Equipment for Mobile Air-Conditioning Systems

2.1.2 ARI PUBLICATIONS—Available from Air Conditioning and Refrigeration Institute, 1501 Wilson Boulevard, Sixth Floor, Arlington, VA 22209.

ARI 720—Refrigerant Access Valves and Hose Connectors

2.1.3 ASTM PUBLICATIONS—Available from ASTM, 1916 Race Street, Philadelphia, PA 19103.

ASTM D 380—Methods of Testing Rubber Hoses

2.2 Definitions

2.2.1 HIGH SIDE SERVICE HOSE is a hose connected between the vehicle high side service port and the manifold gauge set or equipment. For CFC-12 (R-12), it includes a 1/4 female refrigeration flare (FFL) nut on both ends and a shutoff device within 30 cm of the end connected to the serviced system or equipment. For HFC-134a (R-134a), it includes a high side coupling, as defined in SAE J639 and a shutoff device within 30 cm of the connection to the serviced system or equipment, and a 1/2 ACME female nut on the other end.

2.2.2 LOW SIDE SERVICE HOSE is a hose connected between the vehicle low side service port and the gauge manifold, or equipment. For R-12, it includes a 1/4 female refrigeration flare (FFL) nut on both ends

and a shutoff device within 30 cm of the end connected to the serviced system or equipment. For R-134a, it includes a low side coupling, as defined in SAE J639, and a shutoff device within 30 cm of the connection to the serviced system or equipment, and a 1/2 ACME female nut on the other end.

2.2.3 UTILITY HOSE is a hose connected between the manifold gauge set and the service equipment (vacuum pump, charging equipment, recovery/recycling unit). For R-12, it includes a 1/4 FFL nut on both ends and a shutoff device within 30 cm of the end connected to the serviced system or equipment. For R-134a, it includes a 1/2 ACME female nut on both ends and a shutoff device within 30 cm of the connection to the serviced system or equipment.

2.2.4 INTERNAL HOSE is a hose connected between components within or as part of service equipment. If the connection is made external to the unit, it shall be a wrench tight connection different than those described in high side service hose, low side service hose and utility hose as previously defined.

2.2.5 CHARGE COUPLING, USED WITH R-134A, is the female connector intended to be used with the vehicle service fittings (ports) as identified in SAE J639.

2.2.6 THE 1/2 ACME FEMALE NUT was established for connecting service hoses to R-134a refrigerant containers to prevent cross contamination of refrigerants. After consideration of existing fittings for refrigerant containers along with manufacturing and safety concerns it was determined that possible cross threading of metric threads could occur. Establishment of the 1/2 ACME thread reduces the chance of cross threading service hoses resulting in leakage and safety concerns.

3. Hose Assembly Construction

3.1 R-12 Hose

3.1.1 No color, fitting restrictions, or shutoff device requirements shall apply to internal hoses. Hoses which use internal or external wrench tight connections shall be exempt from fitting requirements pertaining to the end of the hose so connected.

3.1.2 High side service hoses, low side service hoses, and utility hoses shall be constructed with 1/4 FFL nuts on both ends and shall have a shutoff device within 30 cm of one end of the hose.

3.1.3 A valve core depressor shall be provided on the same end of the hose as the shutoff device. In most cases, valve core pins on the male fittings are located per ARI Standard 720 refrigerant access valves and hose connectors, but other locations have been used.

3.1.4 Adapters will be used to account for different high side vehicle service fittings per SAE J639.

3.1.5 Colors for various hoses shall be:

3.1.5.1 *Low Side Service Hose*—Solid blue is preferred with optional black with continuous blue stripe.

3.1.5.2 *High Side Service Hose*—Solid red is preferred with optional black with continuous red stripe.

3.1.5.3 *Utility Hose*—Solid yellow or solid white is preferred with optional black with yellow or white continuous stripe.

3.1.5.4 Additional marking as noted in Section 5.

3.2 R-134a Hose

3.2.1 No color, fitting restrictions, or shutoff device requirements shall apply to internal hoses. Hoses which use internal or external wrench tight connection shall be exempt from fitting requirements pertaining to the end of the hose so connected.

3.2.2 High side service hose and low side service hose shall be constructed with the charge coupling on one end, a 1/2 ACME female nut per SAE J2197 on the other end, and a shutoff device within 30 cm of the charge coupling end. Charge couplings for high and low side shall meet the requirements and be compatible as defined in SAE J639.

3.2.2.1 Hoses shall be constructed with the charge coupling integral. As defined in SAE J2197, a 14 mm threaded connection for service replacement of the hose portion is optional. The replacement hose shall meet all the other requirements (no charge coupling) of this document.

3.2.3 Utility hose shall have 1/2 ACME female nut per SAE J2197 on both ends and a shutoff device within 30 cm of one end. The end with the shutoff device shall also include a valve core depressor compatible with SAE J2197.

3.2.4 Colors for various hoses shall be:

3.2.4.1 *Low Side Service Hose*—Solid blue with black stripe.

3.2.4.2 *High Side Service Hose*—Solid red with black stripe.

3.2.4.3 *Utility Hose*—Solid yellow with black stripe.

3.2.4.4 See Figure 1 for stripe and marking detail.

3.2.4.5 Additional marking as noted in Section 5.

4. Hose Manufacturer

4.1 Standard sizes are shown in Table 1. In general, the nominal size is determined by the refrigeration fitting rather than the hose I.D.

TABLE 1—STANDARD HOSE SIZES

Nominal Size	Hose I.D. (min) Reference
1/4 inch	4.4 mm
3/8 inch	8.0 mm
1/2 inch	11.1 mm

5. Hose Identification

5.1 The hose shall be identified with "SAE J2196" marking. For R-134a refrigerants "SAE J2196 R-134a" marking is required.

5.2 On R-134a hoses, the refrigerant designation is associated with the stripe and identified in Figure 1.

5.3 Manufacturer's and assembler identification shall be located on the external surface of the hose 180 degrees from the refrigerant marking as identified in Figure 1.

5.4 The external hose identification should be durable for the life of the hose.

5.4.1 The printed information and stripe as required shall be 3 mm minimum in height, and shall be repeated, not to exceed a distance of 30 cm between start and end of the identification.

6. Testing—The test procedure described in the current ASTM D 380, shall be followed whenever applicable.

6.1 Test Conditions

6.1.1 The temperature of the testing chamber shall be maintained at 23 °C ± 2 °C.

6.2 Refrigerant Containment

6.2.1 Test hose assemblies shall not permit refrigerant loss of marked refrigerant (R-12, R-134a) at a rate greater than 9.8 kg/m^2/year (2.0 lbs/ft^2 year) when tested at 49 °C ± 2 °C.

6.2.2 The containment test is designed to measure, by loss of mass, the rate of refrigerant loss.

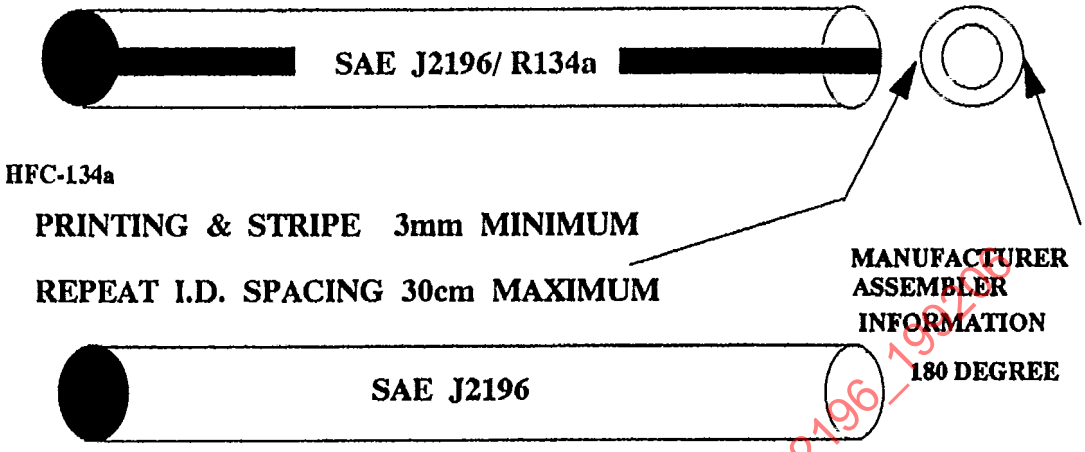

FIGURE 1—SERVICE HOSE

6.2.3 The apparatus required consists of canisters with internal volumes of 475 to 1000 cm^3 and a 21 MPa minimum burst pressure with appropriate fittings to connect to the hose assemblies, halogen detector, circulating air oven capable of maintaining uniform test temperature throughout the test periods, and a weight scale capable of mass measurements to 0.1 g accuracy.

6.2.4 Test Sample Preparation

6.2.4.1 Four hose assemblies, having a free hose length of 1 m, are to be tested.

6.2.4.2 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 the reference for determining the mass loss of the other hoses.

6.2.4.3 Measure the free length of hose in each assembly at zero gauge pressure to the nearest 1 mm. 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 0.1 g.

6.2.4.4 Load three of the test hose assemblies with 0.6 g of liquid refrigerant per cm^3 of each test hose volume to a total variance of ±5 g.

6.2.4.5 Check the loaded test hose assembly with a halogen detector at a sensitivity of 11 g/year to be sure that they do not leak. Any suitable method for safely loading may be used.

6.2.5 Test Procedure

6.2.5.1 Weigh the test samples and record the mass (weight) of each sample.

6.2.5.2 Place the three loaded and one blank (uncharged) test units in the air oven at the specified temperature (49 °C) for a period of 30 min ± 5 min drive off moisture.

6.2.5.2.1 Do not bend the test sample hose in a curve with a diameter smaller than 20 times the outside diameter of the hose while in the oven.

6.2.5.3 Remove the loaded test sample units from the oven and weigh.

6.2.5.4 Check the test samples for leakage and weigh all samples not less than 15 min or more than 30 min after removal from the oven.

6.2.5.5 Weigh the samples and compare the mass as recorded in 6.2.5.1 to determine if the test sample have lost the test refrigerant charge.

6.2.5.6 If the samples contain a refrigerant charge use the mass recorded in 6.2.5.5 as the original mass for future weight loss comparison.

6.2.5.7 Place the test samples back in the air oven, within 1 h after completion of 6.2.5.6, at the specified temperature for 24 h.

6.2.5.8 At the end of the 24 h period, remove the test samples, weigh and record the data in the same manner as previously specified, and return the test samples to the oven.

6.2.5.9 If a loss of 20 g or greater occurs, discontinue the test, check for leaks, and repeat the procedure as defined in 6.2.5.2.

6.2.5.10 The first 24 h period is considered the preconditioning period. If the test samples as checked in 6.2.5.9 have not leaked consider this recorded mass as the initial mass value.

6.2.5.11 Return the samples to the oven for 72 h.

6.2.5.12 Remove the samples from the oven and weigh and record the mass in the same manner as previously described.

6.2.5.13 Calculate the 72 h mass loss and determine the effusion rate by subtracting the corresponding mass of the blank from that of the loaded test sample unit. Express the refrigerant loss rate in $kg/m^2/year$.

6.2.5.14 Calculate the rate of loss of refrigerant mass for the loaded test sample unit as follows:

$$R = K/D * ([(A-B)/L1]-[(C-E)/L2]) \quad \text{(Eq. 1)}$$

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 = 38.7

R = Rate of refrigerant mass loss, kilograms per square meter per year.

L1 = Free length of loaded test unit, m.

L2 = Free hose length of blank test unit, m.

6.3 Refrigerant/Oil (Lubricant) Exposure

6.3.1 Three 457 mm long samples of the hose assembly are required for this test. The hose shall remain intact for this test.

6.3.2 The hose shall be filled to 70% capacity with a mixture of 95% refrigerant and 5% refrigerant lubricant.

6.3.2.1 Testing for R-12 hoses shall use SUNISO 5GS oil or equivalent.

6.3.2.2 Testing for R-134a hoses shall use ICI products lubricant (PAG) EMKAROX RL 118 or equivalent.

6.3.3 The hose assemblies containing the refrigerant/lubricant mixture shall be immersed in ASTM Oil No. 3 at 80 °C for 168 h.

6.3.4 Immediately following the exposure test, the test sample shall withstand, without failure, the tensile test of the assembly required in 6.8 and the burst pressure in 6.7.

6.4 Vacuum Test

6.4.1 The test sample hose shall have a free length of 610 mm.

6.4.1.1 The collapse of the hose shall not exceed 20% of the original outside diameter when subjected to reduced pressure (vacuum) of 1000 micrometers of Hg (microns) absolute for 2 min.

6.4.1.2 Bend the test hose assembly to a "U" shape with the inside radius at the base of the "U" being 20 times the nominal size of the hose as identified in Table 1 in 4.1.

6.4.1.3 Apply a reduced pressure (vacuum) of 1000 microns absolute to the bent hose assembly for 2 min. At the end of the 2 min period, while the hose is still under reduced pressure, measure the outside diameter of the hose at the base of the "U" to determine the minimum diameter in any plane.

6.5 Aging Test

6.5.1 The test sample hose shall show no cracks or other disintegration when tested as specified after aging at 95 °C ± 2 °C for 168 h.

6.5.2 The test sample hose, which had been used for vacuum testing in 6.4, shall have a length of 610 mm.

6.5.3 Fill the interior of the hose with nitrogen to atmospheric pressure and cap the open ends.

6.5.4 The hose assembly shall be wrapped around a mandrel (metal tube) having a diameter 20 times the nominal hose size as defined in Chart 1 of 4.1.

6.5.5 Place the test sample in the air circulation oven for the time and temperature defined in 6.5.1.

6.5.6 After removal from the oven, allow the hose assembly to cool to room temperature, then remove it from the mandrel and lay in a straight length and examine the hose for external cracks or other disintegration.

6.5.7 Load the hose with nitrogen to 2.4 MPa.

6.5.8 Place the hose assembly under water.

6.5.8.1 Inspect after 5 min and report any bubbling from the hose assembly as evidence of cracking or disintegration.

6.6 Cold Test

6.6.1 The hose shall show no evidence of cracking or breaking when tested as specified.

6.6.2 The test sample hose shall have a length of 457 mm.

6.6.3 Fill the interior of the hose with the appropriate refrigerant (R-12, R-134a) to 70% of capacity at room temperature (24 °C) and plug the open ends.

6.6.4 Place the test sample in an air circulation oven at 70 °C ± 2 °C for 48 h.

6.6.5 Remove the hose assembly from the oven and allow it to cool to room temperature.

6.6.6 Place the hose assembly in a straight position along with a mandrel (metal tube), having a diameter 20 times the nominal hose size as defined in Chart 1 of 4.1, in a cold chamber at –30 °C ± 2 °C for 24 h.

6.6.7 After 24 h, without removing the test material from the cold chamber, bend the hose through 180 degrees over the mandrel at a uniform rate within a time period of 4 to 8 s.

6.6.8 Remove the hose assembly from the cold chamber and allow to warm to room temperature.

6.6.9 Place the hose assembly under an internal hydrostatic pressure of 2.4 MPa for a 5 min period.

6.6.10 Inspect and report any leakage from the hose assembly as evidence of cracking or disintegration.

6.7 Bursting Strength

6.7.1 The minimum bursting strength for all hose assemblies shall be 17.2 MPa. Perform hydrostatic test per ASTM D 380 using the "Straight Bursting Test Method."

6.8 Tensile Test of Hose Assembly

6.8.1 The minimum force required to pull the hose adapter and separate the hose from the coupling shall not be less than 534 N.

6.8.2 The test hose shall have a minimum free hose length of 300 mm.

6.8.3 The hose assembly shall be mounted to a test apparatus having a crosshead speed not to exceed 25 mm per minute.

PREPARED BY THE SAE INTERIOR CLIMATE CONTROL STANDARDS COMMITTEE