



SURFACE VEHICLE RECOMMENDED PRACTICE

J3291™

AUG2024

Issued

2024-08

Evaluation of Air Conditioning Hoses and Coupled Hose Assemblies
using New Refrigerants or Refrigerant Blends

RATIONALE

This document will provide a means for evaluating new refrigerants or refrigerant blends for use with hoses and assemblies without a need to first identify the refrigerant to be tested.

1. SCOPE

SAE J3291 covers hoses and coupled hose assemblies intended for containing and circulating lubricant, liquid, and gaseous refrigerant in automotive air-conditioning systems. This recommended practice will be used to establish requirements for the validation of hoses, hose assemblies, or nonmetallic line assemblies with any new refrigerant or refrigerant blend being considered for use in automotive air-conditioning systems.

The new refrigerants and blends covered by this document do not include current refrigerants R134a, R1234yf, and R152a. This document does not cover previously used refrigerant R12 nor refrigerants used in transcritical systems, such as R744.

It is the system manufacturer's responsibility to ensure that adequate compatibility testing is completed with new refrigerants, blends, and lubricant combinations together with intended hose materials. The recommended tests include, but are not limited to, volume swell, delamination, and rapid decompression. These tests are not included in the scope of this recommended practice.

Data gathered while testing to this recommended practice shall be acceptable as applied to the final standard when released, providing that no substantive changes to the test methods or acceptance criteria have been made in the final standard.

Details for certification per SAE J2911 will be included in a future revision.

2. REFERENCES

2.1 Applicable Documents

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

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2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J2064 Coupled Automotive Refrigerant Air-Conditioning Hose Assemblies

SAE J2911 Procedure for Certification that Requirements for Mobile Air Conditioning System Components, Service Equipment, and Service Technician Training Meet SAE J Standards

SAE J3062 Automotive Refrigerant Air-Conditioning Hose Requirements

SAE J3143 Non-Metallic, Non-Reinforced Automotive Air-Conditioning Refrigerant Line Assembly Requirements

2.1.2 ASHRAE Publications

Available from ASHRAE Headquarters, 1791 Tullie Circle, NE, Atlanta GA 30329, Tel: 800-527-4723 (U.S. and Canada only) or 404-636-8400, www.ashrae.org.

ANSI/ASHRAE 34 Designation and Safety Classification of Refrigerants

2.1.3 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM D380 Methods of Testing Rubber Hose

3. DEFINITIONS

AZEOTROPIC BLEND: A blend or mixture of two or more refrigerants that boil at the same temperature. The components in this type of refrigerant will evaporate and condense together as one. These refrigerant blends are designated by the R5xx series in ANSI/ASHRAE 34.

CRITICAL TEMPERATURE: The temperature on a plot of thermodynamic properties at which the liquid and vapor states of a refrigerant or azeotropic blend meet and are indistinguishable. It is not acceptable for the purposes of this standard to calculate the critical temperature based on a weighted average of the blend constituents. The critical temperature must be established based on experimental data.

VIRGIN REFRIGERANT: Refrigerant that is unused and has not previously been exposed to any test conditions and has not been recycled or reclaimed. It should be used “as received” from the container obtained from the refrigerant supplier. It is acceptable to pass the refrigerant through a “Dial-a-Charge” or other similar metering device as long as cross contamination with other refrigerants can be avoided.

4. REFRIGERANT CONSIDERATIONS

Refrigerants or blends with a critical temperature below 82 °C or above 120 °C are beyond the scope of this standard. In the case of non-azeotropic blends, the starting (lower) temperature of the phase change process must exceed 82 °C and the ending (upper) temperature must not exceed 120 °C.

5. BASE REQUIREMENTS

5.1 Hoses that are defined by SAE J3062 (Types A through G) shall meet the following sections of SAE J3062:

- Aging Test
- Vacuum Flattening
- Length Change
- Bursting Strength
- Proof Test
- Ozone Test
- Moisture Ingression

5.2 Assemblies that are defined by SAE J3143 shall meet the following sections of SAE J3143:

- Resistance to Zinc Chloride
- Cold Temperature Impact Resistance
- Moisture Ingression
- Tensile Strength of Fittings
- Impulse Test

6. HOSE/ASSEMBLY IDENTIFICATION

A hose/tube assembly that has been successfully tested to this recommended practice shall have a durable label or tag identifying the refrigerant and lubricant combination that was used as well as “J3291.”

7. TESTING

7.1 Coupled Assembly Permeation Emission Test

7.1.1 Test Specimens - 107-cm Samples

The test specimens are to consist of four coupled hose assemblies that have 107 cm $\pm$ 1.2 cm of exposed hose between couplings. Three of the coupled hose assemblies are to be used for determining the permeation rate through the hose at a specific temperature. The fourth coupled and plugged hose assembly is to be used for a control hose. The permeation rate is based on the inside surface area of the hose.

One end of each hose assembly is to be fitted with a capped charge fitting. The other end is to be attached to a canister (optional) or plugged with a fitting. For refrigerants or blends not listed in Table 3, a canister must be used. The coupled hose assemblies are to be connected to clean and empty canisters, each having a minimum internal volume sufficient to contain all of the liquid portion of the refrigerant at the test temperature (see R134a example below). The minimum burst strength of the canister shall be three times the saturated pressure of refrigerant at 82 °C (see R134a example below). The canister shall be attached to one end of the hose and oriented downward (below the hose) during the test to ensure that the hose is exposed to refrigerant vapor only.

Example canister volume calculation (R134a):

- Hose size to be tested: 19-mm ID
- Coupling and tubing portion of the hose assembly (each end): 16-mm ID x 100-mm long
- Internal volume of hose assembly = $107 \text{ cm} \times \pi \times (1.9 \text{ cm}/2)^2 + 2 \times (10 \text{ cm} \times \pi \times (1.6 \text{ cm}/2)^2) = 343.6 \text{ cm}^3$
- To ensure the hose is exposed to only refrigerant vapor, the canister must make up 70% of the full assembly volume. The full assembly volume = hose assembly volume/(1-70%) = $343.6/.30 = 1145 \text{ cm}^3$. The minimum canister volume = $1145 - 343.6 = 801 \text{ cm}^3$. A smaller canister could be used for smaller hoses.
- Minimum burst strength of canister = $3 \times 2747 \text{ kPa (abs)} = 8.24 \text{ MPa (abs)}$

7.1.2 Charging Procedure and Initial Weights

The coupled hose assemblies are to be weighed and recorded to 0.01 g to establish an initial weight prior to charging. The test samples (control sample not charged) are to be evacuated then charged with virgin liquid refrigerant to 70% $\pm$ 3% of the internal volume of the assembly and then reweighed. Cooling of samples is recommended for ease of charging.

Since the permeation rate will vary based on both temperature and pressure, both factors must be kept constant during the test. The refrigerant charge required is intended to maintain a saturated (two-phase) condition at 80 °C, which will ensure a constant pressure. For refrigerant or blends not listed in Table 3, the density must be calculated to ensure the initial charge will not result in a supercritical condition at 82 °C (see R134a example below).

Example charge calculation (R134a): From the saturation table, R134a has a liquid density of 912.1 kg/m³ and a vapor density of 165.0 kg/m³ at 82 °C (the temperature of 82 °C is used as the upper test temperature tolerance). This means that the refrigerant will be saturated if the charge density is between 0.165 and 0.912 g/cm³. To ensure the safety of the test, a charge of 70% liquid volume is chosen. The charge density would then be $0.928 \times 0.70 = 0.65 \text{ g/cm}^3$ (using the saturation density at 80 °C).

7.1.2.1 Initial measurement of length and diameter applies only to assemblies containing non-reinforced thermoplastic tubing (SAE J3143) or reinforced thermoplastic hose (SAE J3062, Type G).

Place reference marks 500 mm apart on the outer surface of the tubing, midway between fittings. Measure the OD at each mark and the length between the marks. The initial measurements shall be made while the assembly is under pressure (i.e., charged).

7.1.3 Temperature Exposure

The test temperature is 80 °C $\pm$ 2 °C.

7.1.3.1 Temperature/humidity exposure applies only to assemblies containing non-reinforced thermoplastic tubing (SAE J3143) or reinforced thermoplastic hose (SAE J3062, Type G).

Charged samples shall be stabilized for 16 hours minimum at 23 °C $\pm$ 2 °C, 50% $\pm$ 10% relative humidity prior to testing. The test conditions shall be 80 °C $\pm$ 2 °C and 50% $\pm$ 5% relative humidity.

7.1.4 Establish Constant Loss Rate

Weigh the samples at the end of the first 24-hour temperature exposure and weigh at periodic intervals (minimum period must be 24 hours). The weighings shall be reported in net weight loss of grams, which is charged sample weight loss minus control sample weight loss. The net weight loss versus time shall continue to be recorded until steady state is reached. Steady state is reached when the last four readings are within 10% of the lowest reading or after 25 days, whichever comes first.