



SURFACE VEHICLE STANDARD

J2970™

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Superseding J2970 MAR2015

Minimum Performance Requirements for Non-Refrigerant Tracer Gases and Electronic Tracer Gas Leak Detectors

RATIONALE

This SAE Standard is being updated as part of the Five-Year Review. There are a few changes, including the accepted use of an adjustable calibration leak standard as an alternative to fixed leak standards, an updated false-trigger list, and an expanded list of required reporting.

1. SCOPE

This SAE Standard provides the testing and functional requirements guidance necessary for a leak detection device that uses any non-A/C refrigerant tracer gas, such as helium or a nitrogen-hydrogen blend, to provide functional performance equivalent to a refrigerant electronic leak detector. It explains how a non-refrigerant leak detector's calibration can be established to provide levels of detection equal to electronic leak detectors that meet SAE J2791 for R-134a and SAE J2913 for R-1234yf.

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.

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 J2197	HFC-134a (R-134a) Service Hose Fittings for Automotive Air-Conditioning Service Equipment
SAE J2670	Stability and Compatibility Criteria for Additives and Flushing Materials Intended for Aftermarket Use in R-134a (HFC-134a) and R-1234yf (HFO-1234yf) Vehicle Air-Conditioning Systems
SAE J2791	HFC-134a Refrigerant Electronic Leak Detectors, Minimum Performance Criteria
SAE J2888	R-1234yf Service Hose, Fittings, and Couplers for Mobile Refrigerant Systems Service Equipment

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Documents

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SAE J2911	Procedure for Certification that Requirements for Mobile Air Conditioning System Components, Service Equipment, and Service Technician Training Meet SAE J Standards
SAE J2913	R-1234yf [HFO-1234yf] Refrigerant Electronic Leak Detectors, Minimum Performance Criteria
SAE J3030	Automotive Refrigerant Recovery/Recycling/Recharging Equipment Intended for Use with Both R-1234yf and R-134a

3. GENERAL DESCRIPTION AND OPERATING INSTRUCTIONS

- 3.1 The tracer gas detector shall be suitable for use in safely detecting the tracer gas following recovery of refrigerant from the system with equipment that meets SAE J2788 (R-134a) or SAE J2810 (R-134a), SAE J2843 (R-1234yf), SAE J2851 (contaminated systems), or other recovery equipment meeting SAE standards published after this standard.
- 3.2 The tracer gas shall be suitable for use at temperatures of 15 to 49 °C (59 to 120 °F) and have the following characteristics:
 - 3.2.1 It shall meet the commodity specifications of the Compressed Gas Association.
 - 3.2.2 It shall be non-flammable.
 - 3.2.3 It shall be removable from the mobile air conditioning system with ordinary A/C shop equipment, and/or self-release from the system, leaving no residue, in less than 30 minutes. (Note: The tracer gas should not be recovered into the tank of SAE J2788 or SAE J2843 recovery/recycling/recharging equipment. When releasing, care should be taken so the background level of the tracer gas is not increased, which may impact further leak detection.)
 - 3.2.4 The pressure required for proper leak detection shall be less than 1.1 MPa (160 psig).
 - 3.2.5 The safety and chemical compatibility of the tracer gas must cover the possibility of a mixture of up to 20% of the system refrigerant from incomplete recovery. Refer to SAE J2670 for example test methods. The method of demonstrating compatibility with R-1234yf and R-134a is left to the discretion of the manufacturer/marketer or the test lab, but shall be described with supporting data, as an addendum to the comments section.
- 3.3 The tracer gas detector shall be tested to meet the performance specifications of this standard by an independent testing facility as defined in SAE J2911, and in accordance with the procedures set forth in SAE J2911. The independent testing facility shall maintain all documentation related to its testing, including calibration and maintenance data for its equipment, for a period of 5 years following the final production test of the specific detector.
 - 3.3.1 The manufacturer may state certification of compliance with this standard (including use of any labeling) only after meeting the requirements in SAE J2911. See Appendix B.
- 3.4 If it complies, the detector shall carry a label that states "Design certified by (name of testing laboratory) to meet SAE J2970 with (type of tracer gas, such as 95% nitrogen/5% hydrogen) at (tracer gas test pressure)" with lettering in bold face type at least 3 mm high.
- 3.5 If it fails to comply, the detector may be retested subject to the limits of Section 11. If a detector fails beyond the retest limits of Section 11, it shall be retested only after the manufacturer/marketer has documented design or process changes made to correct the failure and provided this data to the testing laboratory. A detector must pass the procedures in Sections 7 and 8. A failure in either or both of those sections requires a complete retest. The detector also must meet the requirements of Section 10, passing the no-false-triggering requirement for transmission oil and engine oil (items 14 and 15) and clearing within 20 seconds after a permitted false-trigger.
- 3.6 The tracer gas detector shall be suitable for use in an automotive service garage and operate in ambient temperatures of 15 to 49 °C (59 to 120 °F).

3.7 The tracer gas detector shall be capable of identifying leak rates equivalent to 4 g/year (0.15 oz/year) and 7 g/year (0.25 oz/year) of refrigerant R-134a or R-1234yf when tested using calibrated leak standards certified for both the refrigerant and the tracer gas. At the discretion of the manufacturer, the tracer gas detector may be capable of identifying a leak rate equivalent to 14 g/year (0.5 oz/year). The equivalent leak rates shall be determined at the refrigerant vapor pressure at 20 to 22 °C (68 to 72 °F) and the specified test pressure for proper leak detection for the tracer gas. The selection of the base refrigerant, R-134a or R-1234yf, is at the discretion of the manufacturer/marketer or the test lab.

3.8 Other equipment requirements (if included with the detector):

3.8.1 All couplings for attachment to MAC systems with R-134a shall meet SAE J2197.

3.8.2 All couplings for attachment to MAC systems with R-1234yf shall meet SAE J2888.

4. WHAT SHALL ACCOMPANY THE DETECTOR

4.1 The manufacturer/marketing company shall provide operating instructions for the detector that cover tracer gas specification and pressure needed for proper leak detection, tracer gas installation and removal, detector calibration, normal usage, trouble shooting, and maintenance, including replacement of any sensors, filters, or power supply.

4.2 Tools, adapters, and needed adjustment and calibration devices (including calibration and/or reference bottles) for the detector must be included with the detector.

4.3 The manufacturer/marketing company shall provide all needed safety information and labeling.

4.4 The manufacturer/marketing company shall provide the Section 10 list of all common under-hood chemicals that may affect the operation of an electronic leak detector and indicate with a Y if their detectors will false-trigger from exposure to each of the chemicals on the list, or an N if it will not indicate a false-trigger.

4.5 The resistance to false triggering shall be based on the test procedures described in Section 10. False triggering is defined as the detector making the same or similar indication (sound and/or light) as if it detected a tracer gas leak.

5. REQUIRED BASIC FUNCTIONS

5.1 The detector may self-calibrate or require manual calibration, but once calibrated for an operation, it must hold that calibration for a time sufficient to perform the operations described in Sections 7 and 8 (including 8.1 to 8.6). This does not preclude automatic recalibration for a probe that has been inserted into a contaminated atmosphere (as per Section 8), readjustment of sensitivity by operator selection, or an audible and/or visual warning of a condition beyond the operating scope of its design. The latter must be obviously different from the indication of a leak, although the same functional trigger may be used. Example: a steady indicator light versus a flashing indicator light.

5.2 The detector shall have at least two sensitivity positions, designated "high" and "normal or medium" equivalent to the 4 g/year and 7 g/year leakage rates of refrigerant (SAE J2791 or SAE J2913). At the discretion of the manufacturer, the detector may have additional sensitivity settings included one designated "low" equivalent to the 14 g/year leakage rate of refrigerant (SAE J2791 or SAE J2913). (Note: Whenever the detector is powered on, it must default to the "high" setting.)

5.3 The detector must demonstrate automotive garage durability by continuing to function normally after being dropped 1.2 m (4.0 feet) to a hard surface, such as a concrete floor, four times. This test may be performed with the detector in a protective caddy, provided the caddy is a standard part of the basic detector kit, and does not affect in-shop use of the detector, or testing of the detector under all procedures in Sections 7, 8, 9, and 10.

5.4 The detector must demonstrate automotive garage durability by continuing to function normally after:

- The probe tip has been submerged to a depth of 6 mm (0.25 inch) in a pan of water and drawn through the water at a rate of 75 mm (3 inches) per second for 2 seconds;
- Then, after wiping clean and performing any other cleaning/maintenance prescribed by the manufacturer in its operating instructions manual, including—but not limited to—a sensor replacement or filter change

6. LEAK DETECTION TEST EQUIPMENT

- 6.1 The testing shall be performed with the probe in a 610 mm (2 foot) cube clear sealed chamber as described in Figures A1 and A2. A chamber built to conform to SAE J2791/SAE J2913 is suitable.
- 6.1.1 Illustrations and details of the chamber are described in Appendix A. A vertical wall of the chamber shall have a horizontal slot 200 mm (8 inches) or wider, and large enough for a probe from an externally mounted detector to go through. The slot opening shall be sealed with:
- 6.1.1.1 Overlapping strips of a rubber material that conforms sufficiently around the probe to maintain the specified level of contaminated atmosphere, or
 - 6.1.1.2 A butt-joint of conforming rubber seals with additional sealing from face seals on the detector probe neck that are in contact with the butt joint.
 - 6.1.1.3 Any other slot sealing method that provides the chamber sealing required for Section 8.
 - 6.1.1.4 The rubber strips and face seals may be lubricated to provide smooth movement of the probe and any surrounding brace as described in 6.2.
- 6.1.2 The chamber shall have an access door large enough to insert a calibrated leak standard, a cylindrical sleeve, or round-hole access point for a gas-tight syringe and a built-in mixing fan (~120 V, ~240 V, or local voltage, approximately 68 m³/h [40 cfm]) to circulate an injection of a designated contaminated atmosphere gas to produce uniform distribution of injected gas for the contaminated atmosphere test. The chamber should have a provision for attaching a vacuum source (such as a small household vacuum motor) to permit rapid clearing of the chamber following a contaminated atmosphere test. The cylindrical sleeve or round-hole access shall include a sealing plug or other provision for sealing following use of the gas-tight syringe.
- 6.1.2.1 The designated contaminated atmosphere gas shall be the tracer gas, except as noted in Section 8 for tracer gases with a molecular weight of 20 or lower, which are exempted from the test.
- 6.1.3 The three (optionally four) calibrated leak standards or adjustable calibration leak standard used for the tests shall be calibrated per methods and instruments per the National Institute of Standards and Technology, Washington, DC 20234 (or an equivalent government-recognized source for traceable standards if testing outside the U.S.), and the standards shall be rated accurate (have measurement uncertainty) to within $\pm 20\%$. The leak rates for these standards shall be in common units for R-134a or R-1234yf of 7 g/year (0.25 oz/year), 4 g/year (0.15 oz/year), 2 g/year (0.07 oz/year), and optionally 14 g/year (0.5 oz/year), at the refrigerant vapor pressure at 20 to 22 °C (68 to 72 °F) and certified (calibrated with a certificate of calibration) for use with both the refrigerant and the tracer gas. These leak rates may be different from the leak rates with the tracer gas, as the objective is to determine the refrigerant leak rate, and provide an equivalency for evaluating the refrigeration system integrity. The leak standards shall be designed for connection to a supply of 100% of the tracer gas or if a blend, 100% of the specified blend. If the tracer gas is heavier than air, the standards or their mounting locations in the chamber shall ensure the base of the standard is 75 mm (3 inches) or more from the floor of the chamber. This is to provide a sufficient drop for the tracer gas coming from the leak standard orifice, to minimize puddling around the orifice and/or orifice shroud if used. To mitigate testing inconsistency from possible air turbulence caused by the moving probe, the leak standards may be equipped (as a certification test option) with a shroud around the orifice port. The shroud protrusion from the orifice port shall be no more than 6 mm +0/-0.2 mm (0.236 inch +0/-0.01 inch). A view of a sample configuration, with dimensions within those ranges, is shown in Figure A3. If a shroud is used with any leak standard, this shroud also must be used with all other leak standards for certification of a detector.
- 6.1.3.1 The calibrated leak standards shall be either three (optionally four) individual fixed leak-rate units or an adjustable leak standard. The standards must be made so they are calibrated for refrigerant R-134a or R-1234yf, but engineered to accept the tracer gas supply.

- 6.1.4 The detector shall be mounted on a table with a moving platform, designed to produce a horizontal reciprocating motion of at least 150 mm (6 inches), and a motor drive adjusted to move the platform so the probe tip passes the specified calibrated leak at a rate of 75 mm (3 inches) per second, from a distance of 9.5 mm (3/8 inch) per 7.2. All moving probe tests in this standard shall be performed at that rate as the probe passes the orifice of the calibrated leak standard. The platform shall stop at each end of its travel for no less than 8 seconds and no more than 10 seconds. The stop may be manually controlled by a test operator or performed automatically with a switch at each end-of-travel and a timer. A table that was built to conform to requirements for SAE J2791 or SAE J2913 is suitable.
- 6.2 It is necessary to hold steady the detector's flexible neck and probe, as the detector probe moves side to side through the sealed slot in the vertical wall of the chamber. If the design of the flex neck requires, this may be done by adding to the platform a brace (may be C or U channel) sized to hold the flex neck and probe securely, and long enough to protrude through the slot to within a distance conveniently short of the 9.5 mm (3/8 inch) from the orifice of the calibrated leak.
- 6.3 The detector probe may be aimed so that the tip is horizontal or up to 45 degrees above or below horizontal, the latter two positions to compensate for a tracer gas that is lighter or heavier than air

7. DETECTOR REQUIRED PERFORMANCE AND TEST PROCEDURE

- 7.1 Begin all testing for a single detector with a chamber cleared of tracer gas from any previous testing. Give the calibrated leak standards any maintenance/cleaning prescribed by the manufacturer making sure they are properly charged with the tracer gas. Perform the leakage rate tests separately, with the specific calibrated leak standard in the same position within the chamber. Position the calibrated leak standard so its orifice is at the exact midpoint of the moving platform's travel.
- 7.2 Adjust the detector and probe position for all tests so detector and probe are at one extreme end of the test table sweep. The probe shall sense two or three leakage rates: of 4 g/year (0.15 oz/year), 7 g/year (0.25 oz/year), and optionally 14 g/year (0.5 oz/year) when moved at a rate of 75 mm/s (3 in/s) past a calibrated leak standard, coming no closer than 9.5 mm (3/8 inch) from the orifice of the calibrated leak. The 9.5 mm (3/8 inch) distance from the orifice of the calibrated leak standard shall be horizontal or up to 45 degrees downward offset. Under these same operating conditions, the detector also shall not indicate a leak of 2 g/year (0.07 oz/year) leak with the detector sensitivity selector in the 4 g/year (0.15 oz/year) position, a 4 g/year (0.15 oz/year) leak with the sensitivity selector in the 7 g/year (0.25 oz/year) position, and a 7 g/year (0.25 oz/year) leak with the sensitivity selector in the 14 g/year (0.5 oz/year) position if available.
- 7.2.1 Begin with the calibrated leak standard for 2 g/year (0.07 oz/year) or set the adjustable standard to a leak rate of 2 g/year (0.07 oz/year) in position. Warm up the detector, select 4 g/year (0.15 oz/year), and operate the moving table so the probe sweeps past the calibrated leak standard a total of ten times (five side to side and back again movements at the specified rate and distance from the orifice). The probe shall indicate no leak nine of ten times or the leak detector fails.
- 7.2.2 Replace the 2 g/year (0.07 oz/year) calibrated leak standard with the 4 g/year (0.15 oz/year) calibrated leak standard or set the adjustable standard to a leak rate of 4 g/year (0.15 oz/year). Operate the moving table so the probe sweeps past the calibrated leak standard orifice a total of ten times (five side to side and back again movements). The probe shall sense the leak within 2 seconds and clear within 2 seconds of passing the orifice, at least nine of the ten times. "Clear" is defined as a clearly audible reduction in sound and/or substantial decrease in indicator lighting from the indication of a leak. If after an apparent "clear," the detector sounds in the stop period at each end of travel, following any one of the ten sweeps past the calibrated leak standard, the leak detector fails.
- 7.2.3 Immediately following the 4 g/year (0.15 oz/year) test, move the detector sensitivity selector to the 7 g/year (0.25 oz/year) position and perform a ten-sweep test with the 4 g/year-calibrated leak standard still in position. The detector shall indicate no leak at least nine of ten times or it fails.