

**Stability and Compatibility Criteria for Additives and Flushing Materials Intended for
Use in Vehicle Air-Conditioning Systems Using R-134a****Foreword**

The purpose of this standard is to provide testing and acceptance criteria to evaluate the stability and compatibility of chemicals, including flushing materials and additives (e.g., to enhance lubrication, durability, cooling performance, energy performance, prevent/fix leaks) intended for use in R-134a vehicle air conditioning systems. Successful completion of all requirements contained in this specification indicates acceptable compatibility with the AC system materials, but does not suggest that the additive improves system performance in any way.

1. Scope

This SAE standard applies to any and all additives and chemical solutions intended for aftermarket use in the refrigerant circuit of vehicle air-conditioning systems. This standard provides testing and acceptance criteria for determining the stability and compatibility of additives and flushing materials (solutions) with A/C system materials and components, that may be intended for use in servicing or operation of vehicle air conditioning systems. This standard does not provide test criteria for additive, compressor lubricant, or flushing solution effectiveness; such testing is the responsibility of the additive and/or solution manufacturer/supplier. It is not the intent of this document to identify the requirements for Standard J2297 Ultraviolet Leak Detection: Stability and Compatibility Criteria of Fluorescent Refrigerant Leak Detection Dyes for Mobile R-134a Air-conditioning Systems. All leak detection materials must meet the requirements of J2297.

Additives for mobile air conditioning systems are not tested under this standard for system enhancement or performance. This standard only indicates if the additive is chemically compatible with the system components.

Flushing solvents when used completely fill the component/system being flushed and, hence, should not harm system components at 100% concentration. They are not intended to remain in the system, either as a solvent or as an additive, but, because it is not possible to remove all of the flushing solvent, an indeterminate amount remains. The residual remaining in the system depends on many factors, including system/component configuration, component blind spots where liquid cannot be removed, the volatility of the solvent, the procedure(s) used to remove the solvent, and evacuation capability and procedure. No means exists to identify and/or specify the amount of residual solvent that either can, or will, remain in any given system after the procedure(s) have been followed. This standard does not address the flushing solvent procedure or its effectiveness at removing residual flushing agent.

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1.1 Rationale

The purpose of this standard is to provide testing and acceptance criteria to evaluate the stability and compatibility of chemicals, including flushing materials and additives (e.g., to enhance lubrication, durability, cooling performance, energy performance, prevent/fix leaks) intended for use in R-134a vehicle air conditioning systems. Successful completion of all requirements contained in this specification indicates acceptable compatibility with the AC system, but does not suggest that the performance of the additive improves system performance in any way.

2. References

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise specified, the most recent publication shall apply.

2.1.1 ANSI PUBLICATION

Available from ANSI, 25 West 43rd Street, New York, NY 10036-8007.

ANSI-ASHRAE Standard 97—Sealed Glass Tube Method to Test the Chemical Stability of Material for Use Within Refrigerant Systems

2.1.2 ASTM PUBLICATIONS

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

ASTM D 445—Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)

ASTM D 664—Test Method of Acid Number of Petroleum Products by Potentiometric Titration

ASTM D 3233—Method for Measurement of Extreme Pressure Properties of Fluid Lubricants (Falex Method)

3. Specifications and General Description

3.1 The additive or flushing solution shall be certified that it meets this specification by a qualified, ISO certified laboratory. The laboratory shall maintain documentation of testing to this specification for each change in formulation certified, including all calibration data and equipment calibration dates for a period of 5 years following the end of the production run for a certified additive.

3.2 The additive package or flushing solution shall be labeled "This Additive or flushing solution is Certified to Meet SAE J2670 for R-134a and PAG lubricants" on an exterior surface.

4. Use Instructions

The additive manufacturer shall provide use instructions for the addition of the additive or flushing solution to the refrigerant system.

5. Associated Equipment

The additive shall be usable via direct addition into an unpressurized system. The flushing solution shall be usable with the appropriate service equipment.

6. Testing of Additives or Flushing Solutions

6.1 These test procedures and requirements shall be used to determine the stability and the compatibility of additives intended for use within a mobile air-conditioning system. An additive or flushing solution must meet all of the acceptance criteria for each test to be certified to this specification.

6.2 The same PAG lubricant shall be used in all the tests defined in this specification. This lubricant must be one commonly used in the mobile air-conditioning industry in OEM R-134a systems. (For example, the following polyalkyleneglycols (PAGs) would be acceptable: Denso ND-8, Ford YN-12B, General Motors 12345923 or 12378526, Sanden SP-10 or SP-20, Zexel ZXL-100 PG or ZXL-200 PG, SP-15).

6.3 Rank order analysis is to be used to establish the acceptance criteria for the additive or flushing solution evaluated to the specifications defined in this document. The rationale for rank order analysis for a set of three test samples and three control samples is as follows. Statistically, if the addition of additive or flushing solution has no effect on the test results, the numerical ranges for the control group and test sample group will overlap. If the additive has an effect, the ranges will not overlap, i.e., there will be a complete separation. If a separation occurs, this could be the result of a positive effect or a negative effect, depending on the attribute tested. Accordingly, a test is considered passed when the ranges of results for the sample and control groups overlap, or when a complete separation of ranges occurs where the sample's results positively affect the desirable properties of the lubricant, i.e., a positive effect from the additive. A test is considered failed when the ranges of results for the sample and control groups do not overlap, and the separation is the result of a negative effect on the desirable properties of the lubricant, i.e., a negative effect.

6.4 Note: R-134a is commonly used as a flushing solvent in conjunction with equipment capable of handling the refrigerant in such a manner. Because R-134a can act as both the refrigerant and a flushing solvent, R-134a is deemed to meet all the requirements set forth in this specification.

7. Stability Testing

7.1 Stability testing shall be performed as described in ANSI-ASHRAE Standard 97. The sealed tubes are to contain an equal volume of liquid refrigerant and lubricant sample as well as the specified metal catalysts.

7.1.1 The test refrigerant shall be composed of 99% R-134a and 1% R-12.

7.1.2 The lubricant sample shall be composed of $\frac{3}{4}$ PAG and $\frac{1}{4}$ mineral oil by weight. The mineral oil shall be one commonly used within the mobile air-conditioning industry in R-12 systems (e.g., Chrysler 209500, Ford F2AZ19577AB, General Motors 15-117, or Suniso 5GS). The total acid number of each sample is to be determined according to ASTM D 664 to a final pH of 11.0 before and after aging.

- 7.1.3 The metal catalysts shall consist of standard metal specimens consisting of 3 mm by 19 mm coupons of steel and copper, separated by aluminum shims so that the copper is not in direct contact with the steel.
- 7.2 Six samples shall be tested. Three shall be composed of neat lubricant and three shall be composed of the same lubricant containing double the recommended service concentration of the additive. For flushing solution (six samples) three samples [control] shall be composed of neat lubricant and three shall be composed of the same lubricant containing a 20:80 mixture by volume of the flushing agent and the lubricant.
- 7.3 These samples shall be aged at 175 °C for 14 days.
- 7.4 Acceptance criteria shall consist of three separate determinations.
- 7.4.1 The presence of the additive or flushing solution shall not cause an increase of refrigerant and/or lubricant decomposition when compared to the neat samples via rank order analysis of total acid number increases.
- 7.4.2 The presence of the additive or flushing solution shall not cause an increase of corrosion or copper plating of the tested metal coupons when compared to those tested in the neat samples via rank order analysis.
- 7.4.3 The presence of the additive or flushing solution shall not cause an increase in particles, precipitates, or insolubles in the sealed tubes when compared to those tested in the neat samples via rank order analysis.

8. Nonmetallic Materials Compatibility Testing

- 8.1 Nonmetallic materials compatibility testing shall be performed to determine the compatibility of the additive or flushing solution with typical elastomer and plastic materials.
- 8.2 The materials to be tested are:
- PTFE commercial grade skived sheet (e.g., Tex-O-Lon Manufacturing Company's Teflon)
 - Nylon 66 (e.g., DuPont Plastics Zytel 101L NC010)
 - Polyester (e.g., GE Plastics' PBT 420K Valox)
 - HNBR O-ring (e.g., Dowty Seal Company)
 - Neoprene WRT O-ring (e.g., Dowty Seal Company)
 - NBR O-ring (e.g., Dowty Seal Company)
 - EPDM O-ring (e.g. Parker-Wynn's)
- 8.3 Six samples shall be prepared from each material. Three shall be tested with neat lubricant and three shall be tested with the neat lubricant containing double the recommended service concentration of the additive. For flushing solution (six samples) three samples [control] shall be composed of neat lubricant and three shall be composed of the same lubricant containing a 20:80 mixture by volume of the flushing agent and the lubricant.
- 8.4 Before and after the aging procedure, materials a-c shall be tested for hardness by Shore Durometer D, while Shore A shall be used for materials d-g.