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SURFACE VEHICLE STANDARD

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Recovery and Recycle Equipment for Mobile Automotive Air-Conditioning Systems

Foreword—Due to the damaging effect of CFC's on the ozone layer, CFC-12 (R-12) used in mobile air-conditioning (A/C) systems must be recovered and recycled to eliminate venting refrigerant during normal service operations. This SAE Standard establishes recycle specifications for CFC-12 (R-12) so as to provide the same level of air-conditioning performance as new refrigerant.

Extensive field testing with the EPA and the auto industry indicates that CFC-12 (R-12) can be reused, provided that it is cleaned to specifications in SAE J1991. The purpose of this document is to establish the specific minimum equipment specifications required for recycle of CFC-12 (R-12) that has been directly removed from mobile systems for reuse in mobile automotive A/C systems.

1. Scope

Scope—The purpose of this SAE Standard is to provide equipment specifications for CFC-12 (R-12) recycling equipment. This information applies to equipment used to service automobiles, light trucks, and other vehicles with similar CFC-12 (R-12) air-conditioning (A/C) systems. Systems used on mobile vehicles for refrigerating cargo that have hermetically sealed systems are not covered in this document. The equipment in this document is intended for use with refrigerant that has been directly removed from, and intended to be returned to, a mobile A/C system. Should other revisions due to operational or technical requirements occur, this document may be amended.

2. References

2.1 Applicable Publications—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, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J1991—Standard of Purity for Use in Mobile Air-Conditioning Systems
SAE J2196—Service Hose for Automotive Air Conditioning

2.1.2 CGA PUBLICATION—Available from CGA, Crystal Square #2, Jefferson Davis Highway, Arlington, VA 22202-4102.

CGA Pamphlet S-1.1—Pressure Relief Device Standard Part 1—Cylinders for Compressed Gases

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2.1.3 DOT SPECIFICATION—Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

CFR 49, Section 173.304—Shippers—General Requirements for Shipments and Packagings

2.1.4 UL PUBLICATION—Available from Underwriters Laboratories, 333 Pfingsten Road, Northbrook, IL 60062-2096.

UL 1769—Cylinder Valves

3. Specification and General Description

3.1 The equipment must be able to extract, recover, and process CFC-12 (R-12) from mobile A/C systems. The equipment shall process the contaminated CFC-12 (R-12) samples as defined in 8.4 and shall clean the refrigerant to the level as defined in SAE J1991.

3.2 The equipment shall be suitable for use in an automotive service environment and be capable of continuous operation in ambient from 10 to 49 °C.

3.3 The equipment must be certified by Underwriters Laboratories or an equivalent EPA listed certifying laboratory.

3.4 The equipment shall have a label "Design Certified by (Company Name) to Meet SAE J1991." The minimum letter size shall be bold type 3 mm in height.

4. Refrigeration Recycle Equipment Requirements

4.1 Moisture and Acid—The equipment shall incorporate a desiccant package that must be replaced before saturated with moisture and whose mineral acid capacity is at least 5% by weight of total system dry desiccant.

4.1.1 The equipment shall be provided with a moisture detection device that is reliable, visible, and indicates when moisture in the CFC-12 (R-12) exceeds the allowable level and requires the filter/dryer replacement.

4.2 Filter—The equipment shall incorporate an in-line filter that will trap particulates of 15 micron spherical diameter or greater.

4.3 Noncondensable Gas

4.3.1 The equipment shall automatically either purge noncondensables (NCGs) if the acceptable level is exceeded or incorporate a device to alert the operator that NCG level has been exceeded. NCG removal must be part of normal operation of the equipment and instructions must be provided to enable the task to be accomplished within 30 min.

4.3.1.1 Pressure gauges that are used to identify NCG level shall have readable divisions of 7 kPa values in order to identify the level of excess NCGs in the refrigerant.

4.3.1.2 Equipment that use the manual NCG purge process shall provide a method to determine the temperature of the refrigerant in the container being purged. This is required for determining the container refrigerant pressure/temperature relationship as the container lowers in temperature during the purge process. This is required to alert the operator if they have properly operated the purge cycle and determined the amount of NCG remaining in the container that has been purged. The procedure shall be identified in the instruction manual provided with the recycling equipment.

4.3.1.3 Equipment with automatic noncondensable (NCG) purge, and manual purge, shall not combine the refrigerant recycling operation with some other equipment operation (e.g., Recovery) unless a method to indicate that the recycled refrigerant has been processed and meets the specification in SAE 1991 before it can be charged into the mobile A/C system.

4.3.2 Refrigerant loss from noncondensable gas purging during testing described in Section 8 shall not exceed 5% by weight of the total contaminated refrigerant removed from the test systems.

4.3.3 TRANSFER OF RECYCLED REFRIGERANT—Recycled refrigerant for recharging and transfer shall be taken from the liquid phase only.

5. Safety Requirements

5.1 The equipment must comply with applicable federal, state, and local requirements on equipment related to the handling of CFC-12 (R-12) material. Safety precautions or notices related to the safe operation of the equipment shall be prominently displayed on the equipment and should also state "CAUTION—SHOULD BE OPERATED BY QUALIFIED PERSONS."

6. Operating Instructions

6.1 The equipment manufacturer shall provide a warning in the instruction manual regarding the possibility of refrigerant contamination in the mobile A/C system being serviced.

6.1.1 Recovery/recycle equipment having refrigerant identification equipment shall meet the requirements of SAE J1771.

6.1.2 Recovery/recycling equipment not having refrigerant identification capability shall have instructions in the equipment manual covering possible contamination problems to the equipment and container contamination of the existing recycled refrigerant in the equipment.

6.2 The equipment manufacturer must provide operating instructions, including proper attainment of vehicle system vacuum (i.e., when to stop the recovery process), filter/desiccant replacement, and purging of noncondensable gases (air). Also to be included are any other necessary maintenance procedures, source information for replacement parts and repair, and safety precautions.

6.2.1 The manual shall identify the proper maintaining of hose and seals preventing the addition of excess air, due to leaks, during the recovery process, that may increase the NCG level in the recovered refrigerant.

6.3 The equipment must prominently display the manufacturer's name, address, the type of refrigerant it is designed to recycle, a service telephone number, and the part number for the replacement filter/drier.

7. Functional Description

7.1 The equipment must be capable of ensuring recovery of the CFC-12 (R-12) from the system being serviced, by reducing the system pressure below atmospheric to a minimum of 102 mm of mercury below atmospheric pressure (i.e, vacuum).

7.2 To prevent overcharge, the equipment must be equipped to protect the tank used to store the recycled refrigerant with a shutoff device and a mechanical pressure relief valve.

7.3 Portable refillable tanks or containers used in conjunction with this equipment must meet applicable Department of Transportation (DOT) or Underwriters Laboratories (UL) Standards and be adaptable to existing refrigerant service and charging equipment.

7.4 During operation, the equipment shall provide overfill protection to assure the storage container, internal or external, liquid fill does not exceed 80% of the tank's rated volume at 21.1 °C per DOT standard, CFR Title 49, Section 173.304 and the American Society of Mechanical Engineers.

7.4.1 ADDITIONAL STORAGE TANK REQUIREMENTS

7.4.1.1 The cylinder valve shall comply with the standard for cylinder valves, UL 1769.

7.4.1.2 The pressure relief device shall comply with the pressure relief device standard part 1, CGA Pamphlet S-1.1.

7.4.1.3 The tank assembly shall be marked to indicate the first retest date, which shall be 5 years after date of manufacture. The marking shall indicate that retest must be performed every subsequent 5 years. SAE J2296 provides an inspection procedure. The marking shall be in letters at least 6.4 mm high.

7.5 All flexible hoses must meet SAE J2196 hose specification effective January 1, 1992.

7.6 Service hoses must have shutoff devices located within 30 cm of the connection point to the system being serviced to minimize introduction of noncondensable gases into the recovery equipment and the release of the refrigerant when being disconnected.

7.7 The equipment must be able to separate the lubricant from the recovered refrigerant and accurately indicate the amount removed during the process, in 30 mL units. Refrigerant dissolves in lubricant and, as a result, increases the volume of the recovered lubricant sample. This creates the illusion that more lubricant has been recovered than actually has been. The equipment lubricant measuring system must take in account such dissolved refrigerant to prevent overcharging the vehicle system with lubricant.

7.7.1 This statement shall be predominately identified in the equipment service manual.

NOTE—Use only new lubricant to replace the amount removed during the recovery/recycle process. Used lubricant should be discarded per applicable federal, state, and local requirements.

7.8 The equipment must be capable of continuous operation in ambient of 10 to 49 °C.

7.9 The equipment should be compatible with leak detection material that may be present in the mobile A/C system.

8. ***Testing—***This test procedure and the requirements are used for evaluation of the equipment for its ability to clean the contaminated CFC-12 (R-12) refrigerant.

8.1 The equipment shall clean the contaminated CFC-12 (R-12) refrigerant to the minimum purity level as defined in SAE J1991, when tested in accordance with the following conditions:

8.2 For test validation, the equipment is to be operated according to the manufacturer's instructions.

8.3 The equipment must be preconditioned with 13.6 kg of the standard contaminated CFC-12 (R-12) at an ambient of 21 °C before starting the test cycle. Sample amounts are not to exceed 1.13 kg with sample amounts to be repeated every 5 min. The sample method fixture, defined in Figure 1, shall be operated at 24 °C.

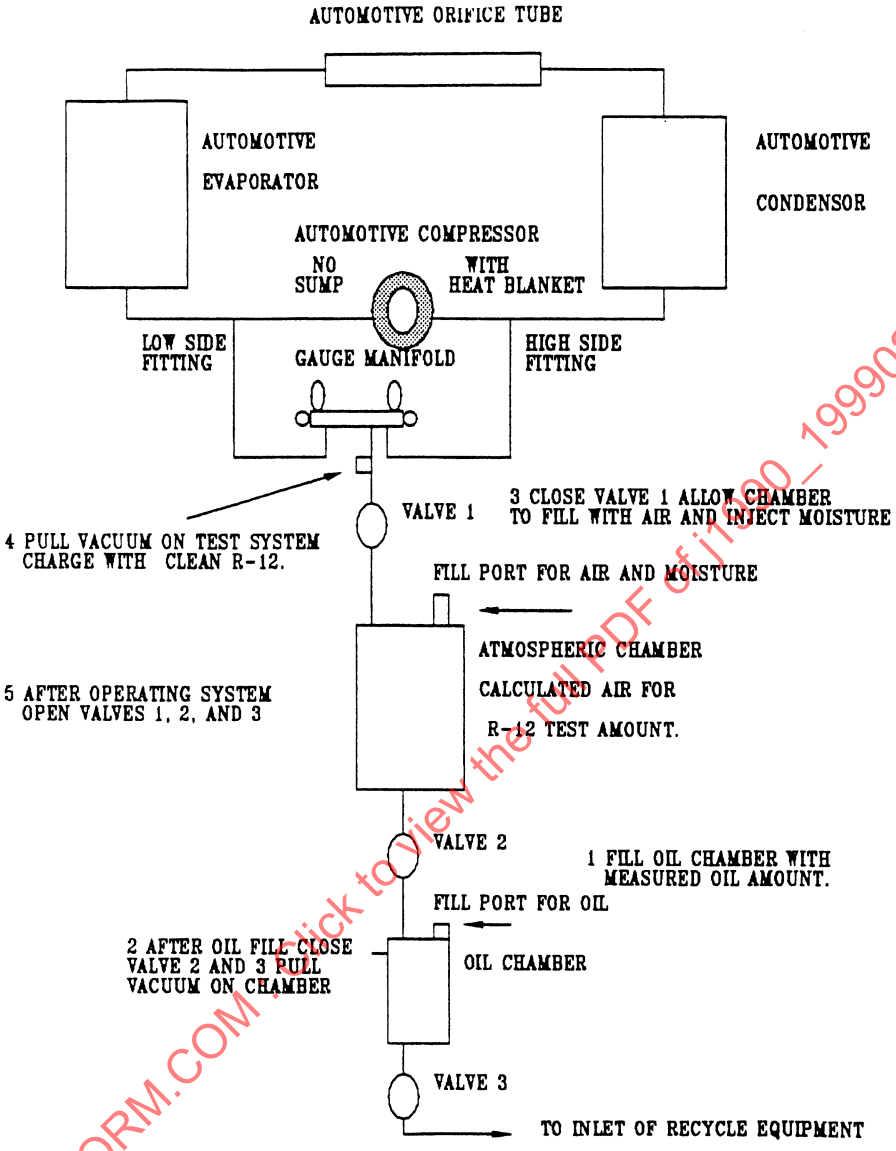

FIGURE 1—TEST METHOD FIXTURE

8.4 Contaminated CFC-12 (R-12) Samples

8.4.1 Standard contaminated CFC-12 (R-12) refrigerant shall consist of liquid R-12 with 100 ppm (by weight) moisture at 21 °C and 45 000 ppm (by weight) mineral oil 525 suspension nominal and 770 ppm by weight of noncondensable gases (air).

8.4.2 High moisture contaminated sample shall consist of CFC-12 (R-12) vapor with 1000 ppm (by weight) moisture.

8.4.3 High oil contaminated sample shall consist of CFC-12 (R-12) with 200 000 ppm (by weight) mineral oil 525 suspension viscosity nominal.

8.5 Test Cycle

8.5.1 After preconditioning as stated in 8.3, the test cycle is started, processing the following contaminated samples through the equipment:

8.5.1.1 13.6 kg of standard contaminated CFC-12 (R-12)

8.5.1.2 1 kg of high oil contaminated CFC-12 (R-12)

8.5.1.3 4.5 kg of standard contaminated CFC-12 (R-12)

8.5.1.4 1 kg of high moisture contaminated CFC-12 (R-12)

8.6 Equipment Operating Ambient

8.6.1 The CFC-12 (R-12) is to be cleaned to the minimum purity level, as defined in SAE J1991, with the equipment operating in a stable ambient of 10, 21, and 49 °C and processing the samples as defined in 8.5.

8.7 Sample Analysis

8.7.1 The processed contaminated sample shall be analyzed according to the following procedure.

8.8 Quantitative Determination of Moisture

8.8.1 The recycled liquid phase sample of CFC-12 (R-12) shall be analyzed for moisture content via Karl Fischer coulometer titration or an equivalent method. The Karl Fischer apparatus is an instrument for precise determination of small amounts of water dissolved in liquid and/or gas samples.

8.8.2 In conducting the test, a weighed sample of 30 to 130 g is vaporized directly into the Karl Fischer anolyte. A coulometer titration is conducted and the results are calculated and displayed as parts per million moisture (weight).

8.9 Determination of Percent Lubricant

8.9.1 The amount of lubricant in the recycled sample of CFC-12 (R-12) is to be determined by gravimetric analysis.

8.9.2 Following venting of noncondensable, in accordance with the manufacturer's operating instructions, the refrigerant container shall be shaken for 5 min prior to extracting samples for test.

8.9.3 A weighed sample of 175 to 225 g of liquid CFC-12 (R-12) is allowed to evaporate at room temperature. The percent lubricant is to be calculated from the weight of the original sample and the residue remaining after the evaporation.

8.10 Noncondensable Gas

8.10.1 The amount of noncondensable gas is to be determined by gas chromatography. A sample of vaporized refrigerant liquid shall be separated and analyzed by gas chromatrography. A Porapak Q column at 130 °C and a hot wire detector may be used for analysis.

8.10.2 This test shall be conducted on liquid phase samples of recycled refrigerant taken from a full container as defined in 7.4 within 30 min following the proper venting of noncondensable gases.

8.10.3 The samples shall be shaken for at least 15 min prior to testing while at a temperature of 24 °C ± 2.8 °C.