

the preparatory process, including installation of the charge.

APPENDIX E TO SUBPART B OF PART 82—
THE STANDARD FOR AUTOMOTIVE REFRIGERANT RECYCLING EQUIPMENT INTENDED FOR USE WITH BOTH CFC-12 AND HFC-134A

SAE J2211, Recommended Service Procedure for the Containment of HFC-134a, as set forth under Appendix C of this subpart, and SAE J1989, Recommended Service Procedure for the Containment of CFC-12, as set forth under Appendix A of this subpart, also apply to this Appendix E of this subpart.

SAE J1770, issued December, 1995.

AUTOMOTIVE REFRIGERANT RECYCLE EQUIPMENT INTENDED FOR USE WITH BOTH CFC-12 AND HFC-134A

Foreword

The purpose of this standard is to establish specific minimum equipment requirements for automotive refrigerant recycling equipment intended for use with both CFC-12 and HFC-134a in a common refrigerant circuit. Establishing such specifications will assure that this equipment does not cross contaminate refrigerant above specified limits when used under normal operating conditions.

1. Scope

The purpose of this standard is to establish the specific minimum equipment intended for use with both CFC-12 and HFC-134a in a common refrigerant circuit that has been directly removed from, and is intended for reuse in, mobile air-conditioning (A/C) systems. This standard does not apply to equipment used for CFC-12 and HFC-134a having a common enclosure with separate circuits for each refrigerant.

2. References

2.1 Applicable Documents—The following publications form a part of this specification to the extent specified. The latest issue of SAE publications shall apply.

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

SAE J2099—Standard of Purity for Recycled HFC-134a for Use in Mobile Air-Conditioning Systems

SAE 1991—Standard of Purity for Use in Mobile Air-Conditioning Systems

SAE J2196—Service Hoses for Automotive Air-Conditioning

SAE J2197—Service Hose Fittings for Automotive Air-Conditioning

SAE J2210—HFC-134a (R-134a) Recycling Equipment for Mobile A/C Systems

SAE J1990—Extraction and Recycling Equipment for Mobile A/C Systems

2.1.2 Compressed Gas Association (CGA) Publications—Available from CGA, 1235 Jefferson Davis Highway, Arlington, VA 22202.

CGA Pamphlet S-1.1—Pressure Relief Device Standard

Part 1—Cylinders for Compressed Gases

2.1.3 DOT Publications—Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402

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

UL 1769—Cylinder Valves

UL 1963—Refrigerant Recovery/Recycling Equipment

3. Specification and General Description

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

3.2 The equipment must be certified that it meets this specification by Underwriters Laboratories Inc. (UL), or by an equivalent Nationally Recognized Testing Laboratory (NRTL).

3.3 The equipment shall have a label which states "Design Certified by (Certifying Agent) to meet SAE J1770 for recycling CFC-12 and HFC-134a using common refrigerant circuits", in bold-type letters a minimum of 3 mm in height.

4. Equipment Requirements

4.1 General

4.1.1 The equipment shall be capable of preventing cross contamination to the level required by Section 9.2.1.G before an operation involving a different refrigerant can begin. The equipment must prevent initiation of the recovery operation if the equipment is not set up properly.

4.1.2 If an operator action is required to clear the unit prior to reconnecting for a different refrigerant, the equipment shall be provided with a means which indicates which refrigerant was last processed.

4.1.3 Means shall be provided to prevent recovery from both an CFC-12 and HFC-134a mobile air conditioning system concurrently.

4.1.4 Transfer of recycled refrigerant—Recycled refrigerant for recharging and transfer shall be taken from the liquid phase only.

4.2 Seat Leakage Test

4.2.1 Valves, including electrically operated solenoid valves, that are used to isolate CFC-12 and HFC-134a refrigerant circuits, shall have a seat leakage rate not exceeding 15 g/yr (½ oz/yr) before and after 100,000 cycles of operation. This Endurance Test shall be conducted with HFC-134a at maximum operating pressure as determined by sections 8.1 and 8.2. The Seat Leakage Test shall be

performed at 1.5 times this pressure at an ambient of 24 °C.

4.3 Interlocks

4.3.1 Electrical interlock devices used to prevent cross contamination of refrigerant shall be operated for 100,000 cycles and there shall be no failure that would permit cross contamination of refrigerant. Solid state inter lock devices shall comply with the Transient Overvoltage Test and the Fast Transient (Electric Noise) Test contained in the Standard for Tests for Safety Related Controls Employing Solid-State Devices, UL 991.

4.4 Noncondensable Gases

4.4.1 The equipment shall either automatically purge noncondensables (NCGs) if the acceptable level is exceeded or incorporate a device that indicates to the operator the NCG level has been exceeded. A pressure gauge used to indicate an NCG level shall be readable in 1 psig increments. NCG removal must be part of the normal operation of the equipment and instructions must be provided to enable the task to be accomplished within 30 minutes.

4.4.2 Refrigerant loss from noncondensable gas purging, oil removal, and refrigerant clearing shall not exceed more than 5 percent by weight of the total amount of refrigerant through the equipment as detailed in Sections 8.1, 8.2, and 9.2.

4.5 Filter

4.5.1 A 15 micron filter, or other equivalent means, to remove particulates of 15 micrometers spherical diameter or greater shall be located before any manual electrically operated valves that may cause cross contamination.

4.6 Moisture and Acid

4.6.1 The equipment shall incorporate a desiccant package that must be replaced before saturated with moisture, and whose acid capacity is at least 5% by weight of the dry desiccant.

4.6.2 The equipment shall be provided with a moisture detection means that will reliably indicate when moisture in the HFC-134a exceeds 50 ppm, or in the CFC-12 exceeds 15 ppm, and requires the filter/drier replacement.

5. Operating Instructions

5.1 The equipment manufacturer must provide operating instructions, including proper attainment of vehicle system vacuum (*i.e.*, when to stop the extraction process, and also to stop the extraction process if it is noticed that the A/C system being serviced has a leak), filter/desiccant replacement, and purging of noncondensable gases (air). The instructions shall indicate that the correct sequence of operation be followed so that the equipment can properly remove contaminants to the acceptable level. Also to be included are any other necessary maintenance procedures, source information for replace-

ment parts and repair, and safety precautions.

5.2 The equipment must prominently display the manufacturer's name, address, the type of refrigerant (CFC-12 and HFC-134a), a service telephone number, and the part number for the replacement filter/drier. Operation manuals must cover information for complete maintenance of the equipment to assure proper operation.

6. Safety Requirements

6.1 The equipment must comply with applicable federal, state, and local requirements on equipment related to handling CFC-12 and HFC-134a 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 PERSONNEL".

6.2 HFC-134a has been shown to be non-flammable at ambient temperature and atmospheric pressure. The following statement shall be in the operating manual: "Caution: HFC-134a service equipment or vehicle A/C systems should not be pressure tested or leak tested with compressed air. Some mixtures of air and HFC-134a have been shown to be combustible at elevated pressures (when contained in a pipe or tank). These mixtures may be potentially dangerous, causing injury or property damage. Additional health and safety information may be obtained from refrigerant and lubricant manufacturers."

7. Functional Description

7.1 General

7.1.1 The equipment must be capable of ensuring recovery of the CFC-12 and HFC-134a from the system being serviced, by reducing the system to a minimum of 102 mm of mercury below atmospheric pressure (*i.e.*, vacuum).

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

7.2 Shut Off Device

7.2.1 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 Storage Tanks

7.3.1 Portable refillable tanks or containers shall be supplied with this equipment and must be labeled "HFC-134a" or "CFC-12" as appropriate, meet applicable Department of Transportation (DOT) or NRTL's Standards and be adaptable to existing refrigerant service and charging equipment.

7.3.2 The cylinder valve shall comply with the Standard for Cylinder Valves, UL 1769.

7.3.3 The pressure relief device shall comply with the Pressure Relief Device Standard

Part 1—Cylinders for Compressed Gases, CGA Pamphlet S-1.1.

7.3.4 The tank assembly shall be marked to indicate the first retest date, which shall be 5 years after the date of manufacture. The marking shall indicate that retest must be performed every subsequent 5 years. The marking shall be in letters at least 6 mm high.

7.4 Overfill Protection

7.4.1 During operation, the equipment must provide overfill protection to assure that during filling or transfer, the tank or storage container cannot exceed 80% of volume at 21.1 °C of its maximum rating as defined by DOT standards, 49 CFR 173.304 and American Society of Mechanical Engineers.

7.5 Hoses and Connections

7.5.1 Separate inlet and outlet hoses with fittings and separate connections shall be provided for each refrigerant circuit.

7.5.2 All flexible hoses and fittings must meet SAE J2196 (for CFC-12) and SAE J2197 (for HFC-134a).

7.5.3 Service hoses must have shutoff devices located within 30 cm of the connection point to the system being serviced.

7.6 Lubricant Separation

7.6.1 The equipment must be able to separate the lubricant from the removed refrigerant and accurately indicate the amount of lubricant removed during the process, in 30 mL (1 fl oz) 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 into account such dissolved refrigerant removed from the A/C system being serviced to prevent overcharging the vehicle system with lubricant.

(NOTE: Use only new lubricant to replace the amount removed the recycling process. Used lubricant should be discarded per applicable federal, state and local requirements.)

7.6.2 The equipment must be provided with some means, such as a lockout device, which will prevent initiation of the recovery operation after switching to the other refrigerant, if the lubricant has not been drained from the oil separator.

8. Testing

8.0 Equipment shall be tested in sequence as noted in sections 8.1, 8.2 and 9.2. The filter/drier may be replaced only as noted by section 4.6.2.

8.1 CFC-12 Recycling Cycle

8.1.1 The maximum operating pressure of the equipment shall be determined when recycling CFC-12 while conducting the following tests. This pressure is needed for the Seat Leakage Test, Section 4.2.

8.1.2 The equipment must be preconditioned with 13.6 kg of the standard

contaminated CFC-12 (see section 8.1.2a) at an ambient of 21 °C before starting the test cycle. Sample amounts shall be 1.13 kg with sample amounts to be repeated every 5 minutes. The sample method fixture, defined in Figure 1 to Appendix A, shall be operated at 21 °C.

8.1.2a Standard contaminated CFC-12 refrigerant shall consist of liquid CFC-12 with 100 ppm (by weight) moisture at 21 °C and 45,000 ppm (by weight) mineral oil 525 suspension viscosity nominal and 770 ppm by weight of noncondensable gases (air).

8.1.3 The high moisture contaminated sample shall consist of CFC-12 vapor with 1000 ppm (by weight) moisture.

8.1.4 The high oil contaminated sample shall consist of CFC-12 with 200,000 ppm (by weight) mineral oil 525 suspension viscosity nominal.

8.1.5 After preconditioning as stated in section 8.1.2, the test cycle is started, processing the following contaminated samples through the equipment.

- A. 13.6 kg (1.13 kg per batch) of standard contaminated CFC-12.
- B. 1 kg of high oil contaminated CFC-12.
- C. 4.5 kg (1.13 kg per batch) of standard contaminated CFC-12.
- D. 1 kg of high moisture contaminated CFC-12.

8.1.6 The CFC-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 section 8.1.5.

8.2 HFC-134a Recycling Cycle

8.2.1 The maximum operating pressure of the equipment shall be determined when recycling HFC-134a while conducting the following tests. This pressure is needed for the Seat Leakage Test, Section 4.2.

8.2.2 The equipment must be preconditioned by processing 13.6 kg of the standard contaminated HFC-134a (see section 8.2.2a) at an ambient of 21 °C before starting the test cycle. 1.13 kg samples are to be processed at 5 minute intervals. The test fixture shown in Figure 1 to Appendix A shall be operated at 21 °C.

8.2.2a The standard contaminated refrigerant shall consist of liquid HFC-134a with 1300 ppm (by weight) moisture (equivalent to saturation at 38°[100 °F]), 45,000 ppm (by weight) HFC-134a compatible lubricant, and 1000 ppm (by weight) of noncondensable gases (air).

8.2.2b The HFC-134a compatible lubricant referred to in section 8.2.2a shall be a polyalkylene glycol based synthetic lubricant or equivalent, which shall contain no more than 1000 ppm by weight of moisture.

8.2.3 Following the preconditioning procedure per section 8.2.2, 18.2 kg of standard contaminated HFC-134a are to be processed by

the equipment at each stable ambient temperature of 10, 21, and 49 °C.

8.2.4 The HFC-134a is to be cleaned to the purity level, as defined in SAE J2099.

9. Refrigerant Cross Contamination Test

9.1 General

9.1.1 For test validation, the equipment is to be operated according to the manufacturer's instruction.

9.1.2 The equipment shall clean the contaminated CFC-12 refrigerant to the minimum purity level as defined in Appendix A, when tested in accordance with the requirements in section 8.1.

9.1.3 The equipment shall clean the contaminated HFC-134a refrigerant to the purity level defined in Appendix C, when tested in accordance with the requirements in section 8.2.

9.2 Test Cycle

9.2.1 The following method shall be used after the tests and requirements in Sections 8.1 and 8.2, respectively, are completed. Following the manufacturer's instructions, the equipment shall be cleared of HFC-134a, prior to beginning step A. The only refrigerant used for this is noted in steps A, C, and E of section 9.2.1. The test fixture shown in Figure 1 to Appendix A shall be used and the test shall be conducted at 10, 21, and 49 °C ambients.

- A. A 1.13 kg standard contaminated sample of CFC-12 (see section 8.1.2a) shall be processed by the equipment.
- B. Follow manufacturer's instructions to clear the equipment of CFC-12 before processing HFC-134a.
- C. Process a 1.13 kg, standard contaminated sample of HFC-134a (see section 8.2.2a) through the equipment.
- D. Follow manufacturer's instructions to clear the equipment of HFC-134a before processing CFC-12.
- E. Process a 1.13 kg standard contaminated sample of CFC-12 (see section 8.1.2a) through the equipment.
- F. Follow manufacturer's instructions to clear the equipment of CFC-12.
- G. The amount of cross contaminated refrigerant, as determined by gas chromatography, in samples processed during steps C and E of section 9.2.1., shall not exceed 0.5 percent by weight.

10. Sample Analysis

10.1 General

10.1.1 The processed contaminated samples shall be analyzed according to the following procedure.

10.2 Quantitative Determination of Moisture

10.2.1 The recycled liquid phase sample of refrigerant 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.

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

10.3 Determination of Percent Lubricant

10.3.1 The amount of lubricant in the recycled sample of refrigerant/lubricant is to be determined by gravimetric analysis.

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

10.3.3 A weighed sample of 175 to 225 g of liquid refrigerant/lubricant 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.

10.4 Noncondensable Gas

10.4.1 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 chromatography. A Propak Q column at 130 °C and a hot wire detector may be used for analysis.

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

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

10.5 Refrigerant Cross Contamination

10.5.1 The amount of cross contamination of CFC-12 in HFC-134a or HFC-134a in CFC-12 shall not exceed 0.5 percent by weight as determined by gas chromatography. A sample of vaporized refrigerant liquid shall be separated and analyzed by gas chromatography. A 1% SP-1000 on Carboxpack B (60/80 mesh) column may be used for the analysis.

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APPENDIX F TO SUBPART B OF PART 82— STANDARD FOR RECOVER-ONLY EQUIPMENT THAT EXTRACTS A SINGLE, SPECIFIC REFRIGERANT OTHER THAN CFC-12 OR HFC-134A

Foreword

These specifications are for equipment that recover, but does not recycle, any single, specific automotive refrigerant other than CFC-12 or HFC-134a, including a blend refrigerant.