SAE International™

SURFACE VEHICLE STANDARD

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Superseding J2788 DEC2006

HFC-134a (R-134a) Recovery/Recycle/Recharging Equipment for Mobile Air-Conditioning Systems

RATIONALE

This Standard has been updated to include the requirements needed to minimize lubricant contamination when servicing HFC-134a electrical compressor MAC systems and additional label requirements.

1. SCOPE

The purpose of this SAE Standard is to establish the specific minimum equipment performance requirements for recovery and recycling of HFC-134a that has been directly removed from, and is intended for reuse in, mobile air-conditioning (A/C) systems. It also is intended to establish requirements for equipment used to recharge HFC-134a to an accuracy level that meets Section 9 of this document and SAE J2099. The requirements apply to the following types of service equipment and their specific applications.

a. Recovery/Recycling Equipment,

b. Recovery/Recycling-Refrigerant Charging,

c. Refrigerant Recharging Equipment Only.

1.1 Improved refrigerant recovery equipment is required to ensure adequate refrigerant recovery to reduce emissions and provide for accurate recharging of mobile air conditioning systems. Therefore, 12 months following the publication date of this standard, requirements in this standard supplements and supersedes, SAE J2210.

1.2 Equipment shall be certified to meet all performance requirements outlined in this document and international/regional construction and safety requirements as outlined in Section 11 of this document.

1.3 This standard supersedes the requirements of SAE J2210 to reduce refrigerant emissions during servicing and provides requirements for charging refrigerant into mobile air conditioning systems.

1.4 Purpose

This SAE Standard is to establish the specific minimum equipment requirements for the recovery/recycling of HFC-134a that has been directly removed from, and is intended for reuse in, mobile air-conditioning systems and recovery/recycling and system recharging of recycled or virgin HFC-134a. Establishing such specifications will ensure that system operation with recycled HFC-134a will provide the same level of performance and durability as new refrigerant.

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

SAE J2099 Standard of Purity for Recycled HFC-134a (R-134a) 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 J2296 Retest of Refrigerant Container

2.1.2 CGA Publications

Available from CGA, 4221 Walney Road, 5th Floor, Chantilly VA 20151-2923, Tel: 703-788-2700, www.cganetcom.

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, Mail Stop: SSOP, Washington, DC 20402-9320.

OT Standard, CFR Title 49, Section 173.304 Shippers-General Requirements for Shipments and Packagings

2.1.4 UL Publications

Available from Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096, Tel: 847-272-8800, www.ul.com.

UL 1769 Cylinder Valves UL 1963 Refrigerant Recovery/Recycling Equipment

UL 1963 Refrigerant Recovery/Recycling Equipment

3. SPECIFICATION AND GENERAL DESCRIPTION

3.1 The equipment must be able to remove and process HFC-134a (R-134a) from mobile A/C systems to the purity level specified in SAE J2099.

3.2 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 (50 to 120 ºF). If it is designed to recharge a system, and it uses a scale for this purpose, the scale must demonstrate the ability to maintain accuracy per the test in 10.2.

3.3 The equipment must be certified that it meets this specification by an EPA listed certifying laboratory.

3.4 The equipment shall have a label, which states, "Certified by (Certifying Agent) to Meet SAE J2788 superseding SAE J2210" in bold-type letters a minimum of 3 mm (1/8 in) in height.

3.5 Equipment meeting high voltage compressor requirements in 8.9.5 shall also be marked below the SAE J2788 marking of 3.4 “Certified for High Voltage Compressor Service” in bold-type letters a minimum of 3 mm (1/8 in) in height and shall incorporate the ISO high voltage symbol.

4. REFRIGERANT RECYCLING EQUIPMENT REQUIREMENTS

4.1 Moisture and Acid

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

4.1.1 The equipment shall be provided with a means of indicating when the filter desiccant moisture capacity has reached the allowable limit and desiccant replacement is required. This may include a reliable means of detecting moisture level or an algorithm based on the amount refrigerant recovered. The user must be clearly alerted to replace the filter prior to the full saturation. Warnings shall be displayed on screens and (printed on printouts where applicable). The warnings must explain that the machine is approaching the end of filter life. The manufacturer must incorporate a lockout when the end of filter life is reached.

4.1.2 The manufacturer shall use an identification system to ensure that a new filter has been installed to reset the machine for operation.

4.2 Filter

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

4.3 Scale (if used)

The scale must maintain accuracy when moved, as per the test in Section 10.

4.4 Purging Noncondensable Gases

4.4.1 The equipment shall automatically purge noncondensables (NCGs), which are primarily air, if the acceptable level is exceeded. 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 min (to reach the refrigerant purity level specified in SAE J2099).

4.4.2 Refrigerant loss from noncondensable gas purging during the testing described in Section 8 shall be minimized by a method that initiates a purge when the machine has not been in use for a period long enough for air-refrigerant separation in the tank to have occurred.

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

4.5 Recharging and transfer of recycled refrigerant shall be taken from the liquid phase only.

5. SAFETY REQUIREMENTS

See Section 11 for International/Regional Construction and Safety Requirements.

5.1 The equipment must comply with applicable federal, state, and local requirements on equipment related to handling HFC-134a material. Safety precautions or notices related to safe operation of the equipment shall be prominently displayed on the equipment and should also state "CAUTION-SHOULD BE OPERATED BY QUALIFIED PERSONNEL."

5.2 Under NO CIRCUMSTANCES should any equipment be pressure tested or leak tested with air/HFC-134a mixtures. Do not use compressed air (shop air) for leak detection in systems containing HFC-134a. This should be clearly stated in the manual.

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 If recovery/recycle equipment has refrigerant identification equipment, the 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 the contamination of the existing recycled refrigerant in the container 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 extraction 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 to prevent the addition of excess air, due to leaks, during the recovery process, which would 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

The ability of the equipment to meet the refrigerant recovery and recharge specifications of this section shall be determined by the test procedures of Section 10.

7.1 The equipment must be capable of continuous operation in ambient temperatures of 10 ºC (50 ºF) to 50 ºC (120 ºF). Continuous is defined as completing recovery/recycle and recharge (if applicable) operations with no more than a brief reset period between vehicles, and shall not include time delays for allowing a system to outgas (which shall be part of the recovery period provided by this standard). Continuous may include time out for an air purge if necessary, although it is understood that extended equipment-off time is preferred to allow NCG and refrigerant separation in the supply tank for optimum results.

7.1.1 The equipment shall be capable of removing a minimum of 95% of the refrigerant from the test system in 30 min or less, without external heating, or use of any device (such as shields, reflectors, special lights, etc.) which could heat components of the system. The recovery procedures shall be based on 21 to 24 ºC (70 to 75 ºF) ambient temperature. The test system for qualifying shall be a 1.4 kg (3 lb) capacity orifice tube/accumulator system in a 2005-2009 Chevrolet Suburban with front and rear A/C, or the test option described in 10.5 and shall be determined by accurately weighing the recovery machine with the resolution and accuracy of within 2.3-g (0.005-lb) in the range of the machine's weight. The laboratory shall maintain records of the vehicle, including its VIN (vehicle identification number).

7.1.2 The preceding shall not preclude a brief period of engine/AC operation at fast idle (up to 15 min, up to 2000 rpm) to circulate refrigerant and oil, and provide some engine and A/C warm-up. The laboratory shall monitor coolant temperature per the vehicle engine coolant temperature sensor, and coolant temperature shall not be allowed to exceed 105 ºC (221 ºF). The time required shall not be included in the total time of 30 min set forth in 7.1.1.

7.1.3 The refrigerant that is recovered, following oil separation, shall be measured and the quantity displayed, accurate to within ±30 g (1.0 oz). The equipment must include a provision for checking the accuracy, per the requirements of 9.1.

7.2 Storage Vessel and Tank Over-fill Protection

See Section 11 listing international/regional construction and safety requirements.

7.3 If the machine is designed for recharging, and the marketer permits use of a non-refillable refrigerant tank, the machine shall include a way to ensure virgin refrigerant remaining in the tank (called the "heel") to no more than 2% of tank rated capacity when the tank is indicated to be empty. This may be done by the machine marketer as follows:

Specify a non-venting procedure, to minimize the amount of unused virgin refrigerant remaining in the tank. The machine shall include any devices required for the procedure, other than ordinary service shop tools and supplies, and include in the operator's manual, any instructions.

Provide an automatic or (with instructions in the operator's manual) semi-automatic non-venting procedure with the machine.

The laboratory shall test for the 2% capability. For testing purposes it may use a refillable tank, minimum 15 lb capacity (6.8 kg) containing a minimum of 7.5 lb (3.4 kg) refrigerant.

The test is as follows:

1. Weigh the tank at the start of the test, on a scale accurate to ±3 g, to ensure it contains sufficient refrigerant.

2. Operate the machine to remove refrigerant from the tank, charging into a holding container until the tank is indicated to be empty. Continue with the marketer's recommended procedure for the 2% capability.

3. Weigh the tank, on a scale accurate to ±3 g.

4. Using the recovery compressor and/or a vacuum pump, draw the tank into a vacuum of 9 to 10 in Mercury (225 to 250 mm Mercury). The tank must hold that vacuum with a decay of less than 10% in 10 min. If vacuum decays 10% or more, the procedure shall be repeated as necessary to ensure the tank is empty.

5. Weigh the tank on a scale accurate to ±3 g. The difference in weight from Steps 3 to 5 shall be within 2% of the weight of the amount of refrigerant that is the tanks rated capacity.

6. This test may be performed at the conclusion of testing in 10.4 or 10.5. If the machine passes or has passed all other testing in this standard, the marketer may make modifications in procedure and/or machine operation and retest once at a later date, within 90 days. If the machine fails the retest, the machine must be completely retested per this standard, or may be certified per the following alternative.

The marketer of the machine may specify use of a non-refillable refrigerant tank that provides for recycling and/or disposal of the residual refrigerant, in either case in a manner that does not vent. Or the marketer may exclude use of a one-way container, in the machine's operating instructions.

7.4 All flexible hoses must comply with SAE J2196.

7.5 Service hoses must have shutoff valves at the connection point to the system being serviced. Further, any hoses or lines to refrigerant storage/holding containers on or in the machine, must have shutoff valves at the connection points to permit tank replacement or charging with refrigerant, without loss of refrigerant. A tank that is a permanent installation is exempt from this requirement.

7.6 The equipment shall separate oil from the refrigerant, measure the amount accurate to (20 mL) (0.7 oz), so the technician has an accurate basis for adding oil to the system.

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

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

8. TESTING

This test procedure and its requirements are to be used to determine the ability of the recycling equipment to adequately recycle contaminated refrigerant.

8.1 The equipment shall be able to clean the contaminated refrigerant in 8.3 to the purity level defined in SAE J2099.

8.2 The equipment shall be operated in accordance with the manufacturer's operating instructions.

8.3 Contaminated HFC-134a Sample

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

8.3.1.1 The HFC-134a compatible lubricant referred to in 8.3.1, shall be polyalkylene glycol (PAG), ISO 100 such as UCLN or PAG ISO 46-55, such as Idemitsu or equivalent, which shall contain no more than 1000 ppm by weight of moisture.

8.3.1.2 Although the test lubricant is a PAG, to conform to that used in the test vehicle system, the equipment manufacturer also shall ensure that the seals used in the equipment are compatible with polyolester lubricant.

8.4 Test Cycle

8.4.1 The equipment must be preconditioned by processing 13.6 kg (30 lb) of the standard contaminated HFC-134a at an ambient of 21 to 24 °C (70 to 75 ºF) before starting the test cycle. 1.13 kg (2.56 lb) samples are to be processed at 5 min intervals. The test fixture, depicted in Figure 1, shall be operated at 21 to 24 °C (70 to 75 ºF).

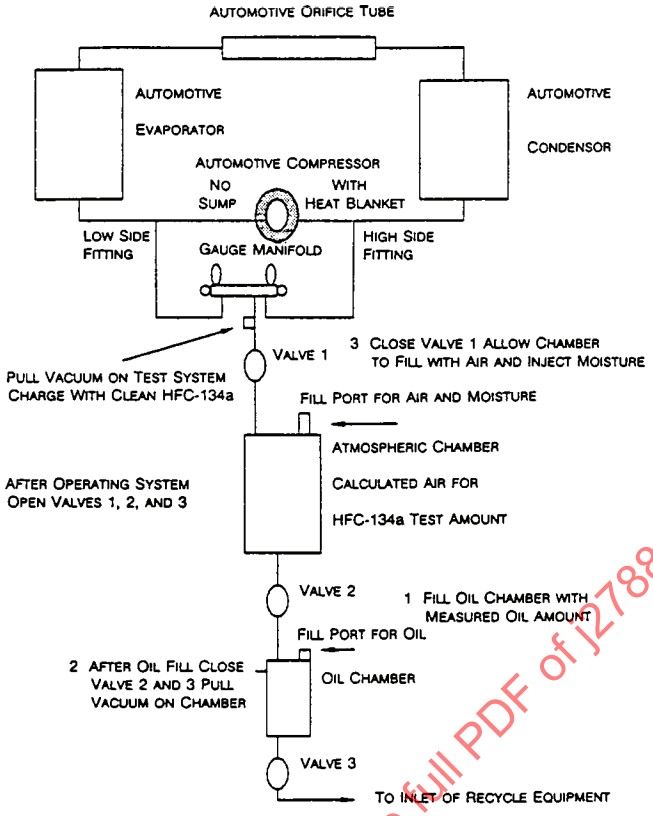

FIGURE 1 -TEST FIXTURE

8.4.2 Following the preconditioning procedure per 8.4.1, 18.2 kg (40 lb) of standard contaminated HFC-134a are to be processed by the equipment.

8.5 Sample Requirements

8.5.1 Samples of the standard contaminated refrigerant from 8.3.1 shall be processed as required in 8.6 and shall be analyzed after said processing as defined in 8.7, 8.8, and 8.9 Note exception for noncondensable gas determination in 8.9.4.

8.6 Equipment Operating Ambient

8.6.1 The HFC-134a is to be cleaned to the purity level, as defined in SAE J2099 with the equipment operating in a stable ambient of 10, 21, and 50 ºC (50, 70, and 120 ºF) while processing the samples as defined in 8.4.

8.7 Quantitative Determination of Moisture

8.7.1 The recycled liquid phase sample of HFC-134a shall be analyzed for moisture content via Karl Fischer coulometric 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.

8.7.2 In conducting this test, a weighed sample of 30 to 130 g is vaporized directly into the Karl Fischer anolyte. A coulometric titration is conducted and the results are reported as parts per million moisture (by weight).

8.8 Determination of Percent Lubricant

8.8.1 The amount of lubricant in the recycled HFC-134a sample shall be determined via gravimetric analysis. The methodology must account for the hygroscopicity of the lubricant.

8.8.2 Following venting of non-condensable gases in accordance with the manufacturer's operating instructions, the refrigerant container shall be shaken for 5 min prior to extracting samples for testing.

8.8.3 A weighed sample of 175 to 225 g of liquid HFC-134a is allowed to evaporate at room temperature. The percent lubricant is calculated from weights of the original sample and the residue remaining after evaporation.

8.9 Non-condensable Gases

8.9.1 The amount of non-condensable gases shall be determined by gas chromatography. A sample of vaporized refrigerant liquid shall be separated and analyzed by gas chromatography. A Porapak Q column at 130 ºC (266 ºF) and a hot wire detector may be used for the analysis.

8.9.2 This test shall be conducted on liquid phase samples of recycled refrigerant taken from a full container as defined in 7.2 within 30 min following the proper venting of non-condensable gases.

8.9.3 The liquid phase samples in 8.9.2 shall be vaporized completely prior to gas chromatographic analysis.

8.9.4 This test shall be conducted at 10 and 50 ºC (50 and 120 ºF) and may be performed in conjunction with the testing defined in 8.6. The equipment shall process at least 13.6 kg (30 lb) of standard contaminated refrigerant for this test.

8.9.5 Equipment Suitable for Servicing Systems with High Voltage Electric Compressors

8.9.5.1 Equipment suitable for servicing systems with high voltage electric compressors that use POE (polyolester) oil shall meet the following criteria and be identified as instructed in 3.5.

The equipment shall be capable of charging refrigerant into a system with less than 0.1% by weight of any residual oil. The percentage of residual oil in refrigerant shall be determined by conducting the following test using the specified test apparatus as shown in Figure 2. Equipment with the high voltage compressor service designation shall not have onboard oil or dye injection capability.

1. This test shall be conducted in an ambient environment 21 to 24 °C (70 to 75 °F).

2. Evacuate the equipment under test to 29 in of Hg minimum (sea level) and then pressurize its recovery tank to 65 psig with vapor HFC-134a.

3. Evacuate the SAE J2788 test Apparatus to 29 in of Hg minimum (sea level) via the VACUUM PORT and then close the VACUUM PORT VALVE.

4. Close the ISOLATION VALVE and allow the vacuum to draw 54 cc (1.8 oz) of 100 viscosity PAG oil into the 500 mL CYLINDER through the OIL FILL PORT and then close the OIL FILL PORT VALVE.

5. Add 1134 g (2.5 lb) of vapor HFC-134a to the 100 lb TANK through the VIRGIN HFC-134a VAPOR IN PORT and then open the ISOLATION VALVE.

6. Connect the equipment hoses to the HIGH AND LOW SIDE SAE HFC-134a PORTS FOR EQUIPMENT HOSE CONNECTION and recover the vapor HFC-134a per the equipment instructions.

7. Repeat steps 3 – 6 two more times such that three total recoveries are performed.

8. Perform the equipment manufacturer's recommended procedure to minimize residual PAG oil in hoses and equipment as specified in the equipment's operator instructions.

9. Immediately charge 454 g (1.0 lb) of liquid HFC-134a from the equipment into a clean, dry, evacuated 2 lb sampling cylinder.

10. Analyze the refrigerant to determine the weight percentage of lubricant per 8.8.

11. Percentage W/W (weight of oil/weight of refrigerant plus weight of oil) must be below 0.1% Equipment passing this criteria shall be marked as outlined in 3.5 and shall have specific operating instructions clearly and permanently marked on the unit and operator manual and/or automatic operation to assure the specification is met. The service hose(s) used for this test shall be the one(s) used for testing to all other parts of this standard and must be documented and specified as a requirement for meeting the SAE J2788 high voltage requirement.

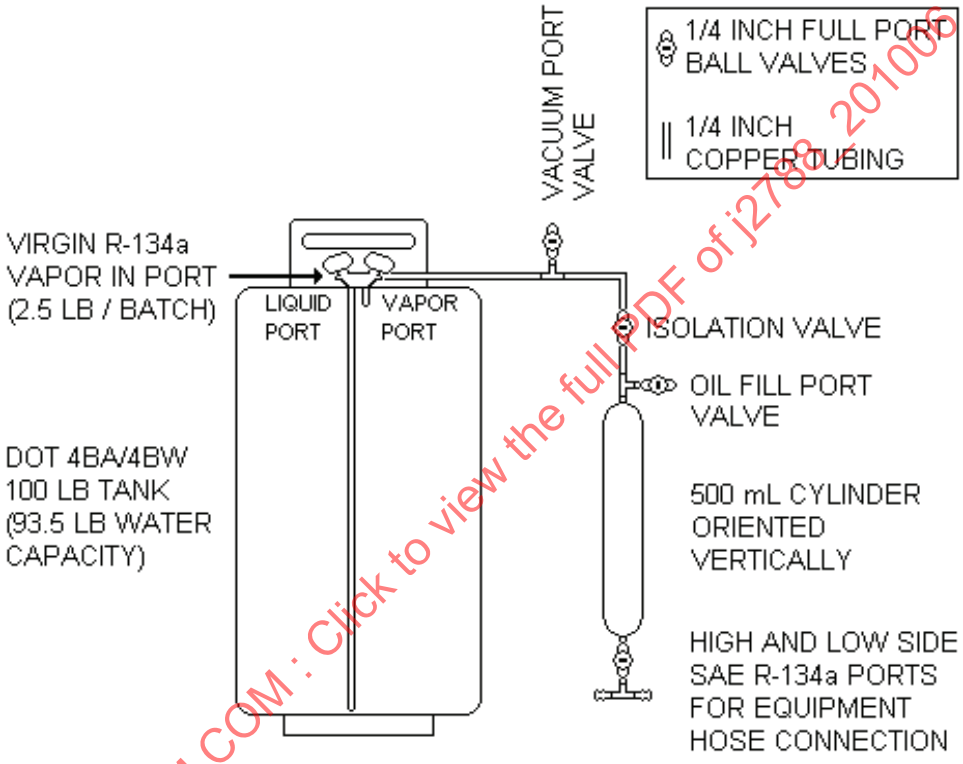

FIGURE 2 - SAE J2788 TEST APPARATUS

9. RECHARGING THE SYSTEM

9.1 It is the responsibility of the equipment manufacturer to ensure that the vacuum removal performance leaves the system 98% free of refrigerant and/or other NCGs before recharging, following recovery and recycle under the provisions of this document.

9.1.1 The equipment must be capable of both indicating and recharging the system to within 15 g (0.5 oz) of vehicle manufacturer's specifications. The laboratory shall test for this capability by choosing a charge amount that is within the range of the vehicle manufacturer's specifications. The equipment must indicate and charge the system with that chosen amount, within ±15 g (0.5 oz) example: if 500 g is chosen, the actual and indicated charge must be 485 to 515 g, with any difference between actual and indicated charge within the laboratory scale accuracy requirements of this standard.

9.1.2 If a scale is used in the machine, the equipment manufacturer shall provide a method or service for the technician to check scale accuracy, and include any necessary accuracy checking device (such as a calibration weight(s)) with the machine.

9.1.3 If a mass flow system is used for charge determination, it must maintain accuracy equal to the 15 g (0.50 oz) specification. The equipment manufacturer shall provide a method for checking accuracy and include any necessary accuracy testing device(s) with the machine.

9.1.4 If the accuracy testing device(s) for a scale or mass flow machine includes a consumable, the manufacturer shall include a quantity of replacement or refill devices for five years of periodic testing as recommended.

9.2 If any other system is used for charge determination, such as a positive displacement pump, the equipment manufacturer shall provide a method and any needed device(s) to check accuracy that is/are appropriate for its method of operation, including any temperature-compensating trim if used.

10. EQUIPMENT TEST PROCEDURE BY LABORATORY FOR RECOVERY/CHARGE AND RECOVERY/RECYCLE/RECHARGING MACHINES

10.1 Preliminary ambient (in shop) temperature shall be 21 to 24 ºC (70 to 75 ºF). Test vehicle shall be “overnight cold” (not run for at least 8 h).

10.2 The machine must have a self-contained provision for checking accuracy of the indicated amount of refrigerant recovered in liquid or vapor or mixture form(s) from a vehicle system and (if applicable) charged into a vehicle, and adjust if necessary, to meet requirements of 9.1 and 9.2. Therefore:

10.2.1 If the machine uses a scale for that purpose, check the accuracy of that scale and make any adjustment if necessary. If an alternative method of measuring refrigerant is used, follow the equipment manufacturer’s procedure for ensuring accuracy.

10.2.2 Prior to conducting R/R/R, move the machine, such as by rolling it, along the floor, a minimum of 20 ft (6.1 m) within 10 s and then, follow with the test procedure in 10.3.

10.3 Test Procedure

If desired, this test procedure may be preceded by engine/system operation for up to 15 min, up to 2000 rpm.

1. You must start with an empty system, using this method: (a) operate machine to recover refrigerant, per equipment manufacturer’s instructions. (b) Deep-vacuum system to a minimum of 710 mm (28 in HG). (c) Monitor vacuum for decay, checking every 20 min. If decay exceeds 75 mm (3 in HG), deep-vacuum again. When system holds 710 mm (28 in HG) +0/-75 mm (3 in HG) vacuum for 3 h, it is considered empty.

2. Place machine on a platform scale with the capacity to weigh the recovery/recycle/recharge machine, and with the resolution and accuracy of within ±2.3 g in the range of the machine’s weight. Weight should include the machine’s service hoses draped over the machine, and with the machine’s oil reservoir removed. If necessary to add oil to vehicle system as a result of a system operation preparatory to the recovery process, inject the needed quantity through the service valve at this time.

3. Record weight of machine as weight A.

4. Reconnect service hoses to the test vehicle.

5. Follow the equipment manufacturer’s specified procedure for charging the vehicle manufacturer’s recommended amount of refrigerant into the system. Note: if this does not apply to the machine under test, i.e., a recovery/charge-only machine, the use of charging equipment that meets this standard and the platform scale shall be used to verify the accuracy of the charge.

6. Disconnect the service hoses from the test vehicle and drape them on the machine. Check and record the weight of the machine. Record this weight as weight B. The difference between weight A and weight B should be equal to the recommended charge that was installed per the machine's display, within 15 g. If the difference is greater than 15 g (±2.3 g), the machine fails the charge accuracy test, and no other tests shall be performed at that time. The manufacturer must document changes made to improve accuracy and furnish them to the laboratory prior to a new test. Exception: if the deviation is no more than a total of 20 g, the calibration of the scale or other measuring system may be rechecked and readjusted once, and the entire test repeated just once.

10.4 Recovery Test Using a Vehicle

1. Following a successful system charge, the system and engine shall be run for 15 min at 2000 rpm to circulate oil and refrigerant, following which engine and system shall rest for 8 h. Then the laboratory may begin the recovery test. If the machine manufacturer specifies, operate the engine/system for up to 15 min, at up to 2000 rpm, then shut off engine/system.

2. If the machine has an automatic air purge, disable it. Check the weight of the machine with the platform scale (service hoses draped over machine, oil reservoir removed). Record the number as Weight C. Reinstall oil reservoir if it had been removed in the recovery procedure.

3. Start timer. Connect service hoses to system of test vehicle and perform recovery per the equipment manufacturer's instructions. The vehicle system service valves' cores must remain in the fittings for this procedure.

4. When recovery is completed, including from service hoses if that is part of the recommended procedure, disconnect hoses and drape over machine. Stop timer. The elapsed time shall be 30 min or less. If it is in excess of this time, the machine fails the test and no retest is allowed. The manufacturer must document changes made to the machine to improve its performance before a new test is allowed, and furnish them to the laboratory.

5. If the recovery is completed in no more than the 30 min, measure the oil level in the reservoir, remove the reservoir and then determine the amount of refrigerant recovered, as detailed in No. 6 and 7: as measured by the machine and also by noting the weight of the platform scale, which shall be recorded as Weight D.

6. The platform scale shall indicate that a minimum of 95% of the amount charged into the system has been recovered. If the platform scale indicates a lower percentage has been recovered, the machine fails the recovery test.

7. The machine display shall indicate that a minimum of 95% of the amount charged into the system has been recovered, within a tolerance of 30 g (1 oz) when compared with the platform scale (Weight D minus Weight C). The 30 g (1 oz) tolerance may produce a machine display reading that is below the 95% recovery. If a greater difference between machine and platform scale occurs, the machine fails the recovery test.

10.5 Recovery Test Fixture Test Option

If an equipment manufacturer chooses, as an alternative to the actual vehicle, it may certify to SAE J2788 with a laboratory fixture that is composed entirely of all the original equipment parts of a single model year for the 3-lb capacity front/rear Chevrolet Suburban A/C system as defined in Appendix A of this document.