Certification Training Manual

APPROVED BY THE U.S. EPA FOR TECHNICIAN TRAINING
REQUIREMENTS UNDER SECTION 609 OF THE CLEAN AIR ACT

REVISED 6/98

REFRIGERANT RECYCLING AND SERVICE PROCEDURES

For Automotive Air Conditioning Technicians

MACS®
MOBILE AIR CONDITIONING SOCIETY
WORLDWIDE

This technician certification program is not intended to test the technical skills of technicians regarding the diagnosis and repair of motor vehicle air conditioners. The basic goal of the technician training and certification program is to teach technicians how to properly recover and recycle refrigerant, and why it must be done to protect the stratospheric ozone layer. In addition. it provides information for servicing and retrofitting air conditioning systems with non-ozone depleting alternate refrigerant.

SEE INSTRUCTIONS FOR TAKING TEST AND OTHER INFORMATION ON INSIDE FRONT COVER...

Important Notes!!!

■ **Do not mix up tests or exchange tests with other individuals at your place of business. All tests are coded with names matching assigned numbers.**
■ **Please review your test upon completion. Any questions marked with more than one answer will be scored incorrect.**
■ **Completely fill in the block (■) to the left of the correct answer.**
Do not mark with a check (✓) or an x (X).

General Information and Instructions

You have registered for MACS certification in REFRIGERANT RECYCLING & SERVICE PROCEDURES FOR AUTOMOTIVE AIR CONDITIONING TECHNICIANS. Following are the steps* necessary for you to take to complete the prescribed training:

*** The following instructions apply to those technicians taking the MACS training course by mail. Those participating in a classroom program should follow the instructions of their trainer/proctor. Tests given in a classroom setting must be closed-book tests. The required score for passing these closed-book tests is less than that required for passing the open-book test.**

1 • Read the instruction manual that came with your recycling machine (and review the training video, if provided). Then, read this manual cover to cover. Re-read as necessary to gain full comprehension of the material presented.

2 • Take the enclosed test. The test is an untimed, "open-book" test, so you may refer to the training manual as often as necessary to research answers to the questions posed. (Note, however, that you must correctly answer a minimum of 21 of the 25 questions to earn certification.) **You must complete the test by yourself, without assistance from anyone, and submit it for scoring. (See 4 below.)**

3 • Fill out and sign the "Identification and Statement of Testing Conditions" block on the back of your test.

4 • Mail your test in the stamped, addressed envelope provided to: MACS-EIF, P.O. Box 88, Lansdale, PA 19446.

5 • MACS-EIF will advise MACS of your test results.

6 • MACS will advise you of your score and, providing that you have attained a passing score, will issue a certificate and a wallet-sized I.D. card, indicating that you have successfully completed this MACS certification training program.

Enclosed:
- Test with identification material, job experience, and declaration to be mailed to scoring facility
- Stamped return envelope (MACS-EIF)

Important • Please note: Tests must be returned for scoring within 90 days of the date they are issued. MACS assumes no responsibility for tests submitted for scoring after this 90-day period. MACS will charge an additional fee for re-issuing tests which are lost, misplaced or destroyed.

Introduction

There is worldwide consensus that chlorofluorocarbons (such as the CFC-12 used as a refrigerant in mobile air conditioning systems) destroy the stratospheric ozone layer. This industry has moved with all possible speed to implement refrigerant containment and recycling of refrigerants in automotive air conditioning systems, and to develop systems that use a non-ozone-depleting refrigerant, HFC-134a.

Now it's all up to you!

If you fail to operate and maintain your refrigerant recycling equipment as required by federal law, and as recommended by the equipment manufacturer, the development of recycling technology to reduce the release of refrigerant to the atmosphere will have been in vain.

You are key to the success of the national refrigerant recovery/recycling program, and a lot is riding on the success of the technology. Please take the time to read this manual completely and do your part to make the recovery/recycling program work.

Table of Contents

A note on refrigerant terminology...

This manual makes repeated reference to two refrigerants: CFC-12 and HFC-134a.

CFC-12 (also known as R12) is a chlorofluorocarbon, and is composed of the elements chlorine, fluorine and carbon. Its specific nomenclature is dichlorodifluoromethane.

HFC-134a (also known as R134a) is a hydrofluorocarbon, and is composed of the elements hydrogen, fluorine and carbon. Its specific nomenclature is 1,1,1,2-tetrafluoroethane.

Stratospheric Ozone Depletion and CFCs

The Issue

Common practice in the service of mobile air conditioning systems has been to add refrigerant to a leaking system and then vent the charge when any other service was required. That practice was acceptable because refrigerant was relatively inexpensive in the past and thought to be environmentally benign. But, knowing what we do today about the role of CFC-12 in the degradation of the earth's protective ozone layer, the service practice of venting CFC-12 is irresponsible and is no longer allowed. Under the Clean Air Act, such service practice is illegal. In other rulings, the EPA prohibits the venting of other substitute refrigerants that are used in mobile air conditioning systems.

Overview

Stratospheric ozone acts as a shield against harmful solar ultraviolet (UV) radiation. A significant reduction in ozone in the upper atmosphere could result in long-term increases in skin cancer and cataracts. Also it may cause damage to the human immune system. Reductions in the abundance of stratospheric ozone also may reduce crop yields and alter terrestrial and aquatic ecosystems.

A worldwide consensus has emerged that substances, including chlorine from synthetic chemicals called chlorofluorocarbons (CFCs) and bromine from chemicals called halons, react in a way which depletes ozone in the stratosphere. CFCs have been used as blowing agents in plastic foam products (cushioning, insulation and packaging), as refrigerants, as solvents, as sterilants, and in aerosol applications. Additionally, halons are used as fire extinguishing agents. To protect the ozone layer, the United States and over 160 other nations have now ratified the 1987 Montreal Protocol on Substances which Deplete the Ozone Layer. This landmark international agreement is designed to control the production and consumption of certain chlorofluorocarbon and halon compounds.

How Stratospheric Ozone Protects Us

Ozone is a pungent, slightly blue gas that absorbs certain wavelengths of the sun's radiation. Ozone is concentrated in a part of the atmosphere called the stratosphere, between 6 and 30 miles above the earth's surface. Stratospheric ozone should not be confused with ground level ozone, commonly referred to as smog.

Ozone depletion results in increased levels of UVB (ultra violet beta radiation) reaching the earth and related health and environmental effects. Ozone normally absorbs incident UVB; decreasing the amount of ozone results in higher UVB levels.

The Theory

Concern about possible depletion of the ozone layer from CFCs was first raised in 1974 with publication of research which theorized that chlorine released from CFCs could migrate to the stratosphere and destroy ozone molecules (Molina and Rowland, 1974). Some CFCs have an atmospheric lifetime of more than 120 years (i.e., they do not break down in the lower atmosphere). As a result, they migrate slowly to the stratosphere where higher energy radiation strikes them, releasing chlorine. Once freed, the chlorine acts as a catalyst, repeatedly combining with, and breaking apart ozone molecules. **It is believed that one CFC molecule can destroy as many as 100,000 ozone molecules.**

When ozone depletion occurs, more UV radiation penetrates to the earth's surface. Moreover, because of the long atmospheric lifetimes of CFCs, it will take many decades for the ozone layer to return to its former concentration and safety when CFCs are no longer used.

Ozone Depletion

The link between CFCs and ozone depletion is supported by scientific evidence.

Chlorofluorocarbons (CFCs) have been widely used, and they migrate into the upper atmosphere after use. Because CFCs are very stable, and they are heavier than air, they do not break down until they are carried by wind currents into the stratosphere, a process that can take as long as 5 to 10 years.

In the stratosphere, these chemicals absorb UV radiation, break apart, and react with ozone, taking one oxygen atom away and forming highly reactive chlorine monoxide. Chlorine monoxide in turns breaks down ozone again by pulling away a single oxygen atom, creating two oxygen molecules, and allowing the chlorine to move freely to another ozone molecule. (See illustration, page 6.)

With the increased release of CFCs to the atmosphere, a British researcher found that vortex winds prevented the mixing of ozone-rich air over the Antarctic, producing the ozone hole.

When scientists began studying ozone depletion in the early 1970s, they investigated several natural phenomena, such as volcanoes and evaporation of seawater.

Volcanoes can produce large quantities of hydrochloric acid. However, most volcanic discharges are not powerful enough to reach the stratosphere. Chlorine evaporation from seawater is dissolved in rain and does not reach the stratosphere.

Chlorine produced by volcanoes or oceans does not leave the troposphere and poses no threat to the ozone layer. However, CFCs, being extremely stable, do not release chlorine until they reach the stratosphere.

In December 1994, NASA announced that three years of satellite data confirmed that CFCs are the primary source of stratospheric chlorine.

Scientists predict that CFC levels should peak by the year 2000 and return to 1979 levels between the years 2020 and 2050. As the CFC levels are reduced, the natural atmospheric process will rebuild the ozone level. Until that time, increased UV levels can lead to a greater chance of overexposure to UV radiation and the consequent health effects.

Health & Environmental Effects

Shielding the earth from much of the damaging part of the sun's radiation, the ozone layer is a critical resource which safeguards life on this planet. Should the ozone layer be depleted, more of the sun's damaging rays would penetrate to the earth's surface. Each 1% depletion, it is estimated, would increase exposure to ultraviolet radiation by 1.5 to 2%.

The Environmental Protection Agency's (EPA) assessment of the risks from ozone depletion focused on the following areas:

- Increases in skin cancers
- Damage to the human immune response system
- Increases in cataracts
- Damage to crops
- Damage to aquatic organisms
- Increases in ground level ozone
- Increased global warming

Human Health Effects

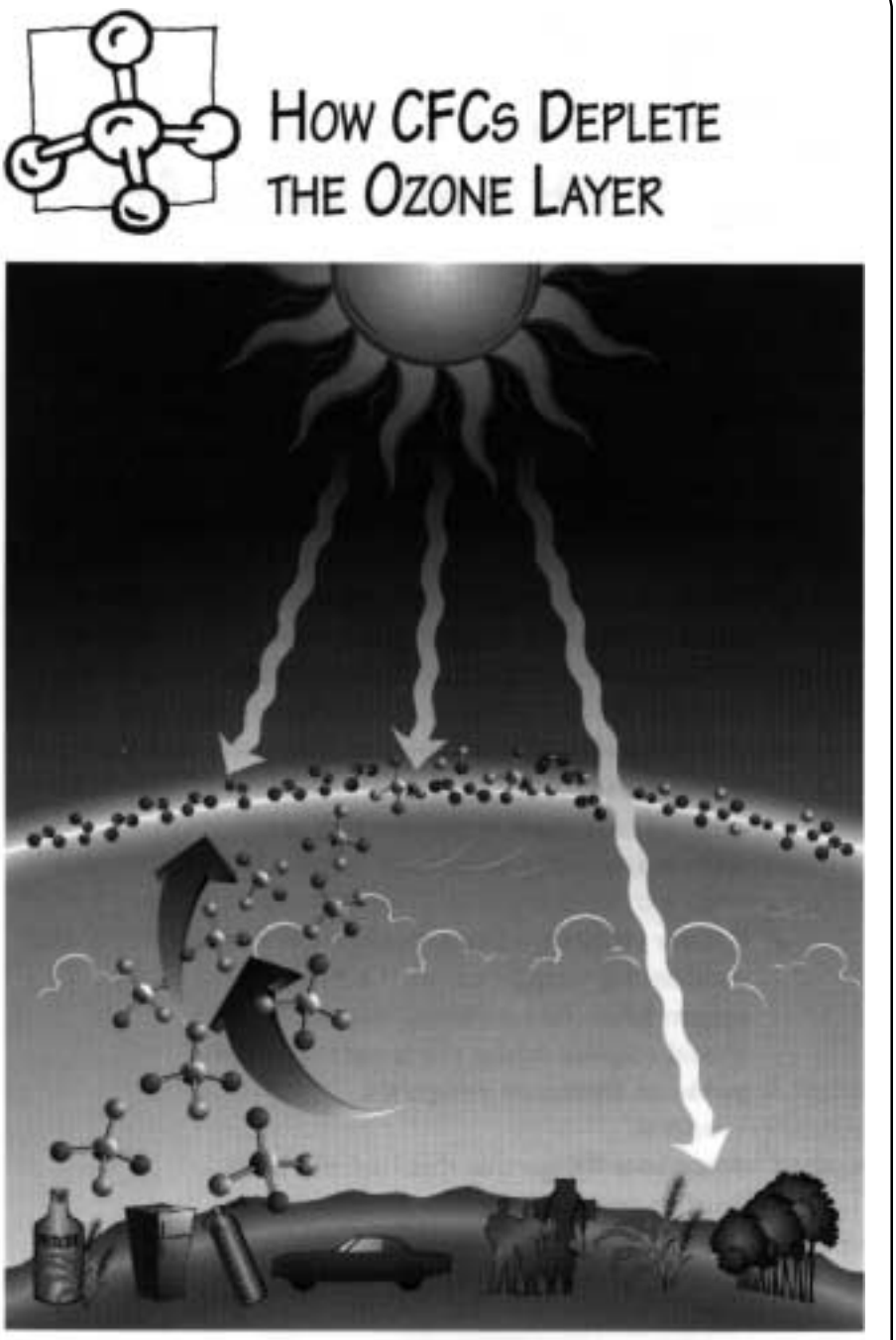
Skin cancer is already a serious problem in the United States and will only increase with further depletion of the ozone layer.

If the ozone layer continues to be depleted, three distinct types of skin cancer will increase.

Basal and squamous cell skin cancers are the two most common types. They now affect about 500,000 people annually in the United States. If detected early, these cancers are treatable. Even so, approximately 1% of all cases result in premature deaths.

Malignant melanoma is far less common but substantially more harmful. About 25,000 cases now occur annually, resulting in 5,000 deaths each year. In 1996, the latest year for which information is available, about 38,000 cases of melanoma occurred, with 7,300 fatalities. Six out of seven skin cancer fatalities are due to melanoma. While the relationship between exposure to UV radiation and melanoma is complex, existing studies provide a basis for estimating future risks associated with ozone depletion.

Cataracts cloud the lens of the eye, thus limiting vision. Although cataracts develop for a variety of reasons, scientific evidence supports the conclusion that increased exposure to UV radiation from ozone depletion would increase the



CFCs drift high up into the stratosphere where the sun's rays break them apart, starting a chain reaction in which chlorine destroys ozone. As the level of protective ozone diminishes, larger amounts of ultraviolet (UV) radiation reach the Earth's surface. For people, overexposure to UV rays can lead to skin cancer, eye cataracts, and can weaken the immune system.

number of people experiencing this particular eye disorder.

Based on epidemiological studies, if current trends in the use of ozone-depleting gases continued, the number of cataract cases would increase by 18 million (for the population alive today and the people born before 2075). Actions required by the Montreal Protocol and the U.S. Clean Air Act to limit the use of these chemicals would reduce the number of additional cases by 92% during this time period.

Damage to the immune system is another possible threat to human health resulting from ozone depletion. Research to date suggests that exposure to UV radiation weakens the immune system's ability to fend off certain diseases (i.e., herpes simplex and leishmaniasis, a parasitic disease common in the tropics). However, more needs to be known about the exact way the immune system is affected and the implication UV radiation exposure has for a wide variety of other diseases.

Plant & Marine Effects

Crops and other terrestrial ecosystems also could be adversely affected by increased exposure to UV radiation. In greenhouse studies, approximately two-thirds of the crops exposed to elevated levels of UV radiation proved sensitive. Field studies of soybeans have shown that ozone depletion of up to 25% could decrease yield by over 20%, with substantially greater losses in years when climatic stresses are also a factor.

Certain marine organisms, particularly phytoplankton and the larvae of many species, also may be sensitive to increased exposure to UV radiation because they spend much of their existence near the surface of the water. Although it is difficult to design experiments replicating aquatic environments, research to date suggests that adverse effects on productivity and species diversity are related to increased exposure to UV radiation.

Other Impacts

Ground Level Ozone — Ozone depletion would increase the rate of formation of ground level (tropospheric) ozone, a major component of what is commonly called smog.

Degradation of Polymers — Ozone depletion would accelerate the weathering (i.e. chalking, yellowing, and cracking) of plastics used in outdoor applications.

Climate Change — CFCs are greenhouse gases (i.e., they have similar properties to carbon dioxide) and thus may contribute to global warming and rising sea levels.

Global Problem

Unlike many other environmental issues, stratospheric ozone protection is truly a global problem. CFCs and halons have been used in many nations, and, given their long atmospheric lifetimes, they become widely dispersed over time. As a result, the release of these chemicals in one country could adversely affect the stratosphere above, and therefore the health and welfare of other countries. Many developed countries produced CFCs and halons. Most consumed these chemicals in a variety of different products. The United States, for example, has been one of the largest consumers of the world's CFCs. Other nations also have been significant users.

Therefore, to protect the ozone layer from the damage that may be caused by the venting of CFCs and halons, an international solution was critical.

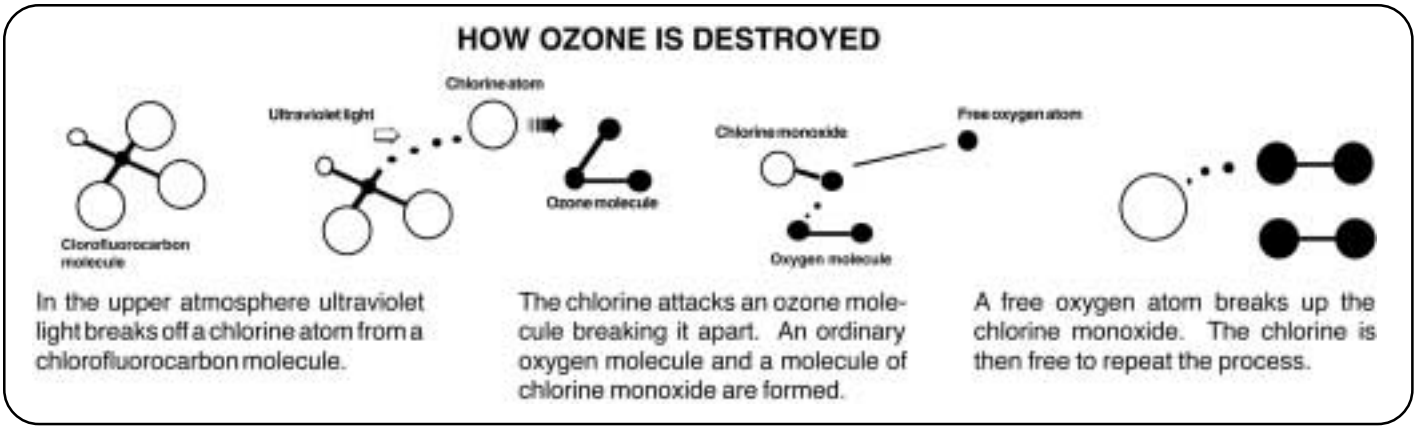
Montreal Protocol

Recognizing the global nature of the problem, on September 16,1987, in Montreal, Canada, 24 nations and the European Economic Community (EEC) signed the Montreal Protocol on Substances which Deplete the Ozone Layer. Currently more than160 nations, representing more than 95 percent of the world's consumption of CFCs, are parties to the Protocol.

The Chemicals

Listed below are the five chemicals controlled by the Montreal Protocol and the associated **ODP** (Ozone Depletion Potential) value, a measure of a chemical's relative ability to destroy ozone molecules in the stratosphere:

• **Fully-Halogenated Chlorofluorocarbons (Grp. 1)**	**ODP**
CFC-11	1.0
CFC-12	1.0
CFC-113	0.8
CFC-114	1.0
CFC-115	0.6



The higher the ODP value, the greater the potential to destroy ozone in the stratosphere.

Focus on CFC-12

Mobile air conditioners, which cool the passenger compartments of automobiles, trucks, and buses, have been the largest single users of CFCs in the United States. CFC-12 refrigerant was used for this purpose. A/C systems used an estimated 54,000 metric tons of CFC-12 in 1985. Out of 15.3 million motor vehicles manufactured or imported in that year, over 85% had factory-installed air conditioners.

Until the fleet of mobile A/C systems produced prior to the mid-1990s is retired or retrofitted, CFCs used in these systems represent a large percentage of the total ozone-depleting potential of CFCs in the United States.

It is therefore important to reduce the release of CFC-12 by identifying, repairing and/or replacing A/C system parts which leak or cause leaks to occur.

Further, government studies show that many A/C-equipped vehicles sent to salvage still contain some refrigerant. Under Section 608 of the federal law, this refrigerant can not be released, and must be recovered before vehicle disposal.

U.S. Joins In Worldwide Action

The U.S. and other countries have signed the Protocol, agreeing to phase out production of ozone-depleting substances. The 1990 Clean Air Act Amendments incorporated the Protocol's original phase-out date: the year 2000. In 1992, President Bush pledged to halt almost* all U.S. production of CFCs by the end of 1995. **(*The President's declaration left open the possibility of allowing some minimum production beyond this date for "essential uses." Automotive A/C systems are not considered "essential uses.")** Millions of vehicles will still require CFCs to maintain A/C system operation or they will have to be retrofitted.

CFC-12 Supply

With the U.S. Dec. 31, 1995 phase-out date for the production of new CFC-12, the supply of both new and reclaimed CFC-12 can be expected to diminish as stockpiles are used up. Vehicle OEMs were fully aware of this situation, and worked both to conserve the available supply of CFC-12 and to efficiently retrofit existing vehicles to HFC-134a refrigerant when appropriate.

In addition, the EPA requested SAE and the industry to develop a retrofit refrigerant program for replacement of CFC-12 systems.

Sources of Refrigerant Venting

Motor vehicle air conditioning systems can release refrigerant into the atmosphere in a number of ways:

- There are system leaks from part failures and venting which occurs when a leak is not repaired and the system is recharged, or "topped off," and returned to the customer.
- Refrigerant can be vented during various service procedures.
- It can be vented from manifold gauges and equipment hoses.
- And when using small cans, refrigerant remaining in the container is likely to ultimately be vented. The refrigerant remaining in larger, 20 and 30 pound one-way containers is also sometimes vented when they are scrapped.

Important Dates

Jan. 1, 1992: Since this date, containment and recycling of CFC-12 (and HCFC refrigerants, none of which are approved by A/C systems manufacturers to date) has been required.

Nov. 15, 1992: Since this date, sales of containers of CFCs under 20 pounds to anyone other than certified Section 609 technicians has been prohibited.

Nov. 14, 1994: Since this date, the sale of ozone-depleting refrigerants in any size container is restricted to certified technicians (Ref.: Sect. 608, CAA).

July 1995: Since this date any CFC-12 mobile air conditioning system that is converted (retrofitted) to use an acceptable alternate refrigerant must have the appropriate unique service fittings and label for that refrigerant.

Nov. 15, 1995: Since this date, recovery and recycling of any substitute substance for CFC-12, such as HFC-134a, used in a motor vehicle air conditioner has been required.

The above requirements apply to both new businesses and those which change ownership.

EPA Q & A

Q: How was HFC-134a selected as a replacement refrigerant for CFC-12 in automobile air conditioning systems?

A: Engineers for automobile manufacturers conducted research and testing on many potential substitutes for CFC-12 before selecting HFC-134a. As part of this research and testing, they reviewed the potential health effects, toxicity, flammability, and corrosivity of each potential substitute, evaluated the effect of each compound on the life and performance of the air-conditioning components in the various models made by each manufacturer, and also determined the effect of each compound on the system's cooling capacity. It was determined that HFC-134a was the most suitable alternative.

Federal Regulations Affecting Motor Vehicle Air Conditioning & Repair

Summary of Federal Mobile A/C Service Requirements

In 1993, the EPA under Section 608 changed the rule so that farm, construction and off-road vehicles must comply with training and service requirements under either Section 608 or Section 609. Since these types of vehicles generally use automotive type air conditioning systems, certification for compliance can be made under Section 609.

New rules issued by the EPA were effective Jan. 29, 1998. These rules will affect the daily operation of the mobile A/C service industry.

Additional information can be obtained from the EPA Hotline at (800) 296-1996 or the EPA Web Site: http://www.epa.gov/ozone/title6/609/.

In summary, current federal requirements for mobile A/C systems are:

1. Any refrigerant including R12, R134a and other alternates, removed during service from a mobile air conditioning system must be recovered and recycled, not vented.
2. All R12 and R134a recovery-only or recovery/recycling equipment must be certified to meet EPA (SAE) standards and certified by UL or ETL.
3. Recovery-only equipment for each SNAP-listed alternate refrigerant must meet EPA equipment standards.
4. All automotive service technicians must be certified to handle non-ozone depleting refrigerants including R134a. Certification is also required for alternate refrigerants listed under the SNAP rule for automotive use. Any technician that had been certified for CFC-12 does not require a new certification. Every technician that opens the refrigerant circuit must be certified to work on the mobile A/C system. This includes any service facilities whose technicians enter the refrigerant circuit, including those that only add refrigerant to ("top off") the system. Facilities that typically only change or add fluids (lube-oil-filter operations) also require certified technicians and equipment. The rule also requires that the refrigerant (R12 and R134a) removed from the vehicle must be recycled before it can be recharged, even if it has been removed from the same vehicle. This does not include alternate blend refrigerants, since currently it is illegal to recycle blends on site.
5. Under federal law it is legal (except as required under more stringent requirements by certain state and local laws) to add refrigerant to a pre-existing leaking system.
6. It is not required under federal regulations to remove refrigerant from a leaking system. (This action may be required under state and local laws.) Service facilities may adopt a policy not to add refrigerant to a leaking system; however, the policy should be explained to the customer in advance, including the fact that the policy is not a federal requirement.
7. If the customer arrives with some unknown amount of refrigerant in the system, and it is removed by the technician, and the system is not repaired, the technician must return to the system any refrigerant which was in the system when it arrived, unless the customer agrees to its removal.

It should be noted that some state and local laws are more stringent regarding servicing of mobile air conditioning systems. Determine if your area of employment requires compliance with both federal and state or local servicing requirements.

Remember that it is mandatory to be a certified technician and to use recovery/recycling equipment whenever you are doing work that might allow refrigerant to escape.

Offer to fix leaks in the air conditioning system. It helps to protect the environment and conserves refrigerant supplies. It is not correct, however, to state or imply that the leak repair is required under federal law. Doing so would constitute consumer fraud. It is important that you determine if local or state laws require that a leaking A/C system be repaired before adding refrigerant.

Salvage and/or Disposal Facilities

1. Salvage and/or disposal facilities must remove R12 and R12 substitutes, including R134a, from salvaged or scrapped mobile A/C systems.
2. Certified 609 A/C technicians can remove R12 and R134a from mobile A/C systems at salvage and/or disposal facilities. The refrigerant they recover can be moved to their facility for recycling and reuse in other vehicles. (Alternate blends cannot be recycled on-site for reuse.)
3. Salvage and/or disposal facilities that have purchased certified recovery equipment can recover refrigerant at their facility and also move the equipment to another salvage and/or disposal facility and recover refrigerant. This refrigerant can be sold to technicians certified under section 609. The salvage employee does not have to be certified for this salvage operation. However, this uncertified person cannot charge this or any other refrigerant into a mobile A/C system without being certified under section 609 and the refrigerant has to be properly processed prior to reuse.

The fact that refrigerant removed at these salvage and/or disposal facilities can be contaminated when removed from vehicles, or be mixed with contaminated refrigerant in recovery equipment, can be a problem. Since there is no requirement to identify the purity of

the refrigerant being removed from these vehicles, or label their containers, there is concern about the possibility of contaminated supplies coming from these facilities.
4. There are record-keeping requirements for salvage and/or disposal facilities to verify that the refrigerant was removed by another, and to record the sale of all ozone-depleting refrigerant. In addition, they must certify to EPA that they have certified recovery equipment.

Off-Site Service

1. The rule allows transportation of certified recovery/recycling equipment to another site to perform mobile A/C system refrigerant service. This allows the use of the certified equipment at body shops, used car dealerships, farms, construction sites, mines and other remote sites.
2. Service of the refrigerant circuit requires certification under section 609 for anyone performing "service for consideration." (See EPA Note on page 11.) Persons working on their own equipment, such as do-it-yourselfers (DIYers) and farmers are not covered under this rule and can add refrigerant without being certified. However, there are two important factors that cover anyone servicing a mobile A/C system. Anyone attempting to remove refrigerant from the system legally cannot vent it and can be fined if they do so. This means that recovery equipment and section 609 certification to operate it is required. So the end result is, working on the A/C system refrigerant circuit at some point requires equipment and refrigerant, both of which require 609 certification.

Section 609, 1990 Clean Air Act Amendments

Section 609 of the Act gives the EPA authority to establish requirements to prevent the release of refrigerants during the servicing of motor vehicle air conditioners. On July 14, 1992, the EPA published the final rules (regulation) implementing this section of the Act (40 CFR Part 82). Requirements outlined in the regulation include the following:

Please Note: Some state and local laws are more stringent than, or have requirements in addition to the federal requirements discussed here. Shop owners/technicians should determine if their local area or state has additional requirements.

Equipment Use

Since Jan. 1, 1992, for R12 (and January 29, 1998 for R134a and other alternates), any technician servicing, repairing or opening a motor vehicle air conditioning system "for consideration" — anything other than free service — must use either refrigerant recovery/recycling or recovery-only equipment approved by EPA.

Technician Training/Certification

Technicians using approved equipment must be trained and certified by an EPA-approved organization. To be certified, technicians must pass a test demonstrating their knowledge in the use of recycling equipment in compliance with SAE Standard J1989, the regulatory requirements, the importance of refrigerant containment and the effects of ozone depletion.

Any person that opens the refrigerant circuit for service must recover the refrigerant and therefore must be certified.

Equipment Certification

It is the responsibility of the equipment owner or another responsible officer to certify (report) to EPA that they own approved equipment. This requirement became effective Jan. 1, 1993. To certify equipment, the following information must be mailed to the EPA at this address: MVAC Recycling Program Manager, Stratospheric Ozone Protection Branch (6205J), 401 M Street, S.W., Washington, DC 20460. **Information to be provided:**

- **Name, address and telephone number** of the establishment where the recovery/recycling equipment is located;
- **Name brand, model number, year and serial number(s)** of the equipment acquired for use at the above establishment.
- **The certification statement must include the above information and can be on a plain sheet of paper and, must be signed** by the person who has acquired the equipment (the person may be the owner of the establishment or another responsible officer). The person who signs is certifying that they have acquired the equipment, that each individual authorized to use the equipment is properly trained and certified, and that the information provided is true and correct. Regardless of the refrigerant type, the service shop certification statement must be sent to the EPA. The repair facility is required to file this certification only one time.

Note: A copy of the equipment certification should be kept on file by the shop owner.

Additional information is available through EPA's Stratospheric Ozone Information Hotline. This toll free public service is available Monday through Friday, 10 a.m. to 4 p.m. (Eastern), except on federal holidays.

The Hotline number is (800) 296-1996.

EPA Q & A

Q: Will shops that sent in their recover/recycling equipment certification forms receive an EPA number for purchasing small cans of refrigerant?

A: No, the equipment certification form is filed and used with inspection information in enforcement actions. The shop will not receive verification of receipt from EPA. Technician certification cards issued under section 609 are the only identification accepted for the purchase of small containers of refrigerant.

Record-Keeping Requirements

Any person who owns approved refrigerant recovery or recovery/recycling equipment must maintain records of the name and address of any facility to which refrigerant is sent.

Records of the amount of refrigerant recovered during service are not required. If refrigerant is sent off-site for reclamation, only the address of the reclamation facility used is required to be kept on record.

Any person who owns approved refrigerant recycling equipment must have records demonstrating that all persons authorized to operate the equipment are currently certified.

If the purchaser is buying small cans for resale, the seller must obtain a written statement from the purchaser that the containers are for resale only and indicate the purchaser's name and business address, Records must be retained for a period of three years.

Any person who sells a Class I or Class II substance for use as a refrigerant in a motor vehicle air conditioner must prominently display a sign which states: "It is a violation of federal law to sell containers of Class I and Class II refrigerant to any person who is not properly trained and certified to operate approved refrigerant recycling equipment."

All service facilities which service motor vehicle air conditioners for consideration must allow an authorized representative of the Administrator entry onto their premises, upon presentation of his or her credentials, and give the authorized representative access to all records required to be maintained.

Some local and state governments have additional requirements.

Overlap Between Section 608 and Section 609

Section 608 of the Act directs EPA to establish requirements to prevent the release of ozone-depleting substances during the servicing, repair, or disposal of appliances and industrial process refrigeration. Section 609 of the Act establishes standards specifically for the service of motor vehicle air conditioners (MVACs). MVACs are included in the definition of appliances under the definition put forth in Section 608; however, since their service and repair are regulated under Section 609 they are not subject to the servicing requirements put forth in Section 608. Procedures involving MVACs that are not covered by Section 609, such as the disposal of MVACs, are covered by Section 608. Below is information concerning specific areas where the overlap between these two sets of regulations may require clarification.

Technician Certification

Both regulations require that technicians become certified. Technicians who repair or service MVACs must be trained and certified by an EPA-approved Section 609 program. These programs are specifically designed to cover MVAC recycling equipment in accordance with SAE Standards and Section 609 regulatory requirements. After completing a required training program MVAC technicians must pass a test to become certified. These tests are different from the Section 608 certification tests.

Under Section 608 EPA has established four types of certification for technicians that service and repair appliances other than MVACs. These technicians must be certified by passing a test in the appropriate area. All training and review classes for Section 608 are voluntary; only passing the test is mandatory. The four categories of certification are:

Type I = small appliances
Type II = high-pressure appliances, except small appliances & MVACs
Type III = low-pressure appliances
Type IV (Universal) = all appliances except MVACs

In addition, people who service or repair MVAC-like appliances (e.g. farm equipment and other non-road vehicles) can choose to be certified by either the Section 609 program or under Section 608 Type II. Due to the similarities between MVAC and MVAC-like appliances, EPA recommends that technicians servicing MVAC-like appliances consider certification under Section 609.

Please note: While buses using CFC-12 are MVACs, buses using HCFC-22 are not MVACs or MVAC-like appliances, but rather high-pressure equipment covered under Type II of the Section 608 test. This also applies to cargo refrigeration equipment.

Refrigerant Sales Restriction

The sale of small cans of CFC-12 will always be limited to Section 609 technicians. After Nov. 14, 1994, under EPA regulations, only certified technicians can purchase CFC or HCFC refrigerants. However, the Clean Air Act itself further restricts the sale of the small containers of CFC-12.

Under the Clean Air Act, only Section 609 technicians can purchase small cans (less than 20 pounds) of CFC-12. Traditionally small cans of CFC-12 have been used for recharging MVAC and MVAC-like appliances. The sales restriction provision in the Act was intended to discourage "do-it-yourselfers" who may release refrigerant because they lack access to recovery/recycling equipment. This restriction did not change after Nov. 14, 1994.

Record-Keeping

Section 608 requires that all persons who sell CFC and HCFC refrigerants retain invoices that indicate name of the purchaser, the date of the sale, and quantity of refrigerant purchased. These requirements are for all sales affected by Section 608.

However, since the sale of small containers of CFC-12 is restricted to technicians certified under Section 609, these record-keeping requirements do not apply to the sale

of small containers of CFC-12. Therefore, while records must be maintained for the sale of all other CFC and HCFC refrigerants in any size container, and for the sale of CFC-12 in containers of 20 pounds or more, it is not necessary to maintain records for the sale of small containers of CFC-12.

EPA's Significant New Alternatives Policy (SNAP) Rule

Under authority of Section 612 of the Clean Air Act, regulations promulgated on March 18, 1994, effective April 18, 1994, establish a program in which EPA will evaluate applications for use of substitute chemicals and technology to replace ozone depleters in specific uses. The Agency does not evaluate the performance or compatibility of substitute chemicals in an automotive air conditioning system.

SNAP requires the manufacturer or importer of a proposed substitute for an ozone-depleting chemical to provide EPA notification 90 days before introducing the substitute into interstate commerce. During the 90-day period, the Agency will evaluate company studies and other information and decide whether the substitute is either acceptable or unacceptable for a specific use, based on whether the substance may have adverse effects on human health or the environment. Some of the criteria EPA will consider in the risk screening include flammability, chemical toxicity, global warming potential and exposure of workers, consumers, the general population and aquatic life.

If EPA places a substance on the unacceptable list, it becomes unlawful to use it as a substitute for an ozone depleter.

Tax on CFC-12

On January 1, 1998 the tax on CFC-12 refrigerant increased to $6.70 per pound. Each year the floor tax increases 45 cents on each pound of refrigerant in stock.

On Jan. 1 of each year, shops with an inventory, or floor stock, of 400 pounds of CFC-12 or more, are required to report their inventory and pay the difference between the prior year tax rate per pound of refrigerant in stock. (If a shop's inventory is 399 pounds or less, no tax payment is required. If inventory is 400 pounds or more, tax is required on all of the refrigerant — the first 399 pounds is not exempted.)

The floor stocks tax on ozone depleting chemicals is due and payable without assessment or notice on or before June 30. The tax must be deposited, together with Form 8109, Federal Tax Coupon, at an authorized depository of the Federal Reserve Bank serving the taxpayer's area.

Every person liable for the floor stocks tax must file a return of tax on Form 720, Quarterly Federal Excise Tax Return, to which Form 6627, Environmental Taxes, is attached, by August 31.

Note: Consult your tax advisor for additional information before filing.

Refrigerant recycled on-site from mobile A/C systems is not taxable.

Imported Used & Recycled Refrigerant

Since January 1, 1996 new CFC refrigerant cannot be imported. However, used or recycled refrigerant can be imported from overseas. There is no federal requirement that containers of used or recycled refrigerant be labeled to identify the content or its purity.

EPA Tip

Handle refrigerants with care to prevent mixing. It is critical that supplies of CFC-12 and R134a are kept free of contamination.

EPA Q & A

Q: Are off-road vehicles, such as agricultural or construction equipment, covered by the section 609 regulation?

A: No, they are not covered by the section 609 regulation directly, but they are covered by the section 608 regulation. This rule was published on May 14, 1993, and requires those servicing MVAC-like appliances, as this type of air-conditioning equipment is classified, to use approved equipment. Also, technicians must be certified. The air conditioning equipment found on construction and agricultural equipment is similar to the motor vehicle equipment and, as a result, the section 608 rule allows technicians to use the equipment and technician certification programs approved under section 609.

EPA Note:

Service for consideration includes persons who are paid to perform service on motor vehicle air conditioners, thus subjecting to regulation all service except that done for free. Fleets of vehicles, whether private, or federal, state or local government owned, are covered because the technicians doing the service are paid. Other examples of establishments covered by the regulations include, but are not limited to: independent repair shops, service stations, fleet shops, body shops, chain or franchised repair shops, new and used car and truck dealers, rental establishments, radiator repair shops, mobile repair operations, vocational technical schools (because instructors are paid), farm equipment dealerships and fleets of vehicles at airports.

Refrigerant Recycling: An Introduction

Why Recycle?

It is important that a supply of CFC-12 be available to ensure that vehicles built to use CFC-12 can be serviced. Without a supply of CFC-12 for service use during ownership, conversion or obsolescence of vehicles could result in additional cost to the owners.

CFC-12 systems were not designed to use any other refrigerant, and A/C system manufacturers recommend that CFC-12 continue to be used for those systems as long as it is available.

Although the mobile air conditioning industry has phased in HFC-134a systems, vehicles with CFC-12 systems will still be in use beyond the year 2000. With a 5-to-10 year vehicle life expectancy, CFC-12 will be required for future service. If CFC-12 is not available for service, the consumer may have to choose among retrofitting to an alternate refrigerant (HFC-134a), purchasing a new vehicle with an HFC-134a system, or doing without air conditioning.

Controlled sale of CFCs, proper repair of leaking systems and recycling of existing CFCs are required to assure consumers the use of their CFC-12 automotive air conditioning systems.

With effective control of CFC supplies and mandatory recycling at all servicing levels, the automotive service industry has effected a major reduction of new CFC-12 requirements.

Field Study

Due to the severity of the ozone depletion issue, industry efforts were immediately directed toward determining if CFCs used in the mobile air conditioning service industry could be recycled.

During the summer of 1988, the EPA, with the support of the Mobile Air Conditioning Society Worldwide (MACS) initiated a sampling program of used refrigerant from 227 vehicles located in four regions of the country. These vehicles included properly operating systems, failed compressors, low-mileage vehicles and vehicles with over 100,000 miles. The chemical analysis of the removed refrigerant indicated a low amount of contamination. From the field study results, the task force established specifications for recycled refrigerant and requested the world's auto manufacturers to determine and approve a level of recycled refrigerant purity in December, 1988. Vehicle and A/C system manufacturers have accepted recycled CFC-12 and HFC-134a meeting the appropriate SAE standard for service and warranty repairs.

System Contaminants

Data obtained from the field study of CFC-12 sampling taken from mobile air conditioning systems identified moisture, refrigerant oil and non-condensable gases (air) as contaminants in used refrigerant which could affect system performance and life.

Standards Developed

Based on the field study, the SAE Interior Climate Control Standards Committee established documents to cover the automotive air conditioning industry handling and use of refrigerants. The documents include:

CFC-12 SAE Documents

- SAE J1989: Service Procedures
- SAE J1990: Specifications for Recycling Equipment
- SAE J1991: Standard of Purity
- SAE J2209: CFC-12 Extraction Equipment

HFC-134a SAE Documents

- SAE J2211: Service Procedures
- SAE J2210: Specifications for Recycling Equipment
- SAE J2099: Standard of Purity
- SAE J1732: HFC-134a Extraction Equipment

SAE documents have been developed for HFC-134a to assure the same level of service integrity as CFC-12 systems, and to protect the present and future environment by preventing the release of the refrigerant into the atmosphere during service operations.

SAE J Documents: CFC-12 and HFC-134a

Refrigerant Purity Standards

The intent of the applicable SAE J standards is to assure that recycled refrigerant used in servicing mobile A/C systems provides a level of purity which will not affect the performance or warranty of the system.

The SAE, in conjunction with the mobile A/C industry, has developed standards of purity which allow re-use of refrigerant. In the SAE standard of purity, the document states: "Recycling equipment developed under SAE standards is for the purpose of cleaning the refrigerant that has been directly removed from, and intended to be returned to, a mobile air-conditioning system."

Also: "Purity specification of recycled refrigerants supplied in containers from other (non-automotive) recycle sources, for service in mobile automotive air-conditioning systems, shall meet the appropriate ARI 700 standard."

These standards of purity are designated SAE J1991 for CFC-12 and SAE J2099 for HFC-134a which has been recycled on-site. All refrigerants sent off-site for processing and/or from other sources, must meet the specific ARI 700 standard to assure that the refrig-

erant is not contaminated and to be in compliance with federal law.

The recycling requirements are referred to in Section 609 of the 1990 Clean Air Act and also in other state and local laws.

Under the law, recycling of CFC-12 has been in effect since January 1, 1992, and recycling of HFC-134a has been in effect since November 15, 1995.

Equipment Certification

The standard for equipment certified to be used for refrigerant recovery/recycling is established by SAE. This equipment must also be certified by an appropriate EPA approved testing laboratory (eg. Underwriters Laboratories, ETL) to meet the required purity specifications. This level of purity for recycled refrigerant is recognized by the auto industry for warranty service applications.

Compliance of Recovery/ Recycling Equipment

To comply with Section 609 of the Clean Air Act, recovery/recycling equipment must be certified to SAE specifications. Recovery/recycling equipment used for commercial refrigeration not certified to the SAE standards, does not meet the federal compliance requirements and cannot be used. To prevent refrigerant contamination, recovery/recycling equipment must only be used with one refrigerant.

Dual Refrigerant Equipment

There are two major designs for single cabinet, dual refrigerant recovery/recycling equipment. Seperate refrigerant circuit equipment mounted on the same cabinet for R12 and R134a must have a labelling that it meets SAE J1991 (R12) or J2099 (R134a) to be in compliance with Section 609. Recovery/recycling equipment having a common refrigerant circuit for R12 and R134a in the same cabinet must be certified to SAE J1770 to meet federal compliance.

Such equipment contains special features to prevent cross-contamination in the refrigeration circuit. The technician must carefully follow the required procedures to switch from one refrigerant to another to prevent cross-contamination.

SAE J1989 & SAE J2211 Service Procedures

The SAE documents J1989 for CFC-12 and J2211 for HFC-134a provide guidelines for containment and assurance that all refrigerant has been removed from a system.

Improperly Recycled Refrigerant

If recycled refrigerant contains non-condensable gases (air) in excess of the allowable amount, high system operating pressure will occur. This will result in loss of air conditioning performance and possible system damage.

Properly operating recycling equipment will remove excess air, provide the maximum level of allowable air in recycled refrigerant, and also provide recycled refrigerant ready for use.

Verification for excess non-condensable contents in auxiliary portable containers of recycled refrigerant is important. Proper procedure to assure correct non-condensable levels is outlined in Section 5 of SAE J1989 for CFC-12 (tables on page 17), and SAE J2211 for HFC-134a (tables on page 19).

When determining the pressure/temperature of refrigerant containers, the location can become critical. If the container is located in a garage, the floor temperature can effect the temperature of the refrigerant. Attaching a temperature measuring device to the lower one half of the refrigerant container surface can provide a more accurate reading. Using only the air temperature surrounding the refrigerant container can result in incorrect refrigerant temperature information.

Only DOT CFR Title 49 or UL-approved storage containers for recycled refrigerant (containers marked DOT 4BW or 4BA) must be be used.

Contaminated Refrigerant

Refrigerant recovery/recycling equipment will not separate or clean contaminated refrigerants.

If either CFC-12 or HFC-134a refrigerant has been contaminated with another refrigerant, or with each other, the refrigerant tank pressure will be higher than that noted in the SAE tables. Refrigerant contamination can also occur from excessive air in the recycled refrigerant. This high NCG level can be caused by improperly operating manual or automatic equipment air purge cycle.

If the pressure is 5% or more higher than the pressure indicated in the SAE tables for either refrigerant, it should be assumed that contamination has occurred. (See example below.) Automotive recycling equipment will not remove this contamination. The tank should be sent off-site for reclamation.

For example, using the SAE tables for each refrigerant at 80°F, your results would be as shown in Chart 1 below.

Chart 1.

For example, using the SAE tables for each refrigerant at 80°F, your results would be as shown in the chart below:

CFC-12	**96 psig**	**(SAE Ref. Chart Pressure)**
	x 1.05	**(Multiplication Factor)**
	= 100.8 psig	**(Contaminated Ref. Press.)**
HFC-134a	**91 psig**	**(SAE Ref. Chart Pressure)**
	x 1.05	**(Multiplication Factor)**
	= 95.5 psig	**(Contaminated Ref. Press.)**

Using a pressure gauge for A/C system/container readings will only identify possible refrigerant contamination and will not identify the refrigerant type. Certified SAE refrigerant identification equipment (SAE J1771) will help determine type.

Note: A/C system refrigerant contamination, by air or other refrigerants, in excess of 3% by weight can cause system operating problems.

Identifying Refrigerants

EPA requires that when any vehicle is retrofitted from R12, a label identifying the new refrigerant in the system must be placed under the hood, and new fittings that are unique to that refrigerant must be attached to the high- and low-side service ports of the A/C system. These EPA requirements obviously don't solve the entire refrigerant identification problem. Your shop could encounter a vehicle that has been retrofitted to another refrigerant but has not been properly labeled, or a vehicle that has the right label, but highly contaminated refrigerant.

Refrigerant Identifiers

Purchasing a refrigerant identifier unit can help pinpoint many refrigerant identification problems, and EPA strongly recommends (but does not require) that technicians obtain this equipment. You can use the identifier to confirm that the refrigerant your supplier is sending you is exactly what he says it is – pure and uncontaminated. The equipment you choose will depend on what you plan to do once you discover that refrigerant in a vehicle is not pure R12 or R134a. If, for example, you decide to turn the customer with a contaminated system away, then a less-expensive identifier that simply tells you whether the refrigerant is pure R12 of R134a (go/no-go) may be sufficient for you.

Keep in mind that even the most sophisticated diagnostic units on the market today cannot properly identify all combinations of chemicals used in blend refrigerants.

Whether you are interested in purchasing a "go/no-go" unit or a diagnostic unit, check that the unit meets the SAE J1771 standard, which is an indication that the unit correctly identifies refrigerants. When claiming to meet this standard, manufacturers of identifier equipment are required to label the unit stating its level of accuracy,

Recovering Contaminated Refrigerant

As a first step, the contaminated or unfamiliar refrigerant must be recovered. EPA prohibits venting any automotive refrigerants (including "unacceptable" refrigerants), no matter what combination of chemicals is in the refrigerant. The best way today that a technician can recover contaminated or unfamiliar refrigerant is to dedicate a recovery-only unit to anything that is not pure R12 or pure R134a. Some equipment manufacturers may also be marketing types of recovery-only stations specifically designed to remove these refrigerants.

If the refrigerant you extract into a recovery unit contains a high level of flammable substances such as propane and butane, a fire hazard may result if the refrigerant comes into contact with an ignition source within the equipment. Make sure you determine what features have been incorporated into the equipment to guard against risks of ignition.

Contaminated Refrigerant Storage and Disposal

Once the refrigerant has been recovered, if you can't recycle it, what do you do with it? The answer is that it depends.

If the refrigerant in your "junk" tank contains significant amounts of flammable substances, it may be considered hazardous and you should make sure you follow any local, state or federal requirements that govern the storage of combustible mixtures.

If the refrigerant in your "junk" tank is a chemical "soup" – either contaminated R12 and R134a, or a mixture of those contaminated refrigerants and some blend refrigerants that you are unfamiliar with – then the contents should be reclaimed or destroyed. You should investigate all your options and pick the one that makes the most economic sense for you.

EPA Q & A

Q: Does the EPA require that all leaks in motor vehicle air conditioners be repaired?

A: The EPA does not require that leaks be repaired, although it recommends that vehicle owners consider repairing leaks to reduce emissions and extend the useful life of their air conditioner. Repair of leaking systems will help vehicle owners avoid the need to continue to refill systems with high-priced refrigerant. EPA recognizes that good service practices include recovering and recycling refrigerant and performing leak detection. If a leak is identified, the customer should be presented with all the options for service, including repair. If leak repair is not chosen, the technician may refill the system if requested to do so by the customer (unless a state or local leak repair requirement exists).

Q: Is a technician required to recover and recycle any refrigerant added to a system for the purpose of leak detection?

A: If a technician adds refrigerant to a system for the purpose of leak detection and if the refrigerant is then removed, it must be recovered and recycled and not released to the environment. The leak detection charge may be left in the system at the request of the customer.

SAE J1991: Purity of Recycled CFC-12

The SAE J1991standard of purity for recycled CFC-12 refrigerant for use in mobile A/C systems, which has been directly removed from automotive A/C systems, shall not exceed the following levels of contaminants:

- **Moisture: 15 PPM (parts per million) by weight**
- **Refrigerant Oil: 4000 PPM by weight**
- **Non-condensable Gases (air): 330 PPM by weight**

Certified recycling equipment is required by the Clean Air Act to meet the SAE J1990 standard.

Equipment which has safety certification, such as Underwriters Laboratories "UL," does not mean it is in compliance with J1990 and J1991.

The equipment also must have a label which states: "Design certified for compliance with SAE J1991," to comply with the Clean Air Act.

SAE J2099: Purity of Recycled HFC-134a

The SAE J2099 standard of purity for recycled HFC-134a refrigerant for use in mobile A/C systems, which has been directly removed from automotive A/C systems, shall not exceed the following levels of contaminants:

- **Moisture: 50 PPM (parts per million) by weight**
- **Refrigerant Oil: 500 PPM by weight**
- **Non-condensable Gases (air): 150 PPM by weight**

Certified recycling equipment is required by the Clean Air Act to meet the SAE J2210 standard.

Equipment which has safety certification, such as Underwriters Laboratories "UL," does not mean it is in compliance with J2099 and J2210.

The equipment must also have a label which states: "Design certified for compliance with SAE J2210," to comply with the Clean Air Act.

SAE J2209: CFC-12 Extraction Equipment

SAE J2209 establishes certification requirements for CFC-12 extraction equipment. Extraction equipment which meets SAE J2209 is designed for the purpose of removing CFC-12 from an automotive air conditioning system. This extraction-only equipment does not recycle the refrigerant for re-use. Refrigerant which is taken from a mobile A/C system by extraction equipment must be recycled (or reprocessed to the appropriate ARI 700 specification) before it can be re-used in an automotive A/C system.

The operation of extraction equipment is similar to the recovery portion of recovery/recycling equipment, but it will not clean the removed refrigerant.

Refrigerant removed with extraction equipment shall not be directly re-used without being recycled or reprocessed to the appropriate ARI 700 specification.

Extraction equipment is also equipped with a device to indicate the amount of lubricant taken out during the removal process. (The procedure for lubricants is found in the "System Lubricant" section on page 30 of this manual.)

The equipment and refrigerant tanks have SAE 3/8-inch, high side service fittings to prevent possible direct use of the dirty refrigerant into an automotive air conditioning system.

Do not use adaptor fittings. Use of adaptor fittings may result in possible contamination of clean CFC-12 supplies and mobile systems.

The refrigerant tanks not only have the approved SAE fitting, but are gray in color, with a yellow top and identification label marking: "DIRTY CFC-12 • DO NOT USE: MUST BE REPROCESSED."

This is intended to prevent possible misuse.

To comply with the regulations of the Clean Air Act, refrigerant removed with extraction equipment must be sent off-site to be reprocessed to the appropriate specifications. Records must be maintained for three years identifying where the refrigerant was sent.

The federal Clean Air Act allows only one exception in the use of extraction equipment: That is, if the owner of the extraction equipment also owns certified recovery/recycling equipment and can assure direct recycling of refrigerant from motor vehicles for re-use in motor vehicles serviced at his facilities.

SAE J1732: HFC-134a Extraction Equipment

Extraction equipment which meets SAE J1732 is designed for the purpose of removing HFC-134a from an automotive air conditioning system. Extraction-only equipment does not recycle the refrigerant for re-use. The operation of extraction equipment is similar to the recovery portion of recovery/recycling equipment, but it will not clean the removed refrigerant.

Refrigerant removed with extraction equipment shall not be directly re-used without being reprocessed to the appropriate ARI 700 specification.

Extraction equipment is also equipped with a device to indicate the amount of lubricant taken out during the removal process. (The procedure for lubricants is found in the "System Lubricant" section on page 30 of this manual.)

The equipment and refrigerant tanks have a 1/2-inch Acme thread service fitting.

The refrigerant tanks not only have the approved SAE fitting, but are gray in color, with a yellow top and identification label marking: "DIRTY HFC-134a • DO NOT USE: MUST BE REPROCESSED."

This is intended to prevent possible misuse.

To comply with the regulations of the Clean Air Act, refrigerant re-

moved with extraction equipment must be sent off-site to be reprocessed to the appropriate specifications. Records must be maintained for three years identifying where the refrigerant was sent.

The federal Clean Air Act allows only one exception in the use of extraction equipment. That is, if the owner of the extraction equipment also owns certified recovery/recycling equipment and can assure direct recycling of refrigerant from motor vehicles for re-use in motor vehicles serviced at his facilities.

SAE J1989 • Recommended Service Procedure

SAE J1989 • Issued October 1989
Recommended Service Procedure for the Containment of CFC-12

1. SCOPE:
During service of mobile air conditioning systems, containment of the refrigerant is important. This procedure provides service guidelines for technicians when repairing vehicles and operating equipment defined in SAE J1990.

2. REFERENCES:
SAE J1990, Extraction and Recycle Equipment for Mobile Automotive Air Conditioning Systems

3. REFRIGERANT RECOVERY PROCEDURE:

3.1 Connect the recovery unit service hoses, which shall have shutoff valves within 12 inches (30 cm) of the service ends, to the vehicle air conditioning system service ports.

3.2 Operate the recovery equipment as covered by the equipment manufacturer's recommended procedure.

3.2.1 Start the recovery process and remove the refrigerant from the vehicle A/C system. Operate the recovery unit until the vehicle system has been reduced from a pressure to a vacuum. With the recovery unit shut off for at least 5 minutes, determine that there is no refrigerant remaining in the vehicle A/C system. If the vehicle system has pressure, additional recovery operation is required to remove the remaining refrigerant. Repeat the operation until the vehicle A/C system vacuum level remains stable for 2 minutes.

3.3 Close the valves in the service lines and then remove the service lines from the vehicle system. Proceed with the repair/service. If the recovery equipment has automatic closing valves, be sure they are operating properly.

4. SERVICE WITH MANIFOLD GAUGE SET:

4.1 Service hoses must have shutoff valves in the high-side, low-side and center service hoses within 12 inches (30 cm) of the service ends. Valves must be closed prior to hose removal from the air conditioning system. This will reduce the volume of refrigerant contained in the service hose which would otherwise be vented to atmosphere.

4.2 During all service operations, the valves should be closed until connected to the vehicle air conditioning system or the charging source to avoid introduction of air, and to contain the refrigerant rather than vent to the open atmosphere.

4.3. When the manifold gauge set is disconnected from the air conditioning system, or when the center hose is moved to another device which cannot accept refrigerant pressure, the gauge set hoses should first be attached to the reclaim equipment to recover the refrigerant from the hoses.

5. RECYCLED REFRIGERANT CHECKING PROCEDURE FOR STORED PORTABLE AUXILIARY CONTAINER:

5.1 To determine if the recycled refrigerant container has excess non-condensable gases (air), the container must be stored at a temperature of 65˚F (18.3˚C) or above, for a period of 12 hours, protected from direct sun.

5.2 Install a calibrated pressure gauge, with 1 psig divisions (0.07 kg), to the container and determine the container pressure.

5.3 With a calibrated thermometer, measure the air temperature within 4 inches (10 cm) of the container surface.

5.4 Compare the observed container pressure and air temperature to determine if the container exceeds the pressure limits found in Table 1 (opposite page), e.g.: at air temperature of 70˚F (21˚C) pressure must not exceed 80 psig (5.62 kg/cm^2).

5.5 If the container pressure is less than the Table 1 values, and has been recycled, limits of non-condensable gases (air) have not been exceeded and the refrigerant may be used.

5.6 If the pressure is greater than the range, and the container contains recycled material, slowly vent from the top of the container a small amount of vapor into the recycle equipment, until the pressure is less than the pressure shown on Table 1.

5.7 If the container still exceeds the pressure shown in Table 1, the entire contents of the container shall be recycled.

MAXIMUM ALLOWABLE CONTAINER PRESSURE — RECYCLED CFC-12

TABLE 1 (Standard)

TEMP°F	PSIG	TEMP°F	PSIG	TEMP°F	PSIG	TEMP°F	PSIG	TEMP°F	PSIG
65	74	75	87	85	102	95	118	105	136
66	75	76	88	86	103	96	120	106	138
67	76	77	90	87	105	97	122	107	140
68	78	78	92	88	107	98	124	108	142
69	79	79	94	89	108	99	125	109	144
70	80	80	96	90	110	100	127	110	146
71	82	81	98	91	111	101	129	111	148
72	83	82	99	92	113	102	130	112	150
73	84	83	100	93	115	103	132	113	152
74	86	84	101	94	116	104	134	114	154

TABLE 1 (Metric)

TEMP°C	PRES	TEMP°C	PRES	TEMP°C	PRES	TEMP°C	PRES	TEMP°C	PRES
18.3	5.20	23.9	6.11	29.4	7.17	35.0	8.29	40.5	9.56
18.8	5.27	24.4	6.18	30.0	7.24	35.5	8.43	41.1	9.70
19.4	5.34	25.0	6.32	30.5	7.38	36.1	8.57	41.6	9.84
20.0	5.48	25.5	6.46	31.1	7.52	36.6	8.71	42.2	9.98
20.5	5.55	26.1	6.60	31.6	7.59	37.2	8.78	42.7	10.12
21.1	5.62	26.6	6.74	32.2	7.73	37.7	8.92	43.3	10.26
21.6	5.76	27.2	6.88	32.7	7.80	38.3	9.06	43.9	10.40
22.2	5.83	27.7	6.95	33.3	7.94	38.8	9.13	44.4	10.54
22.7	5.90	28.3	7.03	33.9	8.08	39.4	9.27	45.0	10.68
23.3	6.04	28.9	7.10	34.4	8.15	40.0	9.42	45.5	10.82

PRES kg/sq cm

6. CONTAINERS FOR STORAGE OF RECYCLED REFRIGERANT:

6.1 Recycled refrigerant should not be salvaged or stored in disposable refrigerant containers. This is the type of container in which virgin refrigerant is sold. Use only DOT CFR Title 49 (marked DOT 4BA or DOT 4BW) or UL approved storage containers for recycled refrigerant.

6.2 Any container of recycled refrigerant which has been stored or transferred must be checked prior to use as defined in Section 5.

7. TRANSFER OF RECYCLED REFRIGERANT:

7.1 When external portable containers are used for transfer, the container must be evacuated to at least 27 inches of vacuum (75 mm Hg absolute pressure) prior to transfer of the recycled refrigerant. External portable containers must meet DOT and UL standards.

7.2 To prevent on-site overfilling when transferring to external containers, the safe filling level must be controlled by weight and must not exceed 60% of container gross weight rating.

8. DISPOSAL OF EMPTY/NEAR EMPTY CONTAINERS:

8.1 Since all the refrigerant may not be removed from disposable refrigerant containers during normal system charging procedures, empty or near empty container contents should be reclaimed prior to disposal of the container.

8.2 Attach the container to the recovery unit and remove the remaining refrigerant. When the container has been reduced from a pressure to a vacuum, the container valve can be closed. The container should be marked empty and is then ready for disposal.

EPA Tip

Beware of illegally imported CFC-12 being offered for sale. This material could be confiscated by the government, and because of its unknown origin could be contaminated.

SAE J2211 • Issued December 1991
Recommended Service Procedure for the Containment of HFC-134a

1. SCOPE:
Refrigerant containment is an important part of servicing mobile air conditioning systems. This procedure provides service guidelines for technicians when repairing vehicles and operating equipment designed for HFC-134a (described in SAE J2210).

2. REFERENCES:

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

2.1.1 SAE Publications — Available from SAE, 400 Commonwealth Drive, Warrendale, Pa. 15096-0001.
SAE J2196 — Service Hoses for Mobile Air Conditioning Systems
SAE J2197 — Service Hose Fittings for Automotive Air-Conditioning
SAE J2210 — Refrigerant Recycling Equipment for HFC-134a Mobile Air Conditioning Systems
SAE J2219 — Concerns to the Mobile Air Conditioning Industry

2.2 DEFINITIONS

2.2.1 Recovery/Recycling (R/R) Unit — Refers to a single piece of equipment which performs both functions of recovery and recycling of refrigerants per SAE J2210.

2.2.2 Recovery — Refers to that portion of the R/R unit operation which removes the refrigerant from the mobile air conditioning system and places it in the R/R unit storage container.

2.2.3 Recycling — Refers to that portion of the R/R unit operation which processes the refrigerant for reuse on the same job site to the purity specifications of SAE J2099.

3. SERVICE PROCEDURE:

3.1 Connect the recycling unit service hoses, which shall have shutoff devices (e.g., valves) within 30 cm (12 in) of the service ends, to the vehicle air-conditioning (A/C) service ports. Hoses shall conform to SAE J2196 and fittings shall conform to SAE J2197.

3.2 Operate the recycling equipment per the equipment manufacturer's recommended procedure.

3.2.1 Verify that the vehicle A/C system has refrigerant pressure. Do not attempt to recycle refrigerant from a discharged system as this will introduce air (non-condensable gas) into the recycling equipment which must later be removed by purging.

3.2.2 Begin the recycling process by removing the refrigerant from the vehicle A/C system. Continue the process until the system pressure has been reduced to a minimum of 102 mm (4 in) of mercury below atmospheric pressure (vacuum). If A/C components show evidence of icing, the component can be gently heated to facilitate refrigerant removal. With the recycling unit shut off for at least 5 minutes, check A/C system pressure. If this pressure has risen above vacuum (0 psig), additional recycler operation is required to remove the remaining refrigerant. Repeat the operation until the system pressure remains stable at vacuum for 2 minutes.

3.3 Close the valves in the service lines and then remove the service lines from the vehicle system. If the recovery equipment has automatic closing valves, be sure they are operating properly. Proceed with the repair/service.

3.4 Upon completion of refrigerant removal from the A/C system, determine the amount of lubricant removed during the process and replenish the system with new lubricant, which is identified on the A/C system label. Used lubricant should be discarded per applicable federal, state, and local requirements.

4. SERVICE WITH A MANIFOLD GAUGE SET:

4.1 High-side, low-side, and center service hoses must have shutoff devices (e.g. valves) within 30 cm (12 in) of the service ends. Valves must be closed prior to hose removal from the A/C system to prevent refrigerant loss to the atmosphere.

4.2 During all service operations, service hose valves should be closed until connected either to the vehicle A/C system or the charging source so as to exclude air and/or contain the refrigerant.

4.3 When the manifold gauge set is disconnected from the A/C system, or when the center hose is moved to another device which cannot accept refrigerant pressure, the gauge set hoses should be attached to the recycling equipment to recover refrigerant from the hoses.

5. SUPPLEMENTAL REFRIGERANT CHECKING PROCEDURE FOR STORED PORTABLE CONTAINERS:

5.1 Certified recycling equipment and the accompanying recycling procedure, when properly followed, will deliver use-ready refrigerant. In the event that the full recycling procedure was not followed, or the

technician is unsure about the noncondensable gas content of a given tank of refrigerant, this procedure can be used to determine whether the recycled refrigerant container meets the specification for noncondensable gases (air).

Note: The use of refrigerant with excess air will result in higher system operating pressures and may cause A/C system damage.

5.2 The container must be stored at a temperature of 18.3°C (65°F) or above for at least 12 hours, protected from direct sunlight.

5.3 Install a calibrated pressure gauge, with 6.9 kPa (1 psig) divisions, to the container and determine the container pressure.

5.4 With a calibrated thermometer, measure the air temperature within 10cm (4 in) of the container surface.

5.5 Compare the observed container pressure and air temperature to the values given in Table 2 (below) to determine whether the container pressure is below the pressure limit given in the Table. For example, at an air temperature of 21°C (70°F), the container pressure must not exceed 524 kPa (76 psig).

5.6 If the refrigerant in the container has been recycled and the container pressure is less than the limit in Tables 1 and 2, the refrigerant may be used.

5.7 If the refrigerant in the container has been recycled and the container pressure exceeds the limit in Tables 1 and 2, slowly vent, from the top of the container, a small amount of vapor into the recycle equipment until the pressure is less than the pressure shown in Tables 1 and 2.

5.8 If, after shaking the container and letting it stand for a few minutes, the container pressure still exceeds the pressure limit shown in Tables 1 and 2, the entire contents of the container shall be recycled.

6. CONTAINERS FOR STORAGE OF RECYCLED REFRIGERANT:

6.1 Recycled refrigerant should not be salvaged or stored in disposable containers (this is one common type of container in which new refrigerant is sold). Use only DOT CFR Title 49 or UL-approved storage containers, specifically marked for HFC-134a, for recycled refrigerant.

6.2 Any container of recycled refrigerant which has been stored or transferred must be checked prior to use as defined in Section 5.

6.3 Evacuate new tanks to at least 635 mm Hg (25 in Hg) below atmospheric pressure (vacuum) prior to first use.

7. TRANSFER OF RECYCLED REFRIGERANT:

7.1 When external portable containers are used for transfer, the

MAXIMUM ALLOWABLE CONTAINER PRESSURE — RECYCLED HFC-134a

TABLE 2 (Metric)

TEMP°C(F)	kPa	TEMP°C(F)	kPa	TEMP°C(F)	kPa	TEMP°C(F)	kPa
18 (65)	476	26 (79)	621	34 (93)	793	42(108)	1007
19 (66)	483	27 (81)	642	35 (95)	814	43(109)	1027
20 (68)	503	28 (82)	655	36 (97)	841	44(111)	1055
21 (70)	524	29 (84)	676	37 (99)	876	45(113)	1089
22 (72)	545	30 (86)	703	38(100)	889	46(115)	1124
23 (73)	552	31 (88)	724	39(102)	917	47(117)	1158
24 (75)	572	32 (90)	752	40(104)	945	48(118)	1179
27 (77)	593	33 (91)	765	41(106)	979	49(120)	1214

TABLE 2 (English)

TEMP°F	PSIG	TEMP°F	PSIG	TEMP°F	PSIG	TEMP°F	PSIG
65	69	79	90	93	115	107	144
66	70	80	91	94	117	108	146
67	71	81	93	95	118	109	149
68	73	82	95	96	120	110	151
69	74	83	96	97	122	111	153
70	76	84	98	98	125	112	156
71	77	85	100	99	127	113	158
72	79	86	102	100	129	114	160
73	80	87	103	101	131	115	163
74	82	88	105	102	133	116	165
75	83	89	107	103	135	117	168
76	85	90	109	104	137	118	171
77	86	91	111	105	139	119	173
78	88	92	113	106	142	120	176

container must be evacuated to at least 635 mm (25 in Hg) below atmospheric pressure (vacuum) prior to transfer of the recycled refrigerant to the container. External portable containers must meet DOT and UL standards.

7.2 To prevent on-site overfilling when transferring to external containers, the safe filling level must be controlled by weight and must not exceed 60% of the container gross weight rating.

8. SAFETY NOTE FOR HFC-134a:

8.1 HFC-134a has been shown to be nonflammable at ambient temperature and atmospheric pressure. However, recent tests under controlled conditions have indicated that, at pressures above atmospheric, and with air concentrations greater than 60% by volume, HFC-134a can form combustible mixtures. While it is recognized that an ignition source is also required for combustion to occur, the presence of combustible mixtures is a potentially dangerous situation and should be avoided.

8.2 Under NO CIRCUMSTANCE 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 HFC-134a systems.

9. DISPOSAL OF EMPTY OR NEAR EMPTY CONTAINERS:

9.1 Since all refrigerant may not have been removed from disposable refrigerant containers during normal system charging procedures, empty or near empty container contents should be recycled prior to disposal of the container.

9.2 Attach the container to the recycling unit and remove the remaining refrigerant. When the container has been reduced from a pressure to a vacuum, the container valve can be closed and the container removed from the unit. The container should be marked "Empty," after which it is ready for disposal.

Recovery & Recycling

Recycling versus reclaiming refrigerant... There is a difference!

When this text refers to **recycled** refrigerant, it is referring to refrigerant that has been recycled on-site at a service facility with automotive recycling equipment certified to the appropriate SAE J standard.

When this text refers to **reclaimed** refrigerant, it is referring to refrigerant that has been sent to an EPA-listed reclamation facility where it processed and returned to the appropriate ARI 700 specification.

The standards of purity for reclaimed refrigerant are much higher than the standards of purity for recycled refrigerant.

Please Note!

Recovery/recycling equipment is not designed to recycle or separate contaminated refrigerants. Contaminated or unknown refrigerant must be removed, using separate recovery equipment, from the mobile A/C system or equipment and properly disposed. Contaminated refrigerant containing CFCs, HCFCs and HFC-134a, under federal law, cannot be vented.

Check Equipment

Recycling equipment should be checked on a monthly basis to ensure that no leakage occurs. Establish records for maintenance and service equipment filter changes as recommended by the equipment manufacturer. These procedures will ensure that the SAE J standards of purity for recycled refrigerant are maintained. Check equipment manual for filter location.

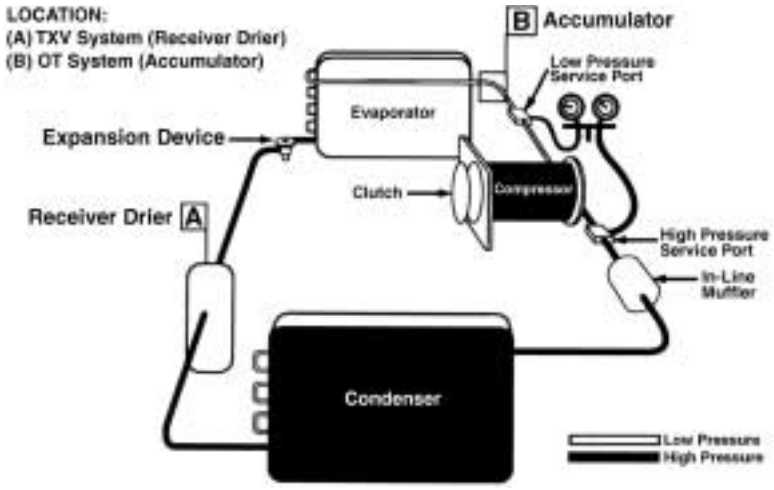
Recover All Refrigerant

All cylinders which contain any unused refrigerant should be connected to the proper recovery/recycling machine and brought to a vacuum before they are discarded.

Always Follow Equipment Manufacturer's Instructions ... when using refrigerant recovery/recycling equipment, it is important to observe the general service procedures in this manual as well as the operating instructions provided by the equipment manufacturer.

Figure 1.

Typical Hookup for A/C Service



NOTE: Low and high side service port fittings may be found anywhere within the respective system loops.

Types of Recovery/Recycling Equipment

Shown here are two types of refrigerant recovery/recycling systems: single-pass and multi-pass. Both systems remove the refrigerant from the vehicle and provide a process for cleaning and storing recycled refrigerant. The single-pass system makes recycled refrigerant available for re-use immediately. The multi-pass system does not.

Single-Pass System

In single-pass systems (Figure 2), refrigerant drawn from the vehicle A/C system passes through an oil separator. This removes any oil. The filter/drier assembly removes moisture and particle contamination. After a single cycle, the contaminant-free recycled refrigerant is then sent to a storage tank.

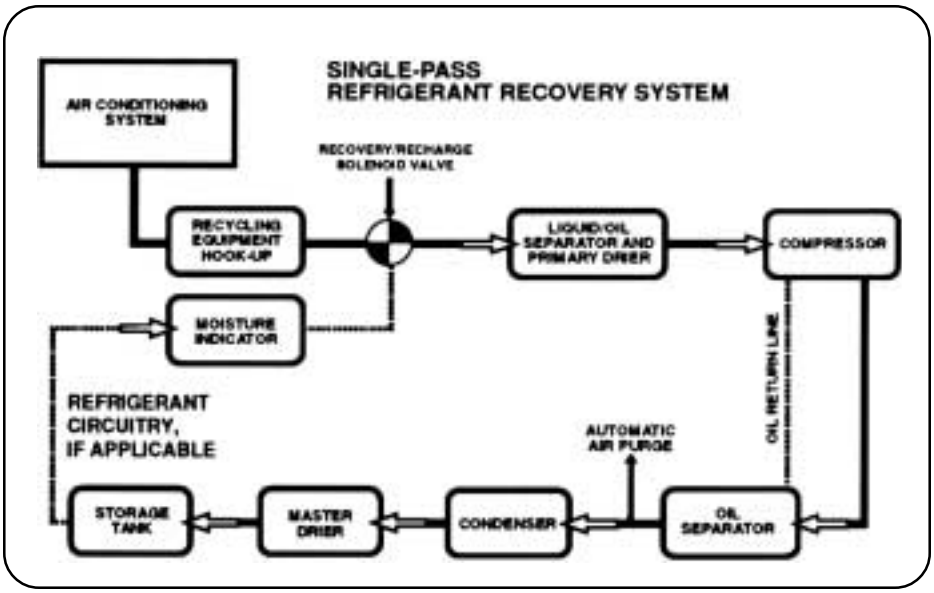


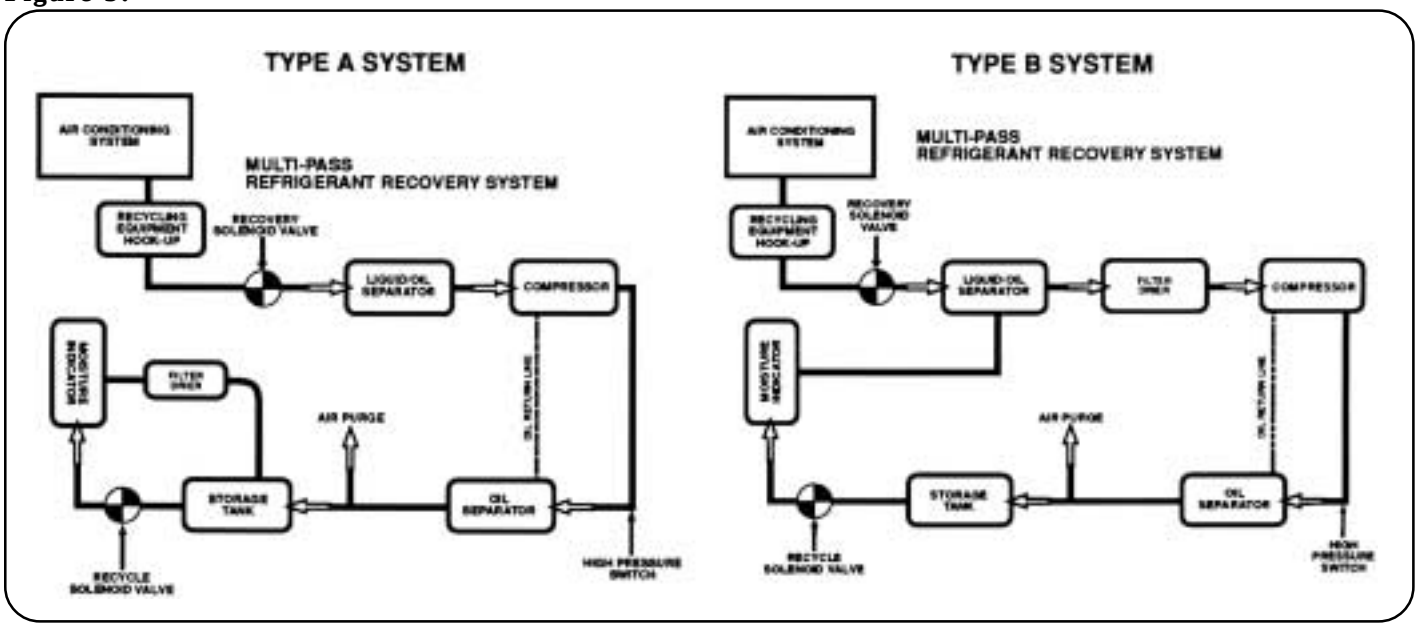
Figure 2.

Multi-Pass System

In multi-pass systems (Figure 3), refrigerant is drawn from the vehicle, passed through an oil separator which removes any oil, and a filter/drier assembly which removes moisture and particle contamination, and then is stored in a tank. (NOTE: Arrangement of system components differs among equipment manufacturers, as shown by diagrams A and B below.)

When recycling is desired, the recycle solenoid valve is opened, allowing a continuous loop-filtering process in which the refrigerant passes through a desiccant (drier) cartridge several times, until the moisture is fully removed. The station has an indicator to alert the service technician — or will automatically vent the recovery tank — to remove air. A moisture indicator will show when the refrigerant is ready for use.

Figure 3.



Servicing Alternate Refrigerants

With the transition from CFC-12, alternate refrigerants have entered the service industry. Under the federal SNAP rule, many alternate refrigerants have been listed for use in automotive A/C systems. HFC-134a is a single chemical refrigerant and it is the refrigerant of choice of the automobile industry. The other alternate refrigerants are blends containing from two to as many as four different chemicals.

All refrigerants listed by EPA for automotive use must be recovered, not vented. This includes R134a and blends containing R22, R124 and R142b. Alternate refrigerants require separate service equipment, and separate hoses and gauge manifolds for each type of refrigerant. Refrigerant and lubricant residue in the hoses are common sources of system contamination; that's why you should never switch service equipment back and forth between different refrigerants. To comply with federal law, every service facility must have service equipment for the type of refrigerant being serviced.

Using equipment for more than one refrigerant will contaminate A/C systems and your refrigerant supply. Recovery and recycling equipment that's SAE certified for use with R12 and R134a isn't certified for use with alternate refrigerants.

Since no certification standards exist for blend refrigerant recovery/recycling equipment, it is illegal to recover/recycle on site for reuse, any blend refrigerant listed under SNAP for automotive use. The use of recovery only equipment will not process the refrigerant for reuse. The refrigerant can be removed from the vehicle using recovery equipment and sent off-site for processing.

As this manual goes to press, the EPA is working to develop standards for equipment and regulations that would allow a blend to be recovered from a vehicle, processed to remove lubricant and moisture, and returned to the same vehicle from which it was recov-

Chart 2.

Pressure/Temperature Comparison

FreeZone, Freeze 12, GHG-X4, GHG, ICOR, FRIGC, CFC-12 and HFC-134a.

Deg.	*FreeZone psig (b) (d)*	*Freeze 12 psig Avg.*	*(R-414A)/GHG-X4 psig (b) (d)*	*R406A/GHG psig (b) (d)*	*(R-414B)/IKOR psig (b) (d)*	*FRIGC psig (b) (d)*	*R-12 psig*	*R-134a psig*
20	15.7-15.8	18.1	25.4-13.3	39.9-28.4	26.9-15.8	15.9-14.2	21.1	18.4
25	19.0-19.2	23.3	29.5-16.5	43.9-31.5	31.1-19.1	19.3-17.5	24.6	22.1
30	22.6-22.8	26.5	33.8-19.8	48.3-34.9	35.6-23.1	22.9-20.9	28.5	26.1
35	26.5-26.7	30.2	38.5-23.5	52.9-38.5	40.5-26.7	26.8-24.6	32.6	30.4
40	30.7-30.9	34.0	43.5-27.5	57.9-42.5	45.6-30.9	31.1-28.7	37.0	35.0
45	35.2-35.4	39.5	48.8-31.7	63.2-46.8	51.2-35.5	35.7-33.0	41.7	40.1
50	40.0-40.3	43.1	54.5-36.3	68.8-51.3	57.0-40.3	40.6-37.6	46.7	45.4
55	45.2-45.5	48.3	60.5-41.3	74.8-56.3	63.6-45.6	45.9-42.6	52.1	51.2
60	50.8-51.1	55.5	67.0-45.5	81.3-61.5	70.0-51.2	51.5-45.7	57.7	57.4
65	56.8-57.7	60.0	73.9-52.2	88.1-67.2	77.8-57.2	57.5-53.7	63.8	64.0
70	63.7-63.5	67.4	81.2-58.3	95.3-73.2	84.6-63.6	64.0-59.8	70.2	71.1
75	69.9-70.4	75.0	88.9-64.7	103.-79.6	92.7-70.5	70.9-66.3	77.0	78.6
80	77.2-77.6	80.6	97.1-71.6	111.1-86.5	101.1-77.8	78.7-73.3	84.2	86.7
85	84.8-85.3	89.1	105.7-79.0	119.7-93.8	110.0-85.6	86.0-79.8	91.8	95.2
90	93.0-93.5	95.4	114.8-86.8	128.8-101.6	119.5-93.8	94.3-88.6	99.8	104.3
95	101.7-102.2	102.2	124.5-95.1	138.3-109.9	129.4-102.5	103.0-97.1	108.3	113.9
100	110.8-111.4	116.7	134.6-103.9	148.4-118.6	139.-111.8	112.3-106.0	117.2	124.1
105	120.5-121.7	125.0	145.3-113.2	159.0-127.8	150.9-121.6	122.1-115.4	126.6	134.9
110	130.7-131.3	135.1	156.5-123.0	170.1-137.6	162.5-132.0	132.5-125.5	136.4	146.4
115	141.5-142.1	145.6	168.3-133.5	181.8-148.0	174.6-142.9	143.4-136.1	146.8	158.4
120	152.9-153.4	157.0	180.6-144.5	194.0-158.9	187.4-154.5	154.9-147.3	157.7	171.1
125	164.8-165.4	165.1	193.6-156.1	206.9-170.4	200.7-166.7	167.1-159.1	169.1	184.5
130	177.4-177.9	183.3	207.1-168.3	220.3-182.6	214.7-179.5	179.8-171.6	181.0	198.7
140	204.3-204.9	211.8	236.1-194.8	249.1-208.8	244.6-207.2	207.2-198.5	206.5	229.3
150	234.0-234.5	243.2	267.7-224.1	280.4-237.9		237.3-228.1	234.5	263.0

ered. Note that this is not the same as recycling, where a refrigerant must be returned to a minimum standard of purity. There is no assurance that the A/C system will provide the same level of performance with the processed blend refrigerant as it did with new refrigerant containing the proper blend formulation.

Systems charged with blends may provide a high level of performance when initially charged. However, each refrigerant in these blends has a different pressure/temperature relationship, and different leakage rates through flexible hose. These blends can separate while in use, and a leak in the system can allow just one component of the blend to escape from the system. This partial leakage can change the entire refrigerant mixture and cause system operating problems.

Chart 3. This is a list of MVAC substitutes for CFC-12, which have been reviewed under EPA's SNAP Program. The most current version of this list may be obtained by calling the EPA's Stratospheric Ozone Hotline at 1-800-296-1997, or through the EPA website, located at http://www.epa.gov/ozone/title6/609/609.html.

Motor Vehicle Air Conditioning Substitutes for CFC-12
Reviewed Under EPA's SNAP Program as of June 3, 1997

Name (1)	Status (2)	Date	Manfacturer	Components / Reasons Unacceptable						
				HCFC-22	HCFC-124	HCFC-142b	HFC-134a	Butane (R-600) (3)	Isobutane (R-600a) (3)	HFC-227ea
HFC-134a	ASU	3/18/94	Several				100			
FRIGC FR-12	ASU	6/13/95	Intermagnetics General 800-555-1442		39		59	2		
Free Zone/ RB-276 (4)	ASU	5/22/96	Freezone 888-373-3066			19	79			
Ikon-12	ASU	5/22/96	Ikon Corp. 601-868-0755	Composition claimed as confidential business information						
R-406A/ GHG/McCool (5)	ASU	10/16/96	People's Welding 800-382-9006	55		41			4	
GHG-X4/ Autofrost/Chill-It (5)	ASU	10/16/96	People's Welding 800-382-9006	51	28.5	16.5			4	
Hot Shot/Kar Kool (5)	ASU	10/16/96	ICOR 800-357-4062	50	39	9.5			1.5	
GHG-HP (5)	ASU	10/16/96	People's Welding 800-382-9006	65		31			4	
FREEZE 12	ASU	10/16/96	Technical Chemical 800-527-0885			20	80			
GHG-X5	ASU	6/3/97	People's Welding 800-382-9006	41		15			4	40
OZ-12	UNA	3/18/94	OZ Technology	Flammable blend of hydrocarbons; insufficient data to demonstrate safety						
R-176	UNA	3/18/94	Arctic Chill	Contains CFC-12, which is inappropriate in a CFC-12 substitute						
HC-12a	UNA	6/13/95	OZ Technology	Flammable blend of hydrocarbons; insufficient data to demonstrate safety						
Duracool 12a	UNA	6/13/95	Duracool Limited	This blend is identical to HC-12a ®						
R-405A	UNA	6/13/95	Greencool	Perfluorocarbon component; extremely high global warning potential and lifetime						

1 — R-401A (made by DuPont), R-401B (DuPont), R-409A (Elf Atochem), Care 30 (Calor Gas), Adak-29/Adak-12 (TACIP Int'l), MT-31 (Millenia Tech), and ES-12R (Intervest) have not been submitted for review in motor vehicle air conditioning, and it is therefore illegal to use these refrigerants in such systems.

2 — See text for details on legality of use according to status.
ASU = acceptable subject to fittings, labeling, no drop-in, and compressor shutoff switch use conditions
UNA = unacceptable; illegal for use as a CFC-12 substitute in motor vehicle air conditioners

3 — Although some blends contain hydrocarbons, all blends that are ASU are nonflammable as blended.

4 — Freezone contains 2% of a lubricant.

5 — HCFC-22 content results in an additional use condition: must be used with barrier hoses.

Blend Refrigerants

Blend refrigerants contain more than one refrigerant, and have a bubble and dew pressure value that affects A/C controls. This bubble and dew characteristic of blends results in a temperature difference across the evaporator and condenser known as "glide." The auto industry doesn't design automotive A/C systems to use blend refrigerants. Installing blend refrigerants with the original A/C system refrigerant controls (expansion valves, pressure controls) could cause system performance problems. The information in Chart 2 compares the different refrigerant pressures.

The terms "bubble" and "dew" refer to the different condensing and vaporization characteristics of a given blend refrigerant. This may seem confusing since the automotive industry has always used single composition refrigerants such as R12 and R134a. Typically, with single composition refrigerants, by controlling the refrigerant pressure, the vaporization and condensing points are at the same temperature at a given pressure. Keep in mind that in order for the refrigerant to change states from a liquid to a vapor (vaporization) or from a vapor to liquid (condensation), it must first transfer a considerable amount of latent heat which is typically measured in BTUs.

With blend refrigerants, there's a variation between the actual vaporization and condensing temperature. The difference is referred to as glide and the greater the difference, the higher the glide. In other words, blend refrigerants do not have a specific pressure or temperature that allows them to be in either a vapor or liquid state, depending on the amount of heat contained.

Chart 4.

Container Fittings

Refrigerant	30# Container			Small Cans		
	Diameter (Inches)	***Thread (Pitch/inch)***	***Thread (Direction)***	***Diameter (Inches)***	***Thread (Pitch/inch)***	***Thread (Direction)***
R12	7/16	20	Right			
R134a	8/16	16 Acme	Right	8/16	16 Acme	Right
Freeze 12	8/16	18	Right	6/16	24	Right
Free Zone/RB-276	9/16	18	Right	6/16	24	Left
Hot Shot/Kar Kool	10/16	18	Right			
GHG-X4/Autofrost/Chill-it	.368	26	Right	14mm	1.25mm spacing	Left
R-406A/GHG/McCool	.368	26	Left	8/16	20	Left
FRIGC/FR-12	8/16	20	Left	7/16	20	Left

Based on EPA information dated October 1996

Mobile A/C Service Fittings

Refrigerant	High Side Service Port			Low Side Service Port		
	Diameter Inches	***Thread Pitch/inch***	***Thread Direction***	***Diameter Inches***	***Thread Pitch/inch***	***Thread Direction***
R12	3/8	24	Right	7/16	20	Right
R134a	Quick	Couple	16 mm	Quick	Couple	13 mm
Freeze 12	7/16	14	Left	8/16	18	Right
Free Zone/RB-276	8/16	13	Right	9/16	18	Right
Hot Shot/Kar Kool	10/16	18	Left	10/16	18	Right
GHG-X4/Autofrost/Chill-it	.305	32	Right	.368	26	Right
R-406A/GHG/McCool	.305	32	Left	.368	26	Left
FRIGC/FR-12	Quick Couple	Different than R134a		Quick Couple	Different than 134a	

Based on EPA information dated October 1996

Retrofitted Vehicles

CFC-12 vehicles that have been retrofitted to use an alternate refrigerant must comply to federal law. Retrofitted vehicles using an alternate refrigerant must have unique service fittings and a new system identification label and compressor high pressure cut-off switch if not already installed.

If a technician is servicing a system with non-barrier hose, and rertofits it to a refrigerant that contains HCFC-22, the technician must install barrier hose.

Chart 3 identifies the SNAP listed alternate refrigerants for automotive A/C systems.

Charts 4 and 5 identify the refrigerant container fittings, service fittings and labels.

System Service

The design of A/C systems affects the amount of time required to extract all of the refrigerant prior to opening the system for repair.

Systems using an accumulator require special attention. Refrigerant removal from accumulator systems requires additional time and precautions. When refrigerant is removed during extraction from an accumulator system, low system pressure results in the accumulator becoming very cold, with external frost sometimes in evidence.

Since the accumulator contains both lubricant and refrigerant, a large quantity of refrigerant will remain in the system until the system has equalized. Also, until the accumulator achieves the temperature of the surrounding area, it will continue to outgas refrigerant.

Because both the lubricant and refrigerant are potentially at this outgas condition, venting and safety are of concern. If the liquid refrigerant has not been completely removed and the refrigerant lines are opened, as the accumulator warms, a sudden release of the mixture can occur.

Use of external heating sources, such as hair dryers and electric heating pads, will raise the pressure in the accumulator and reduce the extraction time.

At no time should an open flame torch be used.

All the refrigerant must be removed before opening any of the system's refrigerant connections.

SAE Standards J1989 and J2211 provide procedures to assure that the refrigerant has been extracted.

Chart 5.

Suppliers, Composition, Labels

EPA "SNAP" Listed Refrigerants for Automotive Use

Refrigerant	*Supplier*	*Refrigerant Chemicals*	*Recommended Desiccant*	*Label Background Color*	*Label Foreground Color*
R-12	Many	100% CFC-12	XH-5, XH-7, XH-9		
R-134a	Many	100 % HFC-134a	XH-7, XH-9	Sky Blue	Black
Freeze 12	Technical Chemical 800-527-0885	80% HFC-134a 20% HCFC-142b	XH-7, XH-9	Yellow	Black
Free Zone RB-276	Refrigerant Gases 888-373-3066	79% HFC-134a 19% HCFC-142b	XH-7, XH-9	Light Green	White
R-414B Hot Shot Kar Kool	ICOR 800-357-4062	50% HCFC-22 39% HCFC-124 9.5% HCFC-142b 1.5% R600a	XH-9	Medium Blue	Black
R-414A GHG-X4 Autofrost Chill-it	People's Welding 800-382-9006	51% HCFC-22 28.5% HCFC-124 16.5% HCFC-142b 4% R600a	XH-9	Red	White
R-406A GHG McCool	People's Welding 800-382-9006	55% HCFC-22 41% HCFC-142b 4% R600a	XH-9		
FRIGC FR-12	Intercool 800-55-1445	59% HFC-134a 39% HCFC-124 2% R600a	XH-7, XH-9	Grey	Black

ASHRAE Chemical spec: Non-flammable +/- 2% Flammable < 1%

Current Systems Using HFC-134a Refrigerant

Starting with some 1992 models with completion by the 1995 model year, HFC-134a replaced CFC-12, which has been used in mobile A/C systems for many years.

Design changes in A/C systems have resulted in the adoption of improved hose and seal materials which reduce system leakage.

The development of recovery/recycling equipment has also resulted in reduced consumption of new refrigerant during normal service operations. On-site recycling is both good for the environment and required by law.

Industry and government cooperation with SAE has resulted in the development of additional SAE documents which provide service equipment guidelines and procedures for mobile A/C system service.

Service hoses and fittings for refrigerants are covered in J2196 and J2197. This includes requirements for lower refrigerant emission leakage rates for service hoses; and to prevent system cross contamination, 14 mm service hose and gauge manifold connections are specified for HFC-134a.

Containers for HFC-134a use a 1/2-inch Acme thread for hose connection and are light blue in color.

It is important to remember that CFC-12 and HFC-134a refrigerant are not directly interchangeable between systems. Should they become mixed, refrigerant contamination will occur, resulting in higher system operating pressures.

There is no "drop-in" replacement refrigerant for CFC-12 automotive A/C systems. **Some system modification will be required with the use of any alternate refrigerant.**

Use of service parts for CFC-12 systems, such as accumulators or receiver dryers, compressors, seals and hoses may cause problems if installed on an HFC-134a system. It is important to use only parts which meet the OEM specifications to assure compatibility with the refrigerant.

HFC-134a does not provide the same system lubricating circulation as CFC-12, and it is important that the proper lubricant be used in an HFC-134a system to ensure adequate lubricant flow to the compressor.

SAE J639 requires that the type of lubricant be identified on the system label. To assure that the proper lubricant is used in an HFC-134a system, confirm the system requirements. The industry is using many different formulations of PAG lubricants (polyalkylene glycol) with various additives to provide compressor lubrication. It is important that the proper lubricant be used and it is recommended that PAG lubricants not be mixed.

PAG lubricant will absorb moisture; it is very important when working on HFC-134a systems, that the system, hoses and containers of lubricant be kept tightly closed to prevent moisture entry. Protective impervious gloves are required to prevent lubricant contact with the skin.

System Identification

Only two refrigerants, CFC-12 and HFC-134a, are recognized and approved by the OE A/C system manufacturers for use in mobile A/C systems. As the availability of CFC-12 is exhausted, CFC-12 systems will require retrofitting.

SAE/industry guidelines are established for retrofitting CFC-12 systems. Use of alternate refrigerants in CFC-12 systems which are not approved and do not meet the guidelines of the industry, could cause problems in the servicing of mobile A/C systems.

Servicing of mobile A/C systems with an alternate refrigerant which has not been approved for retrofit could also contaminate both the CFC-12 and HFC-134a recycled refrigerant supply.

SAE J639 establishes service fittings for both CFC-12 and HFC-134a systems.

CFC-12 systems use screw thread service fittings, with the high side smaller than the low side. HFC-134a systems use a quick-couple fitting with the high side larger than the low side fitting.

In addition, the system service label will identify the specific system refrigerant type, the amount and the lubricant type.

SAE J1660 identifies the requirements for service fittings and labels when retrofitting CFC-12 systems to HFC-134a. Federal law requires that vehicles that are retrofitted shall have unique service fittings and proper identification label for the refrigerant installed to prevent contamination of refrigerant supplies.

System Changes

Changes were required for HFC-134a systems to assure performance equal to systems using CFC-12.

Changes include new hose and seal materials which are compatible with the new refrigerant and lubricant. This includes new hose construction to reduce hose leakage, and a new desiccant material in the accumulator or receiver/dryer for reduction of moisture level in the system.

The most noticeable change, however, is the increased condenser capacity, or increased air flow, to reduce system pressures at low speed operation and city traffic conditions. In general, condenser performance has been increased by approximately 30%, which results in comparable performance for HFC-134a systems as experienced in CFC-12 systems.

One major difference is that on some systems, the sight glass, which in the past has been used to

determine system refrigerant charge, has been eliminated. The sight glass may not be reliable for determining system charge with HFC-134a since layering conditions can exist with the lubricant and HFC-134a. A misreading will result in possible improper servicing of the system refrigerant charge.

It is advisable to charge mobile air conditioning systems only with known charge amounts. This is due to reduced system charge capacities, which, when overcharged can result in high system pressures. The customary "top-off" method of refrigerant charging is no longer recommended for servicing any mobile air conditioning system.

It is important to remember that the mineral oil lubricant used with CFC-12 systems, and the PAG or ester lubricant used with HFC-134a systems, are different. Mixing of these lubricants in systems which have not been retrofitted may cause problems. It is advisable to follow the A/C system manufacturer's recommendations concerning lubricants.

In order to assure that refrigerant supplies are not contaminated, use of separate service equipment, including recovery/recycling equipment, gauge manifold and hoses for each refrigerant is required. Lubricant and refrigerant left in hoses and equipment is a major source of contamination which will cause problems when servicing systems.

Use separate equipment to keep your refrigerant supply pure.

With the concern about the CFC effects on the environment, and the cost of refrigerant, it is important that the service technician, who is the key person involved in servicing the mobile A/C system, maintains the highest level of professional service.

Safety Precautions & Warnings

1. Failure to follow instructions provided by recycling equipment manufacturers could result in personal injury or equipment damage.

2. Always wear safety goggles when servicing an air conditioning system or when handling refrigerant.

REFER TO MATERIAL SAFETY DATA SHEET PROVIDED BY YOUR REFRIGERANT SUPPLIER FOR INFORMATION REGARDING THE PROPER HANDLING OF REFRIGERANT.

3. NEVER perform service on the recycling equipment (other than routine maintenance) without first consulting authorized service personnel. The removal of internal fittings and filters can cause refrigerant under pressure to be expelled. Use care and always wear safety glasses.

4. NEVER perform maintenance or service on the recycling equipment with the unit plugged into electric power unless directed otherwise.

5. NEVER transfer refrigerants to a cylinder or tank unless it is Department of Transportation approved for refilling. DOT approval is indicated by "DOT 4BW" or "DOT 4BA."

6. Recycling equipment incorporates parts, such as snap switches. These tend to produce arcs or sparks. Therefore, when located in a repair shop, recycling equipment should be used in locations with mechanical ventilation.

7. Avoid the use of an extension cord with recycling equipment to assure safe and proper operation. Under extreme situations where extension cords may be required, use minimum length 3-wire (No. 14 AWG minimum) with a ground circuit. To prevent shock hazard and reduce the risk of fire, make sure the extension cord is in good condition (not worn or frayed) with the ground circuit intact.

EPA Q & A

Q: How do I know if a vehicle uses CFC-12 (R12, also known by the trade name Freon)?
A: You can check under the hood for a label that identifies the refrigerant used in the vehicle's A/C system. The change to R134a, a non-ozone-depleting refrigerant, began in 1992 and was completed in 1995.

MACS Recommended Service Procedures

Ensure System Integrity

As a first step in service, always perform a visual inspection to spot obvious problems. If the system does not have refrigerant, installing 10% to 15% of the total system charge is sufficient for leak testing using a certified SAE J1627 electronic leak detector.

Be sure to check service valve fittings and O-ring integrity (the seals) in dust caps. Missing caps and seals at system valve ports are major leak sources. Caps and seals must be properly inspected and installed after service to minimize refrigerant loss.

Service Procedures

To provide containment and reduce unnecessary venting of refrigerant, proper service procedures must be followed.

1. Refrigerant in mobile A/C systems shall not be vented to the atmosphere during service or repair operations.
2. Refrigerant introduced into a system for the purpose of leak detection must be recovered and not vented.
3. The leak should be identified and repaired.

When a customer arrives at your service facility, it is necessary to determine if you are about to work on a contaminated system.

Questions such as when, who, and what was charged into the system the last time it was serviced might keep you out of a problem. Any past history available from the customer also may help keep you from working on a known-to-be contaminated system.

Service Guidelines

When the customer's car has poor cooling, it may be caused by low refrigerant charge, which in most cases may be caused by a leak. Most mobile A/C systems have controls which shut off a low charge system. In this case, the refrigerant remaining in the system could be in the 1/2 pound range or more with no way to identify the actual amount of refrigerant remaining in the system. **Installing gauges on the system and reading pressure will not identify the amount of refrigerant in the system.**

Checking System For Leaks

MACS recommends using the SAE J1628 technician service procedure when checking a mobile A/C system for a leak. It requires the use of an SAE J1627 certified electronic leak detector.

Leak Detection

To assure that serviced systems are returned to their original design-intent leakage specification, leak detection devices should be used. Proper use of leak detection equipment is important since leaks may occur in locations not directly visible to the technician.

SAE J1628 provides guidelines for the use of leak detection devices.

This document follows the guidelines of the A/C system manufacturers in providing technicians with the proper procedures to identify system leaks. The vehicle engine should not be operating during the leak checking procedure. All fittings and components should be checked on all surfaces. Refrigerant leaks are under pressure and can be present at any point, at the top or bottom of the part being checked.

To prevent system chemical contamination, it is recommended that leak detection be done only with the refrigerant which is specified for the system.

Do not use shop air for this procedure. Use of shop air for leak detection may introduce both air and moisture into the system. Use of other gasses having higher pressures, such as nitrogen, can result in damage to the A/C system (e.g., evaporator failure).

The SAE J1628 procedure **does not require a fully charged A/C system to identify if the system has a leak**. If the system has only a few ounces of refrigerant and at least 50 psig system pressure (at 59 °F ambient), that is sufficient to check for a leak. This pressure will be higher with the same amount of refrigerant when the service procedure is performed at warmer temperatures.

1. The system should be inspected for leaks by identification of oil on refrigeration parts or broken parts.
2. If the system has to be charged with refrigerant, only a few ounces are required to obtain a minimum system pressure (about 10 to 15% of the total system charge). The system is then checked with the electronic leak detector to identify any leaks. Use of soap bubbles will only identify leaks that are in excess of 40 ounces per year, as compared to electronic identification of less than one ounce per year.
3. With this limited refrigerant amount you can identify if the system has a leak, however, you can not determine if the refrigerant system will provide cooling. To operate the compressor the system must have additional refrigerant, approximately 1 to 2 pounds. ***CAUTION: Do not operate the compressor without the full charge of refrigerant as specified by the OE manufacturer.**

Under the Clean Air Act, refrigerant added for leak detection must be recovered and not vented.

After the system problem has been identified, and the necessary repair completed, the system should again be thoroughly leak tested.

Some states and local laws have more stringent requirements.

4. After adding refrigerant to the system you can identify which items will require replacement, such as a failed or leaking part/parts.

The EPA, MACS and many facilities recommend that leaking sys-

tems should be repaired for environmental reasons and to save R12 for future use.

Electronic Detectors

Some electronic leak detectors will only indicate CFC-12 leakage and will not indicate an HFC-134a leak. Newer design electronic detectors will provide leakage identification of both refrigerant types.

SAE J1627 equipment manufacturers provide rating information on the leak detecting capability of electronic leak detectors. Detectors which have the most sensitive detection levels will help identify systems which have smaller leaks.

EPA Q & A

Q: I understand that production of CFC-12 is being banned because it depletes the ozone layer. What does this mean for me? How do I keep down the cost of servicing vehicle A/C systems?

A: The continued use of CFC-12 is not banned. Even though production of CFC-12 ended on December 31, 1995, use of CFC-12 will still be permitted, so you can continue to use the CFC-12 that is in the vehicle now, and can continue to put it in vehicles, as long as supplies are available. CFC-12 used today is constantly being recovered and recycled, and some CFC-12 produced in 1994 and 1995 has been placed into inventory, so that there is still refrigerant available for sale after the 1995 deadline, although the price will most likely increase.

In order to minimize paying increasingly higher prices to replace CFC-12 that has leaked out of the A/C system, you should suggest preventive maintenance by checking A/C systems for leaks once a year, and you should suggest that leaks be fixed. Keep in mind that fixing leaks is not an EPA requirement, although some state and local regulations may require it.

Manufacturers' service and maintenance procedures should be followed to ensure proper operation of the equipment.

Trace Dyes

The chemical composition and amount of trace (leak) dyes when injected in mobile A/C systems may cause problems. Trace dye material can affect the A/C system compressor lubricant. Caution should be taken when using trace dyes since they may not be compatible for use with the different refrigerants. R12 dye material may not be compatible when used in an R134a system and may result in a compressor lubrication problem.

Leak dyes should not be added to any automotive A/C system unless the specific product has been approved by the original air conditioning system manufacturer.

If trace dyes are used, dyes meeting SAE J2297 for R134a refrigerant and/or A/C system manufacturer requirements should be considered to maintain system chemical stability.

Proper System Processing

Experimentation has shown that, even when your gauge set reads 28 or 29 inches of mercury, the inside of the system is at a higher value. The gauge indicates vacuum in the hose, not the system. Consider that the small opening in the service valve core fitting is a major restriction. It is very difficult to reduce the actual system to this level and even with a very good vacuum pump, can take a long time. Therefore, manufacturers suggest evacuation times of 30 to 45 minutes to assure that a vacuum has been attained.

When it comes to removing moisture, the entire system volume, not just the service gauge reading, must be below 29 inches of mercury. Actual moisture removal does not start until the system, not what you read on a questionable service gauge, has been reduced to at least 29.25 inches vacuum of mercury. Water boils at 212 °F at 1 atmosphere of pressure. By reducing the actual system pressure to 27 inches of mercury to accomplish moisture removal, the entire system would have to be raised to a temperature of 115 °F. This is not very practical.

So the bottom line is that your service equipment may not remove moisture by evacuation. The best assurance for control of excess moisture in the A/C system is to install a new receiver/drier or accumulator with fresh desiccant.

It is important that processing the system by pulling a vacuum to remove air and refrigerant be done prior to charging additional refrigerant.

Recovery/recycling equipment which meets SAE requirements only has to reduce the system to a minimal level of vacuum to remove refrigerant.

Use of equipment which has a limited vacuum pump capacity may not reduce the system to complete refrigerant out-gassing and removal of air (non-condensable gasses), prior to adding the new refrigerant charge.

To ensure that you are processing the system to the lowest obtainable vacuum levels, use a calibrated vacuum gauge and check the system vacuum level obtained with a good vacuum pump and compare that value with the recovery equipment.

Some equipment manufacturers have either a separate vacuum pump or a procedure to vent the vacuum pump to atmosphere, allowing the equipment to pull 29 inches of mercury.

Be sure that you have pulled at least 29 inches of vacuum on the system before charging the system with refrigerant. (**NOTE:** At facilities located at higher elevations, such as Denver, the gauge reading will be less.)

Desiccant Failure

The desiccant, which removes system moisture, is located in the receiver/drier or accumulator. Desiccant may break down when exposed to an incompatible refrigerant and cause system plugging. It

is important that when servicing the A/C system the correct desiccant is used for the type of refrigerant used in the system.

Desiccant identified as XH5 has been used in CFC-12 systems, and HFC-134a systems require XH7 desiccant. It is advisable that when a receiver/drier or accumulator is being replaced, XH7 should be used since it is compatible with both R12 and R134a refrigerants. Blend refrigerants that contain R22 require XH9 desiccant that is generally not available to the service industry. If the A/C system has contained R22, it may result in damage to the XH5 and XH7 desiccants.

System Lubricant

It is important that a correct system lubricant charge be maintained to assure proper system operation.

Component replacement has general guidelines, supplied by the manufacturer, for lubricant addition during system service.

In general, recycling equipment will remove very little, if any, lubricant from the A/C system during the extraction operation. Design of recycling equipment requires that the amount of lubricant removed during refrigerant extraction be identified.

REMOVED LUBRICANT MUST NOT BE RE-USED IN THE SYSTEM.

When a large quantity of lubricant is removed during extraction, the A/C system may have a lubricant overcharge.

If the indicated sample, removed during the recycling operation, contains refrigerant dissolved in the lubricant, use of this indicated amount may result in replacement of excess new lubricant and cause system damage.

Use only new lubricant, as identified on the A/C system label, to replace the amount removed during the recycling process. Used lubricant should be disposed of in accordance with federal, state and local requirements.

Recovery only and recovery/recycle equipment which meets SAE requirements will separate the lubricant during the extraction process, so that the recycled refrigerant will not contain sufficient lubricant to cause a problem. This is important since HFC-134a systems use a number of different lubricant types. The recovery/recycling equipment must be serviced and maintained to assure its proper operation.

Lubricant Mixing

Do not mix lubricants in systems. Use only the type of lubricant specified by the system manufacturer.

CFC-12 systems use mineral-based lubricants. New HFC-134a systems use several types of PAG lubricants. The proper type of lubricant and amount used is extremely important.

The A/C system label will identify the correct type of lubricant required. Mixing of PAG lubricants may also cause system problems. Use only the lubricant specified by either the A/C system manufacturer or the vehicle maker. Ester lubricant is not generally used by the A/C system manufacuters.

If systems have an overcharge of lubricant, the lubricant may collect in the evaporator and result in warmer outlet air temperatures. Proper system lubricant charge is important. Systems retrofitted without the removal of the mineral oil may have excess lubricant return to the compressor, if systems are overcharged with refrigerant. Follow the system manufac-turer's recommendations.

HFC-134a Lubricants

Caution must be taken when handling both PAG and ester lubricants. Protective impervious gloves are required to prevent lubricant contact with the skin. If lubricant does come into contact with the skin, wash the material off skin with plenty of soap and water. Skin irritation may occur with repeated and/or prolonged contact. Additional health and safety information may be obtained from lubricant manufacturers.

Coating of O-rings and seals prior to installation on A/C parts for HFC-134a systems should only be done with mineral oil, rather than with HFC-134a lubricants, to prevent skin contact. Also, since the PAGs absorb moisture, the potential for connector corrosion at the O-rings is reduced by using mineral oil. Because of the part location, this small amount of mineral oil will not affect system operation.

In addition, care should be taken since damage may result when HFC-134a lubricants contact paint, plastic parts, engine drive belts and coolant hoses.

With the early phase-out of CFCs, the mobile A/C industry has had to consider retrofitting CFC-12 systems to HFC-134a. Certain compromises have to be considered in order to retrofit the CFC-12 fleet. These compromises have included the mixing of mineral oil and PAG system lubricants in retrofitting CFC-12 systems. It is important that when servicing any system, recommendations of the system manufacturer for the proper lubricant (mineral oil, PAG, or ester) should be strictly followed to ensure compressor lubrication.

Flushing of Systems

Open vent system flushing with CFCs is now not only illegal under the Clean Air Act, but has also become a system chemical stability concern. For many years, R11 and R113 have been used for open-vent flushing when cleaning mobile A/C systems. Technical information shows that even small amounts of R11 residue will cause problems in HFC-134a systems.

The practice of open vent flushing often will not remove failed compressor material from some condenser units. Some A/C system manufacturers recommend that flushing not be considered after mechanical failure. The use of an in-line filter is considered to be the more effective method of controlling particle residues.

Use of other flushing solvents are also areas of concern since, depending on their boiling point, the vacuum pump may not remove all the solvent. This will possibly affect the chemical stability of the refrig-

erant, seal and hose materials.

DO NOT use any cleaning solvents (e.g., solvent cleaners of any kind), since they will affect system seals and O-rings, and cannot be totally removed. This may result in future system failures.

If you are still not happy just using filters and want to power flush systems, flush each part with only the refrigerant type used in the system and, so you do not vent it, be sure to collect the discharge with recovery/recycling equipment.

To power-flush a separate part, or the complete system, the flushing equipment must be connected in series with the portion which is being flushed and filled so liquid refrigerant is used for the flushing action.

Attachment of the system at the gauge service ports, even with the valve cores removed, will not provide adequate system flushing. Use of this method will result in the flushing being confined to the system's lowest pressure circuit and may not result in the removal of material.

If another flushing solvent is used, determine if flushing material is classified as hazardous material. Dispose of it in accordance with local, state and federal regulations.

NEVER USE ANY CFC PRODUCT FOR FLUSHING HFC-134a SYSTEMS.

Refrigerant Identification

It is important that when using containers of refrigerant, you identify the container contents. Chemical companies have trademark names, and it is important to identify the refrigerant type to assure proper system operation. Do not rely on a trade name alone to confirm that it is the correct refrigerant. Use only the specific refrigerant designated for the A/C system currently being serviced.

Some bus and truck air conditioning systems use R22, which is covered under Section 608 of the Clean Air Act and requires compliance under that section.

It is essential that the service technician use only the OEM-recommended refrigerant and appropriate service equipment to ensure that refrigerant mixing does not occur.

Use of the wrong refrigerants during top-off service activity which is not a recommended service procedure, will not improve system performance and may cause system damage.

Purity of Refrigerant

The purity of reclaimed refrigerants supplied in containers from sources other than automotive air conditioners for service and re-use in automotive air-conditioning systems, must meet the appropriate ARI 700 standard.

Since there are many other non-automotive uses of both CFC-12 and HFC-134a, it is important that the source of the refrigerant be known.

Since CFC-12 and HFC-134a are also used in residential and commercial systems such as refrigerators, water chillers and central cooling systems, many different contaminants and acids may be present in used refrigerant from these sources.

Use of recycling equipment which meets SAE J1990 and J2210 requirements will not purify refrigerants from non-automotive or other sources to the ARI 700 standard so as to meet automotive air-conditioning purity requirements, and federal requirements.

Refrigerant from any source, other than an automotive A/C system, should not be used unless it has been returned to a reclamation center which can return the refrigerant to the ARI 700 specifications.

Use of refrigerant from non-automotive sources which contains acids and other contaminants, as well as a possible mixture of other refrigerants, will cause serious problems in automotive air conditioning systems.

There are no federal requirements that containers of reclaimed refrigerant must identify contents or purity.

Reclaimed refrigerant purchased for servicing mobile A/C systems must meet ARI specification of 0.5% purity to be in compliance with federal law.

Flammable Refrigerants

Replacement refrigerants which are or can become flammable have been sold for use in A/C systems. Caution should be taken before working on any system suspected of containing this type of refrigerant. Use of leak detection equipment and recovery/recycling service equipment for removal of this type of refrigerant may pose a safety concern.

Service Concerns

1. Some electronic or open flame leak detectors may become the source of ignition when used to attempt identification of leaks in a mobile air conditioning system containing flammable refrigerant.
2. Use of automotive recovery or recycling equipment that is operated by electricity, to remove flammable refrigerants which are not compatible with compressor motor-insulation systems, may pose electrical shock or fire hazards to the operator of such equipment.
3. Mobile air conditioning systems use service port fittings to gain access and refrigerants are released when connecting and removing them. Release of refrigerant that is flammable in a confined area containing an ignition source (such as a torch or pilot light on a gas appliance) could result in fire or explosion.
4. Flammable refrigerants may also contain CFCs or HCFCs. Flammable refrigerants have been installed in motor vehicles, therefore any facility servicing the vehicle may not be aware of a flammable refrigerant's existence in the system. Under federal law systems containing a mixture of these refrigerants can not be vented. Proper disposal is required.

WARNING: REMOVAL AND HANDLING OF FLAMMABLE REFRIGERANTS MAY BE DANGEROUS.

Consequences of Cross-Contamination

Mixing of Refrigerants

Mobile A/C system contamination will occur due to the installation of the wrong refrigerant without proper system identification.

Under no circumstances should refrigerant be mixed in a system, since any mixing will affect recycling programs and cause equipment and system problems.

Damage may include compressor failure, damage to recycling equipment and transfer of the mixed refrigerant to other vehicles, causing additional problems and reduced system performance.

If CFC-12 and HFC-134a are mixed in the same system, increased pressures will occur resulting in loss of performance, system damage (such as compressor failure), hose and seal leakage, and refrigerant contamination.

It is essential that the service technician use the designated separate refrigerant service equipment to make sure cross-contamination does not occur. Professional A/C service facilities should have separate recovery/recycling equipment for CFC-12 and HFC-134a. This also includes having the proper service equipment when servicing other alternate refrigerants. **Under federal law, designated service equipment is required for all SNAP listed refrigerants.**

Applicability to Manifold Gauges and Refrigerant Identifiers

Manifold gauges allow technicians to diagnose system problems and to charge, recover and/or recycle refrigerant. A standard fitting may be used at the end of the hoses attached to the manifold gauges, but unique fittings must be permanently attached at the ends of the hoses that attach to vehicle air conditioning systems and recovery or recycling equipment. Similarly, refrigerant identifiers may be used with multiple refrigerants. The connection between the identifier or similar service equipment and the service hose may be standardized and work with multiple hoses. For each refrigerant, however, the user must attach a hose to the identifier that has a fitting unique to that refrigerant permanently attached to the end going to the vehicle. Adapters for one refrigerant may not be attached to the end going to the vehicle and then be removed and replaced with the fitting for a different refrigerant. The guiding principle is that once attached to a hose, the fitting is permanent and is not to be removed.

CAUTION: This includes manifold gauge sets, hoses, charging and recycling equipment.

General Precautions

Contaminated refrigerant removed from a mobile A/C system can affect recovery/recycling equipment and servicing of other vehicles. When R12 and R134a refrigerant are mixed, it will have a different pressure than pure refrigerant. The indication of this pressure change is found when R12, or R134a have two, five, and ten percent contamination (see Chart 6).

System contamination can occur when a refrigerant other than that specified for the system is added.

If 12 ounces of R22 were added to a typical CFC-12 system, discharge pressures would increase by approximately 30%.

CFC-12 Pressure

			% of HFC-134a MIXED IN CFC-12		
AMBIENT	**PURE CFC-12**	**MAX.NCG/AIR**	**2%**	**5%**	**10%**
80˚ F	84	96	88	93	99
90˚ F	100	110	105	111	116
100˚ F	117	127	123	127	135

HFC-134a Pressure

			% of CFC-12 MIXED IN HFC-134a		
AMBIENT	**PURE HFC-134a**	**MAX. NCG/AIR**	**2%**	**5%**	**10%**
80˚ F	86	91	92	95	98
90˚ F	104	109	109	112	116
100˚ F	124	129	130	133	136

Caution: You cannot rely on system gauge pressure readings to identify refrigerant contamination in an auto A/C system because all parts of the system may not be at equal temperature, which is required to have a stabilized pressure condition.

Chart 6.

Fuel System Fittings

Caution: The fitting on the fuel injection plumbing which contains combustible fluids is the same size as one of the CFC-12 A/C service fittings. Be careful not to attach A/C service lines to the vehicle fuel system.

Eye Protection

To prevent injury when working on refrigeration systems, eye protection must be worn.

Future of CFC-12 Systems

Blend Refrigerants/Retrofits

The only retrofit refrigerant which has been approved by the original mobile air conditioning system manufacturers for replacement in a CFC-12 system is HFC-134a.

Additional system retrofit modifications may include hoses, a high pressure cut-out device, seals, desiccant, lubricant, refrigerant control replacement, increased condenser capacity and other modifications as determined by the equipment manufacturer. Not following the OEM recommendation may result in system damage, loss of performance and affect warranty.

It should be noted that other refrigerants are not compatible with CFC-12 or HFC-134a and under federal law require separate service equipment to prevent cross-contamination.

Since January 1992, the Clean Air Act has required that any refrigerant containing HCFCs, such as blends, must comply with Section 609. These cannot be vented and must be recycled.

Under federal law it is legal to store and use CFC-12 for servicing mobile A/C systems until it is no longer available. However, it can only be purchased, regardless of container size, by personnel certified under section 608 or 609 of the Clean Air Act.

The Federal Clean Air Act "SNAP" ruling has identified refrigerants that are considered acceptable for use in mobile A/C systems. However, simply because a refrigerant is considered acceptable under this ruling does not mean that refrigerant will provide satisfactory A/C system performance. The EPA only considers replacement refrigerants for environmental and safety reasons. The EPA does not test the refrigerants for performance or system durability.

Several refrigerants are considered acceptable under the "SNAP" rule. The only replacement refrigerant currently approved for use by the world automobile manufacturers and many A/C system replacement parts suppliers is HFC-134a. Use of other refrigerants for new vehicles or retrofitting CFC-12 systems may void warranty.

The Federal "SNAP" rule also requires that refrigerants used to service or retrofit CFC-12 mobile A/C systems must have unique service fittings and labels, as well as a high pressure compressor cut-off switch if not already installed.

It will be difficult to enforce requirements that fittings and labels be installed on a nationwide basis. It is most likely that these replacement refrigerants will be installed in some vehicle A/C systems without the required changes, resulting in contamination of refrigerant supplies and equipment.

The "SNAP" ruling has also identified OZ-12, HC-12a manufactured by OZ Technology and other refrigerants which contain hydrocarbons as unacceptable for use as replacements for CFC-12 in mobile A/C systems. Indications are that their use has been somewhat extensive, and there is no information on system material compatibility, and the possibility of early system failures.

These flammable refrigerants have been manufactured to duplicate CFC-12 and HFC-134a refrigerant pressure temperature curves. The pressure temperature relationships of hydrocarbon refrigerants in the field have not been consistent. Given the many possible ignition sources, from the vehicle, shop area and service equipment, flammable refrigerants pose safety concerns.

Recommendations for Retrofit

All mobile A/C system manufacturers encourage use of R12 refrigerant in A/C systems designed to operate with that refrigerant.

If R12 refrigerant is not available, then the more costly system retro-

Final Rule Conditions for Any EPA/SNAP R12 Substitute for Automotive A/C Use

1. No substitute refrigerant may be used to "top off" an automotive A/C system, unless the original refrigerant has first been extracted in accordance with EPA regulations.
2. Only substitute refrigerants listed as acceptable by EPA can be installed in automotive A/C systems in order to be in compliance with federal law. [To date, EPA has listed several refrigerants. To get an up-to-date SNAP list, call the EPA hotline at 1-800-296-1996.]
3. These refrigerants may only be used with a set of fittings unique to that refrigerant.
4. A unique label must be used to identify the refrigerant in the system for the purpose of proper future service. This label must comply with certain standards.
5. If the system does not already have a high pressure compressor clutch cut off switch, one must be installed.
6. Each replacement refrigerant cannot be vented and requires specific recovery equipment.

This means that any R12 system that is retrofitted, converted or altered to use a refrigerant other than R12 must use fittings and labels unique to the new refrigerant, and have a high pressure compressor cut-off switch to be in compliance.

fit must be considered.

Under the Significant New Alternative Policy (SNAP) program rules, the EPA has listed HFC-134a and several other alternatives as acceptable for use in retrofitting existing CFC-12 mobile A/C systems.

The world auto industry has identified HFC-134a as the refrigerant of choice for new and retrofitted mobile A/C systems.

Remember, there is no direct "drop in" replacement for R12 A/C systems.

The SAE, at the request of the U.S. Environmental Protection Agency and the air conditioning industry, has developed a set of retrofit guidelines. Conversion of a CFC-12 system to use HFC-134a is covered in SAE J1660 "Fittings and Labels for Retrofit of R12 Mobile Air Conditioning Systems to R134a," and SAE J1661 "Procedure for Retrofitting R12 Mobile Air Conditioning Systems to HFC-134a." Air conditioning system manufacturers' procedures follow these SAE requirements.

Conversion of a CFC-12 system not following these procedures, or conversion to another refrigerant may result in system problems.

Under the federal requirements, to prevent contamination of mobile A/C systems and refrigerant supplies, each system that uses a refrigerant listed acceptable must have the appropriate service fittings and label for that retrofit refrigerant. **The system must also have a high pressure compressor cut-off switch to be in compliance.**

No CFC-12 automotive A/C system should have HFC-134a charged into that system until it has been retrofitted.

Mobile A/C Service Options for Leak Repair

For example, the A/C system has some pressure and an unknown amount of refrigerant in the system at first inspection. Additional refrigerant is also added to check operation of the system. The system has an identifiable leak and the customer declines to repair the leaking system.

The service facility's option under Section 609 is to charge the customer for the inspection and added refrigerant and return the pre-existing leaking system to the customer. There is no EPA requirement under Section 609 that refrigerant must be removed from a leaking system. If the leaking system is not repaired it must be returned to the customer with at least the same amount of refrigerant as was in the system when it arrived. Note: Some state and local laws have additional requirements regarding this aspect of A/C service.

What if the A/C system has no pressure at first inspection, so any refrigerant added to the system is owned by the service facility? If it is the policy of the facility not to charge a leaking system, and this policy is explained to the customer up front, and the customer declines to have the leaking system fixed, all of the refrigerant added can be removed. But remember, under Section 609 regulations, the pre-existing leaking system can be charged. Note: Some state and local regulations are more stringent than Section 609 on charging a leaking system.

EPA Q & A

Q: Is a service shop that only charges or "tops off" an air conditioning system covered by the requirements to purchase equipment and have technicians certified?

A: Yes, all shops performing service on motor vehicle air conditioning systems are covered by the regulations. Charging systems is defined as performing service.

EPA Q & A

Q: Production of CFCs stopped at the end of 1995. Does that mean consumers can no longer use their vehicle air conditioners?

A: There is no restriction on the use of chemicals in existing equipment. In fact, extending the useful life of existing motor vehicle air conditioning systems is one of the reasons EPA developed a recycling program. Recycling and reusing refrigerant reduces emissions and helps to smooth the transition to the substitute, HFC-134a.

EPA Tip

Follow the accepted procedures for changing fittings and labeling refrigerants in vehicle air conditioners that have been retrofitted. It is important to offer retrofit advice to consumers that is consistent with industry guidance and is technically correct.

At present, advise vehicles owners to have their cars retrofitted only when the air conditioner system needs major work. In the future, as supplies decrease and costs of CFC-12 increase, it is likely that retrofits will make economic sense in more cases.

EPA Tip

Stay informed about which alternate refrigerants are listed acceptable by EPA for use in vehicles and what the manufacturers are saying about how alternatives perform in their autos and trucks. Use only an alternative that is listed as acceptable by EPA. At present R134a is the only alternative listed as acceptable, which has also been fully tested and specified by the OEMs in their retrofit guidelines.

EPA Q & A

Q: I've heard that I might have to convert vehicle A/C systems to use a different refrigerant. When will I need to do that?
A: You will need to allow the customer to decide whether to convert the vehicle's system to use an alternate refrigerant if the system becomes inoperative and requires a new refrigerant charge, and CFC-12 is no longer available. Although there is no way to predict with certainty when supplies of CFC-12 will be exhausted, the extensive recycling and banking of CFC-12 occurring now should make it available for several years. Depending on the age of the vehicle, it may well be the case that CFC-12 will be around for the remainder of its life.

It may also make sense to convert the system if major service is being performed on the A/C system (for example, a front-end collision or a compressor failure). In that event, the additional cost of doing the conversion over and above the cost of repair work may be minimal, because many steps in converting are also necessary in performing major repair.

Q: What will the cost be to convert vehicles to a different refrigerant?
A: EPA estimates that conversions will cost between $100 and $800 or more, depending on the make, model and age of the vehicle. Conversions at a minimum will require that the oil used to lubricate the A/C system, and the fittings, be changed. EPA estimates that this minimal conversion will add less than $200 to the cost of any repair work requested. Other components of the A/C system may have to be replaced, depending on whether the current system A/C components are compatible with the new refrigerant.

Q: If I decide to convert a vehicle, how do I know what changes are required?
A: EPA recommends that you consult vehicle manufacturers' guidelines. Manufacturers have available retrofit guidelines for vehicles manufactured after the late 1980s. The Ozone Protection Hotline will be able to tell you if the manufacturer of the automobile has established specific procedures for the conversion of the vehicle. When considering converting any vehicle, you should rely on the OEMs' retrofit guidelines.

Q: What new refrigerant should be put in my vehicle? Are there many substitute refrigerants that are OK?
A: Automakers are producing new vehicles with R134a, which does not deplete the ozone layer. EPA evaluates all substitutes for CFC-12 under its Significant New Alternatives Policy (SNAP) program in order to determine if they pose any risk to human health or to the environment. Currently, R134a is the only alternative listed as acceptable by EPA, which also has been fully tested and is specified by automakers in their guidelines.

Q: I've been seeing other substitutes for sale. If I find out that a particular alternate has not been reviewed by EPA, or that EPA has not finished its review of the product, can I legally buy the product? What happens if I buy it now, and EPA decides in the future that it is not acceptable?
A: While you can legally purchase the product if the Agency has not made a determination as to its acceptability under the SNAP program, you should keep in mind that such product has not been tested to determine whether it is safe to use. If EPA later declares the product unacceptable, you do not legally need to remove it from the vehicle's air-conditioning system, but you may choose to do so. You should be aware that it may be costly to convert the system back to an acceptable alternative, and that it's illegal to add any more refrigerant that EPA has declared unacceptable. The fine for sale of an unacceptable alternative is up to $25,000 per day and 5 years in jail.

Q: Will any alternative refrigerant listed by EPA as acceptable work in the vehicle?
A: Although EPA's SNAP program determines what risks an alternative poses to human health and the environment, the Agency does not determine whether the alternative will provide adequate performance or will be compatible with the components of the A/C system.

Keep in mind that using a refrigerant not yet reviewed and determined acceptable by EPA may result in damage to the A/C system components including the compressor, and may limit the ability to have the vehicle's system serviced in the future.

Q: I have heard that R134a does not cool nearly as well as CFC-12. Is this true?
A: Vehicle manufacturers have designed air conditioning systems for new vehicles that use R134a while maintaining reliability and cooling performance. Conversion specifications for A/C units using R134a are also designed to maintain performance, but this may vary depending on the condition of the unit prior to the conversion, and on other factors.

Be prepared to provide consumers with up-to-date information about the use of CFC-12 and substitute refrigerants. Service shops should be able to offer information as well as respond to questions. Having brochures, fact sheets, posters, and/or videos on hand will help educate consumers about their options.

HFC-134a Cautionary Statements

Safety Issues

There has been considerable activity by promoters of so called "drop in" refrigerants for mobile A/C systems and this activity has created a lot of misinformation regarding HFC-134a.

The toxicity data base for HFC-134a is even more extensive than that for CFC-12. HFC-134a was listed by the U.S. EPA as acceptable for use in mobile A/C systems in the April, 1994 final SNAP rule.

HFC-134a has been approved for use in metered dose medical inhalers for asthma suffers.

HFC-134a is at least as safe as CFC-12. Regarding reports of HFC-134a being associated with testicle tumors: rats were exposed to 50,000 ppm of HFC-134a for 6 hours per day, five days per week for 2 years. At the end of this period microscopic examination of the male rat testis, indicated an increased incidence of benign tumors. Such tumors are known to occur in rats, not in humans. At levels of 10,000 ppm, no life-threatening effects occurred during the 2 year study.

These results are equivalent to the working lifetime of a human.

Illustrating the safety of R134a, a service technician would have to enclose himself in his garage, close all doors and windows, turn off all means of ventilation, and intentionally release 10 ounces of R134a directly into the garage air to create an exposure level of 1,000 ppm. The allowable occupational exposure limit tells us that a technician could do this for 8 hours per day, 5 days per week, for a lifetime and suffer no adverse effects.

Material Safety Data Sheets for these refrigerants, from a major producer of R12, R22 and R134a, include some of the following statements: "Inhalation of high concentrations of vapor is harmful and may cause heart irregularities, unconsciousness, or death." "Vapor reduces oxygen available for breathing and is heavier than air."

In other words, acute risk from high short dosage will cause problems with any of these refrigerants. Also, "Material is stable. However, avoid open flames and high temperatures. Decomposition products are hazardous. Can be decomposed by high temperatures (open flames, glowing metal surfaces, etc.) forming hydrofluoric acids, and possibly carbonyl halides." All three refrigerants have a 1,000 ppm 8 hour applicable exposure limit.

Both R22 and R134a are not flammable at ambient temperatures and atmospheric pressure. However, R134a and R22 have been shown in tests to be combustible at certain pressures and ambient temperatures when mixed with air (when contained in a pipe or tank). Service equipment or vehicle A/C systems should not be pressure tested or leak tested with compressed air.

These mixtures may be potentially dangerous, causing injury or property damage. Additional health and safety information may be obtained from refrigerant and lubricant manufacturers.

Other Safety Considerations

CAUTION: Avoid breathing A/C refrigerant and lubricant vapor or mist. Exposure may irritate eyes, nose and throat. To remove HFC-134a from the A/C system, use service equipment certified to meet the requirements of SAE J2210 (HFC-134a recovery/recycling equipment). If accidental discharge occurs, ventilate the work area before resuming service. Additional health and safety information may be obtained from refrigerant and lubricant manufacturers.

Shut-Off Valves

Shut-off valves may be either manual or automatic. While SAE J standards say shut-off valves must be used within 12 inches (30 cm) of a connection, some equipment manufacturers use quick-couplers. These automatically shut off the flow of refrigerant when connections are broken. When quick-couplers are used, follow the equipment manufacturer's recommendations.

Proper hookup of refrigerant lines to the system must include shut-off valves on the end of every line. Shut-off valves should be no more than 12 inches (30 cm) from the port where the lines are connected.

Use of a shut-off valve at the hookup for refrigerant canisters also will help ensure minimum refrigerant loss.

EPA Q & A

Q: I know that the old refrigerant, CFC-12, does not pose cancer risks when properly used. Is this true of R134a?

A: R134a is regarded as one of the safest refrigerants yet introduced, based on current toxicity data. The chemical industry's Program for Alternative Fluorocarbon Toxicity Testing (PAFT), a series of protocols for testing fluorocarbons, determined that R134a does not cause cancer or birth defects.

Q: Is R134a flammable?

A: R134a is considered as safe or safer than CFC-12 in motor vehicle uses, including involvement in collisions. Like CFC-12, R134a is not flammable at ambient temperature and atmospheric pressures. However, R134a service equipment and vehicle A/C systems should not be pressure tested or leak tested with compressed air. Some mixtures of air and R134a have been shown to be combustible at elevated pressures. These mixtures may be potentially dangerous, causing injury or property damage.

EPA Tip

KEEPING COOL: ADVICE IN BRIEF

Use CFC-12 as long as it is available.

Inform your customer to have their vehicle serviced by EPA certified technicians in service facilities that use approved recycling equipment. It's the law!

If major repairs are being made to the CFC-12 air conditioning system, discuss the retrofit option with the customer.

Beware of using alternative refrigerants that have not been listed as acceptable by EPA based on health and safety considerations. Currently R134a is the only refrigerant listed as acceptable, which has been fully tested and specified by the OEMs in their retrofit guidelines. (R134a contains no chlorine and therefore does not harm the ozone layer.)

Containers: Handle With Care

CAUTION: NEVER USE A STANDARD DISPOSABLE 30 LB. TANK (THE TYPE OF CONTAINER IN WHICH VIRGIN REFRIGERANT IS SOLD) TO RECLAIM REFRIGERANT CFC-12. USE ONLY DOT CFR TITLE 49 OR UL-APPROVED STORAGE CONTAINERS FOR RECYCLED REFRIGERANT (CONTAINERS MARKED DOT 4BW OR DOT 4BA).

Thermal Expansion

Safety codes recommend that closed tanks not be filled over 80% of the volume with liquid.* The remaining 20% is called head pressure room.

Refrigerant expands when it gets warm.

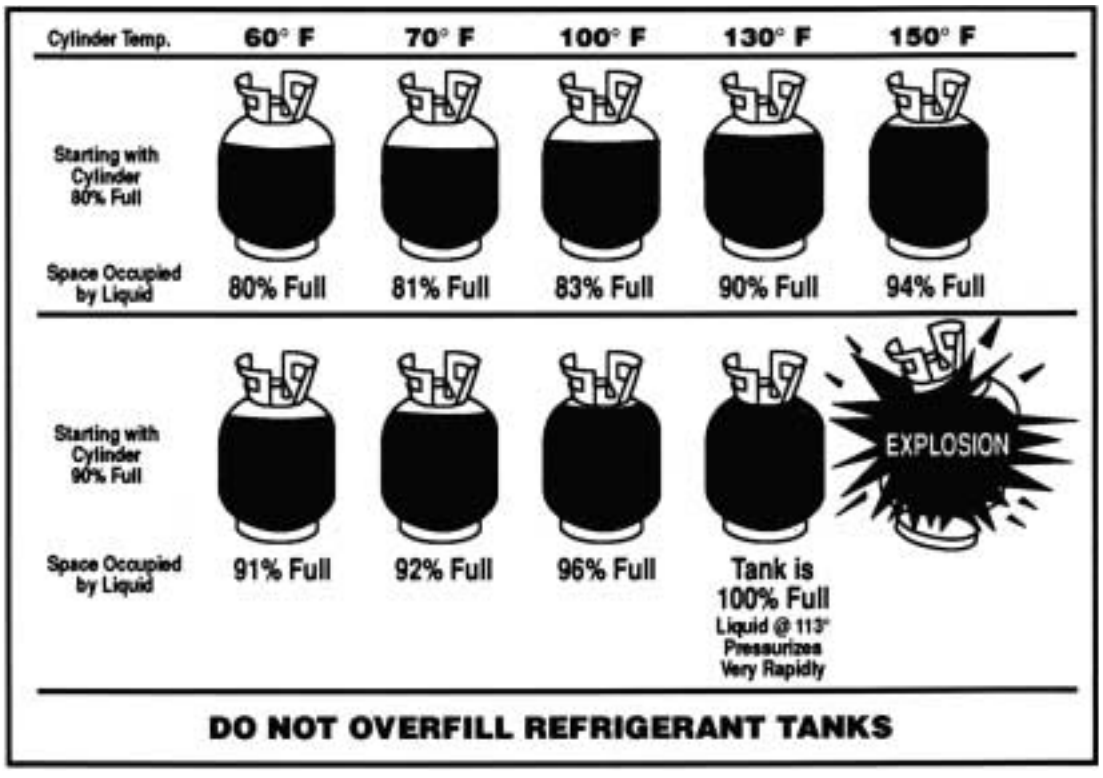
When refrigerant expands some of it boils, thus increasing the pressure.

Remaining liquid expands rapidly and may fill the container 100% full with liquid.

The fuller the tank the more liquid expansion takes place.

Pressure within the tank increases at a slower rate if there is room for the gases. The pressure increases according to the liquid saturation.

A tank filled with 80% liquid is relatively safe.* However, the tank filled with 90% liquid is in essence a time bomb. A 90% fill causes pressure within the tank to rise at a very rapid rate. At temperatures above 100 °F, the tank may explode.



*SAE J1989, Section 7.2 states: "To prevent on-site over-filling when transferring to external containers, the safe filling level must be controlled by weight and must not exceed 60% of container gross weight rating."

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Editor's Note:

Where possible, the information contained in this manual identified as, "EPA Q & A" and "EPA Tip's" have been excerpted from EPA fact sheets; however this information is intended only as an overview, not a detailed accounting of the subject regulations. To learn more about the EPA stratospheric protection program or to order publications, call EPA's Hotline: 1-800-296-1996 or check EPA's website, located at:

http://www.epa.gov/ozone/title6/609/609.html.

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SAE J1989
Recommended Service Procedure for the Containment of CFC-12 (Pages 16-17)

SAE J2211
Recommended Service Procedure for the Containment of HFC-134a (Pages 18-20)

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