INDEX

OVERVIEW OF THE 1990 CLEAN AIR ACT

In response to increase scientific evidence of significant ozone depletion, the land mark international environmental agreement, the Montreal Protocol on Substances that Delete the Ozone Layer, was signed in September 1987. The original Protocol called for 50 percent reduction in CFC's by the year 1998. The discovery of seasonal "ozone hole" over Antarctica highlighted the need for more stringent measures. In June 1990, the Protocol was amended to comply phase-out production CFC's halons (used in fire extinguisher by the year 2000. In November 1992, in response to scientific findings indicted that ozone depletion was more severe than anticipated, the parties to the Montreal Protocol voted to accelerate the phase-out to the end of 1995. Currently, 192 nations, representing over 95 percent of the world's consumption of CFC's are parties to the Protocol.

In addition to the phase out of ozone-depleting substances, title VI includes provisions to reduce emissions of all ozone-depleting substances. Section 608 contains requirements for a "lowest achievable level" of emissions of the controlled substances during use and disposal of appliances and industrial process refrigeration and bans on intentional venting at servicing and disposal. The requirements for auto technicians and the regulations they must follow when servicing an A/C unit are in Section 609 of the Act.

Section 609 of the 1990 Clean Air Act establishes an important new statutory structure to control the release of refrigerants from motor vehicle air conditioners into the atmosphere. After January 1, 1992, any person repairing or servicing motor vehicle air conditioners for consideration must properly use refrigerant recycling equipment that has been approved by the EPA. All such persons must be properly trained and certified.

To obtain your certification, you must read and study the following booklet, including completing the test at the end of the booklet. The test will consist of 25 questions, and will be on the material covered in the booklet. You cannot miss more than five questions to pass. Should you have questions about the booklet, please call the Greater Cleveland Automobile Dealers' Association (328-1500).

WHAT IS THE OZONE LAYER

Ozone is formed when ultraviolet radiation from the sun reacts with oxygen molecules which causes them to split apart into two oxygen atoms. These separated atoms then combine with other oxygen molecules (O2) to form ozone (O3), which contains a total of three oxygen atoms. Ozone is a pungent gas that has a close chemical relationship to molecular oxygen. About 90 percent of the earth's ozone is located in a layer far above the earth's surface in a region known as the stratosphere. This natural layer acts as a shield against ultraviolet radiation. Concern about possible depletion of the ozone layer from CFC's was first raised in 1974 with publication of research which theorized that chlorine released from CFC's could migrate to the stratosphere and destroy ozone molecules. (Molina and Rowland, 1974). Some of the CFC's have an atmospheric lifetime of more than 120 years and as a result, they rise slowly to the stratosphere where the Suns radiation strikes them, releasing chlorine. Once freed, the chlorine acts as a catalyst repeatedly combining with and breaking apart ozone molecules. If ozone depletion occurs, more UV radiation penetrates the earth's surface. Moreover, because of the long atmospheric lifetimes of CFC's, it would take many decades for the ozone layer to return to past concentrations.

HOW IT EFFECTS THE ENVIRONMENT

The ozone layer shielding the earth from much of the damaging part of the sun's radiation and is a critical resource safeguarding life on this planet. Should the ozone layer be depleted, more of the sun's damaging rays would penetrate to the earth's surface. It is believed that for each one percent depletion exposure to damaging ultraviolet radiation would increase by 1.5 to 2 percent. The Environmental Protection Agency's (EPA) assessment of the risks from ozone depletion focused on the following areas:

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

HOW IT EFFECTS THE HUMAN HEALTH

Under current atmospheric conditions, the greater the distance from the equator, the greater the effectiveness of the ozone layer as a shield. As a result, people who live further north are exposed to less damaging UV radiation than those residing closer to the equator. Not surprisingly, the chances of getting skin cancer follow the same gradient; the closer to the equator, the greater the risk. Three distinct types of the skin cancer would increase if the ozone layer is depleted. Basal and squamous cell skin cancers, the two most common types, affect about 500,000 people annually in the United States alone. If detected early, these cancers are treatable. Even so, approximately 1 percent of 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. 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 would increase the number

of people experiencing this 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 16 million (for the population alive today or born before 2075). Suppression of the immune system is another possible threat to human health resulting from ozone depletion.

HOW IT EFFECTS PLANT & MARINE LIFE

Crop and other land based ecosystems could also be adversely affected by increased exposure to UV radiation. In studies of the greenhouse effect, approximately 65 percent of the crops exposed to elevated levels of UV radiation proved sensitive. Certain marine organisms, particularly phytoplankton, may be sensitive to increased exposure to UV radiation because they spend much their existence near the surface of the water.

Other Considerations:

Ground Level Ozone - Ozone depletion in the stratosphere would increase the rate of formation of ground level (tropospheric) ozone, due to higher levels of UV radiation, a major component of what is commonly called smog.

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

Climatic Changes - CFC's are greenhouse gases and thus would contribute to global warming and rising sea levels.

THE GLOBAL CONCERN ON THE OZONE LAYER

Unlike other environmental issues, stratospheric ozone protection is a global concern. CFC's and halons are used by most industrialized nations, and, given their long atmospheric lifetimes, they become widely distributed over time. As a result, the release of these chemicals in one country could adversely affect the stratosphere and therefore the health and welfare of other countries. Many developed and developing countries produce CFC's and halons. Most use the chemicals in a variety of different products. The United States is one of the largest consumers of the world's CFC's. Other nations are also significant users. Therefore, to protect the ozone layer from the damages that may be caused by CFC's and halons, an international solution is critical.

TOPPING OFF LEAKING MVAC SYSTEMS

While topping off a leaking system has been an option in the past, both the EPA and GCADA do NOT encourage topping off a leaking system. Topping off a leaking system can have several detrimental effects to the ac system and unable to charge the system to the correct amount of refrigerant required.

BASIC SERVICE PRACTICES FOR MVAC SYSTEMS

FIXING REFRIGERANT LEAKS:

Fixing leaks in MVAC systems is not required by the EPA where the appliance does not have a charge of at least 50 (fifty) pounds of refrigerant. EPA regulations do require that all commercial and industrial process refrigeration containing more than 50 lbs. of refrigerant MUST be repaired when the annual leak rate exceeds 35%. However, when servicing an MVAC System, leaks should be repaired whenever possible. This is because adding refrigerant to a leaking system is not only wasteful and potentially illegal, but also harmful to the environment. In addition, the EPA does not require that the refrigerant be evacuated and cleaned prior to recharging the system with refrigerant. In other words, the EPA does not require evacuation and recharge, and does permit top-off with the same refrigerant, in motor vehicle air-conditioners.

In detecting a leak, a manufacturer's instructions should be followed when using an electronic leak detector. In addition, a technician should always leak test when the engine is off. Next, only a small amount of refrigerant is required to perform a leak test (50psig is all that is needed). Further, all dirt should be removed from suspected leak areas. Carefully look for signs of leakage, damage, and corrosion on all lines, hoses, and components. To verify an apparent leak, detection dye may be used. When the dye escapes, it leaves a colored deposit at the point of the leak. After completing each step, repeat the leak check. If a technician chooses to fix a leak, compliance with the leak repair requirements requires calculating both the full charge of the appliance and the leak rate.

Where a leak exists, a technician should: (A) isolate leaking from non-leaking components wherever possible; (B) evacuate non-leaking components to be opened to the levels in owner's manual; and (C) evacuate leaking components to be opened to the lowest level that can be attained without substantially contaminating the refrigerant. In no case shall this level exceed 0 psig.

To prevent leakage, manifold hoses must have shut off valves within 12 inches of the ends of each line. Further, if a refrigerant recovery cylinder is being used it must be approved. Approved refrigerant recovery cylinders have yellow tops and gray bodies. Hose assembly requirements should meet or exceed the SAE J2064 standard. The SAE J2064 standard requires that the hose shall be designed to minimize permeation of R134a refrigerant, contamination of the system, and to be functional over a temperature range of -30° to 125°C. Specific construction details are to be agreed upon between user and supplier. A hose marked "J2064" signifies that it has been coupled, tested, and has met the requirements of SAE J2064.

When repairing an MVAC systems there are several risks in handling or coming in contact with refrigerant, which may result in skin or eye irritation or frostbite. Inhalation of concentrated refrigerant fumes is dangerous and can result in death; cases of fatal cardiac arrhythmia have been reported in people accidentally subjected to high levels of refrigerant. Some early symptoms include loss of concentration and drowsiness.

PROPERLY CHARGING AND RECHARGING MVAC SYSTEMS:

In order to properly charge and/or recharge an MVAC system a technician should check the system's owner's manual for an appropriate procedure. The EPA has previously defined full charge as the amount of refrigerant required for normal operating characteristics and conditions as determined by using one or a combination of the four methods. Specifically:

> (1) Use the equipment manufacturer's determination of the correct full charge for the equipment;
> (2) Determine the full charge by making appropriate calculations based on component sizes, density of refrigerant, volume of piping, and other relevant considerations;
> (3) Use actual measurements of the amount of refrigerant added or evacuated from the appliance; and/or
> (4) Use an established range based on the best available data regarding the normal operating characteristics and conditions for the appliance, where the midpoint of the range will serve as the full charge, and where records are maintained in accordance with §82.166(q).

INCORRECT SYSTEM CHARGES

INCORRECT CALCULATION OF CHARGE:

Where a charge calculation is incorrect, a technician should consult the owner's manual, review the appropriate data, and recalculate the charge. Whether or not a full charge exists is determined by making appropriate calculations based on component sizes, density of refrigerant, volume of piping, and other relevant considerations. In order to calculate the charge correctly, the below table may be used when converting units:

UNITS	G	Oz	Lb	Kg
1.00 G =	1.00	.035	.0022	.001
1.00 Oz =	28.35	1.00	.0625	.0284
1.00 Lb =	453.6	16.00	1.00	.4536
1.00 Kg =	1000.00	35.27	2.205	1.00

If overcharged, the system will become oil logged and less efficient, delivering warmer air, or may result in premature compressor failure. Accordingly, all refrigerant must be accounted for to prevent system overcharge. Furthermore, overcharging an AC system can actually decrease performance and work against the production of cooling interior breezes. A system overcharge charge can also result in high pressure from the low pressure duct. On the other hand, an insufficient charge can result in low pressure from the high pressure end.

To prevent an incorrect calculation from being used, it is more than appropriate practice to always retest a charge calculation. Further, a technician may need to consult the owner's manual for instructions on how to properly read a charge calculation.

EQUIPMENT INACCURACY:

Where a system's equipment is functioning inaccurately, a technician should first consult the owner's manual. After checking the manual, a technician should make any appropriate and possible repairs to ensure the accurate functioning of the equipment. Where a system's equipment is functioning inaccurately, it is important to discontinue use of the system until all potential problems have been inspected and all necessary changes have been made.

In order to check for an equipment inaccuracy, a technician should first calibrate the scale. A technician should consult the owner's manual for specific calibrating procedures when applicable.

THE RECYCLING CONCEPT

FIELD STUDY:

Due to the serious nature of the ozone depletion issue, industry efforts were immediately directed toward determining if CFC's 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 (MACS) initiated a sampling program of used refrigerant from 227 vehicles from 4 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 auto manufacturers to approve the level of purity in December, 1988. Many automobile and truck manufacturers have accepted recycled CFC-12 for service and warranty repairs.

SYSTEM CONTAMINANTS:

Data gleaned from the field study of CFC-12 from mobile air conditioning systems identified moisture, refrigerant oil and non-condensable gases (air) as contaminants in used refrigerant that could affect system performance and life. A consensus was achieved establishing the standard of purity for recycled R-12 refrigerant. Recycled refrigerant may not contain impurities that exceed the level specified by SAE J1991:
*Moisture: 15 PPM by weight,
*Refrigerant oil: 4000 PPM by weight,
*Non-condensable gases (air): 330 PPM by weight.

STANDARDS DEVELOPED:

Based on the field study, the Society of Automotive Engineer's R-12 task force published three documents to cover the mobile air conditioning industry use of CFC's.
The documents include:
*SAE J1989: Service Procedures.
*SAE J1990: Specifications for Recycling Equipment.
*SAE J1991: Purity Requirement of Recycled Refrigerant.

PROPER USE OF MVAC REFRIGERANTS

USED REFRIGERANT FROM NON-MOBILE SOURCES:

R12 and R134a recovered from non-MVAC appliances should not be used in MVAC appliances because the MVAC is not stationary operating equipment. Because of the makeup of the MVAC system it is unable to extract the contaminants present in these refrigerants from non-mobile sources.

If a refrigerant that is extracted from an MVAC or an MVAC-like appliance (as that term is defined in §82.152) bound for disposal and located at a motor vehicle disposal facility may not be subsequently used to charge or recharge an MVAC or MVAC-like appliance, unless, prior to such charging or recharging, the refrigerant is either:

> (i) Recovered, and reclaimed in accordance with the regulations promulgated under §82.32(e)(2) of this subpart B; or
>
> (ii) (A) Recovered using approved refrigerant recycling equipment dedicated for use with MVACs and MVAC-like appliances, either by a technician certified under paragraph (a)(2) of this section, or by an employee, owner, or operator of, or contractor to, the disposal facility; and
>
> (B) Subsequently recycled by the facility that charges or recharges the refrigerant into an MVAC or MVAC-like appliance, properly using approved refrigerant recycling equipment in accordance with any applicable recommended service procedures set forth in the appendices to this subpart B.

PURITY OF NEW R134a:

HFC-134a does not contain chlorine and therefore does not contribute to ozone depletion, although like other HFCs, it contributes to global warming. ARI, an A/C and refrigeration manufacturers' trade association, develops standards for the industry. ARI's 700 standard specifies acceptable levels of refrigerant purity for fluorocarbon refrigerants including R-134a. The purpose of the 700 standard is to enable users to evaluate and accept or reject refrigerants, whether virgin, reclaimed or repackaged. Reclamation of these refrigerants in both the motor vehicle and stationary/commercial sectors must follow the 700 standard.

Most refrigerant manufacturers recommend that TWA occupational exposures not exceed 1,000 ppm; this also is the level recommended by the American Industrial Hygiene Association, Workplace Environmental Exposure Limit (WEEL) Committee. Again, exposures still should be kept to the practicable minimum.

The SAE J2099 standard establishes the necessary level 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 contamination:

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

PROHIBITED FLAMMABLE REFRIGERANTS:

The EPA has determined that the below listed refrigerants are unacceptable substitutes for use in motor vehicle air conditioners because of, among others things, unanswered flammability concerns. EPA regulations also state that all flammable substitutes are unacceptable for any use in vehicle a/c.

Substitute (Name Used in the Federal Register)	ODS Being Replaced	End-uses	Reason
All flammable refrigerants, including OZ-12® (Hydrocarbon Blend A), HC-12a® (Hydrocarbon Blend B), and Duracool 12a except HFC-152a in new MVACs	CFC-12	Motor vehicle air conditioning, retrofit and new	Lack of adequate assessment that characterizes incremental flammability risk
OZ-12® (Hydrocarbon Blend A), HC-12a® (Hydrocarbon Blend B), and Duracool 12a	CFC-12	All end-uses other than industrial process refrigeration, retrofit and new	Lack of adequate assessment that characterizes incremental flammability risk
R-141b	CFC-11	centrifugal chillers, new	High ODP; other substitutes with lower overall risk have been identified
R-176 (R-176 contains CFC-12, HCFC-22, and HCFC-142b. It is a different product from RB-276, typically sold under the name "Free Zone.")	CFC-12	All end-uses, retrofit and new	Contains CFC-12
R-403B	R-502	All end-uses, retrofit and new	Contains a perfluorocarbon that exhibits extremely high GWP and very long lifetime
R-405A	CFC-12	All end-uses, retrofit and new	Contains a perfluorocarbon that exhibits extremely high GWP and very long

			lifetime
MT-31	all CFCs and HCFCs	All end-uses, retrofit and new	Toxicity of a constituent
Hexafluropropylene (HFP) and blends containing it	all CFCs and HCFCs	All end-uses, retrofit and new	HFP is toxic
NARM-22	HCFC-22	All end-uses, retrofit and new	Contains HCFC-22
Self-Chilling Cans using HFC-134a or HFC-152a	CFC-12, HCFC-22, R-502	Household Refrigeration, Transport Refrigeration, Vending Machines, Cold Storage Warehouses and Retail Food Refrigeration; retrofit and new	Unacceptably high greenhouse gas emissions from direct release of refrigerant to the atmosphere

OVERVIEW OF RELEVANT SAE STANDARDS FOR MVAC SERVICING AND REPAIR

Mobile air-conditioning systems must be certified to meet SAE standards for performance. Further, all technicians engaging in the service or repair of MVAC systems must be familiar with and compliant with the following SAE standards for MVAC servicing and repair. The applicable SAE standards are briefly summarized below and some relevant items from these standards are contained throughout the study guide. To obtain a complete copy of the standard, you may contact the Society for Automotive Engineering or visit them online at www.sae.org .

SAE J1989

SAE standard J1989 states that all technicians should ensure containment of R-12 refrigerant during the service of mobile air-conditioning systems. Accordingly, all vehicle repairs should be performed in compliance with the service guidelines outlined in the SAE J1990 standard.

SAE J1990

SAE standard J1990 establishes that all equipment used for CFC-12 (R-12) recycling and/or recovery or recharging systems must comply with the equipment specifications set forth in SAE J1990. The SAE J1990 standard applies to equipment used to service automobiles, light trucks, and other vehicles with similar CFC-12 systems, but does not cover mobile vehicles with hermetically sealed systems for refrigerated cargo.

SAE J1991

All refrigerant used in mobile air-conditioning systems should comply with the standard of purity set forth in SAE J1991. The contaminants in R-12 should be limited to 15 ppm by weight for moisture; 4000 ppm by weight for refrigerant oil; and 330 ppm by weight for noncondensable gases. These standards apply to refrigerant used to service automobiles, light trucks, and other vehicles with similar CFC-12 systems.

SAE J2197

SAE J2197 establishes procedures to avoid the cross mixing of refrigerant and lubricants from CFC based systems, all service equipment used in maintaining HFC-134a (R-134a) systems should comply with the unique fitting standards set forth in SAE standard J2197.

SAE J2209

SAE J2209 covers the equipment certification for the removal of CFC-12 from mobile air-conditioning systems that are being sent off site for process to meet ARI 700 purity level.

SAE J2211

SAE standard J2211 requires that all service technicians ensure refrigerant containment during mobile air-conditioning system repair. This standard provides guidelines for technicians for

servicing mobile A/C systems and operating refrigerant recycling equipment designed for HFC-134a (R-134a). Refrigerant containment should be ensured by following the procedures set forth in the standard at each phase of servicing and repair.

SAE J2219

SAE J2219 addresses concerns to the mobile air-conditioning industry that all repair and service technician should be aware of when servicing or repairing MVAC units. All technicians should be familiar with these issues and MVAC recycling equipment must be certified to meet the standards set forth by SAE.

SAE J2788

SAE J2788 provides the specific minimum equipment requirements for the recovery/recycling of HFC-134a that has been directy removed from and intended for reuse in mobile air-conditioning systems, as well as recovery/recycling and system recharging of recycled HFC-134a. These specifications are aimed at ensuring the system will be able to provide the same level of performance and durability with recycled refrigerant as new refrigerant. All technicians should be familiar with the requirements set forth by SAE in this standard.

SAE J2810

SAE J2810 establishes the standard for HFC-134a (R-134a) recovery for only equipment used in conjunction with the on-site recovery/recycling equipment used at service facilities for off-site refrigerant reclamation or other environmentally legal use. The standard provides equipment specifications, safety requirements, operating instructions, as well as a description of the equipment function and testing procedures. All technicians should be familiar with and prepared to comply with this standard.

RECORDKEEPING REQUIREMENTS

All persons who own approved recovery only refrigerant equipment certified under EPA regulations must maintain records of the name and address of the reclamation facility and the date the refrigerant is sent or delivered.

All persons who own approved refrigerant recycling equipment must maintain records demonstrating that all persons authorized to operate equipment are currently certified under EPA regulations.

All persons who sell or distribute any class I or class II substance that is suitable for use as a refrigerant in a motor vehicle air conditioner and is in a container of less than 20 pounds must verify that the purchaser is properly trained and certified under EPA regulations. The only exception to this requirement is if the purchaser is purchasing the small containers for resale and in this case, the seller must receive a written statement from the purchaser that the cans are for resale only. Records must be retained for a period of three years.

All persons who conduct any retail sale class I or class II substance that is suitable for use as a refrigerant in a motor vehicle air conditioner and is in a container of less than 20 pounds must prominently display a sign which states: It is a violation of federal law to sell containers of Class I and Class II refrigerant of less than 20 pounds to anyone who is not properly trained and certified to operate approved refrigerant recycling equipment.

All records required to be maintained pursuant to this section must be kept for a minimum of three years unless otherwise indicated. Entities which service motor vehicle air conditioners for consideration must keep these records on-site.

All entities which service motor vehicle air conditioners for consideration must allow an authorized representative of the administrator entry onto their premises (upon presentation of his/her credentials) and give the authorized representative access to all records required to be maintained pursuant to this section.

EQUIPMENT CERTIFICATION

Equipment must be certified by an independent standards testing organization approved by the administration, Underwriters Laboratories (UL) is approved, under the regulations. To meet either one of the following standards:

Equipment that recovers and recycles refrigerant must meet the Standards HFC-134a (R-134a) Recovery/Recycling Equipment and Recovery/Recycling/Recharging for Mobile Air-Conditioning Systems (SAE J2788) and HFC-134a (R-134a) Refrigerant Recovery Equipment for Mobile Automotive Air-Conditioning Systems (SAE J2810). These standards are both listed above in their entirety.

Under SAE J2788, the machine shall be able to remove 95.0% of the refrigerants within 30.0 minutes and to an accuracy of 0.5oz.

Equipment purchased before the proposal of regulations will be considered approved if the administration (EPA) determines that the equipment is substantially identical to the equipment certified under the previous paragraph.

The administration (EPA) will maintain a list of approved equipment by manufacturer and model. Your Association will maintain a list of approved freon recovery /recycling equipment. Should you have any question about approved equipment, please contact your Association.

The ABC's of Handling Contaminated and Unfamiliar Automotive Refrigerants

It's clear to most automotive service technicians by now that buying and handling A/C refrigerants is a lot more complicated than it used to be. Even when R-12 was the only refrigerant in town, many A/C techs discovered systems that had been contaminated with air, R-22 or hydrocarbons such as propane and butane. Today, with new vehicles using R-134a refrigerant, and with an abundance of other R-12 substitutes reaching the market, the variety of refrigerants that techs may handle on the job is making A/C service more complicated than ever.

This document is designed to assist techs in determining how to identify, recover, and dispose of any contaminated refrigerants they may encounter. This document will also discuss what a tech should do with a substitute refrigerant that he has chosen not to work with or is unfamiliar to him. EPA intends to update this document whenever the Agency receives new information about potential solutions to the problems relating to contaminated or unfamiliar refrigerants.

IDENTIFYING REFRIGERANTS

EPA requires that when any vehicle is retrofitted from R-12, 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 systems. (For a complete discussion of these and other requirements, see the EPA fact sheet "Choosing and Using Alternative Refrigerants.") 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 relabeled, or a vehicle that has the right label, but highly contaminated refrigerant.

Checking refrigerant pressures does not guarantee that you will recognize that refrigerant is contaminated or is a brand that is unfamiliar to you. Unusual head pressures may tip you off that a system labeled to indicate that it has pure R-12 or R-134a in it actually is highly contaminated or contains another refrigerant altogether. However, you may also encounter a contaminated system, or a system that contains a blend refrigerant, that indicates pressures similar to those of pure R-12 or R-134a.

Purchasing a refrigerant identifier unit can help pinpoint many refrigerant identification problems, and EPA strongly recommends (but does not require) that techs 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 R-12 or R-134a. If for example, you decide to turn the customer with a contaminated system away, then a less-expensive identifier that simply tells you whether refrigerant is pure R-12 or R134a ("go/no-go") may be sufficient for you.

However, a unit that can help you identify the chemical composition of the refrigerant more specifically can be an important diagnostic tool, so that the extra cost may be well worth it. Some models can identify flammable substances, which require special care and safe handling (see section B below). Some models can tell you how much air is in recycled refrigerant, so that you can use these models to determine whether the air purge cycle feature on your R-12 or R134a recycling

equipment is functioning properly. Excess air in an A/C system can lead to false readings in electronic low charge indications in some vehicles; rapid clutch cycling and potential clutch failures; and noisy compressor operation. Finally, using this tool may build your customers' confidence in your diagnostic abilities.

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. Diagnostic identifiers being sold today may be able to identify potential R-12 and R134a contaminants such as air, R-22, and hydrocarbons, but were not designed to identify R-124 and R-142b (chemicals that are components in many of the new substitutes), or to recognize particular chemical combinations as specific patented, marketed blend refrigerants. In the future, equipment manufacturers may develop equipment designed to identify all of the substitute refrigerants that are being marketed today.

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 accurately identifies refrigerants. When claiming to meet this standard, manufacturers of identifier equipment are required to label the unit stating its level of accuracy.

If you are reluctant to invest in another piece of equipment, consider making an arrangement to borrow an identifier from a nearby service facility that has purchased one. That facility may agree to make its identifier available to you for a reasonable fee.

Recovering and recycling contaminated or unfamiliar refrigerants

You may not wish to turn away a good customer who comes to the shop with contaminated R-12 or R-134a, or with a substitute refrigerant for which you have no dedicated recovery or recycling equipment. What do you do?

Recovering 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 tech can recover contaminated or unfamiliar refrigerant is to dedicate a recover-only unit to anything that is not pure R-12 or pure R-134a. Some equipment manufacturers may also be marketing new types of recover-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. Whether you are purchasing a new piece of equipment to handle your contaminated and unfamiliar refrigerants, or you are converting a piece of existing equipment for this purpose, make sure you talk to your sales representative about what features have been incorporated into the equipment to guard against risks of ignition.

Refrigerant should be recovered into the standard DOT-certified, gray-with-yellow-top recovery tank, and if the tank is not equipped with a float valve (which serves as overfill protection), make sure it never gets filled beyond 60 % of its gross weighted capacity, as specified in the SAE

J1989 and J2211 standards. It should also be noted that while 60% is the SAE liquid fill limit, 40 CFR 82.42 Appendix A section 7.1, requires a liquid fill limit of 80%.

If A/C service is not a large percentage of your business, then you may be reluctant to invest in another piece of recovery equipment. If this is the case, consider calling a local A/C specialty shop that may have the equipment necessary to service contaminated refrigerants or refrigerants that are unknow to you .

Recycling refrigerant. Once recovered, refrigerant should not be recycled on-site unless uncontanminated R-12 or R-134a. Recovering contaminated R-12 or R-134a refrigerant into recycling equipment may damage the equipments. In addition, EPA regulations currently prohibit technicians from recycling blend substitute refrigerants (contaminated or not). EPA is working with independent testing laboratories and with equipment manufacturers to determine whether it is possible to develop recycling equipment to service these blends that protects both the health or safety of the technician, and the integrity of the A/C system.

Storage and Disposition of Contaminated or Unfamiliar Refrigerants

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

Storage. 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 ordinances that govern the storage of combustible mixtures. In addition, if your shop generates over 100 kilograms (220 pounds) of hazardous wastes per month (including used coolant, and battery acids), then your shop must meet certain storage and transportation requirements under the Resource, Conservation and Recovery Act (RCRA). For more details, call the RCRA Hotline at (800) 424-9346 and ask for EPA publication 530-K-95-001, the 1996 update of "Understanding the Hazardous Waste Rules – A Handbook for Small Business." You may also wish to check out the world wide web site of the Coordinating Committee for Automotive Repair at ww.ccar-greenlink.org.

Disposition. If the refrigerant in your "junk" recovery tank is a chemical "soup" – either contaminated R-12 and R-134a, 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.

If you have a contract in place with a waste hauler, contact the hauler to see if they can handle the material. Waste haulers may require that the contents be identified first and any charge you for this identification procedure. They are most likely to send the tank to an incinerator for destruction. You may also want to contact one or more reclaimers, who will send the refrigerant off-site either for destruction, or for reclamation, which involves breaking it up into its chemical components and purifying each of the components .

Some reclaimers can handle tanks sent to them from anywhere in the nation. A reclaimer does not necessarily have to be located in your area.

Due to the expense involved in reclaiming, some reclaimers may not accept less than 500 or 1000 pounds of contaminated or mixed refrigerant. In addition, you should be aware that not all reclaimers have the technology to handle all contaminated or mixed refrigerants. However, if one tells you that he is not interested in receiving your tank, don't necessarily assume that the next reclaimer you call will say the same thing.

Before you enter into any agreement with either your waste hauler or a reclaimer, make sure you understand all of the costs involved; there may be separate charges for identifying the material, transporting it and destroying it. If you are responsible for shipping the tank, make sure that the hauler or reclaimer explains to you how to comply with any applicable DOT, state and local requirements relating to shipping.

If you have questions about disposing of specific blend refrigerants, call the refrigerant manufacturer. Most manufacturers of blend refrigerants have made arrangements with specific reclaimers to handle their used refrigerant. For a list of these telephone numbers, see the EPA fact sheet "Choosing and Using Alternative Refrigerants," Available from the Hotline or on the web site at http://www.epa.gov/ozone/strathome.html .

Guidance on Retrofitting A/C System to R-134a

The term "retrofit" decries special procedures required to convert an R-12 system to use an alternative refrigerant. This document will describe some facts about aftermarket options and procedures for retrofitting a vehicle's a/c system to R-134a.

Automakers worldwide chose R-134a to be the long-term replacement for R-12 in automotive A/C systems, both in new vehicles and in retrofit applications. If information becomes available, EPA may develop similar guidelines in the future for retrofitting to refrigerants other than R-134a. At this time however, wide- scale performance testing has not been performed on vehicles retrofitted to these refrigerants. Should you have questions about retrofitting to an alternative refrigerant, consult the refrigerant's manufacturer. You may also want to review the EPA publication "Choosing and Using Alternative Refrigerants in Motor Vehicle Air Conditioning" available from the Hotline number listed above, or electronically at www.epa.gov/ozone/title6/snap/macssubs.

OEM Retrofits

Vehicle manufacturers (also known as original equipment manufacturers, or OEMs) have developed retrofit kits or guidelines for some of their models. These procedures were designed to provide the best level of performance with the new R-134a systems. Although using these kits and guidelines will provide the greatest assurance that comparable a/c performance will be achieved, the costs of these OEM procedures will in many instances be relatively high. For example, while certain models can receive an OEM-warranted retrofit for under $150, including labor, other OEM retrofits will run a customer over $650. Many car owners will not want to pay such high costs for a retrofit and may look to the aftermarket for a less expensive solution.

In addition, because the OEM retrofit kits and guidelines are generally only available for late 1980s and early 1990s models, an aftermarket retrofit may be the only option for many vehicle owners.

Least-Cost Aftermarket Retrofit

Many car owners may express interest in receiving a least-cost retrofit. Procedures required for a least-cost retrofit are simple and do not require major component changes. Generally, the process calls for removal of the old refrigerant, installation of new fittings and a new label, and the addition of either a polyalkylene glycol (PAG) or polyol ester (POE or ester) lubricant as wells the R-134a refrigerant. For many vehicles, this simple, least-cost retrofit should provide the vehicle owner either with a/c performance comparable to the R-12 system performance or with a/c performance that, although slightly reduced, is still sufficient to satisfy the customer. A least-cost retrofit, however, may not provide a satisfactory solution for certain vehicles.

Communicating With the Customer

Although EPA has been educating car owners about options available to them in converting their a/c systems, many consumers will primarily rely on their service technician to educate them. Service facilities that wish to offer retrofit as a service to their customers need to consider what kind of retrofit procedure they will offer, and how they will warranty the work performed. When determining whether to recommend a retrofit to a customer, and what kind of retrofit to offer—an OEM-warranted retrofit (if available), a least-cost retrofit, or something in between—a service tech will need to consider (or ideally, discuss with the customer), the three C's: cost, climate and components.

Cost: how much is the customer willing to spend? How much longer will he own the vehicle? Is the vehicle a refrigerant leaker or is this the first time in the life of the vehicle that the A/C system has been serviced?

Climate: does he need adequate A/C performance (because he only takes the car out on Sundays in Boise), or a polar-level A/C performance (because he uses the car six days a week in Biloxi)? If he lives in Biloxi, is he so concerned about retrofit cost that he would prefer the least cost retrofit, even if that retrofit will not, in the tech's judgment, provide performance comparable to the system performance with R-12?

Components: are the existing components in the A/C system in good shape? Are they compatible with R-134a?

If an R-12 system is performing marginally, retrofitting alone will not make it better. In fact, since R-12 systems were not designed for use with R-134a, owners should be prepared for a slight reduction in A/C performance. In most parts of the country, this reduction will not be significant, and vehicle owners may not notice any difference in performance.

In warmer climates, however, where the A/C system is running at full blast many months during the year, performing a simple, least-cost retrofit may not produce satisfactory performance. In that case, a technician should be able to recommend to his customer what additional steps are most appropriate-possibly installing a larger condenser, or adding a fan or high-pressure cut-off switch (this switch is required in some systems; see below). Although these steps make the retrofit more expensive, at least the car owner has a choice of options.

In addition, on older models, it may be necessary to replace worn A/C system components. R-134a may operate at higher pressures than R-12, and these higher pressures may put additional stress on the A/C system, so that older, worn components may be more likely to fail.

Some vehicles may also have components that were not specifically designed with R-134a in mind, and as a result may not withstand the higher pressures of R-134a. As a result, these components may experience a shortened service life. That service life may be shortened only slightly, or a great deal. Only wide-scale durability testing on thousands, if not millions, of retrofitted vehicles will provide the automotive service industry with a full understanding of how retrofit affects the life of each A/C system component.

Service techs should keep in mind that there is no such thing as a universal retrofit procedure, or a simple kit a technician can purchase that will provide all the necessary parts to guarantee a successful retrofit for every, make and model. Even within particular make, model, and year vehicle driven for 90,000 miles in Houston may require a more extensive retrofit than the same make, model and year driven for 35,000 miles in Minneapolis.

The Society of Automotive Engineers (SAE) provides guidelines for A/C retrofit in their publication J1661. Several refrigerant and lubricant procedures have published their own recommendations. EPA is compiling a list of organizations that offer either classroom or home-study (videotape/workbook) retrofit training. Foe EPA's current list; see "Resources for Retrofit Training" at the end of this document.

EPA Requirements for Retrofit

According to EPA regulations, the use of any alternative refrigerant to replace R-12 requires at a minimum that:

- Unique service fittings be used in order to minimize the risk of cross-contamination of either the air-conditioning system or the service facility's recycling equipment;
- The new refrigerant be identified by a uniquely-colored label in order to identify the refrigerant in the system:
- All R-12 be properly removed from the system before filling the system with an alternative refrigerant;
- In order to prevent release of refrigerant to the atmosphere, a high-pressure compressor shutoff switch be installed on any system equipped with a pressure relief device; and
- Separate, dedicated EPA-approved equipment be used to recover the R-12 from the system.

In addition, alternative refrigerant blends that contain R-22 must be used with barrier hoses. Finally, when retrofitting any system that has a pressure release device, the technician must install a high-pressure shutoff switch on the compressor if the system is not already equipped with a switch.

Handling Other Refrigerants that Substitute for CFC-12

Vending Substitute Refrigerants. Other than HFC-13am all EPA- accepted refrigerants that substitute for CFC-12 in motor vehicles, and that are currently on the market, are blends that contain ozone depleting chemicals such as R-22, R-14b and R-124. Section 608 of the Clean Air Act prohibits venting any of these new blend substitutes into the atmosphere. The prohibition on venting these ozone-depleting blends has been in effect since 1992.

Section 609 Regulatory History. The December, 1997 final rule established a standard for equipment that is designed to recover, but not recycle, any single, specific blend substitute refrigerant.

Using Older Equipment to Recover Blends. Technicians have a number of choices in recovering blend refrigerants. One option is that a technician may permanently dedicate an older piece of equipment he owns to recovering one or more blend refrigerants. The technician may also use this equipment must meet.

In addition, EPA is currently working with independent testing laboratories and with equipment manufacturers to devise a standard for new equipment that can recover, but not recycle, both multiple blend refrigerants and contaminated CFC-12 and HFC-134a. EPA will finalize a standard for this type of equipment by the end of 1998. This equipment may be commercially available by the 1998 A/C season. EPA expects to grandfather any equipment purchased in 1998 before the EPA standard becomes finalized.

Recycling Blends. EPA regulations do not currently permit the recycling of blend refrigerants. Today, then, a blend refrigerants must be shipped off for reclamation or destruction after it has been recovered. EPA , however, is currently working with independent testing laborites and with equipment manufacturers to devise a standard for new equipment that an both recover and recycle one or more blend refrigerants. EPA may require that any recycled blend refrigerant be recharged into the same vehicle from which it was originally recovered. EPA will finalize a standard for this type of equipment by the end of 1998. This equipment may be commercially available by the 1998 A/C season. EPA expects to grandfather any equipment purchased in 9198 before the EPA standard becomes finalized.

Converting CFC-12 Recover/ Recycle Equipment for Use with Blend Substitutes. EPA also currently prohibits the conversion of excising CFC-12 or HFC-13 a recycling equipment for either temporary or permanent use with a blend refrigerant. In the future, EPA may issue regulations allowing these conversions but placing certain restrictions on who performs that conversions but placing certain restrictions on who performs the conversions, what models may be converted, etc.

Technician Training and Certification. Technicians who repair or service MVACs that use blend refrigerants must be trained and certified by an EPA-Approved organization. IF a technician is already trained and certified to handle CFC-12 or HFC-13a, he does not need to be recertified to handle a blend refrigerant.

Recordkeeping Requirements. Service facilities that work on vehicles that use blend substitutes must certify to RPA that they own approved equipment designed to service these refrigerants, Note that this certification is a one-time requirement , so that if a shop purchased a piece of CFC-12 or HFC-134a recycling equipment in the past, and sent the certification to EPA, the shop does not need to send a second certification to EPA when it purchases a second piece of equipment, no matter what refrigerant is recovered and send to a reclamation facility, the shop must retain the name and address of that reclaimer.

Retrofitting Vehicles to Alternate Refrigerants

Although section 609 of that Act does not govern retrofitting, section 612 of the Act, which describes the Agency's Significant New Alternatives Policy (SNAP program, does require that when retrofitting a CFC-12 vehicle for use with another refrigerant, the technician must first extract the CFC-12, must cover CFC-12 label with a label that indicates that new refrigerant in the system and other information, must affix new fitting unique to that refrigerant. In addition, if a technician is retrofitting a vehicle to a refrigerant that contains R-22, the technician must ensure that only barrier hoses are used in the A/C system. Finally, if the system includes a pressure relief device, the technician must install a high-pressure compressor shutoff switch to prevent the compressor from increasing pressure until the refrigerant is vented.

Much more information about the SNAP program and about retrofitting procedures is available in a fact sheet called "Choosing and Using Alternative Refrigerants" through the EPA hotline and website listed above.

SERVICING CONSIDERATIONS FOR POSSIBLE FUTURE MVAC SYSTEMS

R744 Systems:

R744 systems are also known as carbon dioxide systems, and are suggested as a replacement for R134a systems. R744 has a boiling point of -78/-109. A comparison of the discharge conditions of a R744 system versus the high side liquid line of an R134a system reveals a significant increase in the refrigerant pressure and temperature for R744 systems. In fact, an R744 system has approximately seven-eight times (7x-8x) higher pressure than an R134a system.

R744 is not considered flammable. However, exposure to fire may cause containers of R744 to rupture/explode. Should a R744 related fire take place, all known extinguishants can be used. Where possible, a technician should stop flow of the product and move away from the container and cool with water from a protected position.

When storing, R744 should be kept in a firmly secured container below 50°C in a well ventilated place. In handling, the sucking back of water into the container must be prevented. Further, backfeed must not be allowed into the container.

R-152a Systems:

R-152a is also known as difluoroethane and is also suggested as a replacement for R-134a. R-152a has a boiling point of -25/-13. It is a halogenated aliphatic composed of carbon, hydrogen, and fluorine ($C_2H_4F_2$) with a relatively low global warming potential.

In handling, it is important to note that R-152a is a flammable under certain circumstances. However, the Consumer Products Safety Commission does not label products using R-152a as a flammable because there is no flame extension while aiming the products at an open flame.

Further, R-152a can produce hydrofluoric acid when exposed to moisture, flames, or extreme heat. Thus, it is important to keep R-152a systems moisture free so that acid does not eat the systems evaporator.

Low Global Warming Potential (GWP) Refrigerant Systems:

GCADA is aware of the discussion of several Low Global Warming Potential Refrigerant Systems. Specifically, there is a new chemical called HFO-1234yf which is currently going through the SNAP review process. It is important to note that HFO-1234yf is flammable. GCADA will continue to remain informed on the introduction of these systems and will update its' technician certification booklet as these systems become prominent in the United States.

YOU HAVE NOW COMPLETED THE SELF-STUDY PORTION OF THE CERTIFICATION.

CHOOSING AND USING ALTERNATIVE REFRIGERANT FOR MOTOR VEHICLE AIR CONDITIONING

SNAP ACCECTABLE SUBSTITUTES REFRIGERANTS

NAME	MANUFACTURER		
HFC-134a	Several	**FRIGG**	Intermagnetics General
FREE ZONE/ RB-276	Refrigerant Gases	**IKON-12**	Ikon Corporation
R-406A/ GHG/McCool	People's Welding	**HOT SHOT/ KAR KOOL**	ICOR
GHG-X4/ Autofrost/ Chill-It	People's Welding	**GHG-HP**	People's Welding
FREEZE 12	Technical Chemical	**GHG-X5**	People's Welding

SNAP NON-ACCECTABLE SUBTITUTES REFRIGERANTS

OZ-12	OZ-Technology	**R-176**	Artic Chill
HC-12a	OZ-Technology	**Duracool 12a**	Duracool Limited
R-405a	Greencool		