



Handling and Reuse of Refrigerants in the United States

Developed and Endorsed by:

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FOREWORD

This manual was developed and prepared by a broad base of refrigeration and air-conditioning interests, including refrigerant reclaimers, air-conditioning and refrigeration equipment manufacturers, refrigeration recovery and recycling equipment manufacturers, refrigerant compressor manufacturers, contractors, engineers, government, food stores, building owners and managers and consumers.

This work was motivated by the industry's concern and at the urging of the U.S. Environmental Protection Agency (EPA) because of the May 1995 "sunsetting" of the EPA regulation regarding the purity of reused refrigerants. Working cooperatively, the parties to this document developed procedures and guidelines to maintain the quality of refrigerants used in refrigeration and air-conditioning equipment. This group is fully intent on protecting the end user, the consumer and the refrigeration and air-conditioning products owned by the consumers.

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I. Guidelines on the Use of Recycled and Recovered Refrigerants

Definitions

For the purposes of this document, the following definitions apply:

Recover: To remove refrigerant in any condition from a system and store it in an external container without necessarily testing or processing it in any way.

Recycle: To reduce contaminants in used refrigerant by oil separation, non-condensable removal and single or multiple passes through devices which reduce moisture, acidity and particulate matter, such as replaceable core filter-driers. This term usually applies to procedures implemented at the field job site or in a local service shop.

Reclaim: To reprocess refrigerant to new product specifications by means which may include distillation. Chemical analysis of the refrigerant is required to determine that appropriate product specifications are met. The identification of contaminants, required chemical

analysis, and acceptable contaminant levels will be established in the latest edition of ARI Standard 700, "Specifications for Fluorocarbon and Other Refrigerants." This term usually implies the use of processes or procedures available only at a reprocessing or manufacturing facility.

For the purposes of this document, recycled refrigerant has unknown purity levels, but may have been recycled by equipment that can clean the refrigerant to the contaminant levels specified in the Table on page 9 if operated and maintained properly. Any manufacturer's warranties, policies or recommendations and EPA or local regulations, shall supersede any information which may conflict with these guidelines.

Scope

This document covers guidelines that should be followed when determining which of the following four options should be used when dealing with refrigerant that has been recovered from a system.

Option 1: Put refrigerant back into the system without recycling it.

Option 2: Recycle refrigerant and put it back into the system from which it was removed or back into a system with the same owner (Reference Table on page 9).

Option 3: Recycle the refrigerant, test to verify conformance to ARI Standard 700 prior to reuse in a different owner's equipment provided that the refrigerant remains in the contractor's custody and control at all times from recovery through recycling to reuse.

Option 4: Send refrigerant to a certified reclaimer.

Introduction

It is recommended that recovered refrigerant contaminant levels should not exceed the refrigerant contaminant levels in the Table on page 9 if it is put back into the system it was removed from, or back into a system of the same owner. If these contaminant levels are exceeded, the refrigerant should be recycled or reclaimed, or new refrigerant should be used. Since it is not always practical or feasible to confirm that a recycled refrigerant meets these levels by test, these guidelines have been written to give the servicing contractor some criteria to help determine which of the four options covered in the "Scope" should be chosen.

There are several important factors that need to be considered when deciding what to do with the refrigerant that has been recovered from a system. These factors include:

- 1) Reason system is being serviced,
- 2) Condition of refrigerant and system,
- 3) Equipment manufacturers' policies,
- 4) Refrigerant cleaning capability of recycling equipment, and
- 5) Feasibility and owner's preference.

After all of these factors have been evaluated, the service person should be able to make a much better decision on whether the recovered refrigerant can be recycled. Each of these factors is discussed further in the next three sections. (See flowchart "Used Refrigerant Guidelines," on pages 6 and 7 for easy reference.)

Reason System is Being Serviced

The reason the system is being serviced will help the service person decide what the condition of the refrigerant is that has been recovered. Compressor failures, especially motor burnouts, will influence the service person's decision on whether the refrigerant needs to be recycled. Other system component failures not affecting the purity of the refrigerant could allow the service person to recover the refrigerant and return it to the system without recycling.

Condition of Refrigerant and System

The system's service history and age can be very important when deciding whether to recycle the used refrigerant from the system. The installation and service procedures used over the life of the system can have a significant effect on the quality of the refrigerant. Systems that were not cleaned or evacuated properly from previous service problems can have high levels of contamination in the refrigerant and in the oil. If the system history is not known, the recovered refrigerant should, at a minimum, be recycled before it is put back into the system.

If the system has had previous compressor problems that required replacing the compressor, then the service person should determine if it was a compressor burnout. The cleanliness of the used refrigerant from a previous burnout will be dependent on how well the system was cleaned up when the compressor was replaced. Because systems with compressor burnouts are going to have some contaminants in the residual oil left in the system, the refrigerant used in these systems should be as clean as possible so as not to add to the contamination that will be in the system after refrigerant is added. It is therefore a good practice to use recycled, reclaimed or new refrigerant in these situations.

When the service person is not sure about the contaminant levels of the refrigerant, preliminary checks may be made with acid test kits and moisture indicators.

If the service person is confident that the refrigerant is not contaminated beyond the recycled refrigerant contaminant levels in the Table on page 9, the refrigerant can be recovered and put back into the same system without recycling provided good service procedures are used when recovering and putting it back into the system.

Equipment Manufacturer's Policies

The service person should understand the original equipment manufacturer's policies or recommendations concerning the use of recycled refrigerant. This should be the primary criterion in determining whether to use recycled refrigerant in that manufacturer's equipment.

Refrigerant Cleaning Capability of Recycling Equipment

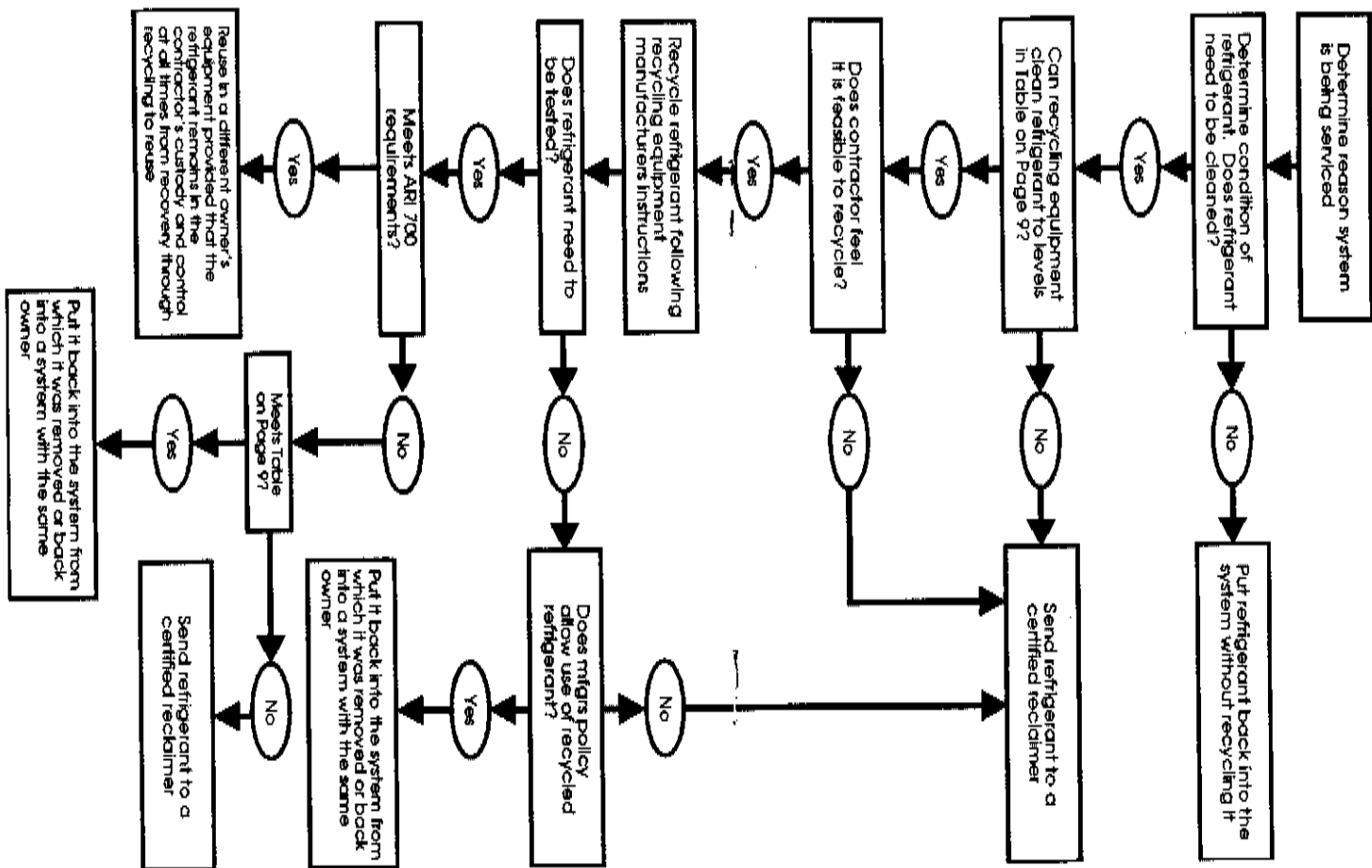
If the refrigerant needs to be recycled before it can be put into a system, it should be cleaned to the recycled refrigerant contaminant levels in the Table on page 9. Recycling equipment that is certified to ARI Standard 740, "Performance of Refrigerant Recovery/Recycling Equipment," and capable of consistently cleaning refrigerant to the contaminant levels in this Table should be used. The refrigerant sample used in ARI Standard 740 is representative of a highly contaminated system, so recycling equipment that can clean the refrigerant in this test to the contaminant levels in the Table has acceptable cleaning capabilities. It is also important to check the equipment's cleaning capability over time to ensure that its cleaning performance has not diminished.

Filter systems in recycling equipment need to be changed or cleaned regularly to properly maintain recycling equipment to ensure maximum performance. Cleaning recycling equipment after it has been used to recycle refrigerant from a burnout is recommended before the recycling equipment is used again. Recycled refrigerant should not be used if the performance of the recycling equipment is uncertain.

Feasibility and Owner's Preference

Even when all of the other factors are favorable, recycling should only be done when it is feasible for the contractor and agreeable to the system owner. Contractors should consider the time and effort required to recycle refrigerant versus recovering and reclaiming it. In many cases, the quantity of refrigerant will affect this decision.

Used Refrigerant Guidelines



General Comments

Regardless of whether recycled refrigerant or new/reclaimed refrigerant is put into a system, the system must be properly cleaned and evacuated prior to putting refrigerant back into the system. Manufacturers' recommended service procedures should be followed to ensure that the system is free of contamination before any refrigerant is put into the system. At a minimum, all driers in the system should be replaced and systems with compressor burnouts should have suction line filters added to assist in removing acids that will be in the oil that remains in the system.

If the refrigerant is removed from a system, recycled and returned to a system, there are several other things to keep in mind. Recovery tanks must be kept clean so that refrigerant that has been recycled doesn't become contaminated again when it enters the recovery tank. To clean recovery tanks, follow the recycling equipment manufacturers' instructions. This is especially important if recycling equipment is used for multiple refrigerants. Mixed refrigerants cannot be recycled (see IV). Any non-condensables in the recovery tank must also be purged according to EPA rules and recycling equipment manufacturers' guidelines to prevent them from getting into the system when the recycled refrigerant is added.

Cleaning and maintaining recycling and recovery equipment regularly, especially after the equipment has been used on jobs with very contaminated refrigerants, is very important to ensure that the contamination from the previous job does not transfer to the next job.

II. Sale of Refrigerants

Used refrigerants shall not be sold, or used in a different owner's equipment, unless the refrigerant has been analyzed and found to meet requirements of ARI Standard 700 (latest edition), "Specifications for Fluorocarbon and Other Refrigerants."*

*Excludes refrigerants contained in equipment that is sold if that refrigerant is used in that same equipment.

III. Recycled Refrigerants, Same System or Same Owner

Refrigerants that are recovered from refrigeration and air-conditioning systems may be reused in that same owner's refrigeration or air-conditioning systems, but the contamination levels of those refrigerants should not exceed the Maximum Contaminant Levels of Recycled Refrigerants before reuse as shown in the following Table:

**Maximum Contaminant Levels of Recycled Refrigerants
In Same Owner's Equipment**

Contaminants	Low Pressure Systems	R-12 Systems	All Other Systems
Acid Content (by wt.)	1.0 PPM	1.0 PPM	1.0 PPM
Moisture (by wt.)	20 PPM	10 PPM	20 PPM
Non Condensable Gas (by Vol.)	N/A	2.0%	2.0%
High Boiling Residues (by Vol.)	1.0%	0.02%	0.02%
Chlorides by Silver Nitrate Test	no turbidity	no turbidity	no turbidity
Particulates	visually clean	visually clean	visually clean
Other Refrigerants	2.0%	2.0%	2.0%

Note: To insure that the recycling equipment maintains its demonstrated capability to achieve the above levels, it must be operated and maintained per the equipment manufacturer's recommendations.

Because there are no means at this time to determine all contaminant levels (other than by laboratory testing), assurance that these contaminant levels are not exceeded can be accomplished by:

- a. the proper use and maintenance of refrigerant recovery / recycling equipment that is capable of recycling refrigerants to or below the levels in the Table, or
- b. laboratory analysis (the Appendix to ARI Standard 700 describes laboratory analysis procedures).

However, refrigerants removed from systems are not necessarily candidates for recycling to these contaminant levels (see I).

IV. Mixed Refrigerants

Definition

Mixed refrigerants refers to the situation where refrigerants become unintentionally mixed as opposed to commercially available zeotropic or azeotropic blends.

Reasons for Concern

Mixed refrigerants are a concern because of the potential adverse impact on operating systems. Other items of concern are listed below:

- Effect on performance and operating characteristics that may affect the capacity and efficiency of the equipment.
- Effect on materials compatibility, lubrication, equipment life and warranty costs.
- Increased service and repair requirements and higher operating costs.
- Introduction of mixed refrigerants into commerce.
- High cost or inability to separate refrigerants.
- High cost of disposal and loss of refrigerant for future service.

Determining the Presence of Mixed Refrigerants

It is difficult to determine the presence of mixed refrigerants without a laboratory test; therefore, every precaution should be taken to avoid mixing in the first place. To aid in determining whether there are mixed refrigerants, check the saturation pressure and temperature of the

refrigerant in the system and compare with the published values for this refrigerant in a pressure-temperature chart. A thorough review of the service history and an understanding of the current problem may provide additional insight into the probability of having mixed refrigerants. The service person should also examine the nameplate and look for stickers that would indicate if the equipment has been retrofitted with an alternate refrigerant.

Reduce the Probability of Mixing Refrigerants

Steps that can be taken to prevent or minimize the probability of mixing refrigerants include the following:

- Properly clear recovery units, or dedicate recovery units to a specific refrigerant.
- Dedicate cylinders to a specific refrigerant.
- Suspect refrigerant should be tested before consolidating into larger batches and before attempting to recycle or reuse.
- Assure that containers are free of oil and other contaminants. Liquid recovery may increase the likelihood of contaminated cylinders because of oil entrainment.
- Keep appropriate records of refrigerant inventory.
- Cylinders used for recovered and/or recycled refrigerants should be suitably marked.

Applications

At the present time, in some applications, such as refrigeration systems and chillers, new systems with alternate refrigerants have been introduced and existing systems have been retrofitted. These applications are of special concern in that separate systems at the same location may contain a variety of refrigerants, increasing the likelihood that the wrong refrigerant will be introduced into the systems or storage containers at that location.

Other applications, such as domestic refrigerators, have used a single refrigerant (R-12) and will likely use a single refrigerant (R-134a) in the future; existing systems will not likely be retrofitted.

Currently, some applications, such as residential air-conditioning, use only one refrigerant (R-22), although this will change as the HCFC phaseout progresses.

While some applications are more likely to create situations where mixing could occur, precaution should be exercised in all applications. Many contractors install and service equipment in more than one application.

Zeotropic Blends

Zeotropic blends are subject to selective leakage of one or more of the constituent refrigerants. The composition of refrigerant may be different at the beginning of recovery than at the end depending on where the service ports are located. The following practices are recommended for zeotropic blends:

- Follow the recommendations of the system manufacturer and the refrigerant and lubricant suppliers.
- Remove and replace with new specification refrigerant while returning the used refrigerant to the refrigerant supplier or reclaimer.
- Recycling should only be attempted if the refrigerant has been analyzed for composition and meets the new product specifications. This will be more applicable to larger systems.