

Initiatives in North America to Use Refrigerants Responsibly

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Manufacturers of heating, air-conditioning and refrigeration equipment are actively pursuing several initiatives to ensure that refrigerants are being used in a responsible manner, including containment, reclamation, and destruction of used refrigerant. Manufacturers are auditing their factories to minimize leaks. Industry is working with the US federal government to empower the US Environmental Protection Administration to enforce no-venting laws. The HVAC community is helping to revise an ASHRAE standard to prevent refrigerant leaks. The industry is also developing plans for a non-profit corporation that will provide financial incentives for returning used refrigerant for reclamation or destruction. ARI, the industry trade association, is working with technical schools to advocate training curricula that promote responsible refrigerant use. Taken together, these initiatives can help curtail refrigerant emissions from heating, ventilating, air conditioning, and refrigeration (HVACR) equipment.

1. Background

Comfort cooling is pervasive in US homes and businesses. Government figures¹ show that as of 2001, 55% percent of all homes in the US had central air conditioners and heat pumps. In addition, 23% utilized room air conditioners. When commercial air conditioning and refrigeration is added, the amount of refrigerants used is extremely large. It is estimated that over 2 billion pounds of refrigerants are currently in place in the US. Of these, 9% are CFCs, 67% are HCFCs and 24% are HFCs².

2. Choosing the Best Refrigerant for an Application

Product development engineers have a lot of considerations and a lot of constraints in choosing a refrigerant for a piece of equipment. Very simply, the refrigerant must operate effectively and efficiently at the temperature of the device, it must operate at pressures that can be safely contained and it should be safe in the unlikely event that a leak should occur. Engineers are very concerned about the overall energy efficiency of the unit and how much power is required to operate it. They are also concerned about its overall environmental footprint. It has been shown³ that for most systems, the chief determinant of the environmental footprint is the efficiency of the system, rather than the global warming factors related to the refrigerant. In other words, the best refrigerant from the standpoint of lowest greenhouse gas (GHG) emissions may be one with a high global warming potential and highest operating efficiency. That is because the possibility of a leak is very small, but the effect of efficiency on burning fossil fuels in the powerplant is very large. Through more responsible use of refrigerants, the scale will tip further in favor of refrigerants that yield high efficiency.

3. Status of Refrigerants in the US

In the United States, HCFC-22 in new equipment will be phased out in 2010 and production and import for servicing in will be phased out in 2020.

This schedule became law through the passage of the Clean Air Act amendments of 1990. That act refers specifically to ozone depleting substances, the CFCs and HCFC refrigerants. Although the Act says that the venting of any refrigerant is prohibited, it does not speak of specific measures to control and contain HFCs. The U.S. Environmental Protection Agency (USEPA) claims that it lacks authority to further regulate HFC use.

US manufacturers are slowly transitioning to HFCs. In 2006, about one quarter⁴ of small unitary air conditioners and heat pumps used HFCs. The balance of the systems were produced to use HCFCs.

Whatever the refrigerant used, manufacturers of this equipment have always focused on the leak tightness of their systems. Generally, every component in a system is tested for leaks and then the entire assembled system is tested. Today's leak detection equipment is sensitive to a leak rate of at least 1.5 grams per year.

Although HFC refrigerant emissions represent less than 2% of total U.S. greenhouse gas emissions, North American manufacturers of HVACR equipment, through their trade association, the Air-conditioning and Refrigeration Institute (ARI), developed recommendations for the responsible use of refrigerants. The program is called the Responsible Use Initiative (RUI). At the request of the ARI Board of Directors, a blue ribbon panel of industry experts suggested a list of activities to promote the responsible use of refrigerants.

4. The Industry's Responsible Use Initiative

4.1. Recommendations for Industry Activities

The blue ribbon panel recommended initiatives to further the responsible use of refrigerants: Those initiatives are:

- Industry endorsement of ASHRAE Standard 147-2002
- Development of industry Responsible Use Guidelines
- Work to strengthen government oversight of venting through the US Clean Air Act
- Promote the use of NATE certified technicians
- Institute a voluntary recycle/reclaim/destruction program for HFCs
- Work with industry partners

4.2. Industry Responsible Use Guidelines

During the life of a refrigerant molecule, nowhere does the equipment manufacturer have more control than in its own manufacturing facility. Because large quantities of refrigerant pass through these sites, there is the potential to emit large quantities or, conversely, to demonstrate excellent containment practices. In 2005, ARI surveyed its member companies to uncover the best refrigerant containment practices that were practiced in facilities. The results were compiled as the publication: *Responsible Use Guide for Minimizing Fluorocarbon Emissions in Manufacturing Facilities*⁵. Seventy percent of respondents reported that, in the past ten years, they have cut emissions in their facilities by 25 to 75%.

The *Guide* provides guidance in recovering refrigerants in plants, design of leak free facilities, preventative maintenance practices, proper storage of refrigerants, and proper shipment of charged systems. While developed by ARI, it is also endorsed by Refrigerants Australia, the Heating, Refrigerating and Air-conditioning Industries Association of Canada (HRAI), the International Council of Air conditioning and Refrigeration Manufacturers Associations (ICARMA), ASHRAE, and the US EPA. The guide is available at the ARI web site.

4.3. Industry Endorsement of ASHRAE Standard 147-2002

ASHRAE Standard 147-2002, *Reducing the Release of Halogenated Refrigerants from Refrigerating and Air Conditioning Equipment Systems*, was developed to help reduce the amount of halogenated refrigerants emitted from air conditioning and refrigeration systems. It pertains to refrigerant usage from the time it is charged into the equipment until the equipment's end of life. The HVACR manufacturing industry reviewed the standard with an eye toward endorsing it. It was determined that the standard was well constructed and comprehensive, except for two areas, the level of refrigerant containment that is practically obtainable as well as a standard method of measuring leak rates.

4.3.1. Obtainable Level of Containment

As currently written, the standard calls for factory acceptance leak rates no more than 0.1 ounce per year (2.8 g/y) or 0.5% of the system charge per year, whichever is greater, for any type of system. However, since field assembled systems tend to be larger and more complex, with more opportunities for leaks as compared to factory assembled systems, the ASHRAE 147 Committee is considering different leak levels for the two. Also being considered are prescriptive requirements for the field assembly of equipment components. For example, the standard could require welded joints in lieu of other types of connections and that flanges, valves and pumps be monitored for refrigerant leaks.

4.4. Leak Measuring Standard

ASHRAE Standard 147 provides a goal for containment but does not provide a test method for measuring leak rates. It is believed that there is not such a leak rate standard in the industry. In a separate effort, ASHRAE is beginning to form a standards committee to address this issue. This separate standard will provide a qualification procedure to measure and test the refrigerant leak rate of HVACR components, equipment, and systems, for use in complying with ASHRAE Standard 147 requirements.

5. Federal Measures

5.1. Clean Air Act Section 608

The Clean Air Act (CAA) amendments of 1990 regulates, among other things, the phase-out and containment of ozone depleting substances and their substitutes. As mentioned above, most HCFCs will be phased out in new equipment in 2010. Section 608 of the CAA prescribes specific requirements for handling HCFCs. Technicians who purchase HCFCs must have training and pass a test to show their proficiency in safely handling them. The regulation stipulates that HCFCs cannot be vented; they must be recovered and either recycled into the same owner's equipment or reclaimed to regulated standards of purity before they can be resold. The federal regulations are quite precise in their specifications. In recent years, however, there has been little federal enforcement of these regulations. While companies that service air conditioning and refrigeration systems have had to show that they have equipment to recover refrigerants, there is no way to know that such equipment is being used. In fact, analyses indicate that some HCFCs are being emitted into the atmosphere.

For HFC use, there is even less US government oversight. While the CAA also prohibits venting of HFCs, there are no requirements for technician training, certification, or recovery/recycling equipment. The USEPA has asserted that, since HFCs are not ozone depleting substances, it does not have authority to regulate them. This may change. Recently, in a case involving automobile tailpipe emissions, the US Supreme Court ruled that EPA does have such authority. It is believed that this will be a precedent for EPA regulatory authority for HFCs, as well.

5.2. North American Technician Excellence (NATE)

In 1997, the HVACR industry established the North American Technician Excellence Program (NATE), to provide testing and accreditation to service technicians. Technicians who earn the NATE accreditation are considered to have knowledge and skills that are above average and these technicians are considered able to handle refrigerants in a more responsible manner. One of the goals of the Responsible Use effort is to have the federal government use NATE certified technicians for all federal facilities.

6. Refrigerant Management USA (RMUSA)

While US law makes it a crime to intentionally vent refrigerants, there is little enforcement and indications are that refrigerants are being vented. A major reason is one of economics: it costs time and money to correctly recover refrigerants and return them for reclamation, and the market value of most refrigerants is too low to make it economical. Furthermore, the costs of destruction are prohibitively high and are borne by the service contractor who is fulfilling his legal obligation of returning the refrigerants. Clearly, the economics of return and reclamation or destruction of refrigerants will have to change if they are to catch on. The US HVACR industry has examined incentive programs in Australia and Canada and has borrowed features of these programs that would be attractive to the American market. The industry has also added features designed for the American market.

6.1. The RMUSA Concept

The concept being developed is to put a levy on virgin (non-reclaimed) refrigerants entering the US market. These would be refrigerants produced in the US, those produced overseas and shipped to the US, and those that enter the US in pre-charged equipment. The program would have mandatory participation. It is proposed that a federal law be enacted that would require producers and importers to pay a levy to the Refrigerant Management USA (RMUSA) not-for-profit corporation. The monies collected will be available for incentive payments in the reclaim market. It is proposed that the payments go to reclaiming businesses, once it can be verified that reclaiming or destruction has, in fact, taken place. In this model, the reclaimer, in an effort to grow its business, would pass the incentive down the value chain, to wholesalers who consolidate the returned refrigerants and then to the service contractor. The amount of the incentive being paid by RMUSA would be known to all, in order to let the market work most efficiently.

The goal of RMUSA is to annually double the amount of refrigerant being returned for reclamation or destruction, until some asymptotic point is reached in which all practically recoverable refrigerant is being processed. It is clear that the US now has the capacity to process more refrigerant than is being returned. In a market with proper incentives, reclaimers will make the capital expenditures required to meet the growing demand.

6.2. Development of RMUSA

As of this writing, the concept has been vetted and approved by members of ARI. A plan is being developed to get congressional approval to make RMUSA a mandatory program for refrigerant producers and importers. At the same time, the structure of the not-for-profit corporation is being planned.

7. Conclusions

Refrigerants are used in a variety of products for a variety of uses. In addition to the HVACR market represented by ARI, refrigerants are used in domestic refrigerators and freezers, room air conditioners, insulating foams, and automobile air conditioning. It will be essential to have participation of all these sectors if the efforts of the Responsible Use Initiative are to have their maximum effect. It is also essential that all segments of those industries (manufacturing, installation, and service) be active players in planning and implementing responsible use programs.

These programs can be reproduced elsewhere in the world, taking into account regional differences, to help reduce emissions and keep fluorocarbon refrigerants an important part of energy efficient and environmentally responsible heating, cooling and refrigeration.

Footnotes

1. http://www.eia.doe.gov/emeu/reps/appli/us_table.html
2. Unpublished ARI data
3. M. Menzer and G. Hourahan, *Air-Conditioning and Refrigeration's Contribution to Global Warming Gases*, paper presented at the 1995 International CFC and Halons Alternatives Conference, October 1995
4. Unpublished ARI statistical data
5. *Responsible Use Guide for Minimizing Fluorocarbon Emissions in Manufacturing Facilities*, volume 3, ARI, January 2007, available for download at <http://www.ari.org/NR/rdonlyres/E87FCE46-8E39-40AE-A089-0E9156059F96/0/RUIGuide1005C.pdf>