Recommended Practices for Minimizing HFC Emissions From Refrigerator-Freezer Factories

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Developed and endorsed by

The Association of Home Appliance Manufacturers (AHAM)

and the U. S. Environmental Protection Agency (EPA)

in agreement with the following companies:

Electrolux Home Products, Inc.
GE Consumer & Industrial
Marvel Industries
Maytag Corporation
Sanyo E & E Corporation
Sub-Zero Freezer Company, Inc.
Viking Range Corporation
W.C. Wood Company Limited
Whirlpool Corporation

Introduction

With the support of the U. S. Environmental Protection Agency (EPA), the Association of Home Appliance Manufacturers (AHAM) has agreed to distribute these voluntary *Recommended Practices* to its members to encourage manufacturers of household refrigerators and freezers to follow the HFC emission reduction strategies outlined herein.

AHAM and EPA also encourage use of these practices throughout the world, wherever HFCs are used in the production of household refrigerators/freezers. These practices should be especially helpful in minimizing emissions at new plants, as they are designed and started up.

Recognizing the importance of coordinated international action and the value of public commitments, AHAM was a signatory of the Responsible Use Principles (RUPs) for HFCs initially published in 2002 by UNEP, EPA, METI (Japan), and the Alliance for Responsible Atmospheric Policy (ARAP). A complete copy of the RUPs can be downloaded from the following web site: (http://www.arap.org/responsible.html). A copy of the sections of the RUPs relevant to household refrigerators/freezers is included as Annex 1.

Whereas the RUPs established good principles for the use of HFCs, this document is intended to go a step further in providing guidance to minimize the emissions of HFCs during the production of household refrigerator/freezers. It is recognized that it may not be practical to implement all of these practices because of unique circumstances in any specific factory, but they are recommended to be used wherever possible.

Even though disassembly and life cycle climate performance (LCCP) are not part of the production process, they should be taken into consideration during design and production. However, details of these considerations are beyond the scope of this document. Helpful information on these topics can be found in various international reports, such as the *2005 IPCC/TEAP Special Report on Safeguarding the Ozone Layer and the Global Climate System: Issues Related to HFC and PFCs*, and the March 21, 2005 Arthur D. Little report, *Global Comparative Analysis of HFC and Alternative Technologies for Refrigeration, Air Conditioning, Foam, Solvent, Aerosol Propellant, and Fire Protection Applications.* Recent research sponsored by AHAM and EPA has provided important information on emissions of blowing agent contained in the foam components of discarded appliances; ongoing studies will quantify the ultimate environmental fate of these components.

None of the practices recommended herein are intended to supersede any applicable government regulations on storage, use, or handling of HFC's, such as those contained in the Clean Air Act. In addition to following all applicable government regulations, factories should follow all applicable industry standards with regard to safety, design, installation, operation and maintenance of chemical blending tanks, holding tanks, dispensing equipment and ventilation.

Measurement and quantification of factory emissions of HFCs is currently not required and standardized sampling methods are not readily available. The EPA Vintaging Model currently assumes a 4% loss of blowing agent during appliance manufacture. It is possible to estimate factory emissions and AHAM and EPA have committed to work together to develop quantification methodologies and modify current assumptions, if necessary. EPA will contribute funds and appropriate expertise toward developing such methodologies. AHAM and EPA will review new data and new analytical tools to consider how voluntary reporting through a 3rd party could be established so that the industry's efforts to minimize emissions can accurately be represented.

However, it should be noted that due to the increasing cost of refrigerants and blowing agents, there is already a strong incentive for manufacturers to minimize emissions and waste. Therefore, it is in the best interest of companies to implement the practices outlined herein. These practices are intended to be used as part of a comprehensive program which includes preventative maintenance, training, and education.

Recommended Practices for Minimizing Factory HFC Emissions

1. Delivery, Transfer and Storage of Refrigerants and Blowing Agents in Tanks, Trucks or Cylinders

a. Keep a log of the specifications and weights of chemicals delivered to the plant
b. Contain emissions from relief valves, without violating safety provisions, to capture accidental releases
c. Inspect all transfer pumps on a regular basis for any sign of fatigue or leakage, especially around pump seals
d. Use a pressure equalization line during tank to tank transfers to recover any vapor that would otherwise escape during the pumping process
e. Do not vent the batch tank during transfer of blowing agents to the batch blending tank
f. Use dripless fittings on all trucks, rail cars, and tanks
g. Control the temperature and pressure during transfer
h. To avoid cross-contamination or misidentification of chemicals, containers should only be filled with the chemicals indicated on the container

2. Factory Piping (Hard Lines) Emissions

a. All process and storage lines should be brazed or welded, where possible
b. Flanges, valves and pumps should be monitored for refrigerant leaks
c. Low emitting valves should be specified. Use seal cap valves where appropriate
d. Locate isolation valves close to disconnect points. Monitor all connection points, metering points, electronic controls and pump connections for leaks
e. Provide refrigerant recovery during refrigerant sampling
f. Ensure that all equipment and any lines are emptied without emissions during scheduled/routine maintenance using recovery and/or disposal lines
g. Install systems to minimize/prevent damage to any piping that could result in refrigerant leaks. This may mean protecting or concealing piping when practicable.

3. Blending Operations of HFC Foam Blowing Agents in the Factory

a. Do not vent the batch tank during the blending process
b. Consider closed tank blending of resin, blowing agent and other ingredients into the blended master batch
c. The blending tank, the recirculation process piping and components should be rated for the highest pressure anticipated to avoid inadvertent releases

4. Calibration of Blowing Agent Equipment

a. When practical, use a closed loop calibration system, a reliable mass flow meter or volumetric flow meter monitoring system as an alternate to “wet” cup calibration for blowing agents
b. Return all calibration shots to the metering system

5. Foam Injection

a. Regularly inspect all pipes and hoses carrying the foam mixture to the cabinet mixhead
b. Quality control for the door and cabinet foaming system should be computer controlled to check mixture temperatures, pressures, flow rates, and mixhead alignments to verify metered insulating materials comply with engineering tolerances for overpack percentage and void minimization
c. Cabinet and door molds should be marked by model and serial number for conducting preventive maintenance and dimensional audits to prevent loss of cabinet or door foam in production
d. Formed cabinets and doors should be dimensionally audited daily, prior to foaming, to minimize foam leakage during production

6. Refrigerant System Charging

a. A refrigerant inventory record should be kept to account for the amount of virgin refrigerant received and used in manufactured products and test samples
b. Units should be evacuated to 1 mm Hg (130 Pa) or less prior to charging
c. Units should be designed to leak less than 0.5% of the total charge per year or 0.1 oz/yr (2.8 g/y), whichever is greater

7. Trial Runs

a. Contain the refrigerant and blowing agent in the product during the charging, foam injection, and curing process
b. Use metering system storage tanks whenever possible to avoid manual setups and inadvertent losses

8. Laboratory Testing

a. Refrigerant used in test samples should never be released to the atmosphere
b. Used refrigerant should be recovered at end of use and stored in a suitable container
c. Laboratory test models should be pressurized and leak checked, prior to evacuation and system refrigerant charging
d. Test samples should be monitored to identify and fix refrigerant leaks during tests

9. Factory Scrap Material

a. Recover refrigerant from scrap units prior to scrapping
b. Develop, maintain and monitor a plan for the disposition of scrap materials containing HFCs.

10. Refrigerant Recovery

a. Recovery equipment should be available to all qualified personnel in both manufacturing areas and testing laboratories
b. All personnel using recovery equipment should be properly trained and certified, as appropriate by governmental and private organizations, in the safe handling and use of applicable equipment and refrigerants
c. Recovered refrigerant should be stored in a suitable container and either recycled, reclaimed or disposed of properly

11. Product Design

a. Give consideration to disassembly and separation opportunities when the product is decommissioned at end of life
b. Design cabinets for tight fit between wrapper and liner to minimize foam leakage due to expansion within wall cavities during foaming, while still allowing air to vent during that process. (Optimize foam flow pattern and density to minimize the amount of foam needed, so as to reduce foam leakage through any cracks.)
c. Select cost effective refrigerant and foam formulations that optimize the Life Cycle Climate Performance (LCCP) and the amount of HFC used per refrigerator

ANNEX 1

RESPONSIBLE USE PRINCIPLES FOR HYDROFLUOROCARBONS (HFCs)

Published in 2002 by UNEP, EPA, METI (Japan), and the Alliance for Responsible Atmospheric Policy (ARAP)

A complete copy of the RUPs can be downloaded from the following web site: (http://www.arap.org/responsible.html). Sections relevant to household refrigerators/freezers are included in this Annex.

HFCs are used in important applications in both developed and developing countries including metered dose inhalers, foam insulation, refrigeration, air conditioning, technical aerosol products, solvents, and fire extinguishants.

HFCs are necessary for an orderly phase out of ozone depleting substances under the Montreal Protocol.

HFCs are included in the basket of greenhouse gases under the Kyoto Protocol.

HFCs are low in toxicity, cost-effective, safe to use, and in many applications provide high energy efficiency.

Without responsible use, it is projected that by 2050 HFCs could account for up to 2% of total greenhouse gas contributions.

It is resolved by this partnership of governments, international organizations, and HFC-producing and using industries to apply worldwide the following Responsible Use Principles:

- Select HFCs for applications where they provide health and safety, environmental, technical, economic, or unique societal benefits
- Minimize HFC emissions to the lowest practical level during manufacture of the chemical, and during use and disposal of equipment using cost-effective technology
- Design and operate HFC-producing plants with the goal of achieving zero HFC emissions
- Engineer, operate and maintain HFC-using systems to minimize emissions and maximize energy efficiency
- Recover, recycle, reclaim and/or destroy used HFCs where technically and economically feasible
- Promote comprehensive technician training in HFC handling to assure compliance with regulations and stewardship practices
- Meet standards governing HFC equipment installation and maintenance, HFC transport and storage, and exceed such standards when appropriate
- Accurately report HFC production and promote models, that accurately estimate emissions
- Consider alternatives that are technically, environmentally, and economically feasible

HFCS ARE PART OF BALANCED SOLUTIONS FOR SOCIETY.

Comprehensive national climate change plans use the basket approach to reduce emissions of the six principal greenhouse gases, including HFCs. With respect to HFCs, the plans should fully balance relevant environmental, safety, health, energy efficiency, and economic factors.

Life Cycle Climate Performance (LCCP) is a tool that should be used to evaluate the environmental benefits of refrigeration, air conditioning and insulation.

HFC emissions reductions are already occurring through voluntary actions and industry-government partnerships. Such partnerships are also jointly engaged in research, communication and other activities to find new technologies, designs and processes to enhance overall product viability, including energy efficiency and cost.

The UNEP Technology and Economic Assessment Panel (TEAP) of the Montreal Protocol on Substances that Deplete the Ozone Layer (1999) concluded that HFCs are important to the current safe and cost-effective phaseout of CFCs in developing countries. They are essential substitutes for highly important uses of ozone-depleting substances and are also technically and economically necessary for phase out of HCFCs in developed and developing countries.

The Intergovernmental Panel on Climate Change (IPCC) Third Assessment Report (2001) documented options for reducing emissions of HFCs and concluded that for some HFC applications, alternatives are not technically and economically feasible.

The European Union's submission to the United Nations Framework Convention on Climate Change (July 1999), stated, "Action taken to reduce HFC emissions should not undermine the efforts to phase out ozone-depleting substances."

A report by Arthur D. Little entitled *Global Comparative Analysis of HFC and Alternative Technologies...* (2002) found that HFCs are the preferred alternative to replace ozone-depleting substances where they provide superior overall technical, environmental, and safety benefits.

HOUSEHOLD REFRIGERATION

- Contain refrigerants in tight systems and containers minimizing atmospheric releases
- Recover, recycle and reclaim refrigerants
- Minimize end of life emissions where technically and economically feasible
- Train all personnel in proper refrigerant handling
- Design, install and operate to optimize energy efficiency
- Minimize emissions during refrigerator manufacture

FOAM INSULATION

- Provide safe and energy efficient insulation products to meet societal needs for energy conservation and to minimize carbon dioxide (CO_2) emissions
- Promote the reuse of insulation where technically and economically feasible to minimize end-of-life emissions
- Minimize foam insulation manufacturing emissions based on commercially viable technology