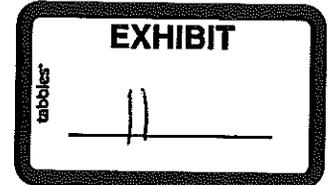




WHERE BUSINESS AND THE ENVIRONMENT CONVERGE

588 Silver Street, Agawam, MA 01001 tel 413.789.5530 fax 413.789.2776 www.ecsconsult.com

June 8, 2009



Mr. Elisa Nahas
Department of Consumer Protection
165 Capitol Avenue
Hartford, CT 06106

RECEIVED

JUN 12 2009

LEGAL DIVISION
CONSUMER PROTECTION

RE: Informational Session – DX Geothermal Refrigerants

Dear Ms. Nahas:

I am writing this letter to provide information pertaining to the use of refrigerants as heat transfer media for DX Geothermal systems. As you are aware, DX Geothermal Systems are currently using HFC-407C and HFC-410A (amongst other refrigerants) as a replacement for the ozone-depleting refrigerant HCFC-22, which is being phased out pursuant to the Montreal Protocol and the Clean Air Act of 1990. Though there is limited toxicity data available for these refrigerants, neither is believed to be toxic or persistent in groundwater according to the United States Environmental Protection Agency (USEPA)¹. Additionally, in an email response from Ms. Margaret Sheppard of the USEPA to my colleague Sam Johnston II, bioconcentration factors and aquatic toxicity are expected to be low, as modeled by the PBT Profiler². A copy of the email from the EPA and the PBT Profiler results are provided as **Attachment I**.

As a Licensed Environmental Professional in Connecticut, a Licensed Site Professional in Massachusetts, and a Professional Engineer, I have been involved in the investigation and remediation of hundreds of contaminated properties involving various chemicals, including heavy metals, PCBs, solvents, and petroleum hydrocarbons (gasoline, fuel oil, coal tar and kerosene). In cases where site remediation (excavation or in situ treatment) was required to meet regulatory standards, a substantial quantity of contaminant (usually greater than 10 gallons³ of liquid, equivalent to 60 pounds or more) was released to the environment. In most cases, chemical releases would go unnoticed for a long period of time (years to decades), until some evidence of the release was detected at a sensitive receptor (such as a stream or potable well), or during assessment of a property prior to transfer to a new owner.

¹ <http://www.epa.gov/ozone/snap/refrigerants/safety.html>

² <http://www.pbtprofiler.net/Results.asp> (Note: profiler evaluates individual components of the mixture called HFC-407C)

³ 10 gallons is the Reportable Quantity in Massachusetts. Connecticut does not utilize a threshold quantity for reporting releases to the CTDEP.

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This background is provided as context for the following response to DCP concerns regarding the use of refrigerants in closed loop piping for DX geothermal systems:

- ECS designs and installs geothermal systems, including both DX and closed loop water systems. As with most construction related activities, there are manageable risks to the environment associated with both of these system configurations; however, I believe the risks are associated with drilling in areas where soil and groundwater contamination is already present from historic activities, and not from the leakage of heat transfer fluids contained in the closed-loop system. These risks can be minimized by proper site evaluation and siting of the geothermal loop field so that cross contamination of media and aquifers does not occur.
- Most of the known toxic contaminants in soil and groundwater currently regulated by the States and the EPA are liquids or solids at room temperature. The refrigerants being used for DX geothermal systems boil at -47 degrees Fahrenheit, and are gases at room temperature. Material Safety Data Sheets (MSDS) for both HFC-410A and -407C indicate that these chemicals are expected to partition almost exclusively into the atmosphere. Furthermore, toxicity information for these compounds suggests chronic effects for animals only at very high concentrations (greater than 40,000 parts per million) in air. Copies of the MSDS for the refrigerants are provided in **Attachment II**.
- Unlike a slow leak of petroleum from a fuel storage system, the loss of refrigerant from a geothermal system will be noticed immediately by the property owner, as they will no longer obtain heating and cooling with their system. The loss of refrigerant would require pressure testing of the entire system to locate the source of the release, and refrigerant would only be added after the leak was found due to the high cost (in labor and materials) associated with recharging the system. If a leak were found in the subsurface piping, than the loop field would necessitate repair or replacement. Furthermore, the quantity of refrigerant that could be released is limited to the total refrigerant charge in the system, generally less than 22 pounds for a typical residential system.
- DX loops that are installed below the groundwater surface should be grouted in place to minimize contact between groundwater and the loops themselves. In the event of a breach in the piping, refrigerant mobility would then be restricted to the borehole and grout, and would be less likely to dissolve in the groundwater to any appreciable extent. However, it should be noted that not all geothermal systems require drilling below the groundwater table. For ground loops that are installed in unsaturated soils, sand bedding would be adequate as any release or refrigerant from the piping would boil into a vapor, and would have minimal impact to groundwater.

As an engineer and an environmental professional, it is my opinion that the risks to the environment and to human health are nominal for DX geothermal systems when compared to the benefits that the individual and society receive from the decreased use of fossil fuel. It is my opinion that the risks posed by DX systems may be lower than closed loop water systems since the vertical depth required for the DX loops are generally less than water-based systems (typically 100 feet or less for a DX system versus several hundred to over one thousand feet for water loop systems). The reduced vertical depth for DX ground loops minimize the potential for cross-contamination of aquifers by any existing groundwater or

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soil contamination present at, or in the immediate vicinity of, the site. This risk can be minimized for both systems by the use of grout in the borehole when groundwater is present.

Proper regulation of any geothermal system is appropriate. The successful and safe installation of a geothermal system will be as much dependent upon the proper design and siting of the subsurface loop field, as on proper drilling and installation methods. I would recommend that the permitting process for geothermal well and loop field installation should not be limited to water well drillers and should be expanded to include blasting contractors/drillers, Professional Engineers and Professional Geologists, and LEPs familiar with these systems.

Thank you for the opportunity to provide information regarding this important issue.

Respectfully Submitted,
ENVIRONMENTAL COMPLIANCE SERVICES, INC.

A handwritten signature in black ink, appearing to read "Daniel W. Felten". The signature is stylized and cursive.

Daniel W. Felten, P.E., LEP, LSP
Principal Engineer/Chief Technical Officer

DWF/dlm
Attachment

ATTACHMENT I

EPA EMAIL AND PBT PROFILER RESULTS

EPA RE R410AR421422Excerpt.txt

From: Sheppard.Margaret@epamail.epa.gov
Sent: Tuesday, September 04, 2007 10:25 AM
To: Sam E. Johnston II
Cc: Belefski.Mary@epamail.epa.gov
Subject: RE: R410A/R421/422

Sam,

Bioconcentration factors are low for all components of R-410A, R-421, and R-422--anything above 1000 is considered too high:

HFC-32 (in R-410A): BCF = 3.2

HFC-125 (in R-410A): BCF = 3.1

HFC-134a: BCF = 3.9

Isobutane (in R-422): BCF = 27

Aquatic toxicity values-- according to the PBT profiler, isobutane is more toxic than the other components, and is the only one of potential concern. It also is a small constituent of the blends, so impact would be lessened. LC50= concentration at which 50% of fish die in test--higher numbers are less toxic. LC50 > 10 mg/l are not of significant concern.

HFC-32 (in R-410A): LC50 = 66 mg/l

HFC-125 (in R-410A): LC50 = 28 mg/l

HFC-134a: LC50 = 18 mg/l

Isobutane (in R-422): LC50 = 3.5 mg/l

R-22 falls in a similar range with the HFCs.

I know that EPA convened an advisory committee to evaluate different environmental criteria for evaluating new chemicals that might disrupt the endocrine system. The relevant EPA staff may be able to point you to further information on how to determine whether particular chemicals in the environment may be of concern. I see on the web site the contact name of Mary Belefski at 202-564-8461

Good luck--thanks for trying to identify refrigerants that are likely to minimize environmental impacts.

Margaret Sheppard
USEPA/Stratospheric Protection Division
SNAP Program
Tel. 202-343-9163
Fax 202-343-2362
email: sheppard.margaret@epa.gov

[Methodology](#) · [Criteria](#) · [Definitions](#) · [Chemicals That Should Not be Profiled](#)

[Home](#) · [Start a New Profile](#) · [Results](#) · [Terms of Use](#) · [Security](#)

Results

Orange or red highlights indicate that the EPA criteria have been exceeded.
[Black-and-white version](#)

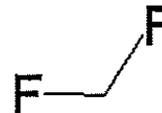
Persistence

Bioaccumulation Toxicity

75-10-5 Methane, difluoro-

PBT Profiler Estimate = PBT

<u>Media</u>	<u>Half-Life</u> (days)	<u>Percent in</u> <u>Each Medium</u>	<u>BCF</u>	<u>Fish ChV</u> (mg/l)
Water	15	43%	3.2	66
Soil	30	1%		
Sediment	140	0%		
Air	1,500	57%		

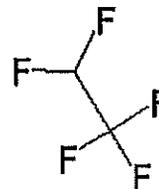


P2 Considerations and more information

354-33-6 Pentafluoroethane

PBT Profiler Estimate = PBT

<u>Media</u>	<u>Half-Life</u> (days)	<u>Percent in</u> <u>Each Medium</u>	<u>BCF</u>	<u>Fish ChV</u> (mg/l)
Water	38	47%	3.1	28
Soil	75	0%		
Sediment	340	0%		
Air	8,300	52%		



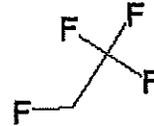
P2 Considerations and more information

811-97-2 1,1,1,2-Tetrafluoroethane

PBT Profiler Estimate = PBT

<u>Media</u>	<u>Half-Life</u> (days)	<u>Percent in</u> <u>Each Medium</u>	<u>BCF</u>	<u>Fish ChV</u> (mg/l)
Water	38	47%	3.9	18

Soil	75	0%
Sediment	340	0%
Air	3,200	 52%



P2 Considerations and more information

[Start a New Profile](#)

[Add More Chemicals to Your Profile](#)

The PBT Profiler Results are available for 20 minutes

Developed by the Environmental Science Center under contract to the Office of Pollution Prevention and Toxics, U.S. Environmental Protection Agency

Computer Resources Donated by Syracuse Research Corporation Ver 1.203 Last Updated September 21, 2006

ATTACHMENT II

MATERIAL SAFETY DATA SHEETS



Material Safety Data Sheet

R-407C

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: R-407C
DISTRIBUTOR: National Refrigerants, Inc.
661 Kenyon Avenue
Bridgeton, New Jersey 08302

FOR MORE INFORMATION CALL:
(Monday-Friday, 8:00am-5:00pm)
1-800-262-0012

IN CASE OF EMERGENCY CALL:
CHEMTREC: 1-800-424-9300

2. COMPOSITION / INFORMATION ON INGREDIENTS

Table with 3 columns: INGREDIENT NAME, CAS NUMBER, WEIGHT %. Rows include Difluoromethane (HFC-32), Pentafluoroethane (HFC-125), and 1,1,1,2-Tetrafluoroethane (HFC-134a).

Trace impurities and additional material names not listed above may also appear in Section 15 toward the end of the MSDS. These materials may be listed for local "Right-To-Know" compliance and for other reasons.

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: Colorless, volatile liquid with ethereal and faint sweetish odor. Non-flammable material. Overexposure may cause dizziness and loss of concentration. At higher levels, CNS depression and cardiac arrhythmia may result from exposure. Vapors displace air and can cause asphyxiation in confined spaces. At higher temperatures, (>250°C), decomposition products may include Hydrofluoric Acid (HF) and carbonyl halides.

POTENTIAL HEALTH HAZARDS

SKIN: Irritation would result from a defatting action on tissue. Liquid contact could cause frostbite.

EYES: Liquid contact can cause severe irritation and frostbite. Mist may irritate.

INHALATION: R-407C is low in acute toxicity in animals. When oxygen levels in air are reduced to 12-14% by displacement, symptoms of asphyxiation, loss of coordination, increased pulse rate and deeper respiration will occur. At high levels, cardiac arrhythmia may occur.

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R-407C

INGESTION: Ingestion is unlikely because of the low boiling point of the material. Should it occur, discomfort in the gastrointestinal tract from rapid evaporation of the material and consequent evolution of gas would result. Some effects of inhalation and skin exposure would be expected.

DELAYED EFFECTS: None known.

Ingredients found on one of the OSHA designated carcinogen lists are listed below.

<u>INGREDIENT NAME</u>	<u>NTP STATUS</u>	<u>IARC STATUS</u>	<u>OSHA LIST</u>
No ingredients listed in this section			

4. FIRST AID MEASURES

SKIN: Promptly flush skin with water until all chemical is removed. If there is evidence of frostbite, bathe (do not rub) with lukewarm (not hot) water. If water is not available, cover with a clean, soft cloth or similar covering. Get medical attention if symptoms persist.

EYES: Immediately flush eyes with large amounts of water for at least 15 minutes (in case of frostbite water should be lukewarm, not hot) lifting eyelids occasionally to facilitate irrigation. Get medical attention if symptoms persist.

INHALATION: Immediately remove to fresh air. If breathing has stopped, give artificial respiration. Use oxygen as required, provided a qualified operator is available. Get medical attention. Do not give epinephrine (adrenaline).

INGESTION: Ingestion is unlikely because of the physical properties and is not expected to be hazardous. Do not induce vomiting unless instructed to do so by a physician.

ADVICE TO PHYSICIAN: Because of the possible disturbances of cardiac rhythm, catecholamine drugs, such as epinephrine, should be used with special caution and only in situations of emergency life support. Treatment of overexposure should be directed at the control of symptoms and the clinical conditions.

5. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES

FLASH POINT:	Gas, not applicable per DOT regulations
FLASH POINT METHOD:	Not applicable
AUTOIGNITION TEMPERATURE:	Unknown for mixture
UPPER FLAME LIMIT (volume % in air):	None*
LOWER FLAME LIMIT (volume % in air):	None*
	*Based on ASHRAE Standard 34 with match ignition
FLAME PROPAGATION RATE (solids):	Not applicable
OSHA FLAMMABILITY CLASS:	Not applicable

EXTINGUISHING MEDIA:

Use any standard agent – choose the one most appropriate for type of surrounding fire (material itself is not flammable)

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R-407C

UNUSUAL FIRE AND EXPLOSION HAZARDS:

R-407C is not flammable at ambient temperatures and atmospheric pressure. However, this material will become combustible when mixed with air under pressure and exposed to strong ignition sources. Contact with certain reactive metals may result in formation of explosive or exothermic reactions under specific conditions (e.g. very high temperatures and/or appropriate pressures).

SPECIAL FIRE FIGHTING PRECAUTIONS/INSTRUCTIONS:

Firefighters should wear self-contained, NIOSH-approved breathing apparatus for protection against possible toxic decomposition products. Proper eye and skin protection should be provided. Use water spray to keep fire-exposed containers cool.

6. ACCIDENTAL RELEASE MEASURES

IN CASE OF SPILL OR OTHER RELEASE: (Always wear recommended personal protective equipment.)

Evacuate unprotected personnel. Protected personnel should remove ignition sources and shut off leak, if without risk, and provide ventilation. Unprotected personnel should not return until air has been tested and determined safe, including low-lying areas.

Spills and releases may have to be reported to Federal and/or local authorities. See Section 15 regarding reporting requirements.

7. HANDLING AND STORAGE

NORMAL HANDLING: (Always wear recommended personal protective equipment.)

Avoid breathing vapors and liquid contact with eyes, skin or clothing. Do not puncture or drop cylinders, expose them to open flame or excessive heat. Use authorized cylinders only. Follow standard safety precautions for handling and use of compressed gas cylinders.

R-407C should not be mixed with air above atmospheric pressure for leak testing or any other purpose.

STORAGE RECOMMENDATIONS:

Store in a cool, well-ventilated area of low fire risk and out of direct sunlight. Protect cylinder and its fittings from physical damage. Storage in subsurface locations should be avoided. Close valve tightly after use and when empty.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

ENGINEERING CONTROLS:

Provide local ventilation at filling zones and areas where leakage is probable. Mechanical (general) ventilation may be adequate for other operating and storage areas.

PERSONAL PROTECTIVE EQUIPMENT

SKIN PROTECTION:

Skin contact with refrigerant may cause frostbite. General work clothing and gloves (leather) should provide adequate protection. If prolonged contact with the liquid or gas is anticipated, insulated gloves constructed of PVA, neoprene or butyl rubber should be used. Any contaminated clothing should be promptly removed and washed before reuse.

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R-407C

EYE PROTECTION:

For normal conditions, wear safety glasses. Where there is reasonable probability of liquid contact, wear chemical safety goggles.

RESPIRATORY PROTECTION:

None generally required for adequately ventilated work situations. For accidental release or non-ventilated situations, or release into confined space, where the concentration may be above the PEL of 1,000 ppm, use a self-contained, NIOSH-approved breathing apparatus or supplied air respirator. For escape: use the former or a NIOSH-approved gas mask with organic vapor canister.

ADDITIONAL RECOMMENDATIONS:

Where contact with liquid is likely, such as in a spill or leak, impervious boots and clothing should be worn. High dose-level warning signs are recommended for areas of principle exposure. Provide eyewash stations and quick-drench shower facilities at convenient locations. For tank cleaning operations, see OSHA regulations, 29 CFR 1910.132 and 29 CFR 1910.133.

EXPOSURE GUIDELINES

<u>INGREDIENT NAME</u>	<u>ACGIH TLV</u>	<u>OSHA PEL</u>	<u>OTHER LIMIT</u>
Difluoromethane	None	None	*1000 ppm TWA (8hr)
Pentafluoroethane	None	None	*1000 ppm TWA (8hr)
1,1,1,2-Tetrafluoroethane	None	None	*1000 ppm TWA (8hr)

* = Workplace Environmental Exposure Level (AIHA)

OTHER EXPOSURE LIMITS FOR POTENTIAL DECOMPOSITION PRODUCTS:

Hydrogen Fluoride: ACGIH TLV: 3 ppm ceiling

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE:	Clear, colorless liquid and vapor
PHYSICAL STATE:	Gas at ambient temperatures
MOLECULAR WEIGHT:	86.2
CHEMICAL FORMULA:	CH ₂ F ₂ , CF ₃ CHF ₂ , CH ₂ FCF ₃
ODOR:	Faint ethereal odor
SPECIFIC GRAVITY (water = 1.0):	1.16 @ 21.1°C (70°F)
SOLUBILITY IN WATER (weight %):	Unknown
pH:	Neutral
BOILING POINT:	-43°C (-45.4°F)
FREEZING POINT:	Not determined
VAPOR PRESSURE:	156.2 psia @ 70°F 356.7 psia @ 130°F
VAPOR DENSITY (air = 1.0):	3.0
EVAPORATION RATE:	>1
% VOLATILES:	100
FLASH POINT:	Not applicable

(Flash point method and additional flammability data are found in Section 5.)

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R-407C

10. STABILITY AND REACTIVITY

NORMALLY STABLE? (CONDITIONS TO AVOID):

The product is stable.

Do not mix with oxygen or air above atmospheric pressure. Any source of high temperature, such as lighted cigarettes, flames, hot spots or welding may yield toxic and/or corrosive decomposition products.

INCOMPATIBILITIES:

(Under specific conditions: e.g. very high temperatures and/or appropriate pressures) – Freshly abraded aluminum surfaces (may cause strong exothermic reaction). Chemically active metals: potassium, calcium, powdered aluminum, magnesium and zinc.

HAZARDOUS DECOMPOSITION PRODUCTS:

Halogens, halogen acids and possibly carbonyl halides.

HAZARDOUS POLYMERIZATION:

Will not occur.

11. TOXICOLOGICAL INFORMATION

IMMEDIATE (ACUTE) EFFECTS:

HFC-32: LC₅₀: 4 hr. (rat) - 520,000 ppm / Cardiac Sensitization threshold (dog) 350,000 ppm
HFC-125: LC₅₀: 4 hr. (rat) - > 800,000 ppm / Cardiac Sensitization threshold (dog) 75,000 ppm
HFC-134a: LC₅₀: 4 hr. (rat) - > 500,000 ppm / Cardiac Sensitization threshold (dog) > 80,000 ppm

DELAYED (SUBCHRONIC AND CHRONIC) EFFECTS:

HFC-32: Teratogenic NOEL (rat and rabbit) – 50,000 ppm
Subchronic inhalation (rat) NOEL – 50,000 ppm
HFC-125: Teratogenic NOEL (rat and rabbit) – 50,000 ppm
Subchronic inhalation (rat) NOEL - ≥ 50,000 ppm
Chronic NOEL – 10,000 ppm
HFC-134a: Teratogenic NOEL (rat and rabbit) – 40,000 ppm
Subchronic inhalation (rat) NOEL – 50,000 ppm
Chronic NOEL – 10,000 ppm

OTHER DATA:

HFC-32, HFC-125, HFC-134a: Not active in four genetic studies

12. ECOLOGICAL INFORMATION

Degradability (BOD): R-407C is a gas at room temperature; therefore, it is unlikely to remain in water.
Octanol Water Partition Coefficient: Unknown for mixture

NATIONAL REFRIGERANTS

R-407C

STATE RIGHT-TO-KNOW

In addition to the ingredients found in Section 2, the following are listed for state right-to-know purposes.

<u>INGREDIENT NAME</u>	<u>WEIGHT %</u>	<u>COMMENT</u>
No ingredients listed in this section		

ADDITIONAL REGULATORY INFORMATION:

R-407C is subject to U.S. Environmental Protection Agency Clean Air Act Regulations at 40 CFR Part 82.

WARNING: Do not vent to the atmosphere. To comply with provisions of the U.S. Clean Air Act, any residual must be recovered. Contains Pentafluoroethane (HFC-125), Difluoromethane (HFC-32), and Tetrafluoroethane (HFC-134a), greenhouse gases which may contribute to global warming.

WHMIS CLASSIFICATION (CANADA):

This product has been evaluated in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

FOREIGN INVENTORY STATUS:

EU – EINECS # 2065578 – HFC-125
2008394 – HFC-32
223770 – HFC-134a

16. OTHER INFORMATION

CURRENT ISSUE DATE: December, 2008
PREVIOUS ISSUE DATE: August, 2007

OTHER INFORMATION: HMIS Classification: Health – 1, Flammability – 1, Reactivity – 0
NFPA Classification: Health – 2, Flammability – 1, Reactivity – 0
ANSI / ASHRAE 34 Safety Group – A1

Regulatory Standards:

1. OSHA regulations for compressed gases: 29 CFR 1910.101
 2. DOT classification per 49 CFR 172.101
- Toxicity information per PAFT Testing

17. DISCLAIMER

National Refrigerants, Inc. believes that the information and recommendations contained herein (including data and statements) are accurate as of the date hereof. NO WARRANTY OF FITNESS FOR ANY PARTICULAR PURPOSE, WARRANTY OF MERCHANTABILITY, OR ANY OTHER WARRANTY, EXPRESSED OR IMPLIED, IS MADE CONCERNING THE INFORMATION PROVIDED HEREIN. The information provided herein relates only to the specific product designated and may not be valid where such product is used in combination with any other methods or use of the product and of the information referred to herein are beyond the control of National Refrigerants. National Refrigerants expressly disclaims any and all liability as to any results obtained or arising from any use of the product or reliance on such information.



1 PRODUCT AND COMPANY IDENTIFICATION

DFO
2000 Market Street

Philadelphia, PA 19103

EMERGENCY PHONE NUMBERS:
Chemtrec: (800) 424-9300 (24hrs) or (703) 527-3887
Medical: Rocky Mountain Poison Control Center
(866) 767-5089 (24Hrs)

Information Telephone Numbers	Phone Number	Available Hrs
Product Information	800-245-5858	8:00 am - 5:30 pm (Eastern)

Product Name Forane (R) 410A
Product Synonym(s) R-410A, HFC/HFC-410A, FORANE FX 41

Chemical Family Hydrofluorocarbon Blend
Chemical Formula CH₂F₂/CHF₂CF₃
Chemical Name Pentafluoroethane / Difluoromethane
EPA Reg Num
Product Use Refrigerant

2 COMPOSITION / INFORMATION ON INGREDIENTS

Ingredient Name	CAS RegistryNumber	Typical Wt. %	OSHA
pentafluoroethane (HFC-125)	354-33-6	50	Y
difluoromethane (HFC-32)	75-10-5	50	Y

The substance(s) marked with a "Y" in the OSHA column, are identified as hazardous chemicals according to the criteria of the OSHA Hazard Communication Standard (29 CFR 1910.1200)

This material is classified as hazardous under Federal OSHA regulation.

The components of this product are all on the TSCA Inventory list.

3 HAZARDS IDENTIFICATION

Emergency Overview

Clear, Colorless liquid and vapor with a faint ethereal odor.

WARNING!
LIQUID AND GAS UNDER PRESSURE, OVERHEATING AND OVERPRESSURIZING MAY CAUSE GAS RELEASE OR VIOLENT CYLINDER BURSTING. MAY DECOMPOSE ON CONTACT WITH FLAMES OR EXTREMELY HOT METAL SURFACES TO PRODUCE TOXIC AND CORROSIVE PRODUCTS. VAPOR REDUCES OXYGEN AVAILABLE FOR BREATHING AND IS HEAVIER THAN AIR. HARMFUL IF INHALED AND MAY CAUSE HEART IRREGULARITIES, UNCONSCIOUSNESS OR DEATH. LIQUID CONTACT WITH EYES OR SKIN MAY CAUSE FROSTBITE.

Potential Health Effects

Inhalation and skin contact are expected to be the primary routes of occupational exposure to this material. As with most liquified gases, contact with the rapidly volatilizing liquid can cause frostbite to any tissue. High vapor concentrations are irritating to the eyes and respiratory tract and may result in central nervous system (CNS) effects such as headache, dizziness, drowsiness and, in severe exposure, loss of consciousness and death. The dense vapor of this material may reduce the available oxygen for breathing. Prolonged exposure to an oxygen-deficient atmosphere may be fatal. Inhalation may cause an increase in the sensitivity of the heart to adrenaline, which could result in



Irregular or rapid heartbeats. Medical conditions aggravated by exposure to this material include heart disease or compromised heart function.

4 FIRST AID MEASURES

IF IN EYES, immediately flush with plenty of water. Get medical attention if irritation persists.

IF ON SKIN, Flush exposed skin with lukewarm water (not hot), or use other means to warm skin slowly. Get medical attention if frostbitten by liquid or if irritation occurs.

IF SWALLOWED, Not applicable - product is a gas at ambient temperatures.

IF INHALED, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention. Do not give adrenaline, epinephrin or similar drugs following exposure to this product.

5 FIRE FIGHTING MEASURES

Fire and Explosive Properties

Auto-Ignition Temperature	NE	
Flash Point	NA - Gas	Flash Point Method
Flammable Limits- Upper	NONE	
Lower	NONE	

Extinguishing Media

Use extinguishing media appropriate to surrounding fire conditions.

Fire Fighting Instructions

Stop the flow of gas if possible. Use water spray on person making shut-off. Fire fighters and others who may be exposed to products of combustion should wear full fire fighting turn out gear (full Bunker Gear) and self-contained breathing apparatus (pressure demand NIOSH approved or equivalent). Fire fighting equipment should be thoroughly decontaminated after use.

Fire and Explosion Hazards

May decompose on contact with flames or extremely hot metal surfaces to produce toxic and corrosive products. Liquid and gas under pressure, overheating or overpressurizing may cause gas release and/or violent cylinder bursting. Container may explode if heated due to resulting pressure rise. Some mixtures of HCFCs and/or HFCs, and air or oxygen may be combustible if pressurized and exposed to extreme heat or flame.

6 ACCIDENTAL RELEASE MEASURES

In Case of Spill or Leak

Use Halogen leak detector or other suitable means to locate leaks or check atmosphere. Keep upwind. Evacuate enclosed spaces and disperse gas with floor-level forced-air ventilation. Exhaust vapors outdoors. Do not smoke or operate internal combustion engines. Remove flames and heating elements.

7 HANDLING AND STORAGE

Handling

Avoid breathing gas. Avoid contact with eyes, skin and clothing. Keep container closed. Use only with adequate ventilation. Do not enter confined spaces unless adequately ventilated.



7 HANDLING AND STORAGE

Storage

Do not apply direct flame to cylinder. Do not store cylinder in direct sun or expose it to heat above 120 F. Do not drop or refill this cylinder. Keep away from heat, sparks and flames.

8 EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering Controls

Investigate engineering techniques to reduce exposures below airborne exposure limits. Provide ventilation if necessary to control exposure levels below airborne exposure limits (see below). If practical, use local mechanical exhaust ventilation at sources of air contamination such as open process equipment.

Eye / Face Protection

Where there is potential for eye contact, wear chemical goggles and have eye flushing equipment available.

Skin Protection

Wear appropriate chemical resistant protective clothing and chemical resistant gloves to prevent skin contact. Consult glove manufacturer to determine appropriate type glove material for given application. Rinse contaminated skin promptly. Wash contaminated clothing and clean protective equipment before reuse. Wash skin thoroughly after handling.

Respiratory Protection

Avoid breathing gas. When airborne exposure limits are exceeded (see below), use NIOSH approved respiratory protection equipment appropriate to the material and/or its components (full facepiece recommended). Consult respirator manufacturer to determine appropriate type equipment for a given application. Observe respirator use limitations specified by NIOSH or the manufacturer. For emergency and other conditions where exposure limit may be significantly exceeded, use an approved full face positive-pressure, self-contained breathing apparatus or positive-pressure airline with auxiliary self-contained air supply. Respiratory protection programs must comply with 29 CFR § 1910.134.

Airborne Exposure Guidelines for Ingredients

Exposure Limit		Value
pentafluoroethane (HFC-125)		
WEEL TWA	-	4900 mg/m3 1000 ppm
difluoromethane (HFC-32)		
WEEL TWA	-	2200 mg/m3 1000 ppm

- Only those components with exposure limits are printed in this section.
- Skin contact limits designated with a "Y" above have skin contact effect. Air sampling alone is insufficient to accurately quantitate exposure. Measures to prevent significant cutaneous absorption may be required.
- ACGIH Sensitizer designator with a value of "Y" above means that exposure to this material may cause allergic reactions.
- WEEL-AIHA Sensitizer designator with a value of "Y" above means that exposure to this material may cause allergic skin reactions.



9 PHYSICAL AND CHEMICAL PROPERTIES

Appearance/Odor	Clear, Colorless liquid and vapor with a faint ethereal odor.
pH	NE
Specific Gravity	1.06 @ 25 C
Vapor Pressure	(BUBBLE) 213.9 PSIA @ 21.1C (70 F)
Vapor Density	(AIR = 1) 2.52
Melting Point	NE
Freezing Point	NE
Boiling Point	- 52.8 C
Solubility In Water	Unknown
Molecular Weight	72.59

10 STABILITY AND REACTIVITY

Stability

This material is chemically stable under specified conditions or storage, shipment and/or use. See HANDLING AND STORAGE section of this MSDS for specified conditions.

Incompatibility

Avoid contact with strong alkali or alkaline earth metals, finely powdered metals such as aluminum, magnesium or zinc and strong oxidizers, since they may react or accelerate decomposition.

Hazardous Decomposition Products

Thermal decomposition products could include Halogen acid (HF), Carbon monoxide, Carbon dioxide, and Carbonyl halide.

11 TOXICOLOGICAL INFORMATION

Toxicological Information

Ethane, pentafluoro-
Inhalation followed by intravenous injection of epinephrine to simulate stress reactions resulted in cardiac sensitization in dogs. Following repeated inhalation exposure, no adverse effects were observed in rats. No birth defects were noted in the offspring of rats or rabbits exposed by inhalation during pregnancy. No genetic changes were observed in tests using bacteria, animal cells or animals. Single exposure (acute) studies indicate:

Inhalation - Practically Non-toxic to Rats (4-hr LC50 >800,000 ppm)

Methane, difluoro-

Inhalation of this material, followed by intravenous injection of epinephrine to simulate stress reactions, resulted in cardiac sensitization in dogs. Acute inhalation of high concentrations has produced an anesthetic effect in rats. Following repeated inhalation exposure, no adverse effects were observed in rats. No birth defects were noted in the offspring of rats or rabbits exposed by inhalation during pregnancy, even at dosages which produced significant adverse effects in the mother. No genetic changes were observed in tests using bacteria, animal cells or animals. Single exposure (acute) studies indicate:

Inhalation - Practically Non-toxic to Rats (4-hr LC50 >520,000 ppm)

12 ECOLOGICAL INFORMATION

Ecotoxicological Information

No data are available.



12 ECOLOGICAL INFORMATION

Chemical Fate Information

Ethane, pentafluoro-

When released into the environment, this material is expected to partition almost exclusively into the atmosphere. Based on its low n-octanol/water partition coefficient (log Pow 1.48), bioaccumulation is considered unlikely. In a 28-day ready biodegradability closed bottle test, it appeared to be stable (about 10% degraded). This material does not dissociate in water.

Methane, difluoro-

The log Pow for this material is 1.62 indicating a low bioconcentration factor. In a 28-day ready biodegradability closed bottle test, this material appeared to be stable.

13 DISPOSAL CONSIDERATIONS

Waste Disposal

Recover, reclaim or recycle when practical. Dispose of in accordance with federal, state and local regulations. Note: Chemical additions to, processing of, or otherwise altering this material may make this waste management information incomplete, inaccurate, or otherwise inappropriate. Furthermore, state and local waste disposal requirements may be more restrictive or otherwise different from federal laws and regulations.

14 TRANSPORT INFORMATION

DOT Name	Liquefied Gas NOS
DOT Technical Name	(Pentafluoroethane, Difluoromethane)
DOT Hazard Class	2.2
UN Number	UN 3163
DOT Packing Group	PG NA

RQ

15 REGULATORY INFORMATION

Hazard Categories Under Criteria of SARA Title III Rules (40 CFR Part 370)

Immediate (Acute) Health	Y	Fire	N
Delayed (Chronic) Health	N	Reactive	N
		Sudden Release of Pressure	Y

The components of this product are all on the TSCA Inventory list.

Ingredient Related Regulatory Information:

New Jersey Right to Know

This product does contain the following chemical(s), as indicated below, currently on the New Jersey Right-to-Know Substances List.
difluoromethane (HFC-32)

Pennsylvania Environmental Hazard

This product does contain the following chemical(s), as indicated below, currently on the Pennsylvania Environmental Hazard List.
difluoromethane (HFC-32)

Pennsylvania Right to Know

This product does contain the following chemical(s), as indicated below, currently on the Pennsylvania Hazardous Substance List.
difluoromethane (HFC-32)



16 OTHER INFORMATION

Revision Information

Revision Date 11 OCT 2004 Revision Number 9
Supersedes Revision Dated 30-SEP-2004

Revision Summary

ATOFINA Chemicals, Inc. has changed its name to Arkema Inc.

Key

NE= Not Established NA= Not Applicable (R) = Registered Trademark

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