Developing a California Inventory for Industrial Applications of Perfluorocarbons, Sulfur Hexafluoride, Hydrofluorocarbons, Nitrogen Trifluoride, Hydrofluoroethers and Ozone Depleting Substances
Appendices
Agreement Number 07-313

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The California Air Resources Board and the California Environmental Protection Agency

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TABLE OF CONTENTS

Appendix A
Solvents

Material Safety Data Sheets for GHG Solvents Used In Film Cleaning

3M

Material Safety Data Sheet

SECTION 1: PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: HFE-7200 3M (TM) Novec (TM) Engineered Fluid
MANUFACTURER: 3M
DIVISION: Electronics Markets Materials Division

ADDRESS: 3M Center
St. Paul, MN 55144-1000

EMERGENCY PHONE: 1-800-364-3577 or (651) 737-6501 (24 hours)

Issue Date: 02/05/2004
Supercedes Date: 12/30/2003

Document Group: 08-1308-9

Product Use:
Intended Use: FOR INDUSTRIAL USE ONLY. NOT INTENDED FOR USE AS A MEDICAL DEVICE OR DRUG.
Specific Use: Solvent for Cleaning and Coating; Heat Transfer Fluid

SECTION 2: INGREDIENTS

Ingredient	C.A.S. No.	% by Wt
ETHYL NONAFLUOROISOBUTYL ETHER	163702-06-5	20 - 80
ETHYL NONAFLUOROBUTYL ETHER	163702-05-4	20 - 80

SECTION 3: HAZARDS IDENTIFICATION

3.1 EMERGENCY OVERVIEW

Specific Physical Form: liquid
Odor, Color, Grade: Clear, colorless liquid. Faint odor.
General Physical Form: Liquid
Immediate health, physical, and environmental hazards:

3.2 POTENTIAL HEALTH EFFECTS

Eye Contact:
Contact with the eyes during product use is not expected to result in significant irritation.

Skin Contact:
Contact with the skin during product use is not expected to result in significant irritation.

Inhalation:
Vapors from heated material may cause irritation of the respiratory system. Signs/symptoms may include cough, sneezing, nasal discharge, headache, hoarseness, and nose and throat pain.

If thermal decomposition occurs:
May be harmful if inhaled.

Ingestion:
No health effects are expected.

3.3 POTENTIAL ENVIRONMENTAL EFFECTS

A 3M Product Environmental Data Sheet (PED) is available.
This substance has chemical moieties that are resistant to biodegradation and is likely to only undergo partial biodegradation in the environment. The high potential of this substance to move from water to the atmosphere means its potential to bioconcentrate is likely to disappear rapidly from aerobic environments. Take precautions to prevent direct release of this substance to the environment. AQUATIC TOXICITY: Testing results indicate that this product has insignificant toxicity to aquatic organisms at its saturation point (Lowest LC50,EC50, IC50 > substance water solubility). (June 1997): Fathead Minnow (Pimephales promelas) 96-hr LC50: >750 mg/L NOTE: This data reflects the CA method which was used to satisfy the California (CA) Title 22 Hazard Evaluation Bioassay. This substance is highly volatile and has a high Henry's Law constant and is thus expected to move rapidly through vaporization from solution in an aquatic compartment or from a soil surface in a terrestrial compartment to the atmosphere.

ATMOSPHERIC FATE: Zero Ozone Depletion Potential (ODP). Atmospheric lifetime: approximately 0.8 yrs. Global Warming Potential (GWP): 50 (100-yr ITH, IPCC1995 method). Global Warming Potential (GWP): 55 (100-yr ITH, IPCC2001 method). Atmospheric degradation products are expected to include: for ethyl nonfluoroisobutyl ether: predominantly isoperfluorobutyric acid, CO2, HF, and perhaps also CF3COOH; for ethyl nonfluorobutyl ether: n-perfluorobutyric acid, CO2, and HF.

SECTION 4: FIRST AID MEASURES

4.1 FIRST AID PROCEDURES

The following first aid recommendations are based on an assumption that appropriate personal and industrial hygiene practices are

followed.

Eye Contact: Flush eyes with large amounts of water. If signs/symptoms persist, get medical attention.

Skin Contact: Wash affected area with soap and water. If signs/symptoms develop, get medical attention.

Inhalation: If signs/symptoms develop, remove person to fresh air. If signs/symptoms persist, get medical attention.

If Swallowed: If signs/symptoms develop, get medical attention. No need for first aid is anticipated.

4.2 NOTE TO PHYSICIANS

Exposures resulting from intentional misuse and abuse may cause.an increase in myocardial irritability. Do not administer sympathomimetic drugs unless absolutely necessary.

SECTION 5: FIRE FIGHTING MEASURES

5.1 FLAMMABLE PROPERTIES

Autoignition temperature	375 °C [*Details:* ASTM E659-78 Method]
Flash Point	*No Flash Point per ASTM D3278*
Flammable Limits - LEL	210 g/m3 [*Details:* ASTM E681-94 Method]
Flammable Limits - UEL	1070 g/m3 [*Details:* ASTM E681-94 Method]

5.2 EXTINGUISHING MEDIA

Material will not burn.

5.3 PROTECTION OF FIRE FIGHTERS

Special Fire Fighting Procedures: Exposure to extreme heat can give rise to thermal decomposition. Wear full protective equipment (Bunker Gear) and a self-contained breathing apparatus (SCBA).

Unusual Fire and Explosion Hazards: No unusual fire or explosion hazards are anticipated. No unusual effects are anticipated during fire extinguishing operations. Avoid breathing the products and substances that may result from the thermal decomposition of the product or the other substances in the fire zone. Keep containers cool with water spray when exposed to fire to avoid rupture.

Note: See STABILITY AND REACTIVITY (SECTION 10) for hazardous combustion and thermal decomposition information.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Accidental Release Measures: Observe precautions from other sections. Call 3M- HELPS line (1-800-364-3577) for more information on handling and managing the spill. Ventilate the area with fresh air. Contain spill. Working from around the edges of the spill inward, cover with bentonite, vermiculite, or commercially available inorganic absorbent material. Mix in sufficient absorbent until it appears dry. Collect as much of the spilled material as possible. Clean up residue with an appropriate organic solvent. Read and follow safety precautions on the solvent label and MSDS. Collect the resulting residue containing solution. Place in a metal container approved for transportation by appropriate authorities. Seal the container. Dispose of collected material as soon as possible.

In the event of a release of this material, the user should determine if the release qualifies as reportable according to local, state, and federal regulations.

SECTION 7: HANDLING AND STORAGE

7.1 HANDLING

For industrial or professional use only. No smoking: Smoking while using this product can result in contamination of the tobacco and/or smoke and lead to the formation of the hazardous decomposition products mentioned in the Reactivity Data section of this MSDS. Store work clothes separately from other clothing, food and tobacco products. Use general dilution ventilation and/or local exhaust ventilation to control airborne exposures to below Occupational Exposure Limits. If ventilation is not adequate, use respiratory protection equipment. Avoid continuous exposure of the material to extreme condidtions of heat, i.e., above 150C (welding, open flame, misuse or equipment failure). Avoid exceeding a watt density of 50 watts/inch2 from a heater surface. Continuous exposure to 150C results in a very slight decomposition of this product and, therefore, is a very conservative use temperature threshold. Applications involving exposure of the fluid to temperatures exceeding 150C should be reviewed with 3M Technical Service.

7.2 STORAGE

Keep container tightly closed. Keep container in well-ventilated area. Store away from heat. Store away from strong bases.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 ENGINEERING CONTROLS

Provide appropriate local exhaust when product is heated. Provide appropriate local exhaust ventilation on open containers. For those situations where the fluid might be exposed to extreme overheating due to misuse or equipment failure, use with appropriate local exhaust ventilation sufficient to maintain levels of thermal decomposition products below their exposure guidelines. Provide local exhaust ventilation at transfer points.

8.2 PERSONAL PROTECTIVE EQUIPMENT (PPE)

8.2.1 Eye/Face Protection

Avoid eye contact.
The following eye protection(s) are recommended: Safety Glasses with side shields.

8.2.2 Skin Protection

Avoid skin contact with hot material. Wear appropriate gloves, such as Nomex, when handling this material to prevent thermal burns.

Select and use gloves and/or protective clothing to prevent skin contact based on the results of an exposure assessment. Consult with your glove and/or protective clothing manufacturer for selection of appropriate compatible materials.
Gloves made from the following material(s) are recommended: Nitrile Rubber.

8.2.3 Respiratory Protection

Avoid breathing of vapors, mists or spray. Under normal use conditions, airborne exposures are not expected to be significant enough to require respiratory protection.
Select one of the following NIOSH approved respirators based on airborne concentration of contaminants and in accordance with OSHA regulations: Half facepiece or fullface air-purifying respirator with organic vapor cartridges. Consult the current 3M Respiratory Selection Guide for additional information or call 1-800-243-4630 for 3M technical assistance. If thermal decomposition occurs, use a fullface supplied-air respirator.

8.2.4 Prevention of Swallowing

Do not eat, drink or smoke when using this product. Wash exposed areas thoroughly with soap and water.

8.3 EXPOSURE GUIDELINES

Ingredient	Authority	Type	Limit	Additional Information
ETHYL NONAFLUOROBUTYL ETHER	3M	TWA - specific form	200 ppm	as total isomers
ETHYL NONAFLUOROISOBUTYL ETHER	3M	TWA - specific form	200 ppm	as total isomers

SOURCE OF EXPOSURE LIMIT DATA:
ACGIH: American Conference of Governmental Industrial Hygienists
CMRG: Chemical Manufacturer Recommended Guideline
OSHA: Occupational Safety and Health Administration
AIHA: American Industrial Hygiene Association Workplace Environmental Exposure Level (WEEL)

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Specific Physical Form:	liquid
Odor, Color, Grade:	Clear, colorless liquid. Faint odor.
General Physical Form:	Liquid
Autoignition temperature	375 °C [*Details:* ASTM E659-78 Method]
Flash Point	*No Flash Point per ASTM D3278*
Flammable Limits - LEL	210 g/m3 [*Details:* ASTM E681-94 Method]
Flammable Limits - UEL	1070 g/m3 [*Details:* ASTM E681-94 Method]
Boiling point	76 °C
Density	1.43 g/ml
Vapor Density	Approximately 9.1 [*Ref Std:* AIR=1]
Vapor Pressure	109 mmHg [@ 25 °C]
Specific Gravity	1.43 [*Ref Std:* WATER=1]
pH	*Not Applicable*
Melting point	-138 °C
Solubility In Water	[*Details:* Insoluble]
Evaporation rate	33 [*Ref Std:* BUOAC=1]
Volatile Organic Compounds	[*Details:* Exempt]
Percent volatile	100 %
VOC Less H2O & Exempt Solvents	[*Details:* Exempt]
Viscosity	0.43 centistoke

SECTION 10: STABILITY AND REACTIVITY

Stability: Stable.

Materials and Conditions to Avoid: Strong bases

Hazardous Polymerization: Hazardous polymerization will not occur.

Hazardous Decomposition or By-Products

Substance	Condition
Hydrogen Fluoride	At Elevated Temperatures - extreme conditions of heat
Perfluoroisobutylene (PFIB)	At Elevated Temperatures - extreme conditions of heat

Hazardous Decomposition: Perfluorinated Acid Fluorides

Hydrogen Fluoride has an ACGIH Threshold Limit Value of 3 parts per million (as fluoride) as a Ceiling Limit and an OSHA PEL of 3 ppm of fluoride as an eight hour Time_Weighted Average and 6 ppm of fluoride as a Short Term Exposure Limit. The odor threshold for HF is 0.04 ppm, providing good warning properties for exposure.

Decomposition of this product at temperatures above 300 degrees C can form perfluoroisobutylene (PFIB), but PFIB will only accumulate with continuous exposure to excessive heat in a sealed vessel. The formation rate for PFIB is about 1000 times less than the rate for primary thermal decomposition products such as HF. During normal use conditions, no health hazard is associated with the use of this material due to PFIB exposure.

SECTION 11: TOXICOLOGICAL INFORMATION

Product-Based Toxicology Information:

For a mixture of ethyl nonafluorobutyl ether and its isomer, a single positive response for cardiac sensitization was observed at an exposure level of 49,000 ppm. No adverse health effects are anticipated from normal handling and use.

SECTION 12: ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION

Test Organism	Test Type	Result
Water flea, Daphnia magna	48 hours Effect Concentration 50%	>2.55 mg/l
Fathead Minnow, Pimephales promelas	96 hours Lethal Concentration 50%	>2.75 mg/l
Green algae, Selenastrum capricornutum	96 hours Effect Concentration 50%	>2.32 mg/l

CHEMICAL FATE INFORMATION

Test Type	Result	Protocol
28 days Biological Oxygen Demand	Nil	

SECTION 13: DISPOSAL CONSIDERATIONS

Waste Disposal Method: Reclaim if feasible. As a disposal alternative, incinerate in an industrial or commercial facility in the presence of a combustible material. Combustion products will include HF. Facility must be capable of handling halogenated materials.

To reclaim or return, check product label for contact.

EPA Hazardous Waste Number (RCRA): Not regulated

Since regulations vary, consult applicable regulations or authorities before disposal.

SECTION 14:TRANSPORT INFORMATION

ID Number(s):
98-0211-9362-2, 98-0211-9363-0, 98-0211-9364-8, 98-0211-9365-5, 98-0211-9366-3, 98-0211-9367-1, 98-0211-9368-9, 98-0211-9369-7, 98-0212-3147-1, 98-0212-3148-9, 98-0212-3149-7

Please contact the emergency numbers listed on the first page of the MSDS for Transportation Information for this material.

SECTION 15: REGULATORY INFORMATION

US FEDERAL REGULATIONS

Contact 3M for more information.

311/312 Hazard Categories:
Fire Hazard - No Pressure Hazard - No Reactivity Hazard - No Immediate Hazard - No Delayed Hazard - No

STATE REGULATIONS

Contact 3M for more information.

CHEMICAL INVENTORIES

One or more of the components of this product have been notified to NICNAS (National Industrial Chemical Notification and Assessment Scheme) of Australia. Certain restrictions apply. Contact the selling division for additional information.

The components of this product are in compliance with the chemical notification requirements of TSCA.

Contact 3M for more information.

Additional Information: The components of this product are in compliance with the chemical notification requirements of AICS, ELINCS, METI, CICS, KECI.

INTERNATIONAL REGULATIONS

Contact 3M for more information.

ADDITIONAL INFORMATION

The U.S. Environmental Protection Agency (EPA) has listed 3M(TM) HFE-7200 as an acceptable substitute for ozone depleting substances in specific solvent cleaning and aerosol industry applications under its Significant New Alternatives Program (SNAP). Section 612 of the Clean Air Act requires the EPA to administer this program to evaluate and approve alternatives for ozone depleting substances.

This MSDS has been prepared to meet the U.S. OSHA Hazard Communication Standard, 29 CFR 1910.1200.

SECTION 16: OTHER INFORMATION

NFPA Hazard Classification

Health: 3 Flammability: 1 Reactivity: 0 Special Hazards: None

National Fire Protection Association (NFPA) hazard ratings are designed for use by emergency response personnel to address the hazards that are presented by short-term, acute exposure to a material under conditions of fire, spill, or similar emergencies. Hazard ratings are primarily based on the inherent physical and toxic properties of the material but also include the toxic properties of combustion or decomposition products that are known to be generated in significant quantities. The hazard ratings assigned to this product are based on the properties of combustion or decomposition products that can occur in an uncontrolled fire situation.

HMIS Hazard Classification

Health: 0 Flammability: 1 Reactivity: 0 Protection: X - See PPE section.

Hazardous Material Identification System (HMIS(r)) hazard ratings are designed to inform employees of chemical hazards in the workplace. These ratings are based on the inherent properties of the material under expected conditions of normal use and are not intended for use in emergency situations. HMIS(r) ratings are to be used with a fully implemented HMIS(r) program. HMIS(r) is a registered mark of the National Paint and Coatings Association (NPCA).

Revision Changes:
Copyright was modified.
Section 3: Potential effects from inhalation information was modified.
Section 4: First aid for inhalation - termination of exposure - was modified.
Section 4: First aid for inhalation - medical assistance - was modified.
Section 15: Inventories information was modified.
Section 11: Product-based toxicology information comment was modified.
Section 3: Potential effects from inhalation comment was deleted.
Section 3: Immediate other hazard(s) was deleted.

DISCLAIMER: The information in this Material Safety Data Sheet (MSDS) is believed to be correct as of the date issued. 3M MAKES NO WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR COURSE OF PERFORMANCE OR USAGE OF TRADE. User is responsible for determining whether the 3M product is fit for a particular purpose and suitable for user's method of use or application. Given the variety of factors that can affect the use and application of a 3M product, some of which are uniquely within the user's knowledge and control, it is essential that the

user evaluate the 3M product to determine whether it is fit for a particular purpose and suitable for user's method of use or application.

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3M MSDSs are available at www.3M.com

HFE-8200

3M

Material Safety Data Sheet

SECTION 1: PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: HFE-8200 3M (TM) Novec (TM) Engineered Fluid
MANUFACTURER: 3M
DIVISION: Electronics Markets Materials Division

ADDRESS: 3M Center
St. Paul, MN 55144-1000

EMERGENCY PHONE: 1-800-364-3577 or (651) 737-6501 (24 hours)

Issue Date: 02/20/2006
Supercedes Date: 02/20/2006

Document Group: 09-3827-4

Product Use:
Intended Use: FOR INDUSTRIAL USE ONLY. NOT INTENDED FOR USE AS A MEDICAL DEVICE OR DRUG.
Specific Use: CLEANING MOVIE FILM

SECTION 2: INGREDIENTS

Ingredient	C.A.S. No.	% by Wt
ETHYL NONAFLUOROISOBUTYL ETHER	163702-06-5	20 - 80
ETHYL NONAFLUOROBUTYL ETHER	163702-05-4	20 - 80

SECTION 3: HAZARDS IDENTIFICATION

3.1 EMERGENCY OVERVIEW

Specific Physical Form: liquid
Odor, Color, Grade: Clear, colorless liquid. Faint odor.
General Physical Form: Liquid
Immediate health, physical, and environmental hazards:

3.2 POTENTIAL HEALTH EFFECTS

Eye Contact:
Contact with the eyes during product use is not expected to result in significant irritation.

Skin Contact:
Contact with the skin during product use is not expected to result in significant irritation.

Inhalation:
If thermal decomposition occurs:
May be harmful if inhaled.

Intentional concentration and inhalation may be harmful or fatal (see section 11)

Ingestion:
No health effects are expected.

3.3 POTENTIAL ENVIRONMENTAL EFFECTS

This substance has chemical moieties that are resistant to biodegradation and is likely to only undergo partial biodegradation in the environment. The high potential of this substance to move from water to the atmosphere means its potential to bioconcentrate is likely to disappear rapidly from aerobic environments. Take precautions to prevent direct release of this product to the environment. AQUATIC TOXICITY: Testing results indicate that this product has insignificant toxicity to aquatic organisms at its saturation point (Lowest LC50, EC50, IC50 >substance water solubility). (June 1997): Fathead Minnow (Pimephales promelas) 96-hr LC50: >750 mg/L NOTE: This data point reflects the CA method which was used to satisfy the California (CA) Title 22 Hazad Evaluation Bioassay. This substance is highly volatile and has a high Henry's Law constant and is thus expected to move rapidly through vaporization from solution in an aquatic compartment or from a soil surface in a terrestrial compartment to the atmosphere.

ATMOSPHERIC FATE: Zero Ozone Depletion Potential (ODP). Atmospheric Lifetime: approximately 0.8 yr. Global Warming Potential (GWP): 55 (100-yr ITH, WMO 1998 method). Atmospheric degradation products are expected to include: for ethyl nonafluoroisobutyl ether: predominantly iso-perfluorobutyric acid, CO2, HF, and perhaps also CF3COOH; for ethyl nonafluorobutyl ether; n-perfluorobutyric acid, CO2, and HF.

SECTION 4: FIRST AID MEASURES

4.1 FIRST AID PROCEDURES

The following first aid recommendations are based on an assumption that appropriate personal and industrial hygiene practices are followed.

Eye Contact: No need for first aid is anticipated.

Skin Contact: No need for first aid is anticipated.

Inhalation: If signs/symptoms develop, remove person to fresh air. If signs/symptoms persist, get medical attention.

If Swallowed: No need for first aid is anticipated.

4.2 NOTE TO PHYSICIANS

Exposures resulting from intentional misuse and abuse may cause.an increase in myocardial irritability. Do not administer sympathomimetic drugs unless absolutely necessary.

SECTION 5: FIRE FIGHTING MEASURES

5.1 FLAMMABLE PROPERTIES

Autoignition temperature	375 °C [*Details:* ASTM E659-78 Method]
Flash Point	*No Flash Point per ASTM D3278 method*
Flammable Limits - LEL	210 g/m3 [*Details:* ASTM E681-94 Method]
Flammable Limits - UEL	1070 g/m3 [*Details:* ASTM E681-94 Method]

5.2 EXTINGUISHING MEDIA
Material will not burn.

5.3 PROTECTION OF FIRE FIGHTERS

Special Fire Fighting Procedures: Exposure to extreme heat can give rise to thermal decomposition. Wear full protective equipment (Bunker Gear) and a self-contained breathing apparatus (SCBA).

Unusual Fire and Explosion Hazards: No unusual fire or explosion hazards are anticipated. No unusual effects are anticipated during fire extinguishing operations. Avoid breathing the products and substances that may result from the thermal decomposition of the product or the other substances in the fire zone. Keep containers cool with water spray when exposed to fire to avoid rupture.

Note: See STABILITY AND REACTIVITY (SECTION 10) for hazardous combustion and thermal decomposition information.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Accidental Release Measures: Observe precautions from other sections. Call 3M- HELPS line (1-800-364-3577) for more information on handling and managing the spill. Evacuate unprotected and untrained personnel from hazard area. The spill should be cleaned up by qualified personnel. Ventilate the area with fresh air. Contain spill. Working from around the edges of the spill inward, cover with bentonite, vermiculite, or commercially available inorganic absorbent material. Mix in sufficient absorbent until it appears dry. Collect as much of the spilled material as possible. Clean up residue with detergent and water. Collect the resulting residue containing solution. Place in a metal container approved for transportation by appropriate authorities. Dispose of collected material as soon as possible.

In the event of a release of this material, the user should determine if the release qualifies as reportable according to local, state, and federal regulations.

SECTION 7: HANDLING AND STORAGE

7.1 HANDLING
For industrial or professional use only. Contents may be under pressure, open carefully. Avoid skin contact with hot material. No smoking: Smoking while using this product can result in contamination of the tobacco and/or smoke and lead to the formation of the hazardous decomposition products mentioned in the Reactivity Data section of this MSDS. Avoid continuous exposure of the material to extreme condidtions of heat, i.e., above 150C (welding, open flame, misuse or equipment failure). Avoid exceeding a watt density of 50 watts/inch2 from a heater surface. Continuous exposure to 150C results in a very slight decomposition of this product and, therefore, is a very conservative use temperature threshold. Do not breathe thermal decomposition products. For additional information about applications involving exposure of the fluid to temperatures exceeding 150C, please contact 3M Technical Service.

7.2 STORAGE
Keep container in well-ventilated area. Keep container tightly closed. Store away from heat. Store away from strong bases.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 ENGINEERING CONTROLS

Provide appropriate local exhaust when product is heated. For those situations where the fluid might be exposed to extreme overheating due to misuse or equipment failure, use with appropriate local exhaust ventilation sufficient to maintain levels of thermal decomposition products below their exposure guidelines.

8.2 PERSONAL PROTECTIVE EQUIPMENT (PPE)

8.2.1 Eye/Face Protection

As a good industrial hygiene practice:
Avoid eye contact.

8.2.2 Skin Protection

Gloves are not required. Avoid skin contact with hot material.

Wear appropriate gloves when handling hot material to prevent thermal burns.

8.2.3 Respiratory Protection

Under normal use conditions, airborne exposures are not expected to be significant enough to require respiratory protection.
If thermal degradation products are expected, use fullface supplied air respirator.

8.2.4 Prevention of Swallowing

Not applicable.

8.3 EXPOSURE GUIDELINES

Ingredient	Authority	Type	Limit	Additional Information
ETHYL NONAFLUOROBUTYL ETHER	3M	TWA, as total isomers	200 ppm	
ETHYL NONAFLUOROISOBUTYL ETHER	3M	TWA, as total isomers	200 ppm	

SOURCE OF EXPOSURE LIMIT DATA:
ACGIH: American Conference of Governmental Industrial Hygienists
CMRG: Chemical Manufacturer Recommended Guideline
OSHA: Occupational Safety and Health Administration
AIHA: American Industrial Hygiene Association Workplace Environmental Exposure Level (WEEL)

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Specific Physical Form:	liquid
Odor, Color, Grade:	Clear, colorless liquid. Faint odor.
General Physical Form:	Liquid
Autoignition temperature	375 °C [*Details:* ASTM E659-78 Method]
Flash Point	*No Flash Point per ASTM D3278 method*
Flammable Limits - LEL	210 g/m3 [*Details:* ASTM E681-94 Method]
Flammable Limits - UEL	1070 g/m3 [*Details:* ASTM E681-94 Method]
Boiling point	76 °C
Density	1.43 g/ml
Vapor Density	Approximately 9.1 [*Ref Std:* AIR=1]
Vapor Pressure	109 mmHg [@ 25 °C]
Specific Gravity	1.43 [*Ref Std:* WATER=1]

pH	*Not Applicable*
Melting point	-138 °C
Solubility In Water	[*Details:* Insoluble]
Evaporation rate	33 [*Ref Std:* BUOAC=1]
Volatile Organic Compounds	[*Details:* Exempt]
Percent volatile	100 %
VOC Less H2O & Exempt Solvents	[*Details:* Exempt]
Viscosity	0.43 centistoke

SECTION 10: STABILITY AND REACTIVITY

Stability: Stable.

Materials and Conditions to Avoid: Strong bases

Hazardous Polymerization: Hazardous polymerization will not occur.

Hazardous Decomposition or By-Products

Substance	Condition
Hydrogen Fluoride	At Elevated Temperatures - extreme conditions of heat
Perfluoroisobutylene (PFIB)	At Elevated Temperatures - extreme conditions of heat

Hazardous Decomposition: Perfluorinated Acid Fluorides

Hydrogen Fluoride has an ACGIH Threshold Limit Value of 3 parts per million (as fluoride) as a Ceiling Limit and an OSHA PEL of 3 ppm of fluoride as an eight hour Time_Weighted Average and 6 ppm of fluoride as a Short Term Exposure Limit. The odor threshold for HF is 0.04 ppm, providing good warning properties for exposure.

Decomposition of this product at temperatures above 300 degrees C can form perfluoroisobutylene (PFIB), but PFIB will only accumulate with continuous exposure to excessive heat in a sealed vessel. The formation rate for PFIB is about 1000 times less than the rate for primary thermal decomposition products such as HF. During normal use conditions, no health hazard is associated with the use of this material due to PFIB exposure.

SECTION 11: TOXICOLOGICAL INFORMATION

Product-Based Toxicology Information:

For a mixture of ethyl nonafluorobutyl ether and its isomer, a single positive response for cardiac sensitization was observed at an exposure level of 49,000 ppm. No adverse health effects are anticipated from normal handling and use.

SECTION 12: ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION

Test Organism	Test Type	Result
Water flea, Daphnia magna	48 hours Effect Concentration 50%	>2.55 mg/l

Fathead Minnow, Pimephales promelas	96 hours Lethal Concentration 50%	>2.75 mg/l
Green algae, Selenastrum capricornutum	96 hours Effect Concentration 50%	>2.32 mg/l

CHEMICAL FATE INFORMATION

Test Type	Result	Protocol
28 days Biological Oxygen Demand	Nil	

SECTION 13: DISPOSAL CONSIDERATIONS

Waste Disposal Method: Reclaim if feasible. To reclaim or return, contact your 3M sales representative. Incinerate uncured product in a permitted hazardous waste incinerator in the presence of a combustible material.
As a disposal alternative, incinerate in an industrial or commercial facility in the presence of a combustible material. Combustion products will include HF. Facility must be capable of handling halogenated materials.
To reclaim or return, check product label for contact.

EPA Hazardous Waste Number (RCRA): Not regulated

Since regulations vary, consult applicable regulations or authorities before disposal.

SECTION 14:TRANSPORT INFORMATION

ID Number(s):
98-0212-2775-0, 98-0212-2776-8

Please contact the emergency numbers listed on the first page of the MSDS for Transportation Information for this material.

SECTION 15: REGULATORY INFORMATION

US FEDERAL REGULATIONS
Contact 3M for more information.

311/312 Hazard Categories:
Fire Hazard - No Pressure Hazard - No Reactivity Hazard - No Immediate Hazard - Yes Delayed Hazard - No

STATE REGULATIONS
Contact 3M for more information.

CHEMICAL INVENTORIES
The components of this product are in compliance with the chemical notification requirements of TSCA.

One or more of the components of this product have been notified to NICNAS (National Industrial Chemical Notification and Assessment Scheme) of Australia. Certain restrictions apply. Contact the selling division for additional information. Contact 3M for more information.

Additional Information: The components of this product are in compliance with the chemical notification requirements of ELINCS, METI, CICS and KECI. The product was notified to ERMA (New Zealand), and no further registration is necessary.

INTERNATIONAL REGULATIONS

Contact 3M for more information.

ADDITIONAL INFORMATION

The U.S. Environmental Protection Agency (EPA) has listed 3M(TM) HFE-8200 as an acceptable substitute for ozone depleting substances in specific solvent cleaning and aerosol industry applications under its Significant New Alternatives Program (SNAP). Section 612 of the Clean Air Act requires the EPA to administer this program to evaluate and approve alternatives for ozone depleting substances.

This MSDS has been prepared to meet the U.S. OSHA Hazard Communication Standard, 29 CFR 1910.1200.

SECTION 16: OTHER INFORMATION

NFPA Hazard Classification

Health: 3 **Flammability:** 1 **Reactivity:** 0 **Special Hazards:** None

National Fire Protection Association (NFPA) hazard ratings are designed for use by emergency response personnel to address the hazards that are presented by short-term, acute exposure to a material under conditions of fire, spill, or similar emergencies. Hazard ratings are primarily based on the inherent physical and toxic properties of the material but also include the toxic properties of combustion or decomposition products that are known to be generated in significant quantities. The hazard ratings assigned to this product are based on the properties of combustion or decomposition products that can occur in an uncontrolled fire situation.

HMIS Hazard Classification

Health: 2 **Flammability:** 1 **Reactivity:** 0 **Protection:** X - See PPE section.

Hazardous Material Identification System (HMIS®) hazard ratings are designed to inform employees of chemical hazards in the workplace. These ratings are based on the inherent properties of the material under expected conditions of normal use and are not intended for use in emergency situations. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint and Coatings Association (NPCA).

Reason for Reissue: The MSDS has been revised because 3M has adopted the 16-section ANSI/ISO format. The potential hazards of the product have not changed. We encourage you to reread the MSDS and review the information.

Revision Changes: Not Applicable

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HCFC-225

SAFETY DATA SHEET

No. U-1100A-17

Identity (As Used on Label and List)

- **Date Prepared:** August 18, 1992
- **Date Revised:** January 1, 2008

ASAHIKLIN AK- 225

1. PRODUCT AND COMPANY INFORMATION

Product Name: ASAHIKLIN AK-225
Synonym: HCFC-225
General Use: solvent
MSDS Number: U-1100A

Manufacturer
Company Name: ASAHI GLASS CO., LTD. Chemicals Company Gas & Solvent
Address: 1-12-1, Yurakucho, Chiyoda-ku, Tokyo, 100-8405, Japan
Telephone No.: +81-3-3218-5479
Facsimile No.: +81-3-3218-7854

Supplier
Company Name: AGC Chemicals Americas, Inc.
Address: 55 E. Uwchlan Ave Suite 201, Exton, PA 19341 USA
Telephone No: (704) 329-7614

24 HR. EMERGENCY TELEPHONE NUMBERS
CHEMTREC (US): 800-424-9300 24hours
MEDICAL EMERGENCY: (800) 420-8479
Transportation Phone: (800) 424-9300
Customer Service: (704) 329-7614

2. COMPOSITION/INFORMATION ON INGREDIENTS

Components	Cas No.	%
3,3-Dichloro-1,1,1,2,2-pentafluoropropane (HCFC-225ca)	422-56-0	40 – 50
1,3-Dichloro-1,1,2,2,3-pentafluoropropane (HCFC-225cb)	507-55-1	50 – 60

Note: This product does not contain any CFCs.

OSHA Hazardous Components (29 CFR 1910.1200)
None

3. HAZARDS IDENTIFICATION

This product is not hazardous under OSHA.

Potential Health Effects

- **Inhalation:** Inhalation of high concentrations could cause unconsciousness, heart effects, liver effects and death
- **Skin Contact:** May cause skin irritation.
- **Eye Contact:** May cause eye irritation.

4. FIRST AID MEASURES

- **Inhalation:** If high concentrations are inhaled, immediately remove to fresh air. Keep person calm. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.
- **Skin contact:** In case of skin contact, flush with water. Get medical attention if irritation is present.
- **Eye contact:** In case of eye contact, immediately flush eyes with plenty of water for 15minutes. Call a physician.
- **Ingestion:** No specific intervention is indicated as the compound is not likely to be hazardous by ingestion. Consult a physician if necessary. Do not induce vomiting because the hazard of aspirating the material into the lungs is considered greater than swallowing it.

5. FIRE-FIGHTING MEASURES

- **Suitable extinguishing media:** As appropriate for combustibles in area.
- **Unsuitable extinguish media/methods:** None
- **Hazardous combustion product or gases:** Containers may rupture under fire conditions. Decomposition of this product at temperature above 300deg.C (572deg.F) can form hydrogen fluoride (HF), but HF will only accumulate with continuous exposure to excess heat in a sealed vessel.
- **Special protective equipment for fire fighters:** Self-contained breathing apparatus (SCBA) is required if drums rupture and contents are spilled under fire conditions.
- **Additional information:** Use water spray to cool containers.
  Move containers from fire areas if it can be done without risk.

6. ACCIDENTAL RELEASE MEASURES

In case of spill or other release:
NOTES: Review chapter 5, chapter 7 and chapter 8 before proceeding with clean up. Use appropriate Personal Protective Equipment during clean up.

Shut off flames in area to avoid forming dangerous decomposition products (See chapter 5).
Dike spill. Prevent liquid from entering sewers, waterways or low areas. Ventilate area. Collect on

absorbent material and transfer to steel drums for recovery/disposal. Comply with Federal, State, and local regulations on reporting releases.

Additional information:
Information for safe handling is found in chapter 7.
Information for disposal is found in chapter 13.

7. HANDLING AND STORAGE

Handling
Use with sufficient ventilation to keep employee exposure below recommended limits. Provide adequate ventilation for storage, handling, and use, especially for enclosed or low spaces. Avoid contact of liquid with eyes and prolonged skin exposure. Do not allow product to contact open flame or electrical heating elements because dangerous decomposition products may form.

Storage
Store in clean, dry, well-ventilated area. Do not heat above 30deg.C. (86deg.F)

8. EXPOSURE CONTROL / PERSONAL PROTECTION

Exposure guidelines:

- **ASAHIKLIN AK-225**
  AEL*: 100ppm (8h-TWA)
  MAK-Values (Germany): Not established
  TLV-TWA (ACGIH): Not established
  * AEL is the Acceptable Exposure Limit set by Asahi Glass Co., Ltd.

  EEL*: 1000ppm (time limit 15 min.), 2000ppm (time limit 1 min.)
  * EEL is the Emergency Exposure Limit set by Asahi Glass Co., Ltd.

  Emergency Exposure Limits (EELs) are to be used for short-term emergency exposure control. They are concentrations of short periods which should not result in permanent adverse health effects or interfere with escape. They should not be confused with ACGIH TLV-TWA or TLV STEL values that are designed for repeated exposure guidelines. For the use of AK-225, daily exposure limits such as AEL as well as EEL are to be followed. The EEL for AK-225 is needed to avoid anesthetic effects which could prevent self-rescue. If an EEL is exceeded for specified duration, evacuation, sheltering in place or other mitigation steps should be taken.

  Remarks
  AELs (Asahi Glass Co., Ltd.) of HCFC-225ca and HCFC-225cb are 50 and 400ppm, respectively. Though no ACGIH TLV or OSHA PEL are assigned, Asahi Glass temporarily recommends that workplace exposure level should be maintained at 100ppm or less for the mixture (ca/cb=45/55) until the authorized control level such as ACGIH TLV or OSHA PEL are assigned.

Exposure controls.
Occupational exposure controls.
Engineering Controls:
Normal ventilation for standard manufacturing procedures is generally adequate. Local exhaust should be used when large amounts are released. Mechanical ventilation should be used in low places.

Personal protection:

- **Respiratory protection:** Use respiratory protection approved by NIOSH in USA or other equivalent in each country if exposure limits may be exceeded. Self-contained breathing apparatus (SCBA) is required if a large spill occurs.
- **Hand protection:** Impermeable gloves
- **Eye protection:** Chemical splash goggles

Other Precautionary Information:

NPCA - HMIS (National Paint and Coating Association - Hazardous Materials Identification System) Hazard Rating

HMIS codes are intended for use in everyday workplace setting to provide a rapid indication of the occupational hazards associated with chemicals used in the workplace.

a) Flammability - 1, b) Health - 1, c) Reactivity- 0

9. PHYSICAL AND CHEMICAL PROPERTIES

- **Appearance and Odor:** Clear, colorless liquid with slight ethereal odor.
- **Boiling point:** 54deg.C (129.2deg.F)
- **Flash point (method):** None (Tag Closed Cup & Cleveland Open Cup)
- **Lower explosive limit:** None
- **Upper explosive limit:** None
- **Autoignition temperature:** N/D
- **Freezing point:** -131deg.C(-204deg.F)
- **Vapor pressure (25deg.C):** 0.038 MPa
- **Specific Gravity (25deg.C):** 1.55
- **Solubility (25deg.C) in water**: 0.033g / 100g H_2O
- **pH value (20deg.C):** N/D
- **Partition coefficient: n-octanol / water:** 3.17 (HCFC-225ca), 3.13 (HCFC-225cb)
- **Vapor density:** 7.0
- **Evaporation rate (Diethyl ether=1):** 0.9

10. STABILITY AND REACTIVITY

Conditions to avoid: Material is stable. However, avoid open flames and high temperature.

Stability: Stable

Materials to avoid (Incompatibilities): Incompatible with alkali or alkaline earth metals-powdered Al, Zn, Be, etc.

Hazardous decomposition products:
Decomposition products are hazardous. This compound can be decomposed by high temperatures (open flames, glowing metal surfaces, etc.) forming hydrochloric and hydrofluoric acids and possibly carbonyl halides.

Hazardous Polymerization: will not occur

11. TOXICOLOGICAL INFORMATION

Animal Data:

3,3-Dichloro-1, 1,1,2, 2-pentafluoropropane (HCFC-225ca)

Inhalation: 4-h LC50: 37,300ppm in rats
Oral: LD50: >5 g/kg in rats
Dermal: LD50: >2g/kg in rabbit.
Eye: Not irritant up to 0.1ml in rabbit.

1,3-Dichloro-1, 1,2,2, 3-pentafluoropropane (HCFC-225cb)

Inhalation: 4-h LC50: 36,800ppm in rats
Oral: LD50: >5 g/kg in rats
Dermal: LD50: >2g/kg in rabbit.
Eye: Not irritant up to 0.1ml in rabbit.

Data from acute toxicity studies indicate that HCFC-225ca and HCFC-225cb have very low acute toxicity. Neither isomer causes eye irritation nor dermal toxicity in standardized tests; skin application of both isomers at high doses (2,000mg/kg body weight) produces no adverse effects. Therefore, the dermal LD50s are greater than 2,000mg/kg body weight. Oral administration of either isomer at high doses (5,000mg/kg body weight) does not cause any mortality and the oral LD50s are greater than 5,000mg/kg body weight. Both isomers also have very low acute inhalation toxicity as measured by the concentration that cause 50% mortality in experimental animals, the LC50, listed above. Cardiac sensitization response in dogs is observed at approximately 15,000ppm for the mixture of HCFC-225ca/HCFC-225cb (45/55 %) and 20,000ppm for HCFC-225cb.

In 28-day inhalation studies with rat, the activity and responsiveness of the animals was reduced at 5,000ppm or greater for each isomer. Toxicity was otherwise confined to the liver; liver enlargement and induction of peroxisomes was seen following treatment with either of the isomers. HCFC-225ca was more potent than HCFC-225cb in eliciting these liver effects. In 90-day study of HCFC-225ca/HCFC-225cb mixture (45/55 %) with rat, toxic effects were observed in liver; liver enlargement and induction of peroxisomes. In 28-day study with marmoset, exposure to

HCFC-225ca at 1,000ppm caused effects on the liver, such as slight fat deposition associated with changes in serum biochemical parameters. In the same study, exposure to HCFC-225cb at 5,000ppm caused somnolence during exposure and an increase of cytochrome P-450, indicative of an adaptive response to HCFC-225cb. However, no liver enlargement was seen and virtually no peroxisome induction was observed in either isomer.

Animal testing with HCFC-225ca/HCFC-225cb (=45/55) mixture indicates that the compounds are not teratogenic.

The compounds do not produce genetic damage in bacterial cell cultures (Ames Assay), CHL, and in-vivo unscheduled DNA syntheses assay. In one in-vitro study with mammalian cell cultures (human lymphocytes) HCFC-225ca caused genetic damage while HCFC- 225cb elicited a marginal response. However, the overall evidence from these studies implies that neither isomer is genotoxic.

Carcinogenicity
HCFC-225ca and HCFC225cb are not listed by NTP, IARC or OSHA as carcinogens.

12. ECOLOGICAL INFORMATION

Biodegradability: 3 % (HCFC-225ca), 7% (HCFC-225cb) by BOD
Bioaccumulation: Bioconcentration factor <64/6 weeks (HCFC-225ca)
Other information:
Fish, Acute toxicity Test LC50 (Oryzias latipes) 83.5 mg/l/48h (HCFC-225ca)

13. DISPOSAL CONSIDERATIONS

Waste treatment: Recover by distillation or remove to permitted waste disposal facility.
Packaging treatment: Dispose of waste containers to authorized landfill, in accordance with local laws and regulations.

Comply with all federal, state and local regulations.
Do not dump this product into sewers, on the ground or into any body of water.

14. TRANSPORT INFORMATION

US DEPARTMENT OF TRANSPORTATION (DOT)
Hazardous Materials: N/A
Hazardous Materials Description and Proper Shipping Name: N/A
Hazardous Class or Division: Not classified
Identification Number: Not regulated
Packing Group: Not classified
Label(s) Required: Not classified

UN Number: N/A
IMDG Status: Not restricted
Marine Pollutant: No
ICAO/IATA Status: Not restricted

15. REGULATORY INFORMATION

For European Union

EEC Classification: Not classified
Hazard Symbol: Not established
Risk phrases: Not established
Safety phrases: Not established, but recommend 23 (Don't breathe gas/fumes/vapor/spray), 24/25 (Toxic in contact with skin and if swallowed), 36/37 (Irritation to eyes and respiratory system)
Council Directive 92/32/EEC Status: These chemicals are listed on the EINECS (HCFC-225ca: 207-016-9, HCFC-225cb: 208-076-9).

For United States of America

SNAP Acceptable: HCFC-225ca and HCFC-225cb are listed as SNAP acceptable substitutes for CFCs in the Solvent Cleaning Sector of the Clean Air Act.
Non-VOC: HCFC-225ca and HCFC-225cb are exempted from VOC regulations in the Clean Air Act.
TSCA Status: These chemicals are listed on the TSCA Inventory.
SARA Section 302: None of the chemicals are Section 302 hazard.
SARA Section 311, 312: Acute = Yes
Chronic = Yes
Fire = No
Reactivity = No
Pressure = No
SARA Section 313 = Yes (HCFC-225ca, HCFC-225cb)
User should ensure that this material is in compliance with federal requirements and ensure conformity to local regulations.
State Regulations (United States)
California Proposition 65: "WARNING!-THIS PRODUCT CONTAINS A CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER – Chloroform (67-66-3)"

For Canada: WHMIS Classification
Note: This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

16. OTHER INFORMATION

- **N/E:** Not Established
- **N/A:** Not Applicable
- **N/D:** No Data
- **ACGIH:** American Conference of Governmental Industrial Hygienists

NFPA Hazard Code

NFPA codes are designed for use by firefighters, sheriffs, or other emergency response teams who are concerned with the hazards of burning or exploding materials. These NFPA codes are not intended to address the hazards of this product other than in a fire situation.

Decomposition of this product at temperature above 300 deg. C can form hydrogen fluoride (HF), but HF will only accumulate with continuous exposure to excess heat in a sealed vessel.

Health	Fire	Reactivity
2	0	0

Revision Summary: Chapters 1, 2, 11, 15, 16 (2007.6)

The product is not designed for special applications such as pharmaceutical and medical uses.

The information given in this safety data sheet is for safety purposes only. It is given in good faith and based on the best knowledge and experience of the company at the date of issuing.
The company is not responsible for any loss or damage caused by the use of the product in applications for which it was not intended or for conditions of use contrary to the recommendations in this safety data sheet.

WARNINGS
This substance harms public health and environment by destroying ozone in the upper atmosphere.

Material Safety Data Sheet for Cleaning Agents Used in Vapor Degreasing

HFE-72 DE

3.2 POTENTIAL HEALTH EFFECTS

Eye Contact:
Moderate Eye Irritation: Signs/symptoms may include redness, swelling, pain, tearing, and blurred or hazy vision.

Skin Contact:
Moderate Skin Irritation: Signs/symptoms may include localized redness, swelling, itching, and dryness.

Inhalation:
Respiratory Tract Irritation: Signs/symptoms may include cough, sneezing, nasal discharge, headache, hoarseness, and nose and throat pain.

Cardiac Sensitization: Signs/symptoms may include irregular heartbeat (arrhythmia), faintness, chest pain, and may be fatal.

If thermal decomposition occurs:
May be harmful if inhaled.

May be absorbed following inhalation and cause target organ effects.

Ingestion:
Gastrointestinal Irritation: Signs/symptoms may include abdominal pain, stomach upset, nausea, vomiting and diarrhea.

Target Organ Effects:
Central Nervous System (CNS) Depression: Signs/symptoms may include headache, dizziness, drowsiness, incoordination, nausea, slowed reaction time, slurred speech, giddiness, and unconsciousness.

3.3 POTENTIAL ENVIRONMENTAL EFFECTS

AQUATIC TOXICITY:

Testing results indicate that ethyl nonafluoroisobutyl ether, ethyl nonafluorobutyl ether, methyl nonafluoroisobutyl ether and methyl nonafluorobutyl ether have insignificant toxicity to aquatic organisms at their saturation point (Lowest LC50, EC50, or IC50 > substance water solubility). 1,2-Trans-dichloroethylene is harmful to aquatic organisms (10 mg/L < Lowest LC50, EC50, or IC50 < 100 mg/L). These compounds are highly volatile and have high Henry's Law constants and are thus expected to move rapidly through vaporization from solution in an aquatic compartment or from a soil surface in a terrestrial compartment to the atmosphere.

BIOCONCENTRATION:

Ethyl nonafluoroisobutylether, ethyl nonafluorobutylether, methyl nonafluoroisobutylether, and methyl nonafluorobutylether are highly insoluble and very volatile. Bioconcentration is therefore unlikely and not expected as they are not likely to enter aqueous waste streams from typical uses and disposal, or, in the case of a spill, remain in the aquatic or terrestrial compartments. The high

potential for these components to move from aquatic or terrestrial environments to the atmosphere indicates bioconcentration is unlikely to occur as they are not expected to be bioavailable. Thus, emphasis has been placed on the atmospheric fate.

1,2-Trans-dichloroethylene has an octanol/water partition coefficient of <3 indicating it is unlikely to bioconcentrate.

ATMOSPHERIC FATE:

This product has Zero Ozone Depletion Potential (ODP).

Atmospheric Lifetime: approximately 6 days for 1,2-trans-dichloroethylene; approximately 4.7 years and 3.7 years for methyl nonafluoroisobutyl ether and methyl nonafluorobutyl ether, respectively; 0.8 years for the mixture of ethyl nonafluoroisobutyl ether and ethyl nonafluorobutyl ether.

Global Warming Potential (GWP): 320 (100 year ITH, WMO 1998 method) for methyl nonafluoroisobutyl ether and methyl nonafluorobutyl ether; 55 (100-yr ITH) for ethyl nonafluoroisobutyl ether and ethyl nonafluorobutyl ether using the calculation method outlined in Climate Change 2001; and essentially zero for 1,2-trans-dichloroethylene. GWP of product as formulated: approximately 43 (100-yr ITH).

Ethyl nonafluoroisobutylether, ethyl nonafluorobutylether, methyl nonafluoroisobutylether, and methyl nonafluorobutylether are exempt from the US EPA definition of a volatile organic compound (VOC).

Take precautions to prevent direct release to the environment.

SECTION 4: FIRST AID MEASURES

4.1 FIRST AID PROCEDURES

The following first aid recommendations are based on an assumption that appropriate personal and industrial hygiene practices are followed.

Eye Contact: Flush eyes with large amounts of water. If signs/symptoms persist, get medical attention.

Skin Contact: Remove contaminated clothing and shoes. Immediately flush skin with large amounts of water. Get medical attention. Wash contaminated clothing and clean shoes before reuse.

Inhalation: Remove person to fresh air. Get immediate medical attention.

If Swallowed: Do not induce vomiting unless instructed to do so by medical personnel. Give victim two glasses of water. Never give anything by mouth to an unconscious person. Get medical attention.

4.2 NOTE TO PHYSICIANS

Exposures resulting from intentional misuse and abuse may cause an increase in myocardial irritability. Do not administer sympathomimetic drugs unless absolutely necessary.

SECTION 5: FIRE FIGHTING MEASURES

Vertrel SMT

5.1 FLAMMABLE PROPERTIES

Autoignition temperature	396 °C
Flash Point	[*Details:* No flash point per ASTM 3278 method]
Flammable Limits - LEL	6.7 % volume
Flammable Limits - UEL	13.7 % volume

5.2 EXTINGUISHING MEDIA
Use fire extinguishers with class B extinguishing agents (e.g., dry chemical, carbon dioxide).

5.3 PROTECTION OF FIRE FIGHTERS

Special Fire Fighting Procedures: Exposure to extreme heat can give rise to thermal decomposition. Wear full protective equipment (Bunker Gear) and a self-contained breathing apparatus (SCBA).

Unusual Fire and Explosion Hazards: No unusual fire or explosion hazards are anticipated. Extreme conditions of heat (welding, open flame, misuse, or equipment failure) may produce decomposition products that include hydrogen fluoride and hydrogen chloride.

Note: See STABILITY AND REACTIVITY (SECTION 10) for hazardous combustion and thermal decomposition information.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Accidental Release Measures: Refer to other sections of this MSDS for information regarding physical and health hazards, respiratory protection, ventilation, and personal protective equipment. Call 3M-HELPS line (1-800-364-3577) for more information on handling and managing the spill. Evacuate unprotected and untrained personnel from hazard area. The spill should be cleaned up by qualified personnel. Ventilate the area with fresh air. For large spill, or spills in confined spaces, provide mechanical ventilation to disperse or exhaust vapors, in accordance with good industrial hygiene practice. Warning! A motor could be an ignition source and could cause flammable gases or vapors in the spill area to burn or explode. Contain spill. For larger spills, cover drains and build dikes to prevent entry into sewer systems or bodies of water. Working from around the edges of the spill inward, cover with bentonite, vermiculite, or commercially available inorganic absorbent material. Mix in sufficient absorbent until it appears dry. Collect as much of the spilled material as possible. Collect as much of the spilled material as possible using non-sparking tools. Clean up residue with an appropriate solvent selected by a qualified and authorized person. Ventilate the area with fresh air. Read and follow safety precautions on the solvent label and MSDS. Collect the resulting residue containing solution. Place in a closed container approved for transportation by appropriate authorities. Dispose of collected material as soon as possible.

In the event of a release of this material, the user should determine if the release qualifies as reportable according to local, state, and federal regulations.

SECTION 7: HANDLING AND STORAGE

7.1 HANDLING
Do not eat, drink or smoke when using this product. Wash exposed areas thoroughly with soap and water. Contents may be under pressure, open carefully. Avoid breathing of vapors, mists or spray. Avoid skin contact with hot material. Avoid eye contact with vapors, mists, or spray. For industrial or professional use only. Store work clothes separately from other clothing, food and tobacco products. Avoid contact with oxidizing agents. Avoid skin contact. Use general dilution ventilation and/or local exhaust ventilation to control airborne exposures to below Occupational Exposure Limits. If ventilation is not adequate, use respiratory protection equipment. Avoid continuous exposure of the material to extreme conditions of heat, i.e., above 150C (welding, open flame, misuse or equipment failure). Avoid exceeding a watt density of 50 watts/inch2 from a heater surface. Continuous exposure to 150C results in very slight decomposition of this product and, therefore, is a very conservative use temperature threshold. Do not breathe thermal decomposition products. For additional information about applications involving exposure of the fluid to temperatures exceeding 150C, please contact 3M Technical Service.

7.2 STORAGE
Store away from heat. Store out of direct sunlight. Keep container in well-ventilated area. Store away from oxidizing agents. Keep container tightly closed. Store away from strong bases. Contents may be under pressure if stored/shipped under elevated temperature. Open closure slowly to vent pressure.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 ENGINEERING CONTROLS

Use with appropriate local exhaust ventilation. Provide appropriate local exhaust ventilation on open containers. Do not use in a confined area or areas with little or no air movement. For those situations where the fluid might be exposed to extreme overheating due to misuse or equipment failure, use with appropriate local exhaust ventilation sufficient to maintain levels of thermal decomposition products below their exposure guidelines.

8.2 PERSONAL PROTECTIVE EQUIPMENT (PPE)

8.2.1 Eye/Face Protection

Avoid eye contact with vapors, mists, or spray.
The following eye protection(s) are recommended: Safety Glasses with side shields, Indirect Vented Goggles.

8.2.2 Skin Protection

Wear appropriate gloves, such as Nomex, when handling this material to prevent thermal burns. Avoid skin contact. Avoid skin contact with hot material.

Select and use gloves and/or protective clothing to prevent skin contact based on the results of an exposure assessment. Consult with your glove and/or protective clothing manufacturer for selection of appropriate compatible materials.
Gloves made from the following material(s) are recommended: Fluoroelastomer (Viton), Polyethylene/Ethylene Vinyl Alcohol.

8.2.3 Respiratory Protection

Avoid breathing of vapors, mists or spray. Under normal use conditions, airborne exposures are not expected to be significant enough to require respiratory protection.
Select one of the following NIOSH approved respirators based on airborne concentration of contaminants and in accordance with OSHA regulations: Half facepiece or fullface air-purifying respirator with organic vapor cartridges. Consult the current 3M Respiratory Selection Guide for additional information or call 1-800-243-4630 for 3M technical assistance. If thermal decomposition occurs, wear supplied air respiratory protection.

8.2.4 Prevention of Swallowing

Do not eat, drink or smoke when using this product. Wash exposed areas thoroughly with soap and water. Not applicable.

8.3 EXPOSURE GUIDELINES

Ingredient	Authority	Type	Limit	Additional Information
1,2-Trans-Dichloroethylene	ACGIH	TWA	200 ppm	
1,2-Trans-Dichloroethylene	OSHA	TWA	200 ppm	
Methyl Nonafluorobutyl Ether	AIHA	TWA	750 ppm	
Ethyl Nonafluorobutyl Ether	3M	TWA, as total isomers	200 ppm	
Ethyl Nonafluoroisobutyl Ether	3M	TWA, as total isomers	200 ppm	
Methyl Nonafluoroisobutyl Ether	AIHA	TWA	750 ppm	

SOURCE OF EXPOSURE LIMIT DATA:
ACGIH: American Conference of Governmental Industrial Hygienists
CMRG: Chemical Manufacturer Recommended Guideline
OSHA: Occupational Safety and Health Administration
AIHA: American Industrial Hygiene Association Workplace Environmental Exposure Level (WEEL)

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Specific Physical Form:	Liquid
Odor, Color, Grade:	Clear, colorless with slight odor.
General Physical Form:	Liquid
Autoignition temperature	396 °C
Flash Point	[*Details:* No flash point per ASTM 3278 method]
Flammable Limits - LEL	6.7 % volume
Flammable Limits - UEL	13.7 % volume
Boiling point	43 °C
Density	1.28 g/ml
Vapor Density	*No Data Available*
Vapor Pressure	350 mmHg [@ 25 °C]
Specific Gravity	1.28 [*Ref Std:* WATER=1]
pH	*Not Applicable*
Melting point	*Not Applicable*
Solubility in Water	Negligible
Evaporation rate	*No Data Available*
Volatile Organic Compounds	896 g/l [*Test Method:* South Cost Air Qual Mgmt Dist]
Percent volatile	100 %
VOC Less H2O & Exempt Solvents	896 g/l [*Test Method:* calculated SCAQMD rule 443.1]
Viscosity	0.45 centipoise

SECTION 10: STABILITY AND REACTIVITY

Stability: Stable.

Materials and Conditions to Avoid: Strong bases; Strong oxidizing agents; Heat(excessive temperatures)

Hazardous Polymerization: Hazardous polymerization will not occur.

Hazardous Decomposition or By-Products

Substance	Condition
Hydrogen Chloride	At Elevated Temperatures - extreme conditions of heat
Hydrogen Fluoride	At Elevated Temperatures - extreme conditions of heat
Perfluoroisobutylene (PFIB)	At Elevated Temperatures - extreme conditions of heat

Hazardous Decomposition: Perfluorinated Acid Fluorides

Hydrogen Fluoride has an ACGIH Threshold Limit Value of 3 parts per million (as fluoride) as a Ceiling Limit and an OSHA PEL of 3 ppm of fluoride as an eight hour Time_Weighted Average and 6 ppm of fluoride as a Short Term Exposure Limit. The odor threshold for HF is 0.04 ppm, providing good warning properties for exposure.

Decomposition of this product at temperatures above 300 degrees C can form perfluoroisobutylene (PFIB), but PFIB will only accumulate with continuous exposure to excessive heat in a sealed vessel. The formation rate for PFIB is about 1000 times less than the rate for primary thermal decomposition products such as HF. During normal use conditions, no health hazard is associated with the use of this material due to PFIB exposure.

SECTION 11: TOXICOLOGICAL INFORMATION

Product-Based Toxicology Information:

HFE-72DE is considered non-toxic by inhalation based on a 4-hour inhalation study in rats (4-hour LC50 greater than 20 mg/L).

Component-Based Toxicology Information:

For a mixture of ethyl nonafluorobutyl ether and its isomer, a single positive response for cardiac sensitization was observed at an exposure level of 49,000 ppm. No adverse health effects are anticipated from normal handling and use.

SECTION 12: ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION

Test Organism	Test Type	Result
Water flea, Daphnia magna	48 hours Effect Concentration 50%	>300 mg/l
Bluegill, Lepomis macrochirus	96 hours Lethal Concentration 50%	>190 mg/l

CHEMICAL FATE INFORMATION

Test Type	Result	Protocol
	See 3.3	

SECTION 13: DISPOSAL CONSIDERATIONS

Waste Disposal Method: Reclaim if feasible. To reclaim or return, contact your 3M sales representative.
As a disposal alternative, incinerate in an industrial or commercial facility in the presence of a combustible material. As a disposal alternative, dispose of waste product in a facility permitted to accept chemical waste. Combustion products will include HF and HCl. Facility must be capable of handling halogenated materials.
To reclaim or return, check product label for contact.

EPA Hazardous Waste Number (RCRA): Not regulated

Since regulations vary, consult applicable regulations or authorities before disposal.

SECTION 14:TRANSPORT INFORMATION

ID Number(s):
98-0212-2966-5, 98-0212-2967-3, 98-0212-2968-1, 98-0212-3162-0, 98-0212-3507-6

Please contact the emergency numbers listed on the first page of the MSDS for Transportation Information for this material.

SECTION 15: REGULATORY INFORMATION

US FEDERAL REGULATIONS
Contact 3M for more information.

311/312 Hazard Categories:
Fire Hazard - No Pressure Hazard - No Reactivity Hazard - No Immediate Hazard - Yes Delayed Hazard - No

STATE REGULATIONS
Contact 3M for more information.

CHEMICAL INVENTORIES
The components of this product are in compliance with the chemical notification requirements of TSCA

The components of this product are listed on the Canadian Domestic Substances List.

One or more of the components of this product have been notified to NICNAS (National Industrial Chemical Notification and Assessment Scheme) of Australia. Certain restrictions apply. Contact the selling division for additional information. One or more of the components of this product have been notified to ELINCS (European List of Notified or New Chemical Substances). Certain restrictions apply. Contact the selling division for additional information.

The components of this product are listed on Japan's Chemical Substance Control Law List (also known as the Existing and New Chemical Substances List.)

The components of this material are in compliance with the new chemical notification requirements for the Korean Existing Chemicals Inventory.

All the components of this product are listed on China's Inventory of Chemical Substances.

Contact 3M for more information.

INTERNATIONAL REGULATIONS
Contact 3M for more information.

This MSDS has been prepared to meet the U.S. OSHA Hazard Communication Standard, 29 CFR 1910.1200.

SECTION 16: OTHER INFORMATION

NFPA Hazard Classification
Health: 3 **Flammability:** 1 **Reactivity:** 0 **Special Hazards:** None

National Fire Protection Association (NFPA) hazard ratings are designed for use by emergency response personnel to address the hazards that are presented by short-term, acute exposure to a material under conditions of fire, spill, or similar emergencies. Hazard ratings are primarily based on the inherent physical and toxic properties of the material but also include the toxic properties of combustion or decomposition products that are known to be generated in significant quantities.

HMIS Hazard Classification
Health: 2 **Flammability:** 1 **Reactivity:** 0 **Protection:** X - See PPE section.

Hazardous Material Identification System (HMIS(r)) hazard ratings are designed to inform employees of chemical hazards in the workplace. These ratings are based on the inherent properties of the material under expected conditions of normal use and are not intended for use in emergency situations. HMIS(r) ratings are to be used with a fully implemented HMIS(r) program. HMIS(r) is a registered mark of the National Paint and Coatings Association (NPCA).

Revision Changes:
Section 9: Vapor pressure value was modified.
Section 9: Boiling point information was modified.

DISCLAIMER: The information in this Material Safety Data Sheet (MSDS) is believed to be correct as of the date issued. 3M MAKES NO WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR COURSE OF PERFORMANCE OR USAGE OF TRADE. User is responsible for determining whether the 3M product is fit for a particular purpose and suitable for user's method of use or application. Given the variety of factors that can affect the use and application of a 3M product, some of which are uniquely within the user's knowledge and control, it is essential that the user evaluate the 3M product to determine whether it is fit for a particular purpose and suitable for user's method of use or application.

3M provides information in electronic form as a service to its customers. Due to the remote possibility that electronic transfer may have resulted in errors, omissions or alterations in this information, 3M makes no representations as to its completeness or accuracy. In addition, information obtained from a database may not be as current as the information in the MSDS available directly from 3M.

3M MSDSs are available at www.3M.com

HFE-71 DE

3M

Material Safety Data Sheet

SECTION 1: PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: HFE-71DE 3M(TM) Novec(TM) Engineered Fluid
MANUFACTURER: 3M
DIVISION: Electronics Markets Materials Division

ADDRESS: 3M Center
St. Paul, MN 55144-1000

EMERGENCY PHONE: 1-800-364-3577 or (651) 737-6501 (24 hours)

Issue Date: 10/23/2008
Supercedes Date: 08/28/2008

Document Group: 07-7119-6

Product Use:
Intended Use: For Industrial Use Only. Not Intended For Use As A Medical Device Or Drug.
Specific Use: Cleaning and Coating Solvent

SECTION 2: INGREDIENTS

Ingredient	C.A.S. No.	% by Wt
1,2-Trans-Dichloroethylene	156-60-5	49 - 51
Methyl Nonafluoroisobutyl Ether	163702-08-7	10 - 40
Methyl Nonafluorobutyl Ether	163702-07-6	10 - 40

SECTION 3: HAZARDS IDENTIFICATION

3.1 EMERGENCY OVERVIEW

Specific Physical Form: liquid
Odor, Color, Grade: Clear, colorless liquid. Slight odor.
General Physical Form: Liquid
Immediate health, physical, and environmental hazards: May cause target organ effects.

3.2 POTENTIAL HEALTH EFFECTS

Eye Contact:
Moderate Eye Irritation: Signs/symptoms may include redness, swelling, pain, tearing, and blurred or hazy vision.

Skin Contact:
Moderate Skin Irritation: Signs/symptoms may include localized redness, swelling, itching, and dryness.

Inhalation:
Respiratory Tract Irritation: Signs/symptoms may include cough, sneezing, nasal discharge, headache, hoarseness, and nose and throat pain.

If thermal decomposition occurs:
May be harmful if inhaled.

May be absorbed following inhalation and cause target organ effects.

Ingestion:
Gastrointestinal Irritation: Signs/symptoms may include abdominal pain, stomach upset, nausea, vomiting and diarrhea.

May be absorbed following ingestion and cause target organ effects.

Target Organ Effects:
Central Nervous System (CNS) Depression: Signs/symptoms may include headache, dizziness, drowsiness, incoordination, nausea, slowed reaction time, slurred speech, giddiness, and unconsciousness.

3.3 POTENTIAL ENVIRONMENTAL EFFECTS

AQUATIC TOXICITY:

Testing results indicate that methyl nonafluoroisobutyl ether and methyl nonafluorobutyl ether have insignificant toxicity to aquatic organisms at their saturation point (Lowest LC50, EC50, or IC50 > substance water solubility). 1,2-Trans-dichloroethylene is harmful to aquatic organisms (10 mg/L < Lowest LC50, EC50, or IC50 < 100 mg/L). These compounds are highly volatile and have high Henry's Law constants and are thus expected to move rapidly through vaporization from solution in an aquatic compartment or from a soil surface in a terrestrial compartment to the atmosphere.

BIOCONCENTRATION:

Methyl nonafluoroisobutylether, and methyl nonafluorobutylether are highly insoluble and very volatile. Bioconcentration is therefore unlikely and not expected as they are not likely to enter aqueous waste streams from typical uses and disposal, or, in the case of a spill, remain in the aquatic or terrestrial compartments. The high potential for these components to move from aquatic or terrestrial environments to the atmosphere indicates bioconcentration is unlikely to occur as they are not expected to be bioavailable. Thus, emphasis has been placed on the atmospheric fate.

1,2-Trans-dichloroethylene has an octanol/water partition coefficient of <3 indicating it is unlikely to bioconcentrate.

ATMOSPHERIC FATE:

This product has Zero Ozone Depletion Potential (ODP).

Atmospheric Lifetime: approximately 6 days for 1,2-trans-dichloroethylene and approximately 4.7 yr and 3.7 yr for methyl nonafluorobutyl ether and methyl nonafluoroisobutyl ether, respectively.

Global Warming Potential (GWP): 320 (100 year ITH, WMO 1998 method) for n-butyl and iso-butyl isomers and essentially zero for 1,2-trans-dichloroethylene. The mixture has a global warming potential of 160 on weight basis (100 year ITH, WMO 1998 method).

Atmospheric degradation products are expected to include: for methyl nonafluoroisobutyl ether: predominantly isoperfluorobutyric acid, CO2, HF, and perhaps also CF3COOH; for methyl nonafluorobutyl ether: n-perfluorobutyric acid, CO2, and HF.

SECTION 4: FIRST AID MEASURES

4.1 FIRST AID PROCEDURES

The following first aid recommendations are based on an assumption that appropriate personal and industrial hygiene practices are followed.

Eye Contact: Flush eyes with large amounts of water. If signs/symptoms persist, get medical attention.

Skin Contact: Remove contaminated clothing and shoes. Immediately flush skin with large amounts of water. Get medical attention. Wash contaminated clothing and clean shoes before reuse.

Inhalation: Remove person to fresh air. If signs/symptoms develop, get medical attention.

If Swallowed: Do not induce vomiting unless instructed to do so by medical personnel. Give victim two glasses of water. Never give anything by mouth to an unconscious person. Get medical attention.

SECTION 5: FIRE FIGHTING MEASURES

5.1 FLAMMABLE PROPERTIES

Autoignition temperature	410 °C
Flash Point	*Not Applicable*
Flammable Limits - LEL	[*Details:* None acc to ASTM E681-94, @ 100C]
Flammable Limits - UEL	[*Details:* None acc to ASTM E681-94, @ 100C]

5.2 EXTINGUISHING MEDIA

Material will not burn.

5.3 PROTECTION OF FIRE FIGHTERS

Special Fire Fighting Procedures: Exposure to extreme heat can give rise to thermal decomposition. Wear full protective equipment (Bunker Gear) and a self-contained breathing apparatus (SCBA).

Unusual Fire and Explosion Hazards: No unusual fire or explosion hazards are anticipated. Extreme conditions of heat (welding, open flame, misuse, or equipment failure) may produce decomposition products that include hydrogen fluoride and hydrogen chloride.

Note: See STABILITY AND REACTIVITY (SECTION 10) for hazardous combustion and thermal decomposition information.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Accidental Release Measures: Observe precautions from other sections. Call 3M- HELPS line (1-800-364-3577) for more information on handling and managing the spill. Ventilate the area with fresh air. Contain spill. For larger spills, cover drains and build dikes to prevent entry into sewer systems or bodies of water. Working from around the edges of the spill inward, cover with bentonite, vermiculite, or commercially available inorganic absorbent material. Mix in sufficient absorbent until it appears dry. Collect as much of the spilled material as possible. Place in a closed container approved for transportation by appropriate authorities. Dispose of collected material as soon as possible.

In the event of a release of this material, the user should determine if the release qualifies as reportable according to local, state, and federal regulations.

SECTION 7: HANDLING AND STORAGE

7.1 HANDLING

Avoid eye contact with vapors, mists, or spray. Avoid breathing of vapors, mists or spray. Contents may be under pressure, open carefully. For industrial or professional use only. No smoking: Smoking while using this product can result in contamination of the tobacco and/or smoke and lead to the formation of the hazardous decomposition products mentioned in the Reactivity Data section of this MSDS. Store work clothes separately from other clothing, food and tobacco products. Avoid contact with oxidizing agents. Use general dilution ventilation and/or local exhaust ventilation to control airborne exposures to below Occupational Exposure Limits. If ventilation is not adequate, use respiratory protection equipment. Avoid skin contact. Avoid continuous exposure of the material to extreme conditions of heat, i.e., above 150C (welding, open flame, misuse or equipment failure). Avoid exceeding a watt density of 50 watts/inch2 from a heater surface. Continuous exposure to 150C results in very slight decomposition of this product and, therefore, is a very conservative use temperature threshold. Applications involving exposure of the fluid to temperatures exceeding 150C should be reviewed with 3M Technical Service.

7.2 STORAGE

Store away from heat. Store out of direct sunlight. Store away from oxidizing agents. Keep container tightly closed. Keep container in well-ventilated area. Store away from strong bases. Contents may be under pressure if stored/shipped under elevated temperature. Open closure slowly to vent pressure.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 ENGINEERING CONTROLS

Use with appropriate local exhaust ventilation. Provide appropriate local exhaust ventilation on open containers. For those situations where the fluid might be exposed to extreme overheating due to misuse or equipment failure, use with appropriate local exhaust ventilation sufficient to maintain levels of thermal decomposition products below their exposure guidelines.

8.2 PERSONAL PROTECTIVE EQUIPMENT (PPE)

8.2.1 Eye/Face Protection

Avoid eye contact. Avoid eye contact with vapors, mists, or spray.
The following eye protection(s) are recommended: Safety Glasses with side shields, Indirect Vented Goggles.

8.2.2 Skin Protection

Avoid skin contact with hot material. Wear appropriate gloves, such as Nomex, when handling this material to prevent thermal burns.

Select and use gloves and/or protective clothing to prevent skin contact based on the results of an exposure assessment. Consult with your glove and/or protective clothing manufacturer for selection of appropriate compatible materials.
Gloves made from the following material(s) are recommended: Fluoroelastomer (Viton), Polyethylene/Ethylene Vinyl Alcohol.

8.2.3 Respiratory Protection

Avoid breathing of vapors, mists or spray. Under normal use conditions, airborne exposures are not expected to be significant enough

to require respiratory protection.
Select one of the following NIOSH approved respirators based on airborne concentration of contaminants and in accordance with OSHA regulations: Half facepiece or fullface air-purifying respirator with organic vapor cartridges. Consult the current 3M Respiratory Selection Guide for additional information or call 1-800-243-4630 for 3M technical assistance. If thermal decomposition occurs, wear supplied air respiratory protection.

8.2.4 Prevention of Swallowing
Do not eat, drink or smoke when using this product. Wash exposed areas thoroughly with soap and water.

8.3 EXPOSURE GUIDELINES

Ingredient	Authority	Type	Limit	Additional Information
1,2-Trans-Dichloroethylene	ACGIH	TWA	200 ppm	
1,2-Trans-Dichloroethylene	OSHA	TWA	200 ppm	
Methyl Nonafluorobutyl Ether	AIHA	TWA	750 ppm	
Methyl Nonafluoroisobutyl Ether	AIHA	TWA	750 ppm	

SOURCE OF EXPOSURE LIMIT DATA:
ACGIH: American Conference of Governmental Industrial Hygienists
CMRG: Chemical Manufacturer Recommended Guideline
OSHA: Occupational Safety and Health Administration
AIHA: American Industrial Hygiene Association Workplace Environmental Exposure Level (WEEL)

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Specific Physical Form:	liquid
Odor, Color, Grade:	Clear, colorless liquid. Slight odor.
General Physical Form:	Liquid
Autoignition temperature	410 °C
Flash Point	*Not Applicable*
Flammable Limits - LEL	[*Details:* None acc to ASTM E681-94, @ 100C]
Flammable Limits - UEL	[*Details:* None acc to ASTM E681-94, @ 100C]
Boiling point	41 °C
Density	1.37 g/ml
Vapor Density	Approximately 4.8 [*Ref Std:* AIR=1]
Vapor Pressure	383 mmHg [@ 25 °C]
Specific Gravity	1.37 [*Ref Std:* WATER=1]
pH	*Not Applicable*
Melting point	*Not Applicable*
Solubility in Water	Slight (less than 10%)
Evaporation rate	70 [*Ref Std:* BUOAC=1]
Volatile Organic Compounds	685 g/l [*Test Method:* South Cost Air Qual Mgmt Dist]
Percent volatile	100 %
VOC Less H2O & Exempt Solvents	685 g/l [*Test Method:* calculated SCAQMD rule 443.1]
Viscosity	0.43 centipoise [@ 25 °C]

SECTION 10: STABILITY AND REACTIVITY

Stability: Stable.

Materials and Conditions to Avoid: Strong bases; Strong oxidizing agents; Heat(excessive temperatures)

Hazardous Polymerization: Hazardous polymerization will not occur.

Hazardous Decomposition or By-Products

Substance	Condition
Hydrogen Chloride	At Elevated Temperatures - extreme conditions of heat
Hydrogen Fluoride	At Elevated Temperatures - extreme conditions of heat
Perfluoroisobutylene (PFIB)	At Elevated Temperatures - extreme conditions of heat

Hazardous Decomposition: Perfluorinated Acid Fluorides

Hydrogen Fluoride has an ACGIH Threshold Limit Value of 3 parts per million (as fluoride) as a Ceiling Limit and an OSHA PEL of 3 ppm of fluoride as an eight hour Time_Weighted Average and 6 ppm of fluoride as a Short Term Exposure Limit. The odor threshold for HF is 0.04 ppm, providing good warning properties for exposure.

Decomposition of this product at temperatures above 300 degrees C can form perfluoroisobutylene (PFIB), but PFIB will only accumulate with continuous exposure to excessive heat in a sealed vessel. The formation rate for PFIB is about 1000 times less than the rate for primary thermal decomposition products such as HF. During normal use conditions, no health hazard is associated with the use of this material due to PFIB exposure.

SECTION 11: TOXICOLOGICAL INFORMATION

Please contact the address listed on the first page of the MSDS for Toxicological Information on this material and/or its components.

SECTION 12: ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION

Test Organism	Test Type	Result
Water flea, Daphnia magna	48 hours Effect Concentration 50%	>400 mg/l
Bluegill, Lepomis macrochirus	96 hours Bioconcentration Factor	>250 mg/l

CHEMICAL FATE INFORMATION

See information in Section 3.3 - Potential Environmental Effects

SECTION 13: DISPOSAL CONSIDERATIONS

Waste Disposal Method: Reclaim if feasible. To reclaim or return, contact your 3M sales representative.
Incinerate in an industrial or commercial facility in the presence of a combustible material. As a disposal alternative, dispose of waste product in a facility permitted to accept chemical waste. Combustion products will include HF and HCl. Facility must be capable of

handling halogenated materials.

EPA Hazardous Waste Number (RCRA): Not regulated

Since regulations vary, consult applicable regulations or authorities before disposal.

SECTION 14:TRANSPORT INFORMATION

ID Number(s):
98-0211-9219-4, 98-0211-9221-0, 98-0211-9222-8, 98-0211-9223-6, 98-0212-1172-1, 98-0212-3141-4, 98-0212-3142-2, 98-0212-3143-0, 98-0212-3502-7

Please contact the emergency numbers listed on the first page of the MSDS for Transportation Information for this material.

SECTION 15: REGULATORY INFORMATION

US FEDERAL REGULATIONS
Contact 3M for more information.

311/312 Hazard Categories:
Fire Hazard - No Pressure Hazard - No Reactivity Hazard - No Immediate Hazard - Yes Delayed Hazard - No

STATE REGULATIONS
Contact 3M for more information.

CHEMICAL INVENTORIES
The components of this product are in compliance with the chemical notification requirements of TSCA.

Contact 3M for more information.

Additional Information: The components of this product are in compliance with the chemical notification requirements of ELINCS, METI, AICS, KECI, PICCS, CICS, CEPA.

INTERNATIONAL REGULATIONS
Contact 3M for more information.

ADDITIONAL INFORMATION

The U.S. Environmental Protection Agency (EPA) has listed the ingredients of 3M(TM) HFE-71DE as acceptable substitutes for ozone depleting substances in specific solvent cleaning and aerosol industry applications under its Significant New Alternatives Program (SNAP). Section 612 of the Clean Air Act requires the EPA to administer this program to evaluate and approve alternatives for ozone depleting substances.

This MSDS has been prepared to meet the U.S. OSHA Hazard Communication Standard, 29 CFR 1910.1200.

SECTION 16: OTHER INFORMATION

NFPA Hazard Classification

Health: 3 **Flammability:** 1 **Reactivity:** 0 **Special Hazards:** None

National Fire Protection Association (NFPA) hazard ratings are designed for use by emergency response personnel to address the hazards that are presented by short-term, acute exposure to a material under conditions of fire, spill, or similar emergencies. Hazard ratings are primarily based on the inherent physical and toxic properties of the material but also include the toxic properties of combustion or decomposition products that are known to be generated in significant quantities.

HMIS Hazard Classification

Health: 2 **Flammability:** 1 **Reactivity:** 0 **Protection:** X - See PPE section.

Hazardous Material Identification System (HMIS(r)) hazard ratings are designed to inform employees of chemical hazards in the workplace. These ratings are based on the inherent properties of the material under expected conditions of normal use and are not intended for use in emergency situations. HMIS(r) ratings are to be used with a fully implemented HMIS(r) program. HMIS(r) is a registered mark of the National Paint and Coatings Association (NPCA).

Revision Changes:
Section 1: Product use information was modified.
Section 6: Release measures information was modified.
Section 13: Waste disposal method information was modified.
Section 2: Ingredient table was modified.
Section 8: Exposure guidelines ingredient information was modified.
Section 13: Waste disposal method comment was deleted.

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3M MSDSs are available at www.3M.com

Vertrel SMT

VERTREL® SMT

6093FR Revised 26-SEP-2001

CHEMICAL PRODUCT/COMPANY IDENTIFICATION

Material Identification

Formula : CF3CHFCHFCF2CF3, CC1H=CC1H(TRANS), CH3OH

Company Identification

MANUFACTURER/DISTRIBUTOR
DuPont
1007 Market Street
Wilmington, DE 19898

PHONE NUMBERS
Product Information : 1-800-441-7515 (outside the U.S. 302-774-1000)
Transport Emergency : CHEMTREC 1-800-424-9300(outside U.S. 703-527-3887)
Medical Emergency : 1-800-441-3637 (outside the U.S. 302-774-1000)

COMPOSITION/INFORMATION ON INGREDIENTS

Components	CAS Number	%
1,1,1,2,2,3,4,5,5,5-decafluoropentane (HFC-43-10mee)	138495-42-8	49.0-55.0
TRANS, 1,2-DICHLOROETHYLENE	156-60-5	40.0-46.0
*METHANOL	67-56-1	2.0-6.0
NITROMETHANE	75-52-5	0.05-0.7

* Disclosure as a toxic chemical is required under Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR part 372.

HAZARDS IDENTIFICATION

Potential Health Effects

Gross overexposure by inhalation to HFC-43-10mee may cause suffocation if air is displaced by vapors and central nervous system stimulation with increased activity or sleeplessness, tremors or convulsions. These effects may be followed by central nervous system depression with dizziness, confusion, incoordination, drowsiness or unconsciousness. Based on data from other fluorocarbons, gross overexposure to HFC-43-10mee may cause irregular heart beat with a strange sensation in the chest, "heart thumping" apprehension, lightheadedness, feeling of fainting, dizziness, weakness, sometimes progressing to loss of consciousness and death. Intentional misuse or deliberate inhalation may cause death without warning. Vapor reduces oxygen available for breathing and is heavier than air. Immediate effects to HFC-43-10mee by skin contact may include slight irritation with itching, redness or swelling. Repeated and/or prolonged exposure may cause defatting of the skin with itching, redness or rash. Based on animal data, significant skin permeation, and systemic toxicity after skin contact, appears unlikely. Immediate effects of overexposure to HFC-43-10mee by eye contact may include eye irritation with tearing, pain or blurred vision. The major ingestion hazard of HFC-43-10mee is aspiration (liquid entering the lungs during ingestion or vomiting) which may result in "chemical pneumonia." Symptoms include coughing, gasping, choking, shortness of breath, bluish discoloration of the skin, rapid breathing and heart rate, and fever. Pulmonary edema or bleeding, drowsiness, confusion, coma and seizures may occur in more serious cases. Symptoms may develop immediately or as late as 24 hours after exposure, depending on how much chemical entered the lungs. Increased susceptibility to the effects of HFC-43-10mee may be observed in persons with pre-existing disease of the central nervous system or the cardiovascular system.

Inhalation of t-DCE may cause central nervous system depression with dizziness, confusion, incoordination, drowsiness or unconsciousness; or tremors, nausea, vomiting, weakness, and abdominal cramps. Other effects may include irregular heart beat with a strange sensation in the chest, "heart thumping",apprehension, lightheadedness, feeling of fainting, dizziness, or weakness. Skin contact with t-DCE may cause severe irritation with burning, redness, swelling, pain or rash. Eye contact with t-DCE may cause severe eye irritation with tearing, pain or blurred vision. Ingestion of t-DCE may cause pulmonary edema (body fluid in the lungs) with cough, wheezing, abnormal lung sounds, possibly progressing to severe shortness of breath and bluish

discoloration of the skin: symptoms may be delayed. Ingestion may also cause pathological changes in the liver, central nervous system depression with dizziness, confusion, incoordination, drowsiness or unconsciousness, and structural (pathological) changes in heart muscle tissue.

The fatal dose of Methyl Alcohol by ingestion is from 60 to 250 ml. Inhalation of Methyl Alcohol may cause irritation of the nose and throat with sneezing, sore throat or runny nose. Skin contact with Methyl Alcohol may cause irritation with itching, burning, redness, swelling or rash. Skin permeation may occur in amounts capable of producing the effects of systemic toxicity. Eye contact with Methyl Alcohol may cause eye irritation with tearing, pain or blurred vision. Ingestion of Methyl Alcohol may cause irritation of the digestive tract with stomach pain, heartburn, nausea, vomiting or diarrhea; however there may be no symptoms at all. Inhalation, ingestion or skin contact with Methyl Alcohol may cause temporary mild depression of the central nervous system with dizziness, confusion, incoordination or drowsiness followed by an asymptomatic period usually ranging from 12 to 24 hours. Metabolic acidosis develops followed by ocular toxicity (visual disturbance including blindness). Other effects include non-specific effects such as headache, nausea and weakness. Gross overexposure may cause pathological changes in the liver and kidneys; nerve damage with numbness, weakness or muscle rigidity; tremors; convulsions; and fatality. Increased susceptibility to the effects of Methyl Alcohol may be observed in persons with pre-existing disease of the nervous system, visual system, liver, kidneys, and cardiovascular system.

Short-term overexposure by inhalation to Nitromethane may cause irritation of the nose and throat with sneezing, sore throat or runny nose. Based on animal data repeated and/or prolonged exposure may cause irritation of nose, throat, and lungs with cough, difficulty breathing or shortness of breath, pathological changes in the liver, central nervous system depression with dizziness, confusion, incoordination, drowsiness or unconsciousness, peripheral nervous system effects with tingling, pain, or loss of sensation in extremities which may be accompanied by weakness or loss of muscle control, altered blood cell counts, impaired functioning of the blood-forming system with alterations in blood cell counts and/or anemia, effects on the nervous tissue, and clinical pathological changes of the thyroid. Skin contact with Nitromethane may cause skin irritation with itching, burning, redness, swelling or rash. Eye contact with Nitromethane may cause eye irritation with tearing, pain or blurred vision. Based on animal data, ingestion of Nitromethane may cause abnormal liver function with altered enzyme levels in blood, or abnormal kidney function with altered results on blood tests.

Carcinogenicity Information

The following components are listed by IARC, NTP, OSHA or ACGIH as carcinogens.

Material	IARC	NTP	OSHA	ACGIH

FIRST AID MEASURES

First Aid

INHALATION

If inhaled, immediately remove to fresh air. Keep person calm. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

SKIN CONTACT

Flush skin with water after contact. Wash contaminated clothing before reuse.

EYE CONTACT

In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Call a physician.

INGESTION

If swallowed, immediately give 2 glasses of water and induce vomiting. Never give anything by mouth to an unconscious person. Call a physician.

Notes to Physicians

Ethanol (ETOH) is antidotal and should be administered early in the treatment. Ethanol is a potent inhibitor of Methanol metabolism because it is preferentially acted on by liver alcohol dehydrogenase, thus delaying or preventing toxic metabolites from Methanol.

Treatment is started after residual ingested substance is removed from the stomach. Ethanol is administered orally or IV with a goal of maintaining a blood alcohol level of approximately 22 mmol/L or 1.0 mg/L.

To prepare antidote, make a solution using 100 mL of 100 proof ethyl alcohol and 1900 mL of water. Give 1.5 mL/kg or 100 mL for an average adult. This may be mixed with orange juice for oral use if necessary. More Ethanol is to be given at 2 hour intervals to achieve and maintain the desired blood alcohol levels. Treatment may be necessary for several days.

The patient should be monitored for metabolic acidosis. Use of appropriate buffering solutions, such as bicarbonate, may be indicated.

Hemodialysis may be required.

THIS MATERIAL MAY MAKE THE HEART MORE SUSCEPTIBLE TO ARRHYTHMIAS. Catecholamines such as adrenaline, and other compounds having

similar effects, should be reserved for emergencies and then used only with special caution.

FIRE FIGHTING MEASURES

Flammable Properties

Flammable limits in Air, % by Volume
LEL : 7.0 %
UEL : 15.0 %

Flash Point : None
Method : Pensky-Martens Closed Cup (ASTM D 93)

Flash Point : None
Method : Tag Open Cup (ASTM D 1310)

AUTOIGNITION TEMPERATURE:

Has not yet been determined for VERTREL® SMT.

Fire and Explosion Hazards:

Use water spray or fog to cool containers. Drums may rupture under fire conditions. Decomposition may occur.

Extinguishing Media

Use media appropriate for surrounding material.

Fire Fighting Instructions

Self-contained breathing apparatus (SCBA) is required if drums rupture and contents are spilled under fire conditions.

ACCIDENTAL RELEASE MEASURES

Safeguards (Personnel)

NOTE: Review FIRE FIGHTING MEASURES and HANDLING (PERSONNEL) sections before proceeding with clean-up. Use appropriate PERSONAL PROTECTIVE EQUIPMENT during clean-up.

Initial Containment

Dike spill. Prevent material from entering sewers, waterways, or low areas.

Spill Clean Up

Immediately evacuate the area and provide maximum ventilation, especially in low places where heavy vapors might collect. Unprotected personnel should move upwind of spill. Only personnel equipped with proper respiratory and skin/eye protection should be permitted in area. Soak up with sawdust, sand, oil dry or other absorbent material. After all visible traces, including ignitable vapors, have been removed, thoroughly wet vacuum the area. Do not flush to sewer. If area of spill is porous, remove as much contaminated earth and gravel, etc. as necessary and place in closed containers for disposal.

In spill or leak situations, the composition of vapors above the liquid may fall within the LEL/UEL and, therefore, become flammable. Provide ventilation and assure no ignition sources are present.

HANDLING AND STORAGE

Handling (Personnel)

Avoid breathing vapors or mist. Avoid contact with eyes, skin, or clothing. Wash thoroughly after handling.

The use of gloves is recommended when working with the material containers. Material should not be dispensed from its container by pouring, except for small sample containers where fume hoods or where other ventilation is used to manage the exposure limits. The use of a drum pump is recommended for dispensing from shipping containers.

Storage

Store in a clean, dry place.

Store in a clean, dry area. Do not allow stored product to exceed 52 C (125 F) to prevent leakage or potential rupture of container from pressure and expansion. Protect from freezing temperatures. If solvent is stored below -10 C (14 F), mix prior to use.

EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls

Use only with adequate ventilation. Keep container tightly closed.

Vapors are heavier than air posing a hazard of asphyxia if they are trapped in enclosed or low places.

Personal Protective Equipment

EYE/FACE PROTECTION

Wear safety glasses or coverall chemical splash goggles.

RESPIRATORS

Where there is potential for airborne exposures in excess of applicable limits, wear NIOSH approved respiratory protection.

PROTECTIVE CLOTHING

Where there is potential for skin contact have available and wear as appropriate impervious gloves, apron, pants, and jacket.

Protective gloves and chemical splash goggles should be used when handling liquid.

Exposure Guidelines

Applicable Exposure Limits

1,1,1,2,2,3,4,5,5,5-DECAFLUOROPENTANE

PEL	(OSHA)	: None Established
TLV	(ACGIH)	: None Established
AEL *	(DuPont)	: 200 ppm, 8 & 12 Hr. TWA 400 ppm, Ceiling

TRANS, 1,2-DICHLOROETHYLENE

PEL	(OSHA)	: 200 ppm, 790 mg/m3, 8 Hr. TWA
TLV	(ACGIH)	: 200 ppm, 8 Hr. TWA
AEL *	(DuPont)	: 200 ppm, 8 & 12 Hr. TWA

METHANOL

PEL	(OSHA)	: 200 ppm, 260 mg/m3, 8 Hr. TWA
TLV	(ACGIH)	: 200 ppm, 8 Hr. TWA, Skin STEL 250 ppm
AEL *	(DuPont)	: 200 ppm, 8 & 12 Hr. TWA, Skin

NITROMETHANE

PEL	(OSHA)	: 100 ppm, 250 mg/m3, 8 Hr. TWA
TLV	(ACGIH)	: 20 ppm, 8 Hr. TWA, A3
AEL *	(DuPont)	: 10 ppm, 8 & 12 Hr. TWA

* AEL is DuPont's Acceptable Exposure Limit. Where governmentally imposed occupational exposure limits which are lower than the AEL are in effect, such limits shall take precedence.

PHYSICAL AND CHEMICAL PROPERTIES

Physical Data

Boiling Point	: 37 C (99 F)
Vapor Pressure	: 470 mm Hg @ 25 C (77 F)
Vapor Density	: 4.4 (Air=1.0)

Form	: Liquid
Color	: Colorless
Density	: 1.37 g/cm3 @ 25 C (77 F) 11.4 lb/gal

STABILITY AND REACTIVITY

Chemical Stability

Stable at normal temperatures and storage conditions.

Incompatibility with Other Materials

Incompatible with alkali or alkaline earth metals - powdered Al, Zn, Be, Na, Mg, etc.

Incompatible with strong bases such as NaOH, KOH, etc.

Decomposition

Decomposes with heat. High temperatures (open flames, glowing metal surfaces, etc.) can decompose HFC-43-10mee forming hydrofluoric acids and possibly carbonyl halides.

HFC-43-10mee is incompatible with strong bases and can react to form salts of hydrofluoric acid and unsaturated compounds of unknown toxicity.

1,2-Trans DCE is unstable at high temperatures and will form hydrochloric acid and unsaturates as well as break down or react in the presence of caustic to form salts of hydrochloric acid.

Polymerization

Polymerization will not occur.

TOXICOLOGICAL INFORMATION

Animal Data

HFC-43-10mee

Oral LD50:	> 5,000 mg/kg in rats
Dermal ALD:	> 5,000 mg/kg in rabbits
Inhalation, 4 hour LC50:	11,100 ppm in rats

t-DCE

Oral LD50:	1275 mg/kg in rats
Dermal LD50:	> 5000 mg/kg in rabbits

Inhalation LC50, 4 hr: 24,100 ppm in rats

Methyl Alcohol

Oral LD50: 9,100 mg/kg in rats
Dermal LD50 15,840 mg/kg in rabbits
Inhalation 1 hour LC50: > 145,000 ppm in rats

Nitromethane

Inhalation 4 hour ALC: 6000 ppm in rats
Oral LD50: 1210 mg/kg in rats
Dermal LD50: > 2000 mg/kg in rabbits

Animal testing indicates that HFC-43-10mee is a slight skin irritant and a mild eye irritant, but is not a skin sensitizer. Single exposure to 5,000 ppm HFC-43-10mee by inhalation caused tremors. A different single exposure study by inhalation in rats caused incoordination, hyperactivity and prostration; pathological examination of rats from this study revealed kidney and lung changes, and external hair loss. Repeated exposures to 1,900 - 3,500 ppm caused tremors or convulsions, behavioral effects, and altered clinical chemistry. These effects were temporary. In a different repeated exposure test the No-Observed-Adverse-Effect-Level (NOAEL) for convulsions was 1000 ppm. Results indicate convulsions is an acute effect of HFC-43-10mee. The 90-day No-Observed-Adverse-Effect-Level (NOAEL) is 500 ppm. In animal testing HFC-43-10mee produced developmental effects only at exposure levels producing other toxic effects in the adult animal. No animal data are available to define the carcinogenic or reproductive hazards of HFC-43-10mee. Tests have shown that HFC-43-10mee does not cause genetic damage in bacterial or mammalian cell cultures. It has not produced genetic damage in tests on animals.

t-DCE is a severe eye irritant, and a moderate to severe skin irritant. Single and repeated exposure to t-DCE by ingestion caused increased kidney weight, histopathological changes of the lungs, liver effects, decreased motor activity, pulmonary edema, cardiovascular system changes, and mortality. Single and repeated exposure to t-DCE by inhalation caused pathological changes of the liver and lungs, inactivity or anaesthesia, altered white blood cell count, cardiovascular system changes and weak cardiac sensitization, a potentially fatal disturbance of the heart rhythm caused by a heightened sensitivity to the action of epinephrine. Long-term exposure caused altered liver and lung function. A more recent inhalation study (Dec. 1998) conducted with well-characterized t-DCE containing > 99.4% t-DCE, produced no adverse, compound-related effects. The NOEL was 4000 ppm. Exposure of pregnant rats shows maternal toxicity at 2000, 6000 and 12,000 ppm. Developmental toxicity was seen only at 12,000 ppm. Tests have shown that t-DCE does not cause genetic damage in bacterial or mammalian cell cultures. No animal data are available to define the carcinogenic or reproductive hazards of t-DCE.

Animal testing indicates Methyl Alcohol is an eye and skin

irritant. Eye contact with Methyl Alcohol caused clouding of the eye (corneal opacity). Repeated skin contact with higher concentrations of Methyl Alcohol caused some mortality. Single exposure by ingestion caused narcosis, liver effects, and hypothermia. Repeated exposure caused pathological changes of the eyes and acidosis. Repeated exposure by inhalation caused irritation of the eyes, and blindness. No animal data are available to define the carcinogenicity of Methyl Alcohol. Exposure of pregnant rats shows the following developmental effects: reduced birth weight, bone abnormalities, and behavioral abnormalities. Exposure of pregnant mice shows the following developmental effects: reduced birth weight, resorption, and bone abnormalities. No adequate animal data are available to define the reproductive effects of Methyl Alcohol. Tests have shown that Methyl Alcohol does not cause genetic damage in bacterial or mammalian cell cultures, or in animals. Methyl Alcohol has not been tested for its ability to cause permanent genetic damage in reproductive cells of mammals (not tested for heritable genetic damage).

Nitromethane is a skin irritant, and a slight eye irritant, but is not a skin sensitizer in animals. Single inhalation exposure to Nitromethane caused upper respiratory tract irritation, liver and kidney effects, central nervous system depression, incoordination, eye irritation, and some mortality. Repeated inhalation exposures caused loss of mobility in the hind limbs, alterations to the blood-forming system, altered hematology and clinical chemistry, respiratory injury, testicular effects, reduced sperm counts, altered estrous cycle, degeneration of the sciatic nerve, and spinal cord. Long-term exposure caused reduced weight gain, altered hematology, increased thyroid weight, decreased thyroxine levels and pathological changes of the lungs. Single ingestion exposure to high doses caused histopathological changes of the liver and kidney injury. Repeated exposures caused reduced weight gain, and liver injury. Repeated dermal exposure caused no significant toxicological effects. In one study, Nitromethane produced evidence of carcinogenic activity in male and female mice exposed to concentrations of 188, 375, or 750 ppm for 2 years, and in female rats exposed to concentrations of 94, 188, or 375 ppm for 2 years. There was no evidence of carcinogenic activity in male rats exposed for 2 years to concentrations of 94, 188, or 375 ppm. In a different study, with male and female rats exposure to concentrations of 100 or 200 ppm for 2 years did not produce evidence of carcinogenic activity. No adequate animal data are available to define the developmental or reproductive toxicity of Nitromethane. Tests have shown that Nitromethane did not cause genetic damage in bacterial or mammalian cell cultures.

ECOLOGICAL INFORMATION

Ecotoxicological Information

Aquatic Toxicity:

HFC-43-10mee:

96 hour LC50 - fathead minnows: 27.2 mg/L.
96 hour LC50 - rainbow trout: 13.9 mg/L.
48 hour LC50 - Daphnia magna: 11.7 mg/L.

t-DCE:

96 hour LC50 - bluegill sunfish: 1350 mg/L.
48 hour LC50 - Daphnia magna: 220 mg/L.

Methanol:

96 hour LC50 - fathead minnows: 28,100 mg/L.

Nitromethane:

96 hour LC50 - fathead minnows: 1710 mg/L.
48 hour LC50 - Daphnia magna: 100 mg/L.

DISPOSAL CONSIDERATIONS

Waste Disposal

Treatment, storage, transportation, and disposal must be in accordance with applicable Federal, State/Provincial, and Local regulations.

TRANSPORTATION INFORMATION

Shipping Information

DOT/IMO/IATA - Not regulated in containers with less than 2300 lbs. If greater than 2300 lbs., use:

Proper Shipping Name: Environmentally Hazardous Substance, Liquid, N.O.S. (Trans-1,2-Dichloroethylene)
Hazard Class : 9
UN Number : 3082
Packing Group : III
Reportable Quantity : 1000 lbs. (Trans-1,2-Dichloroethylene
5000 lbs. (Methanol)
2300 lbs. (VERTREL® SMT)

REGULATORY INFORMATION

U.S. Federal Regulations

All Components Are Listed on the TSCA Public Inventory

TITLE III HAZARD CLASSIFICATIONS SECTIONS 311, 312

Acute : Yes
Chronic : No
Fire : No
Reactivity : No
Pressure : No

1,1,1,2,2,3,4,5,5,5-DECAFLUOROPENTANE (CAS 138495-42-8) is controlled by TSCA Section 5, Significant New Use Rule (SNUR; 40 CFR 721.5645) The approved uses are: precision and general cleaning, carrier fluid, displacement drying, printed circuit board cleaning, particulate removal and film cleaning, process medium, heat transfer fluid (dielectric and non-dielectric), and test fluid. Processors and users of this substance must also comply with the applicable general SNUR requirements set forth in 40 CFR 721 subpart A and the applicable record keeping requirements set forth at 40 CFR 721.125.

LISTS:
SARA Extremely Hazardous Substance -No
CERCLA Hazardous Substance -Yes*

*Methanol and Trans-1,2-Dichloroethylene

State Regulations (U.S.)

"WARNING - SUBSTANCES KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER - Nitromethane (75-52-5)"

OTHER INFORMATION

NFPA, NPCA-HMIS

NPCA-HMIS Rating
Health : 2
Flammability : 0
Reactivity : 1

Personal Protection Rating to be supplied by user, depending on use and conditions.

VERTREL® is a registered trademark of DuPont.

The data in this Material Safety Data Sheet relates only to the specific material designated herein and does not relate to use in combination with any other material or in any process.

Information in this format is provided as a service to our customers and is intended only for their use. Others may use it at their own discretion and risk.

The MSDS format adheres to U.S. standards and regulatory requirements and may not meet regulatory requirements in other locations.

This information is based upon technical information believed to be reliable. It is subject to revision as additional knowledge and experience are gained. Please return to this website for the most current version.

Responsibility for MSDS:

MSDS Coordinator

DuPont Fluoroproducts

Wilmington, DE 19898

(800) 441-7515

End of MSDS

HFE-7100

3M

Material Safety Data Sheet

SECTION 1: PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: HFE-7100 3M (TM) Novec (TM) Engineered Fluid
MANUFACTURER: 3M
DIVISION: Electronics Markets Materials Division

ADDRESS: 3M Center
St. Paul, MN 55144-1000

EMERGENCY PHONE: 1-800-364-3577 or (651) 737-6501 (24 hours)

Issue Date: 04/09/2004
Supercedes Date: 09/16/2003

Document Group: 07-6378-9

Product Use:
Intended Use: FOR INDUSTRIAL USE ONLY. NOT INTENDED FOR USE AS A MEDICAL DEVICE OR DRUG.
Specific Use: Cleaning and Coating Solvent; Heat Transfer Fluid

SECTION 2: INGREDIENTS

Ingredient	C.A.S. No.	% by Wt
METHYL NONAFLUOROISOBUTYL ETHER	163702-08-7	20 - 80
METHYL NONAFLUOROBUTYL ETHER	163702-07-6	20 - 80

SECTION 3: HAZARDS IDENTIFICATION

3.1 EMERGENCY OVERVIEW

Specific Physical Form: liquid
Odor, Color, Grade: Clear, colorless, liquid. Slight ethereal odor.
General Physical Form: Liquid
Immediate health, physical, and environmental hazards: NONE KNOWN

3.2 POTENTIAL HEALTH EFFECTS

Eye Contact:
Contact with the eyes during product use is not expected to result in significant irritation.

Skin Contact:
Contact with the skin during product use is not expected to result in significant irritation.

Inhalation:
If thermal decomposition occurs:
Respiratory Effects: Signs/symptoms may include cough, sneezing, shortness of breath, chest tightness, nasal discharge, and wheezing.

Ingestion:
No health effects are expected.

3.3 POTENTIAL ENVIRONMENTAL EFFECTS

A 3M Product Environmental Data Sheet (PED) is available.
This substance has chemical moieties that are resistant to biodegradation and is likely to only undergo partial biodegradation in the environment. The high potential of this substance to move from water to the atmosphere means its potential to bioconcentrate is likely to disappear rapidly from aerobic environments. Take precautions to prevent direct release of this product to the environment.

AQUATIC TOXICITY: Testing results indicate that this product has insignificant toxicity to aquatic organisms at its saturation point (Lowest LC50, EC50, or IC50 > substance water solubility). This substance is highly volatile and has a high Henry's Law constant and is thus expected to move rapidly through vaporization from solution in an aquatic compartment or from a soil surface in a terrestrial compartment to the atmosphere.

ATMOSPHERIC FATE: Zero Ozone Depletion Potential (ODP). Atmospheric Lifetime: approximately 4.1 yrs. Global Warming Potential (GWP): 280 (100 year ITH, IPCC1995 method). Global Warming Potential (GWP): 320 (100 yr ITH, IPCC2001 method). Atmospheric degradation products are expected to include: for methyl nonafluoroisobutyl ether: predominantly isoperfluorobutyric acid, CO2, HF, and perhaps also CF3COOH; for methyl nonafluorobutyl ether: n-perfluorobutyric acid, CO2, and HF.

SECTION 4: FIRST AID MEASURES

4.1 FIRST AID PROCEDURES

The following first aid recommendations are based on an assumption that appropriate personal and industrial hygiene practices are followed.

Eye Contact: Flush eyes with large amounts of water. If signs/symptoms persist, get medical attention.

Skin Contact: Wash affected area with soap and water. If signs/symptoms develop, get medical attention.

Inhalation: If signs/symptoms develop, remove person to fresh air. If signs/symptoms develop, get medical attention.

If Swallowed: If signs/symptoms develop, get medical attention. No need for first aid is anticipated.

SECTION 5: FIRE FIGHTING MEASURES

5.1 FLAMMABLE PROPERTIES

Autoignition temperature	405 °C [*Details:* (ASTM E659-84)]
Flash Point	*No Flash Point acc to ASTM D56(CC) and ASTM D92-85 (OC) methods*

Flammable Limits - LEL	[*Details:* NONE acc to ASTM E681-94, @100C]
Flammable Limits - UEL	[*Details:* NONE acc to ASTM E681-94, @100C]

5.2 EXTINGUISHING MEDIA
Material will not burn.

5.3 PROTECTION OF FIRE FIGHTERS

Special Fire Fighting Procedures: Water may be used to blanket the fire. Exposure to extreme heat can give rise to thermal decomposition. Wear full protective equipment (Bunker Gear) and a self-contained breathing apparatus (SCBA).

Unusual Fire and Explosion Hazards: No unusual fire or explosion hazards are anticipated. No unusual effects are anticipated during fire extinguishing operations. Avoid breathing the products and substances that may result from the thermal decomposition of the product or the other substances in the fire zone. Keep containers cool with water spray when exposed to fire to avoid rupture.

Note: See STABILITY AND REACTIVITY (SECTION 10) for hazardous combustion and thermal decomposition information.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Accidental Release Measures: Observe precautions from other sections. Call 3M- HELPS line (1-800-364-3577) for more information on handling and managing the spill. Ventilate the area with fresh air. Contain spill. Working from around the edges of the spill inward, cover with bentonite, vermiculite, or commercially available inorganic absorbent material. Mix in sufficient absorbent until it appears dry. Collect as much of the spilled material as possible. Clean up residue with an appropriate organic solvent. Read and follow safety precautions on the solvent label and MSDS. Collect the resulting residue containing solution. Place in a metal container approved for transportation by appropriate authorities. Seal the container. Dispose of collected material as soon as possible.

In the event of a release of this material, the user should determine if the release qualifies as reportable according to local, state, and federal regulations.

SECTION 7: HANDLING AND STORAGE

7.1 HANDLING
Avoid skin contact with hot material. For industrial or professional use only. Contents may be under pressure, open carefully. No smoking: Smoking while using this product can result in contamination of the tobacco and/or smoke and lead to the formation of the hazardous decomposition products mentioned in the Reactivity Data section of this MSDS. Store work clothes separately from other clothing, food and tobacco products. Use general dilution ventilation and/or local exhaust ventilation to control airborne exposures to below Occupational Exposure Limits. If ventilation is not adequate, use respiratory protection equipment. Avoid continuous exposure of the material to extreme conditions of heat, i.e., above 150 C (welding, open flame, misuse or equipment failure). Avoid exceeding a watt density of 50 watts/inch2 from a heater surface. Continuous exposure to 150 C results in very slight decomposition of this product and therefore, is a very conservative use temperature threshold. Applications involving exposure of the fluid to temperatures exceeding 150 C or watt densities exceeding 50 watts/inch2 have been safely implemented. Applications which may exceed these use parameters should be reviewed with 3M Technical Service.

7.2 STORAGE
Keep container tightly closed. Keep container in well-ventilated area. Store away from heat. Store away from strong bases.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 ENGINEERING CONTROLS

Use with appropriate local exhaust ventilation. Provide local exhaust ventilation at transfer points. Provide appropriate local exhaust when product is heated. For those situations where the fluid might be exposed to extreme overheating due to misuse or equipment failure, use with appropriate local exhaust ventilation sufficient to maintain levels of thermal decomposition products below their exposure guidelines.

8.2 PERSONAL PROTECTIVE EQUIPMENT (PPE)

8.2.1 Eye/Face Protection

Avoid eye contact.
The following eye protection(s) are recommended: Safety Glasses with side shields.

8.2.2 Skin Protection

Avoid skin contact with hot material. Wear appropriate gloves, such as Nomex, when handling this material to prevent thermal burns.

Select and use gloves and/or protective clothing to prevent skin contact based on the results of an exposure assessment. Consult with your glove and/or protective clothing manufacturer for selection of appropriate compatible materials.
Gloves made from the following material(s) are recommended: Nitrile Rubber.

8.2.3 Respiratory Protection

Avoid breathing of vapors, mists or spray. Under normal use conditions, airborne exposures are not expected to be significant enough to require respiratory protection.
Select one of the following NIOSH approved respirators based on airborne concentration of contaminants and in accordance with OSHA regulations: Half facepiece or fullface air-purifying respirator with organic vapor cartridges. Consult the current 3M Respiratory Selection Guide for additional information or call 1-800-243-4630 for 3M technical assistance. If thermal degradation products are expected, use fullface supplied air respirator.

8.2.4 Prevention of Swallowing

Do not eat, drink or smoke when using this product. Wash exposed areas thoroughly with soap and water.

8.3 EXPOSURE GUIDELINES

Ingredient	Authority	Type	Limit	Additional Information
METHYL NONAFLUOROBUTYL ETHER	AIHA	TWA	750 ppm	
METHYL NONAFLUOROISOBUTYL ETHER	AIHA	TWA	750 ppm	

SOURCE OF EXPOSURE LIMIT DATA:
ACGIH: American Conference of Governmental Industrial Hygienists
CMRG: Chemical Manufacturer Recommended Guideline
OSHA: Occupational Safety and Health Administration
AIHA: American Industrial Hygiene Association Workplace Environmental Exposure Level (WEEL)

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Specific Physical Form:	liquid
Odor, Color, Grade:	Clear, colorless, liquid. Slight ethereal odor.
General Physical Form:	Liquid
Autoignition temperature	405 °C [*Details:* (ASTM E659-84)]
Flash Point	*No Flash Point acc to ASTM D56(CC) and ASTM D92-85 (OC) methods*
Flammable Limits - LEL	[*Details:* NONE acc to ASTM E681-94, @100C]

Flammable Limits - UEL	[*Details:* NONE acc to ASTM E681-94, @100C]
Boiling point	61 °C [@ 760 mmHg]
Density	1.5 g/ml
Vapor Density	8.6 [*Ref Std:* AIR=1]
Vapor Pressure	202 mmHg [@ 25 °C]
Specific Gravity	1.5 [*Ref Std:* WATER=1]
pH	*Not Applicable*
Melting point	-135 °C
Solubility In Water	< 12 ppm
Evaporation rate	49 [*Ref Std:* BUOAC=1]
Volatile Organic Compounds	[*Details:* Exempt]
Percent volatile	100 %
VOC Less H2O & Exempt Solvents	[*Details:* Exempt]
Viscosity	0.6 centipoise [@ 23 °C]

SECTION 10: STABILITY AND REACTIVITY

Stability: Stable.

Materials and Conditions to Avoid: Strong bases

Hazardous Polymerization: Hazardous polymerization will not occur.

Hazardous Decomposition or By-Products

Substance	Condition
Hydrogen Fluoride	At Elevated Temperatures - extreme conditions of heat
Perfluoroisobutylene (PFIB)	At Elevated Temperatures - extreme conditions of heat

Hazardous Decomposition: Perfluorinated Acid Fluorides

Hydrogen Fluoride has an ACGIH Threshold Limit Value of 3 parts per million (as fluoride) as a Ceiling Limit and an OSHA PEL of 3 ppm of fluoride as an eight hour Time_Weighted Average and 6 ppm of fluoride as a Short Term Exposure Limit. The odor threshold for HF is 0.04 ppm, providing good warning properties for exposure.

Decomposition of this product at temperatures above 300 degrees C can form perfluoroisobutylene (PFIB), but PFIB will only accumulate with continuous exposure to excessive heat in a sealed vessel. The formation rate for PFIB is about 1000 times less than the rate for primary thermal decomposition products such as HF. During normal use conditions, no health hazard is associated with the use of this material due to PFIB exposure.

SECTION 11: TOXICOLOGICAL INFORMATION

Please contact the address listed on the first page of the MSDS for Toxicological Information on this material and/or its components.

SECTION 12: ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION

Test Organism	Test Type	Result
Fathead Minnow, Pimephales promelas	96 hours Lethal Concentration 50%	>7.9 mg/l
Green algae, Selenastrum capricornutum	96 hours Inhibitory Concentration 50%	>8.9 mg/l
Water flea, Daphnia magna	48 hours Effect Concentration 50%	>10 mg/l

CHEMICAL FATE INFORMATION

Test Type	Result	Protocol
	See Section 3.3.	

SECTION 13: DISPOSAL CONSIDERATIONS

Waste Disposal Method: Reclaim if feasible. As a disposal alternative, incinerate in an industrial or commercial facility in the presence of a combustible material. Combustion products will include HF. Facility must be capable of handling halogenated materials.

To reclaim or return, check product label for contact.

EPA Hazardous Waste Number (RCRA): Not regulated

Since regulations vary, consult applicable regulations or authorities before disposal.

SECTION 14:TRANSPORT INFORMATION

ID Number(s):
98-0211-8940-6, 98-0211-8941-4, 98-0211-8942-2, 98-0211-8943-0, 98-0211-8944-8, 98-0211-8945-5, 98-0211-8946-3, 98-0212-1011-1, 98-0212-1035-0, 98-0212-1102-8, 98-0212-1128-3, 98-0212-1148-1, 98-0212-3138-0, 98-0212-3139-8, 98-0212-3140-6, 98-0212-3159-6

Please contact the emergency numbers listed on the first page of the MSDS for Transportation Information for this material.

SECTION 15: REGULATORY INFORMATION

US FEDERAL REGULATIONS

Contact 3M for more information.

311/312 Hazard Categories:
Fire Hazard - No Pressure Hazard - No Reactivity Hazard - No Immediate Hazard - No Delayed Hazard - No

STATE REGULATIONS

Contact 3M for more information.

CHEMICAL INVENTORIES

The components of this product are in compliance with the chemical notification requirements of TSCA.

Contact 3M for more information.

Additional Information: The components of this product are in compliance with the chemical registration requirements of ELINCS, METI, AICS, KECI, PICCS, CICS, CEPA.

INTERNATIONAL REGULATIONS

Contact 3M for more information.

ADDITIONAL INFORMATION

The U.S. Environmental Protection Agency (EPA) has listed 3M(TM) HFE-7100 as an acceptable substitute for ozone depleting substances in specific solvent cleaning and aerosol industry applications under its Significant New Alternatives Program (SNAP). Section 612 of the Clean Air Act requires the EPA to administer this program to evaluate and approve alternatives for ozone depleting substances.

This MSDS has been prepared to meet the U.S. OSHA Hazard Communication Standard, 29 CFR 1910.1200.

SECTION 16: OTHER INFORMATION

NFPA Hazard Classification

Health: 3 **Flammability:** 1 **Reactivity:** 0 **Special Hazards:** None

National Fire Protection Association (NFPA) hazard ratings are designed for use by emergency response personnel to address the hazards that are presented by short-term, acute exposure to a material under conditions of fire, spill, or similar emergencies. Hazard ratings are primarily based on the inherent physical and toxic properties of the material but also include the toxic properties of combustion or decomposition products that are known to be generated in significant quantities. The hazard ratings assigned to this product are based on the properties of combustion or decomposition products that can occur in an uncontrolled fire situation.

HMIS Hazard Classification

Health: 0 **Flammability:** 1 **Reactivity:** 0 **Protection:** X - See PPE section.

Hazardous Material Identification System (HMIS ®) hazard ratings are designed to inform employees of chemical hazards in the workplace. These ratings are based on the inherent properties of the material under expected conditions of normal use and are not intended for use in emergency situations. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint and Coatings Association (NPCA).

Revision Changes:
Section 16: NFPA hazard classification heading was modified.
Section 16: HMIS hazard classification heading was modified.
Section 3: Potential environmental effects heading was modified.
Copyright was modified.
Section 8: Exposure guidelines data source legend was modified.
Section 5: Fire fighting procedures information was modified.

Section 15: 311/312 hazard categories heading was modified.
Section 15: International regulations information was modified.
Section 15: State regulations information was modified.
Section 15: US federal regulations information was modified.
Section 15: WHMIS regulations comment was modified.
Section 10: Hazardous polymerization heading was modified.
Section 15: WHMIS regulations comment heading was modified.
Section 16: HMIS explanation was modified.
Section 16: NFPA explanation was modified.
Section 15: Inventories information was modified.
Section 12: Ecotoxicological information heading was modified.
Section 12: Chemical fate information heading was modified.
Section 16: NFPA hazard classification for special hazards was modified.
Section 15: Inventories comment was modified.
Section 10: Hazardous decompostion heading was modified.
Section 2: Ingredient phrase was added.
Section 1: Secondary Division name was deleted.

3M MSDSs are available at www.3M.com

Rho-Tron 225 TM

MATERIAL SAFETY DATA SHEET
RHO-CHEM CORPORATION

(A Fully Owned Subsidiary of Philip Services Corporation)
425 Isis Avenue, Inglewood, California – 90301
Tel.: (323)776-6233, Fax: (310)645-6379

Product : Rho-Tron 225 TM, Revision-04/08-11-2007

1. COMPANY AND MATERIAL IDENTIFICATION :

Product Name/Number	:	Rho-Tron 225 TM
Synonyms	:	N. A.
Chemical Family	:	Hydrochlorofluorocarbon
Stock Number	:	Drums: 8204 Five-gallon pails:8205

2. COMPOSITION OF THE MATERIAL:

Chemical Name	CAS No.	% Concentration
1. 3,3-Dichloro-1,1,1,2,2-pentafluoropropane (HCFC-225ca)	422-56-0	40 – 70 %
2. 1,3-Dichloro-1,1,2,2,3-pentafluoropropane (HCFC-225cb)	507-55-1	15 – 30 %
3. Trans-1,2-Dichloroethylene	156-60-5	15 – 30%
3. Methanol	67-56-1	< 10 %
4. Nitromethane	75-52-5	< 1%

3. HAZARDS IDENTIFICATION :

OCCUPATIONAL EXPOSURE LIMITS:
ACGIH TLVs and OSHA/Cal/OSHA PELs have not been established for the HCFC compounds and for the entire mixture.

EXPOSURE GUIDELINES:

Product	AEL (8 hr TWA)	EEL (15 min)	EEL (1 min)
Rho-Tron 225 AES - VL (HCFC-225ca/HCFC-225cb 45/55 wt% mixture)	100 ppm	1,000 ppm	2,000 ppm

	Cal/OSHA PEL (ppm)			OSHA PEL (ppm)			ACGIH TLV (ppm)	
Component	TWA	Ceiling	STEL	TWA	Ceiling	STEL	TWA	STEL
Trans-1,2-Dichloroehylene	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Methanol	200	1000	260	200	N.A.	250	200	250
Nitromethane	100	N.A.	N.A.	100	N.A.	N.A.	20	N.A.

AEL is the Acceptable Exposure Limit set by the manufacturer of this mixture (HCFC-225ca/HCFC-225cb 45/55 wt% mixture).
EEL is the Emergency Exposure Limit set by the manufacturer of this mixture (HCFC-225ca/HCFC-225cb 45/55 wt% mixture).
Emergency Exposure Limits (EELs) are to be used for short-term emergency exposure control. They are concentrations at which exposure for short periods should not result in permanent adverse health effects or interfere with escape. They should not be confused with ACGIH TLV-TWA or TLV STEL values, which are designed for repeated exposure guidelines.

The EEL is needed to avoid anesthetic effects, which could prevent self-rescue. If an EEL is exceeded for the specified duration, evacuation, sheltering in place, or other mitigating steps should be taken.
Remarks:
AELs of HCFC-225ca and HCFC-225cb are 25 ppm and 400 ppm, respectively.
Though no ACGIH TLV or OSHA PEL are assigned, the manufacturer temporarily recommends that workplace exposure levels be maintained at 100 ppm or less for the mixture (ca/cb = 45/55) until the authorized control level (e.g., ACGIH TLV or OSHA PEL) is assigned.

Inhalation:
Inhalation of high concentrations of vapor is harmful and may cause hepatitis, heart irregularities, unconsciousness, or death. Intentional misuse can be fatal. Vapors are heavier than air and can reduce oxygen available for breathing.

Ingestion:
The product may be hazardous.

Skin Contact:
May cause some irritation to skin.

Eye Contact:
Vapors may be irritating to eyes.

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4. **FIRST AID :**

Inhalation:
Remove the person to fresh air. If no improvement noticed, then transport to the nearest medical care facility for further treatment.

Ingestion:
If swallowed, do not induce vomiting. Transport to the nearest medical care facility for further treatment.

Skin Contact:
Remove contaminated clothing. Flush exposed area with water followed by washing with soap. In case of persistent irritation, consult the physician.

Eye Contact:
Flush eyes with water with eyelids open. Rest eyes for 30 minutes. If redness, burning, blurred vision , or swelling persist, transport to the nearest medical care facility for further treatment.

Medical Conditions Aggravated:
Pre-existing eye, skin, and respiratory disorders may be aggravated by exposure to this product.

Primary Routes of Entry:
Inhalation, (X), Ingestion (X), Skin (X)

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5. FIRE FIGHTING MEASURES :

Clear the area of all non-emergency, un-protected personnel.

Flash Point: None.

Upper Flammable Limit: Not determined.

Lower Flammable Limit: Not determined.

Auto Ignition Temperature: Not established.

Specific Hazards:
Vapor concentrated in a confined or poorly ventilated area can be ignited upon contact with a high energy spark, flame or high intensity source of heat. Vapor may travel a considerable distance to source of ignition and flash back. Vapor-air mixture may be explosive. Containers may rupture under fire conditions. Decomposition may occur.

Extinguishing Media:
As appropriate for combustibles in area. Use water spray to cool containers.

Protective Equipment:
Wear full protective clothing and Self contained breathing apparatus.

Hazardous Polymerization:
Will not occur.

Hazardous Decomposition Products:
Decomposition products are hazardous. These compounds can be decomposed by high temperatures (open flames, glowing metal surfaces, etc.) forming hydrochloric acid, hydrofluoric acid, and possibly carbonyl halides.

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6. ACCIDENTAL RELEASE MEASURES

Observe all relevant local, State, Federal and International regulations as applicable.

Protective measures:
Avoid contact with spilled or released material. Immediately remove all contaminated clothing. For guidance on selection of personal protective equipment, please refer to section 8 and for disposal of spilled material refer to section 13 of this MSDS. Shut off leaks, if no risk is involved. Eliminate all possible ignition sources in surrounding area. Use appropriate containment methods to avoid further contamination to environment and to neighboring areas. Avoid spreading or entering the spilled material into the drains, ditches or rivers by using sand, earth or other appropriate barriers. Attempt to Disperse the vapors to divert its flow to a safe location, by using fog sprays, for example. Take precautionary measures against static discharge. Ensure electrical continuity by bonding and grounding all equipment. Monitor area with combustible gas indicator. A leaking drum or container can be rolled or made up side down in the direction opposite to the leaking spot

Clean Up Methods:
For small liquid spills (< 1 drum of 55 gal), transfer to a labeled, seallable container by mechanical means for safe disposal. Allow residues to evaporate or soak up with an appropriate absorbent material and dispose of safely.
For large liquid spills (> 1 drum of 55 gal), transfer by mechanical means such as vacuum truck to a salvage tank for safe disposal. Retain as a contaminated waste. Allow residues to evaporate or soak up with an appropriate absorbent material and dispose of safely. Remove contaminated soil and dispose of safely.

Additional Information:
Notify appropriate authorities if there is a risk involved to the general public or to the environment or to the neighborhood due to the spill or release of this material. Please report to the National Response Center @ (800)424-8802
if the spilled quantity exceeds the reportable quantity. (Refer to chapter 15 of this MSDS).

7. HANDLING AND STORAGE

General Precautions :
Avoid breathing of or contact with material. Only use in well ventilated areas. Wash thoroughly after handling. Use appropriate P.P.E. per section 8 of this MSDS.

Handling:
Avoid contact with skin, eyes and clothing. Avoid splash filling. Do not smoke. Remove ignition sources. Avoid sparks. Handle and open container with care in a well ventilated area. Ventilate workplace in such a way that the Occupational Exposure Limit (OEL) is not exceeded. Do not empty into drains.

Storage:
Must be stored in a diked (bunded) well-ventilated area, away from sunlight, ignition sources and other sources of heat. Store at ambient temperature, in clean, dry, well ventilated area. Do not heat above 30° C.

Product Transfer:
Keep containers closed when not in use.

Container Recommendation : Emptied containers may still contain explosive vapors. Do Not cut, drill grind or perform similar operations on or near containers

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

General Information:
Wash hands before eating, drinking, smoking and using toilet.

Exposure Control:
The levels of protection and types of controls necessary will vary depending upon potential exposure conditions. Select controls based on a risk assessment of local environment. Ensure adequate ventilation to control airborne concentration, below the exposure guidelines/limits. Eye washes and showers must be used in case of an emergency.

Personal Protective Equipment:
Use Personal Protective Equipment (P.P.E.) that are NIOSH approved and/or recommended per National Standards.

Respiratory Protection:
If an engineering control fail to maintain airborne concentrations to a level, which is safe to protect workers' health, select NIOSH approved respiratory protection equipment suitable for the specific conditions of use and meeting relevant legislation. Also check with the Respiratory Protective Equipment suppliers and refer to the OSHA Respiratory Standard 1910.134 for detailed information. When air-purifying respirator is required, select appropriate respirator and filters suitable for organic gases and vapors. Where air purifying respirators are un-suitable, for example airborne concentration is high, or oxygen is deficient, confined space etc., use appropriate positive pressure, breathing apparatus.

Hand Protection:
Nitrile rubber gloves give good chemical resistance and can be used for regular use.

Eye Protection:
Chemical Splash goggles (Chemical mono-goggles) should be used

Protective Clothing/Safety shoes:
Use chemical resistant clothing, chemical resistant safety shoes or boots.

Environmental Exposure Controls:
Follow and comply with the local, state and federal guidelines for V.O.C. emission control limits, and for the discharge of exhaust air containing vapors of this material.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	:	Clear, colorless liquid.
Odor	:	Slight, ether like odor.
Boiling point Range	:	42° - 65°C at 760 mm Hg
Vapor Pressure	:	0.059 Mpa @ 25° C
Specific Gravity	:	1.32 @ 25° C
Water Solubility	:	Not known
Vapor density (air =1)	:	Not determined.
Evaporation Rate (Diethyl Ether =1)	:	approx. 0.96
Stability	:	Stable.
Volatile Organic Compound	:	521 gms/litre

10. STABILITY AND REACTIVITY

Stability:
Stable under normal conditions of use.
Conditions to Avoid:
Avoid heat, sparks, open flames and other ignition sources.
Incompatibility (Materials to Avoid):
Incompatible with alkali or alkaline earth metals-powdered Al, Zn, Be etc.
Hazardous Decomposition Products:
Decomposition products are hazardous. These compounds can be decomposed by high temperatures (open flames, glowing metal surfaces, etc.) forming hydrochloric acid, hydrofluoric acid, and possibly carbonyl halides.

11. TOXICOLOGICAL INFORMATION

Animal Data
3,3-Dichloro-1,1,1,2, 2-pentafluoropropane (HCFC-225ca)

Inhalation: 4-hour LC50: 37,300 ppm in rats
Oral: LD50: >5 g/kg in rats
Dermal: LD50: >2g/kg in rabbit.
Eye: Not irritant up to 0.1ml in rabbit.

1,3-Dichloro-1,1,2,2, 3-pentafluoropropane (HCFC-225cb)

Inhalation: 4-hour LC50: 36,800 ppm in rats
Oral: LD50: >5 g/kg in rats
Dermal: LD50: >2g/kg in rabbit.
Eye: Not irritant up to 0.1ml in rabbit.

Data from acute toxicity studies indicate that HCFC-225ca and HCFC-225cb have very low acute toxicity. Neither isomer causes eye irritation or dermal toxicity in standardized tests; skin application of both isomers at high doses (2,000mg/kg body weight) produces no adverse effects. Therefore, the dermal LD50s are greater than 2,000mg/kg body weight. Oral administration of either isomer at high doses (5,000mg/kg body weight) does not cause any mortality and the oral LD50s are greater than 5,000mg/kg body weight. Both isomers also have very low acute inhalation toxicity as measured by the concentration that cause 50% mortality in experimental animals, the LC50, listed above. Cardiac sensitization response in dogs is observed at approximately 15,000ppm for the mixture of HCFC-225ca/HCFC-225cb (45/55wt%) and 20,000ppm for HCFC-225cb.

In 28-day inhalation studies with rat, the activity and responsiveness of the animals was reduced at 5,000ppm or greater for each isomer. Toxicity was otherwise confined to the liver; liver enlargement and induction of peroxisomes was seen following treatment with either of the isomers. HCFC-225ca was more potent than HCFC-225cb in eliciting these liver effects. In 90-day study of HCFC-225ca/HCFC-225cb mixture (45/55wt%) with rat, toxic effects were observed in liver; liver enlargement and induction of peroxisomes. In 28-day study with marmoset, exposure to HCFC-225ca at 1,000ppm caused effects on the liver, such as slight fat deposition associated with changes in serum biochemical parameters. In the same study, exposure to HCFC-225cb at 5,000ppm caused somnolence during exposure and an increase of cytochrome P-450, indicative of an adaptive response to HCFC-225cb. However, no liver enlargement was seen and virtually no peroxisome induction was observed in either isomer.

Animal testing with HCFC-225ca/HCFC-225cb(=45/55) mixture indicates that the compounds are not teratogenic.

These HCFC compounds do not produce genetic damage in bacterial cell cultures (Ames Assay), CHL, and in-vivo unscheduled DNA syntheses assay. In one in-vitro study with mammalian cell cultures (human lymphocytes) HCFC-225ca caused genetic damage while HCFC- 225cb elicited a marginal response. However, the overall evidence from these studies implies that neither isomer is genotoxic.

Trans 1, 2-Dichloroethylene:
Inhalation: LC50, rat: 24,100 p.p.m.
Ingestion: LD50, rat: 1235 mg/kg
Dermal: Skin, rabbit, 500 mg-24Hour

Methyl alcohol
Inhalation: LC 50, rat: 64,000 p. p. m.
Ingestion: LD50, rat: 5,628 mg/kg
Dermal: Skin, rabbit, 20 mg-24Hour

Nitromethane
Inhalation: LCLo: 5000 p. p. m /6 Hr, rabbit
Ingestion: LD50: 940 mg/kg in rat
Dermal: LD: >2000 mg/kg, rabbit

* LCLo is the lowest level shown to cause mortality in a subject population

CHRONIC TOXICITY DATA
Is the product or a component of the product listed as carcinogen by the National Toxicity Program (NTP), International Agency for Research on Cancer (IARC), or the Occupational Safety and Health Administration (OSHA), or is it listed in the State of California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65) "Chemicals known to the State to cause cancer or reproductive toxicity"?

Component	NTP	IARC	OSHA	Prop 65
HCFC-225ca	No	No	No	No
HCFC-225cb	No	No	No	No
1, 2-Dichloroethylene	No	No	No	No
Methanol	No	No	No	No
Nitromethane	No	Yes	No	Yes

12. ECOLOGICAL INFORMATION

No ecological studies available on this product.

13. DISPOSAL METHODS

Material Disposal:
Recover or recycle if possible. It is the responsibility of a waste generator to determine the extent of hazard, and physical properties of the material generated. Additionally, the generator of the waste of this material must determine its waste classification and disposal methods in compliance with local, state and federal or other regulations.

Container Disposal:
Drain the container thoroughly, and then vent it in a safe place away from sparks, and fire. Residues may cause an explosion hazard. Do not puncture, cut or weld un-cleaned containers. Send the waste drum to the drum re-coverer or reclaimer.

Local Regulatory Compliance:
The disposal should be in compliance with applicable local, regional, state and national laws and regulations.

14. TRANSPORT INFORMATION

U. S. Department of Transportation Classification (49 CFR)
Not regulated. No UN No. established.

IMDG
Not regulated.

IATA (May vary from country to country)
Not regulated.

15. REGULATORY INFORMATION

Hazardous Materials Identification System (NFPA HMIS):

Health =2, Flammability = 1, Reactivity = 0

SARA Title III:

	HCFC-225ca	HCFC-225cb	Trans-1,2 Dichloroethylene	Methyl alcohol	Nitromethane
Reportable Quantity (40 CFR 302.4)	----------	---------	--------	----------	---------
SARA 311/312 Categories	H-1, H-2	H-1, H-2	H-1, H-2, P3	H-1, H-2, P-3	H-1,H-2,P-3
SARA 313	Yes	Yes	Yes	Yes	No
SARA 302 EHS	----------	---------	---------	---------	--------
PROP-65	----------	---------	No	---------	Yes
TSCA Inventory	Yes	Yes	Yes	Yes	Yes

SARA 311/312 Categories: Health: H-1 = Immediate (acute) health hazard
H-2 = Delayed (chronic) health hazard
Physical: P-3 = Fire hazard

CERCLA Section 103 - Trans-1,2 Dichloroethylene, RQ=1000 lbs.
South Coast Air Quality Management District:
VOC content: 521 g./ l
EINECS : Listed.
HCFC-225a and HCFC-225cb are listed as SNAP acceptable substitutes for CFCs in the Solvent Cleaning Sector of the Clean Air Act.

State Regulatory Information:
WARNING:
California Safe Drinking Water and Toxic Enforcement Act (Proposition 65)
This material contains a chemical known to the State of California to cause cancer, birth defects or other reproductive harm- Nitromethane (75-52-5), Chloroform (67-66-3).

16. OTHER INFORMATION

MSDS Revision level: 3/11-11-04
Uses and Restrictions:
Industrial solvent

Warning:
This substance harms public health and environment by destroying ozone in the upper atmosphere.

MSDS Distribution:
The copy of this MSDS should be available to every one who may handle this material.

Disclaimer:
The properties and characteristics for this mixture are based on the individual ingredients. The content and format of this MSDS is in accordance with the OSHA Hazard Communication Standard, 29 CFR 1910.1200 and the information contained herein is to the best of our knowledge for its original form in which it is supplied and is intended as guidelines for the purpose of handler's and environmental safety. No warranty or guarantee is expressed or implied regarding the accuracy of this data or of the resulting product, using this material.

Brulin 1696 B

MATERIAL SAFETY DATA SHEET

1. Product and Company Identification

Material name	**BRULIN 1696 B**
Product number	431039
Revision date	21-Aug-2007
Company information	Brulin & Company, Inc. P.O. Box 270 Indianapolis, IN 46206 US www.Brulin.com
Emergency	CHEMTREC 1-800-424-9300
General information	Phone: 317-923-3211 Fax: 317-925-4596

2. Hazards Identification

Emergency overview	This product is not considered to be a carcinogen by IARC, ACGIH, NTP, or OSHA.
Potential short term health effects	
Eyes	Contact with eyes may cause irritation.
Skin	Prolonged and/or repeated skin contact may result in mild irritation or redness.
Inhalation	Prolonged or excessive inhalation may cause respiratory tract irritation.
Ingestion	Acute ingestion may result in mild gastrointestinal distress.

3. Composition / Information on Ingredients

Hazardous component(s)	CAS #	Percent
Propylene glycol monomethyl ether	107-98-2	< 10
Triethanolamine	102-71-6	< 10

Composition comments No dangerous ingredients according to Directive 2001/58/EC

4. First Aid Measures

First aid procedures

Eye contact	Immediately flush eyes with plenty of water for at least 20 minutes. Get medical attention if irritation develops or persists.
Skin contact	Wash off with soap and water. Get medical attention if irritation develops or persists. Launder contaminated clothing before reuse.
Inhalation	Move to fresh air. If breathing is difficult, give oxygen.
Ingestion	Give several glasses of water to dilute contents of stomach and call a physician. Never give anything by mouth to a victim who is unconscious or is having convulsions.
General advice	If you feel unwell, seek medical advice (show the label where possible).

5. Fire Fighting Measures

Extinguishing media

Suitable extinguishing media Use methods for the surrounding fire.

6. Accidental Release Measures

Methods for cleaning up Absorb with earth, sand or other non-combustible material and transfer to containers for later disposal. After removal flush contaminated area thoroughly with water.

7. Handling and Storage

Handling	Keep container closed.
Storage	Keep at temperatures between 4 and 49°C.

8. Exposure Controls / Personal Protection

Exposure guidelines Contains no substances with occupational exposure limit values.

ACGIH - Threshold Limits Values - Short Term Exposure Limits (TLV-STEL)

Propylene glycol monomethyl ether	107-98-2	150 Ppm STEL

ACGIH - Threshold Limits Values - Time Weighted Averages (TLV-TWA)

Propylene glycol monomethyl ether	107-98-2	100 Ppm TWA
Triethanolamine	102-71-6	5 Mg/m3 TWA

ACGIH - Threshold Limits Values - TLV Basis - Critical Effects

Propylene glycol monomethyl ether	107-98-2	CNS impairment; eye irritation
Triethanolamine	102-71-6	eye and skin irritation

Personal protective equipment

Eye / face protection	Avoid contact with eyes. Wear chemical goggles. Safety glasses. or Face-shield.
Skin protection	Protective gloves.
Respiratory protection	No personal respiratory protective equipment normally required. When workers are facing concentrations above the exposure limit they must use appropriate certified respirators.
General hygeine considerations	Handle in accordance with good industrial hygiene and safety practice. Avoid contact with the skin and the eyes. Wash hands before breaks and immediately after handling the product.

9. Physical & Chemical Properties

Appearance	clear
Color	Light yellow, clear
Form	Liquid.
Odor	mild detergent
Odor threshold	Not available
pH	7.9 - 8.3
Freezing point	Not available
Boiling point	212 °F
Flash point	> 212 °F Pensky-Martens Closed Cup
Flammability limits in air, lower, % by volume	Not available
Flammability limits in air, upper, % by volume	Not available
Vapor pressure	Not available
Vapor density	Not available
Specific gravity	1.034
Solubility (H2O)	100 %
VOC (Weight %)	3 %

10. Chemical Stability & Reactivity Information

Chemical stability	This is a stable material.
Conditions to avoid	Do not freeze.
Incompatible materials	strong acids and oxidizing agents
Hazardous decomposition products	At thermal decomposition temperatures, carbon monoxide and carbon dioxide. Sulphur oxides and nitrogen oxides (NOx)
Possibility of hazardous reactions	Will not occur.

11. Toxicological Information

Acute effects

Acute LD50: 65809 mg/kg estimated, Rat, Oral
Acute LD50: 66411 mg/kg estimated, Rat, Dermal

12. Ecological Information

Ecotoxicity

Components of this product have been identified as having potential environmental concerns. This material is not expected to be harmful to aquatic life.

13. Disposal Considerations

Disposal instructions

Dispose in accordance with all applicable regulations. This product, in its present state, when discarded or disposed of, is not a hazardous waste according to Federal regulations (40 CFR 261.4 (b)(4)). Under RCRA, it is the responsibility of the user of the product to determine, at the time of disposal, whether the product meets RCRA criteria for hazardous waste.

14. Transport Information

Department of Transportation (DOT) Requirements

Not regulated as dangerous goods.

Department of Transportation (DOT) Requirements NON-BULK

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

15. Regulatory Information

US federal regulations

This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.
CERCLA/SARA Hazardous Substances - Not applicable.

Occupational Safety and Health Administration (OSHA)

29 CFR 1910.1200 hazardous chemical Yes

CERCLA (Superfund) reportable quantity

None

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories

Immediate Hazard - No
Delayed Hazard - Yes
Fire Hazard - No
Pressure Hazard - No
Reactivity Hazard - No

Section 302 extremely hazardous substance No

Section 311 hazardous chemical Yes

International regulations

The product does not need to be labelled in accordance with EC directives or respective national laws.

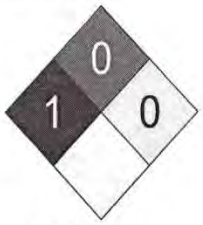
State regulations

This product does not contain a chemical known to the State of California to cause cancer, birth defects or other reproductive harm.

16. Other Information

HMIS rating

NFPA codes



Prepared date 21-Aug-2007 11:08:31

Superseded date 21-Aug-2007 11:03:15

Disclaimer The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release.

Material Safety Data Sheets for Cleaning Agents Used in Disk Lubing

PF-5060

Material Safety Data Sheet

SECTION I - Material Identity

Item Name	
Part Number/Trade Name	PERFORMANCE FLUID, PF-5060
National Stock Number	6810PPF5060
CAGE Code	76381
Part Number Indicator	A
MSDS Number	148861
HAZ Code	B

SECTION II - Manufacturer's Information

Manufacturer Name	3M GENERAL OFFICES
Street	3M CENTER
City	ST PAUL
State	MN
Country	US
Zip Code	55144-1000
Emergency Phone	612-733-1110
Information Phone	612-733-1110

MSDS Preparer's Information

Date MSDS Prepared/Revised	26APR95
Date of Technical Review	14OCT93
Active Indicator	N

Alternate Vendors

Vendor #5 CAGE	BRZTN

SECTION III - Physical/Chemical Characteristics

Hazard Storage Compatibility Code	NK
Appearance/Odor	COLORLESS LIQUID; ODORLESS
Boiling Point	132F,56C
Melting Point	N/A
Vapor Density	11.7
Specific Gravity	1.7 (H*2O=1)
Decomposition Temperature	N/K
Evaporation Rate	>1 (BUTYL ACETATE=1)
Solubility in Water	NIL
Percent Volatiles by Volume	100
Chemical pH	N/A
Corrosion Rate	N/K
Container Pressure Code	4
Temperature Code	8
Product State Code	U

SECTION IV - Fire and Explosion Hazard Data

Flash Point Method	UNK
Lower Explosion Limit	N/A
Upper Explosion Limit	N/A
Extinguishing Media	NOT APPLICABLE. USE STANDARD FIREFIGHTING PROCEDURES FOR SURROUNDING MATERIALS IN THE FIRE
Special Fire Fighting Procedures	USE NIOSH/MSHA APPROVED SCBA & FULL PROTECTIVE EQUIPMENT (FP N)
Unusual Fire/Explosion Hazards	TOXIC VAPORS OR GASES ARE POSSIBLE PRODUCTS OF THERMAL DECOMPOSITION

SECTION V - Reactivity Data

Stability	YES
Stability Conditions to Avoid	NONE SPECIFIED BY MANUFACTURER
Materials to Avoid	FINELY DIVIDED ACTIVE METALS, ALKALI & ALKALINE EARTH METALS
Hazardous Decomposition Products	CARBON MONOXIDE & CARBON DIOXIDE, HYDROGEN FLUORIDE, PERFLUOROISOBUTYLENE (PFIB). TOX VAPS/GASES ARE POSS PRODS (SUPDAT)
Hazardous Polymerization	NO
Polymerization Conditions to Avoid	NOT RELEVANT
LD50 - LD50 Mixture	NONE SPECIFIED BY MANUFACTURER

SECTION VI - Health Hazard Data

Route of Entry: Skin	NO
Route of Entry: Ingestion	NO
Route of Entry: Inhalation	YES
Health Hazards - Acute and Chronic	EYE:NO ADVERSE HLTH EFTS ARE EXPECTED FROM CONT. PROD IS NOT EXPECTED TO PRDCE SIGNIFICANT IRRIT. AFTER PROD HAS BEEN IN USE, CONTAMS MAY BE INTRODUCED THAT MAY CAUSE IRRIT. SIGNS/SYMPS INCL REDNESS, SWELL, PAIN & TEARING. SKIN:NO ADVERSE HLTH EFTS ARE EXPECTED FROM CONT. AFTER PROD HAS BEEN IN USE, (EFTS OF OVEREXP)
Carcinogenity: NTP	NO
Carcinogenity: IARC	NO
Carcinogenity: OSHA	NO
Explanation of Carcinogenity	NOT RELEVANT
Symptoms of Overexposure	HLTH HAZ:CONTAMS MAY BE INTRODUCED THAT MAY CAUSE IRRIT. SIGNS/SYMPS INCL REDNESS, SWELL & ITCHING. INHAL:NO ADVERSE HLTH EFTS ARE EXPECTED FROM EXPOS. HLTH EFTS ARE NOT EXPECTED UNLESS PROD IS OVER HEATED & DECOMP OCCURS. INGEST:NO ADVERSE HLTH EFTS ARE EXPECTED FROM SWALLOWING. CONTAM PROD CAN BE TOX IF (SUPP DATA)
Medical Cond. Aggrevated by Exposure	NONE SPECIFIED BY MANUFACTURER
Emergency/First Aid Procedures	EYE:IMMEDIATELY FLUSH W/LARGE AMOUNTS OF WATER FOR AT LEAST 15 MINUTES. GET IMMEDIATE MEDICAL ATTENTION. SKIN:WASH AFFECTED AREA W/SOAP & WATER. INHAL:IF SIGNS/SYMPTOMS OCCUR, REMOVE PERSON TO FRESH AIR. IF SIGNS/SYMPTOMS CONTINUE, CALL MD. INGEST:DRINK TWO GLASSES OF WATER. CALL MD

SECTION VII - Precautions for Safe Handling and Use

Steps if Material Released/Spilled	OBSERVE PRECAUTIONS FROM OTHER SECTIONS OF THIS MSDS. COVER W/INORGANIC ABSORBENT MATERIAL. COLLECT SPILLED MATERIAL. PLACE IN A CLOSED CONTAINER
Neutralizing Agent	NONE SPECIFIED BY MANUFACTURER
Waste Disposal Method	DISPOSAL MUST BE I/A/W FEDERAL, STATE & LOCAL REGULATIONS (FP N). TO RECLAIM OR RETURN, CONTACT YOUR 3M SALES REPRESENTATIVE
Handling and Storage Precautions	ID EYE CONTACT. AVOID PROLONGED BREATHING OF VAPORS. AVOID INHALATION OF THERMAL DECOMPOSITION PRODUCTS. STORE AT ROOM TEMPERATURE. NO
Other Precautions	NO SMOKING WHILE HANDLING THIS MATERIAL. FOR INDUSTRIAL USE ONLY. NOT INTENDED FOR USE AS A MEDICAL DEVICE OR DRUG

SECTION VIII - Control Measures

Respiratory Protection	IF THERMAL DECOMPOSITION OCCURS, SELECT ONE OF THE FOLLOWING NIOSH/MSHA APPROVED RESPIRATORS BASED ON AIRBORNE CONCENTRATION OF CONTAMINANTS & I/A/W OSHA REGULATIONS: HALF-MASK SUPPLIED AIR RESPIRATOR, FULL-FACE SUPPLIED AIR RESPIRATOR
Ventilation	USE W/APPROP LOC EXHST VENT. LOC EXHST VENT W/MIN CAPTURE VELOCITY OF 50 LINEAR FT/MIN SHOULD BE PROVIDED FOR (ING 4)
Protective Gloves	IMPERVIOUS GLOVES (FP N)
Eye Protection	CHEMICAL SAFETY GOGGLES (FP N)
Other Protective Equipment	NONE SPECIFIED BY MANUFACTURER
Work Hygenic Practices	NONE SPECIFIED BY MANUFACTURER
Supplemental Health/Safety Data	HAZ DECOMP PROD:OF THERMAL DECOMP. EFTS OF OVEREXP:INGESTED. IF PROD IS EXPOS TO EXTREME CNDTN OF HEAT FROM MISUSE/EQUIP FAILURE, TOX DECOMP PRODS THAT INCL HYDROGEN FLUROIDE & PERFLUOROISOBUTYLENE CAN OCCUR. HYDROGEN FLUORIDE HAS TLV OF 3 PPM, C OF FLUORIDE & PEL OF 3 PPM (8-HR TWA) & 6 PPM STEL OF FLUORIDE. (ING 3)
Disposal Code	O

SECTION IX - Label Data

Protect Eye	YES
Protect Skin	YES
Protect Respiratory	YES
Chronic Indicator	UNKNOWN
Contact Code	NONE
Fire Code	UNKNOWN
Health Code	UNKNOWN
React Code	UNKNOWN

SECTION X - Transportation Data

Container Quantity	1
Unit of Measure	GL

SECTION XI - Site Specific/Reporting Information

Volatile Organic Compounds (P/G)	0
Volatile Organic Compounds (G/L)	0

SECTION XII - Ingredients/Identity Information

Ingredient #	01
Ingredient Name	PERFLUORO COMPOUNDS, C5-18; (PERFLUORO COMPOUNDS, (PRIMARILY COMPOUNDS W/7 CARBONS))
CAS Number	86508421
NIOSH Number	1009338PC
Proprietary	NO
Percent	100
OSHA PEL	N/K (FP N)
ACGIH TLV	N/K (FP N)
Recommended Limit	N/K
Ingredient #	02
Ingredient Name	VOLATILE ORGANIC COMPOUNDS
CAS Number	N/K
NIOSH Number	9999999VO
Proprietary	NO
Percent	0 G/L
OSHA PEL	N/K (FP N)
ACGIH TLV	N/K (FP N)
Recommended Limit	N/K
Ingredient #	03
Ingredient Name	SUPDAT:PERFLUORISOBUTYLENE HAS TLV OF 0.01 PPM, C OR 0.082 MG/M3, C
CAS Number	N/K
NIOSH Number	9999999ZZ
Proprietary	NO
Percent	N/K
OSHA PEL	NOT APPLICABLE
ACGIH TLV	NOT APPLICABLE
Recommended Limit	N/K
Ingredient #	04
Ingredient Name	VENT:APPLICATIONS AT/ABOVE BOILING TEMP. IF INTERFERING AIR CURRENTS ARE PRESENT, MIN CAPTURE VELOCITY SHOULD BE (ING 5)
CAS Number	N/K
NIOSH Number	9999999ZZ
Proprietary	NO
Percent	N/K
OSHA PEL	NOT APPLICABLE
ACGIH TLV	NOT APPLICABLE
Recommended Limit	N/K
Ingredient #	05
Ingredient Name	ING 4:AT LEAST 100 LINEAR FEET PER MINUTE
CAS Number	N/K
NIOSH Number	9999999ZZ
Proprietary	NO
Percent	N/K
OSHA PEL	NOT APPLICABLE
ACGIH TLV	NOT APPLICABLE
Recommended Limit	N/K

HFC-4310

The MSDS format adheres to the standards and regulatory requirements of the United States and may not meet regulatory requirements in other countries.

"VERTREL" XF
6044FR Revised 29-SEP-2008

CHEMICAL PRODUCT/COMPANY IDENTIFICATION

Material Identification

"Vertrel" is a registered trademark of DuPont.

Corporate MSDS Number	: DU008057
CAS Number	: 138495-42-8
Formula	: CF3CHFCHFCF2CF3
Molecular Weight	: 252
CAS Name	: Pentane, 1,1,1,2,2,3,4,5,5,5-decafluoro

Tradenames and Synonyms

1,1,1,2,2,3,4,5,5,5-Decafluoropentane
1,1,1,2,3,4,4,5,5,5-Decafluoropentane
2,3-Dihydroperfluoropentane
HFC-43-10mee
43-10mee

Company Identification

MANUFACTURER/DISTRIBUTOR
DuPont Fluoroproducts
1007 Market Street
Wilmington, DE 19898

PHONE NUMBERS

Product Information	: 1-800-441-7515 (outside the U.S. 302-774-1000)
Transport Emergency	: CHEMTREC 1-800-424-9300(outside U.S. 703-527-3887)
Medical Emergency	: 1-800-441-3637 (outside the U.S. 302-774-1000)

COMPOSITION/INFORMATION ON INGREDIENTS

Components

Material	CAS Number	%
Pentane, 1,1,1,2,2,3,4,5,5,5-decafluoro-	138495-42-8	99

HAZARDS IDENTIFICATION

Potential Health Effects

Gross overexposure by inhalation to HFC-43-10mee may cause suffocation if air is displaced by vapors and central nervous system stimulation with increased activity or sleeplessness, tremors or convulsions. These effects may be followed by central nervous system depression with dizziness, confusion, incoordination, drowsiness or unconsciousness. Based on data from other fluorocarbons, gross overexposure may be associated with irregular heartbeat or heart rhythm, which may produce heart palpitation, dizziness, weakness, unconsciousness and death. It is unlikely that concentrations sufficient to produce irregular heartbeat or heart rhythm would be achieved from HFC-43-10MEE without first producing other signs of toxicity. Immediate effects of overexposure to HFC-43-10mee by skin contact may include slight irritation with itching, redness or swelling. Repeated and/or prolonged exposure may cause defatting of the skin with itching, redness or rash. Based on animal data, significant skin permeation, and systemic toxicity after skin contact, appears unlikely. Immediate effects of overexposure to HFC-43-10mee by eye contact may include eye irritation with tearing, pain or blurred vision. The major ingestion hazard of HFC-43-10mee is aspiration (liquid entering the lungs during ingestion or vomiting) which may result in "chemical pneumonia." Symptoms include coughing, gasping, choking, shortness of breath, bluish discoloration of the skin, rapid breathing and heart rate, and fever. Pulmonary edema or bleeding, drowsiness, confusion, coma and seizures may occur in more serious cases. Symptoms may develop immediately or as late as 24 hours after exposure, depending on how much chemical entered the lungs. Increased susceptibility to the effects of HFC-43-10mee may be observed in persons with pre-existing disease of the central nervous system or the cardiovascular system.

Carcinogenicity Information

None of the components present in this material at concentrations equal to or greater than 0.1% are listed by IARC, NTP, OSHA or ACGIH as a carcinogen.

FIRST AID MEASURES

First Aid

INHALATION

If inhaled, immediately remove to fresh air. Keep person calm. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

(FIRST AID MEASURES - Continued)

SKIN CONTACT

Flush skin with water after contact. Wash contaminated clothing before reuse.

EYE CONTACT

In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Call a physician.

INGESTION

Material poses an aspiration hazard. If swallowed, do not induce vomiting. Immediately give 2 glasses of water. Never give anything by mouth to an unconscious person. Call a physician.

If vomiting occurs naturally, have victim lean forward to reduce the risk of aspiration.

Notes to Physicians

THIS MATERIAL MAY MAKE THE HEART MORE SUSCEPTIBLE TO ARRHYTHMIAS. Catecholamines such as adrenaline, and other compounds having similar effects, should be reserved for emergencies and then used only with special caution.

FIRE FIGHTING MEASURES

Flammable Properties

Flammable Limits in Air, % by volume
LEL : None
UEL : None

Flash Point : None
Method : Tag Closed Cup (ASTM D 56)

Flash Point : None
Method : Tag Open Cup (ASTM D 1310)

Fire and Explosion Hazards:

Use water spray or fog to cool containers. Drums may rupture under fire conditions. Decomposition may occur.

Extinguishing Media

Use media appropriate for surrounding material.

(FIRE FIGHTING MEASURES - Continued)

Fire Fighting Instructions

Self-contained breathing apparatus (SCBA) is required if drums rupture and contents are spilled under fire conditions.

ACCIDENTAL RELEASE MEASURES

Safeguards (Personnel)

NOTE: Review FIRE FIGHTING MEASURES and HANDLING (PERSONNEL) sections before proceeding with clean-up. Use appropriate PERSONAL PROTECTIVE EQUIPMENT during clean-up.

Evacuate personnel, thoroughly ventilate area, use self-contained breathing apparatus.

Initial Containment

Dike spill. Prevent material from entering sewers, waterways, or low areas.

Spill Clean Up

Immediately evacuate the area and provide maximum ventilation, especially in low places where heavy vapors might collect. Unprotected personnel should move upwind of spill. Only personnel equipped with proper respiratory and skin/eye protection should be permitted in area. Soak up with sawdust, sand, oil dry or other absorbent material. After all visible traces, including ignitable vapors, have been removed, thoroughly wet vacuum the area. Do not flush to sewer. If area of spill is porous, remove as much contaminated earth and gravel, etc. as necessary and place in closed containers for disposal.

HANDLING AND STORAGE

Handling (Personnel)

Avoid breathing vapors or mist. Avoid contact with eyes, skin, or clothing. Wash thoroughly after handling.

The use of gloves is recommended when working with the material containers. Material should not be dispensed from its container by pouring, except for small sample containers where fume hoods or where other ventilation is used to manage the exposure limits. The use of a drum pump is recommended for dispensing from shipping containers.

(HANDLING AND STORAGE - Continued)

Storage

Store in clean, dry area. Do not allow stored product to exceed 52 C(125 F) to prevent leakage or potential rupture of container from pressure and expansion. Protect from freezing temperatures. If solvent is stored below -10 C (14 F), mix prior to use.

EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls

Normal ventilation for standard manufacturing procedures is generally adequate. Local exhaust should be used when large amounts are released. Mechanical ventilation should be used in low or enclosed places.

Personal Protective Equipment

EYE/FACE PROTECTION:

Wear safety glasses or coverall chemical splash goggles.

RESPIRATORS:

Wear NIOSH approved respiratory protection, as appropriate. Self-contained breathing apparatus (SCBA) is required if large release occurs.

PROTECTIVE CLOTHING:

Where there is potential for skin contact have available and wear as appropriate impervious gloves, apron, pants, and jacket.

Protective gloves and chemical splash goggles should be used when handling liquid.

Exposure Guidelines

Exposure Limits

"VERTREL" XF

PEL	(OSHA)	: None Established
TLV	(ACGIH)	: None Established
AEL *	(DuPont)	: 200 ppm, 8 & 12 Hr. TWA 400 ppm, Ceiling

* AEL is DuPont's Acceptable Exposure Limit. Where governmentally imposed occupational exposure limits which are lower than the AEL are in effect, such limits shall take precedence.

PHYSICAL AND CHEMICAL PROPERTIES

Physical Data

Boiling Point	: 55 C (131 F)
Vapor Pressure	: 226 mm Hg @ 25 C (77 F)
Solubility in Water	: 140 ppm
pH	: Neutral
Form	: Liquid
Color	: Clear, colorless
Density	: 1.58 g/cm3 @ 25 C (77 F) 13.2 lb/gal

STABILITY AND REACTIVITY

Chemical Stability

Stable at normal temperatures and storage conditions.

Incompatibility with Other Materials

Incompatible with alkali or alkaline earth metals - powdered Al, Zn, Be, Na, Mg, etc.

Incompatible with strong bases such as NaOH, KOH, etc.

Decomposition

Decomposes with heat. High temperatures (open flames, glowing metal surfaces, etc.) can decompose HFC-43-10mee forming hydrofluoric acids and possibly carbonyl halides.

HFC-43-10mee is incompatible with strong bases and can react to form salts of hydrofluoric acid and unsaturated compounds of unknown toxicity.

Polymerization

Polymerization will not occur.

TOXICOLOGICAL INFORMATION

Animal Data

HFC-43-10mee

Oral LD50: > 5,000 mg/kg in rats
Dermal ALD: > 5,000 mg/kg in rabbits
Inhalation, 4 hour LC50: 11,100 ppm in rats

Animal testing indicates that HFC-43-10mee is a slight skin irritant and a mild eye irritant, but is not a skin sensitizer. HFC-43-10mee did not cause cardiac sensitization

(TOXICOLOGICAL INFORMATION - Continued)

in dogs exposed to 1000 or 5000 ppm. The cardiac sensitization potential was not evaluated at or above 10,000 ppm due to clinical signs consistent with central nervous system toxicity. Single exposure to 5,000 ppm HFC-43-10mee by inhalation caused tremors. A different single exposure study by inhalation in rats caused incoordination, hyperactivity and prostration; pathological examination of rats from this study revealed kidney and lung changes, and external hair loss. Repeated exposures to 1,900 - 3,500 ppm caused tremors or convulsions, behavioral effects, and altered clinical chemistry. In developmental toxicity studies with laboratory animals, HFC-43-10mee was not uniquely toxic to the developing fetus. No animal data are available to define the carcinogenic or reproductive hazards of HFC-43-10mee. Tests have shown that HFC-43-10mee does not cause genetic damage in bacterial or mammalian cell cultures. It has not produced genetic damage in tests on animals.

ECOLOGICAL INFORMATION

Ecotoxicological Information

Aquatic Toxicity:

HFC-43-10mee:

96 hour LC50, fathead minnows: 27.2 mg/L
96 hour LC50, rainbow trout: 13.9 mg/L
48 hour LC50, Daphnia magna: 11.7 mg/L

DISPOSAL CONSIDERATIONS

Waste Disposal

Treatment, storage, transportation, and disposal must be in accordance with applicable Federal, State/Provincial, and Local regulations.

TRANSPORTATION INFORMATION

Shipping Information

DOT/IMO/IATA
Not Regulated.

REGULATORY INFORMATION

U.S. Federal Regulations

TSCA Inventory Status : Listed.

TITLE III HAZARD CLASSIFICATIONS SECTIONS 311, 312

Acute : Yes
Chronic : No
Fire : No
Reactivity : No
Pressure : No

1,1,1,2,2,3,4,5,5,5-DECAFLUOROPENTANE (CAS# 138495-42-8) is controlled by TSCA Section 5, Significant New Use Rule (SNUR; 40 CFR 721.5645) The approved uses are: precision and general cleaning, carrier fluid, displacement drying, printed circuit board cleaning, particulate removal and film cleaning, process medium, heat transfer fluid (dielectric and non-dielectric), and test fluid. Processors and users of this substance must also comply with the applicable general SNUR requirements set forth in 40 CFR 721 subpart A, including export notification requirements if applicable (40 CFR 721.20), and the applicable record keeping requirements set forth at 40 CFR 721.125.

LISTS:

SARA Extremely Hazardous Substance - No
CERCLA Hazardous Substance - No

OTHER INFORMATION

NFPA, NPCA-HMIS

NPCA-HMIS Rating
Health : 1
Flammability : 0
Reactivity : 1

Personal Protection rating to be supplied by user depending on use conditions.

The data in this Material Safety Data Sheet relates only to the specific material designated herein and does not relate to use in combination with any other material or in any process.

Responsibility for MSDS : MSDS Coordinator
> : DuPont Fluoroproducts
Address : Wilmington, DE 19898
Telephone : (800) 441-7515

(Continued)

# Indicates updated section.

This information is based upon technical information believed to be reliable. It is subject to revision as additional knowledge and experience is gained.

End of MSDS

Appendix B
Fire Protection Agents

Material Safety Data Sheets for Fire Protection Agents Used in Total Flooding Systems

Halon 1301

HALON 1301 - MONOBROMOTRIFLUOROMETHANE

MATERIAL SAFETY DATA SHEET

01/11/00

MSDS PROVIDED BY:
STOODY INDUSTRIAL AND WELDING SUPPLY, INC.
3316 National Ave., San Diego, Ca. 92113
Phone: (619) 234-6750

MILITARY EMERGENCY RESPONSE NUMBER 1-800-851-8061

DEFENSE DISTRIBUTION DEOT RICHMOND VIRGINIA -- HALON 1301 - MONOBROMOTRIFLUOROMETHANE,TECHNICALDEFENSE DISTRIBUTION DEOT RICHMOND VIRGINIA -- HALON 1301 - MONOBROMOTRIFLUOROMETHANE,TECHNICAL
MATERIAL SAFETY DATA SHEET
NSN:
Manufacturer's CAGE: 02LX8
Part No. Indicator: C
Part Number/Trade Name: HALON 1301

General Information

Item Name: MONOBROMOTRIFLUOROMETHANE,TECHNICAL
Company's Name: DEFENSE DISTRIBUTION DEOT RICHMOND VIRGINIA
Company's Street: 8000 JEFFERSON DAVIS HIGHWAY
Company's City: RICHMIND
Company's State: VA
Company's Country: US
Company's Zip Code: 23297
Company's Emerg Ph #: 804-279-3125
Company's Info Ph #: 804-279-3125
Distributor/Vendor # 1: FRC INTL INC (419-867-8990)
Distributor/Vendor # 1 Cage: 0ETK4
Record No. For Safety Entry: 003
Tot Safety Entries This Stk#: 003
Status: SE
Date MSDS Prepared: 14FEB96
Safety Data Review Date: 28FEB96
Supply Item Manager: CX
MSDS Preparer's Name: FRC INTERNATIONAL
MSDS Serial Number: BYFNV
Spec Type, Grade, Class: TYPE 1301
Hazard Characteristic Code: G3
Unit Of Issue: CY
Unit Of Issue Container Qty: UNKNOWN
Type Of Container: CYLINDER
Net Unit Weight: 1123 LBS

Ingredients/Identity Information

Proprietary: NO
Ingredient: BROMOTRIFLUOROMETHANE
Ingredient Sequence Number: 01
Percent: 100
NIOSH (RTECS) Number: 1010907TF
CAS Number: 75-63-8
OSHA PEL: NOT ESTABLISHED
ACGIH TLV: NOT ESTABLISHED
Other Recommended Limit: NONE RECOMMENDED

Physical/Chemical Characteristics

Appearance And Odor: CLEAR, COLORLESS, LIQUIFIED GAS. SLIGHT ETHERAL ODOR.
Boiling Point: -72F,-58C
Melting Point: N/A
Vapor Pressure (MM Hg/70 F): 435 PSIG
Vapor Density (Air=1): 5.14
Specific Gravity: 1.57
Evaporation Rate And Ref: >1 (CCL4=1)
Solubility In Water: 0.03 WT @ 25C
pH: 7

Fire and Explosion Hazard Data

Flash Point: NONE
Extinguishing Media: HALON 1301 IS A FIRE EXTINGUISHING AGENT.
Special Fire Fighting Proc: USE WATER SPRAY OR FOG TO COOL CONTAINERS.

SELF-CONTAINED BREATHING APPARATUS IS REQUIRED IF CYLINDERS RUPTURE OR RELEASE UNDER FIRE CONDITIONS.
Unusual Fire And Expl Hazrds: CYLINDERS ARE EQUIPPED WITH RELIEF DEVICES BUT MAY STILL RUPTURE UNDER FIRE CONDITIONS.

Reactivity Data

Stability: YES
Cond To Avoid (Stability): NONE
Materials To Avoid: ACTIVE METALS, ALKALI, FIRES OF METAL HYDRIDES, AND MATERIAL CONTAINING OWN OXYGEN.
Hazardous Decomp Products: THE PRESENCE OF FLAMES/HOT SURFACES; HYDROGEN FLUORIDE, HYDROGEN BROMIDE, BROMINE, CARBONYL FLUORIDE, CARBONYL BROMIDE.
Hazardous Poly Occur: NO
Conditions To Avoid (Poly): HIGH TEMPERATURES, GOWING METAL SURFACES, OPEN FLAMES.

Health Hazard Data

LD50-LC50 Mixture: TLV: 1000 PPM
Route Of Entry - Inhalation: YES
Route Of Entry - Skin: NO
Route Of Entry - Ingestion: NO
Health Haz Acute And Chronic: HALON 1301 HAS ANESTHETIC & CARDIAC EFFECTS IN HUMANS AT CONCENTRATIONS BELOW 10% ARE CONSIDERED SAFE FOR 0-5 MINUTES EXPOSURES. HALON 1301 IS CLASSIFIED AS GROUP 6 (LEAST TOXIC) IN THE UNDERWRITERS LABORATORIES CLASSIFICATION OF COMPARATIVE LIFE HAZARDS OF FIRE EXTINGUISHING AGENTS.
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: NO
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: NOT A LISTED CARCINOGEN.
Signs/Symptoms Of Overexp: THE ANESTHETIC EFFECTS OF HALON 1301 AT LEVELS BELOW 10% IS SIMILIAR TO A FEELING OF MILD INTOXICATION. ANESTHETIC EFFECTS TO CONCENTRATIONS ABOVE 10% (15-20), MAY LEAD TO UNCONSCIOUSNESS AND POSSIBLY DEATH.
Med Cond Aggravated By Exp: INDIVIDUALS WITH PREEXISTING DISEASE OF THE CENTRAL NERVOUS OR CARDIOVASCULAR SYSTEM MAY HAVE INCREASED SUSCEPTIBILITY TO THE TOXICITY OF EXCESSIVE EXPOSURE.
Emergency/First Aid Proc: INHALE-REMOVE VICTIM TO FRESH AIR. GIVE SYMPTOMATIC AND SUPPORTIVE CARE. GET MEDICAL ATTENTION. NOTE: ADRENALINE IS CONTRAINDICATED IN THE TREATMENT OF OVEREXPOSURE TO HALON 1301. SKIN-FLUSH SKIN WITH PLENTY OF WATER FOR 15 MIN. EYE-IMMEDIATELY FLUSH EYES WITH PLENTY OF WATER FOR AT LEAST 15 MIN. NOTES TO PHYSICIAN: CATECHOLAMINE DRUGS, SUCH AS SPINEPHRICE, SHOULD BE USED WITH CAUTION.

Precautions for Safe Handling and Use

Steps If Matl Released/Spill: AIR OUT ENCLOSED OR LOW AREAS. REMOVE OPEN FLAMES. SELF-CONTAINED BREATHING APPARATUS FOR LARGE LEAKS OR SPILL.
Waste Disposal Method: COMPLY WITH ALL FEDERAL, STATE AND LOCAL REGULATIONS. RECLAIM BY RECOVERY MACHINES AND REMOVE TO PERMITTED WASTE DISPOSAL FACILITY.
Precautions-Handling/Storing: AVOID CONTAINER DAMAGE.
Other Precautions: NONE.

Control Measures

Respiratory Protection: USE NIOSH APPROVED SELF-CONTAINED BREATHING APPARATUS IF EXPOSED TO CONCENTRATIONS GREATER THAN 10%.
Ventilation: LOCAL EXHAUST, NORMAL VENTILATION ADEQUATE. MECHANICAL (GENERAL) VENTILATION, USE IN LOW OR ENCLOSED PLACES.
Protective Gloves: IMPERVIOUS GLOVES FOR PROLONGED CONTACT.
Eye Protection: SPLASH GOGGLES.
Other Protective Equipment: NONE.
Work Hygienic Practices: DETERMINE THAT PIPING IS EMPTY BEFORE DOING MAINTENANCE WORK.
Suppl. Safety & Health Data: NONE

Transportation Data

Trans Data Review Date: 96059

HALON 1301 - MONOBROMOTRIFLUOROMETHANE
MATERIAL SAFETY DATA SHEET

DOT PSN Code: CEX
DOT Proper Shipping Name: BROMOTRIFLUOROMETHANE OR REFRIGERANT GAS, R 13B1.
DOT Class: 2.2
DOT ID Number: UN1009
DOT Label: NONFLAMMABLE GASS
IMO PSN Code: CMN
IMO Proper Shipping Name: BROMOTRIFLUOROMETHANE
IMO Regulations Page Number: 2109
IMO UN Number: 1009
IMO UN Class: 2(2.2)
IMO Subsidiary Risk Label: -
IATA PSN Code: DYC
IATA UN ID Number: 1009
IATA Proper Shipping Name: BROMOTRIFLUOROMETHANE
IATA UN Class: 2.2
IATA Label: NON-FLAMMABLE GAS
AFI PSN Code: DYC
AFI Prop. Shipping Name: BROMOTRIFLUOROMETHANE (R13B1)
AFI Class: 2.2
AFI ID Number: UN1009
AFI Basic Pac Ref: A6.3,A6.5
MMAC Code: NR

Disposal Data

Label Data

Label Required: YES
Technical Review Date: 28FEB96
Label Status: F
Common Name: HALON 1301
Chronic Hazard: YES
Signal Word: CAUTION!
Acute Health Hazard-Slight: X
Contact Hazard-Slight: X
Fire Hazard-None: X
Reactivity Hazard-None: X
Special Hazard Precautions: AVOID CONTAINER DAMAGE. CYLINDERS ARE EQUIPPED WITH RELIEF DEVICES BUT MAY STILL RUPTURE UNDER FIRE CONDITIONS. IN CASE OF SPILL: AIR OUT ENCLOSED OR LOW AREAS. REMOVE OPEN FLAMES. SELF-CONTAINED BREATHING APPARATUS FOR LARGE LEAKS OR SPILL. FIRST AID: INHALE-REMOVE VICTIM TO FRESH AIR. GIVE SYMPTOMATIC AND SUPPORTIVE CARE. GET MEDICAL ATTENTION. NOTE: ADRENALINE IS CONTRAINDICATED IN THE TREATMENT OF OVEREXPOSURE TO HALON 1301. SKIN-FLUSH SKIN WITH PLENTY OF WATER FOR 15 MIN. EYE-IMMEDIATELY FLUSH EYES WITH PLENTY OF WATER FOR AT LEAST 15 MIN. NOTES TO PHYSICIAN: CATECHOLAMINE DRUGS, SUCH AS SPINEPHRICE, SHOULD BE USED WITH CAUTION.
Protect Eye: Y
Protect Skin: Y
Protect Respiratory: Y
Label Name: DEFENSE DISTRIBUTION DEOT RICHMOND VIRGINIA
Label Street: 8000 JEFFERSON DAVIS HIGHWAY
Label City: RICHMIND
Label State: VA
Label Zip Code: 23297
Label Country: US
Label Emergency Number: 804-279-3125

HFC-125

Material Safety Data Sheet

DuPont™ FE-25® fire extinguishing agent

Version 2.0

Revision Date 10/22/2010 Ref. 130000000363

This SDS adheres to the standards and regulatory requirements of the United States and may not meet the regulatory requirements in other countries.

SECTION 1. PRODUCT AND COMPANY IDENTIFICATION

Product name	:	DuPont™ FE-25® fire extinguishing agent
MSDS Number	:	130000000363
Product Use	:	Fire extinguishing agent
Manufacturer	:	DuPont 1007 Market Street Wilmington, DE 19898
Product Information	:	1-302-774-1000
Medical Emergency	:	1-800-441-3637 (outside the U.S. 1-302-774-1139)
Transport Emergency	:	CHEMTREC: 1-800-424-9300 (outside the U.S. 1-703-527-3887)

SECTION 2. HAZARDS IDENTIFICATION

Emergency Overview

Rapid evaporation of the liquid may cause frostbite.

Potential Health Effects

Skin

Pentafluoroethane : Contact with liquid or refrigerated gas can cause cold burns and frostbite.

Eyes

Pentafluoroethane : Contact with liquid or refrigerated gas can cause cold burns and frostbite.

Inhalation

Pentafluoroethane : May cause: Central nervous system depression, Anaesthetic effects, dizziness, confusion, incoordination, drowsiness, or unconsciousness, irregular heartbeat with a strange sensation in the chest, heart thumping, apprehension, feeling of fainting, dizziness or weakness.
Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing.

Carcinogenicity

None of the components present in this material at concentrations equal to or greater than 0.1% are listed by IARC, NTP, or OSHA, as a carcinogen.

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Component	CAS-No.	Concentration
Pentafluoroethane	354-33-6	100 %

SECTION 4. FIRST AID MEASURES

Skin contact : Take off all contaminated clothing immediately. Flush area with lukewarm water. Do not use hot water. If frostbite has occurred, call a physician.

Eye contact : In case of eye contact Hold eyelids apart and flush eyes with plenty of water for at least 15 minutes. Get medical attention.

Inhalation : Remove from exposure, lie down. Move to fresh air. Keep patient warm and at rest. Artificial respiration and/or oxygen may be necessary. Consult a physician.

Ingestion : Is not considered a potential route of exposure.

General advice : Never give anything by mouth to an unconscious person. When symptoms persist or in all cases of doubt seek medical advice.

Notes to physician : Because of possible disturbances of cardiac rhythm, catecholamine drugs, such as epinephrine, that may be used in situations of emergency life support should be used with special caution.

SECTION 5. FIRE-FIGHTING MEASURES

Flammable Properties Flash point	:	does not flash
Lower explosion limit	:	Method : None per ASTM E681
Upper explosion limit	:	Method : None per ASTM E681
Fire and Explosion Hazard	:	pressure build-up Hazardous thermal decomposition products: Carbon oxides Hydrogen fluoride Carbonyl fluoride Fluorocarbons
Firefighting Instructions	:	In the event of fire, wear self-contained breathing apparatus. Wear neoprene gloves during cleaning up work after a fire. Use extinguishing measures that are appropriate to local circumstances and the surrounding environment. Cool containers / tanks with water spray.

SECTION 6. ACCIDENTAL RELEASE MEASURES

NOTE: Review FIRE FIGHTING MEASURES and HANDLING (PERSONNEL) sections before proceeding with clean-up. Use appropriate PERSONAL PROTECTIVE EQUIPMENT during clean-up.

Safeguards (Personnel)	:	Evacuate personnel to safe areas. Ventilate the area. Refer to protective measures listed in sections 7 and 8.
Spill Cleanup	:	Evaporates.
Accidental Release Measures	:	Should not be released into the environment.

SECTION 7. HANDLING AND STORAGE

Handling (Personnel)	:	Avoid breathing vapours or mist. Avoid contact with skin, eyes and clothing. Provide sufficient air exchange and/or exhaust in work rooms. For personal

protection see section 8.
Handle in accordance with good industrial hygiene and safety practice.

Handling (Physical Aspects)	:	No special protective measures against fire required.
Storage	:	Valve protection caps and valve cutlet threaded plugs must remain in place unless container is secured with valve outlet piped to use point. Do not drag, slide or roll cylinders. Never attempt to lift cylinder by its cap. Use a check valve or trap in the discharge line to prevent hazardous back flow into the cylinder. Cylinders should be stored upright and firmly secured to prevent falling or being knocked over. Separate full containers from empty containers. Keep at temperature not exceeding 52°C. Do not store near combustible materials. Keep container tightly closed in a dry and well-ventilated place. Store in original container. Protect from contamination.
Storage temperature	:	< 52 °C (< 126 °F)

SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering controls	:	Ensure adequate ventilation, especially in confined areas. Local exhaust should be used when large amounts are released.
Personal protective equipment Respiratory protection	:	For rescue and maintenance work in storage tanks use self-contained breathing apparatus. Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing.
Hand protection	:	Additional protection: Impervious gloves
Eye protection	:	Safety glasses with side-shields Additionally wear a face shield where the possibility exists for face contact due to splashing, spraying or airborne contact with this material. Wear safety glasses or coverall chemical splash goggles.
Protective measures	:	Self-contained breathing apparatus (SCBA) is required if a large release occurs.

Exposure Guidelines
Exposure Limit Values
Pentafluoroethane

AEL *	(DUPONT)	1,000 ppm	8 & 12 hr. TWA

* AEL is DuPont's Acceptable Exposure Limit. Where governmentally imposed occupational exposure limits which are lower than the AEL are in effect, such limits shall take precedence.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Form	:	Liquefied gas
Color	:	colourless
Odor	:	ether-like
Boiling point	:	-48.1 °C (-54.6 °F) at 1,013 hPa
% Volatile	:	100 %
Vapour Pressure	:	13,779 hPa at 25 °C (77 °F)
Density	:	1.22 g/cm3 at 20 °C (68 °F) (as liquid)
Water solubility	:	0.9 g/l at 25 °C (77 °F) at 1,013 hPa
Vapour density	:	4.2 (Air = 1.0)

SECTION 10. STABILITY AND REACTIVITY

Stability	:	Stable under recommended storage conditions.
Conditions to avoid	:	The product is not flammable in air under ambient conditions of temperature and pressure. When pressurised with air or oxygen, the mixture may become flammable. Certain mixtures of HCFCs or HFCs with chlorine may become flammable or reactive under certain conditions.
Incompatibility	:	Alkali metals Alkaline earth metals, Powdered metals, Powdered metal salts
Hazardous decomposition products	:	Hazardous thermal decomposition products: Carbon oxides, Hydrogen fluoride, Carbonyl fluoride, Fluorocarbons

SECTION 11. TOXICOLOGICAL INFORMATION

DuPont™ FE-25® fire extinguishing agent

Carcinogenicity	:	Animal testing did not show any carcinogenic effects.
Reproductive toxicity	:	Did not show mutagenic or teratogenic effects in animal experiments.

Further information	:	Cardiac sensitisation threshold limit : > 245400 mg/m3 Anaesthetic effects threshold limit : 490800 mg/m3 Rapid evaporation of the liquid may cause frostbite.

Pentafluoroethane

Inhalation 4 h LC50	:	800000 ppm , rat Cardiac sensitization
Repeated dose toxicity	:	Inhalation rat No toxicologically significant effects were found.
Mutagenicity	:	Did not cause genetic damage in animals. Did not cause genetic damage in cultured mammalian cells. Did not cause genetic damage in cultured bacterial cells.
Teratogenicity	:	Animal testing showed no developmental toxicity.

SECTION 12. ECOLOGICAL INFORMATION

SECTION 13. DISPOSAL CONSIDERATIONS

Waste Disposal	:	Recover by distillation or remove to a permitted waste disposal facility. Comply with applicable Federal, State/Provincial and Local Regulations.
Environmental Hazards	:	Empty pressure vessels should be returned to the supplier.

SECTION 14. TRANSPORT INFORMATION

DOT	UN number	: 3220
	Proper shipping name	: Pentafluoroethane
	Class	: 2.2
	Labelling No.	: 2.2
IATA_C	UN number	: 3220

	Proper shipping name	: Pentafluoroethane
	Class	: 2.2
	Labelling No.	: 2.2
IMDG	UN number	: 3220
	Proper shipping name	: Pentafluoroethane
	Class	: 2.2
	Labelling No.	: 2.2

SECTION 15. REGULATORY INFORMATION

California Prop. 65 : Chemicals known to the State of California to cause cancer, birth defects or any other harm: none known

SECTION 16. OTHER INFORMATION

Before use read DuPont's safety information.
For further information contact the local DuPont office or DuPont's nominated distributors.
® DuPont's registered trademark

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

Significant change from previous version is denoted with a double bar.

HFC-227ea

Material Safety Data Sheet

FM-200®

Version 2.0

Revision Date 01/11/2011 Ref. 130000036866

This SDS adheres to the standards and regulatory requirements of the United States and may not meet the regulatory requirements in other countries.

SECTION 1. PRODUCT AND COMPANY IDENTIFICATION

Product name	:	FM-200®
Tradename/Synonym	:	FE-227 2-Hydroperfluoropropane Propane, 1,1,1,2,3,3,3-Heptafluoro- HFC-227eaHP 2-Hydroheptafluoropropane Heptafluoropropane 2-H-heptafluoropropane 1,1,1,2,3,3,3-Heptafluoropropane R-227 R227 HFC-227ea
MSDS Number	:	130000036866
Product Use	:	Fire extinguishing agent
Manufacturer	:	DuPont 1007 Market Street Wilmington, DE 19898
Product Information	:	1-800-441-7515 (outside the U.S. 1-302-774-1000)
Medical Emergency	:	1-800-441-3637 (outside the U.S. 1-302-774-1139)
Transport Emergency	:	CHEMTREC: 1-800-424-9300 (outside the U.S. 1-703-527-3887)

SECTION 2. HAZARDS IDENTIFICATION

Emergency Overview

Misuse or intentional inhalation abuse may lead to death without warning.
Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing.
Rapid evaporation of the liquid may cause frostbite.

Potential Health Effects

Skin : Contact with liquid or refrigerated gas can cause cold burns and frostbite.

Eyes : Contact with liquid or refrigerated gas can cause cold burns and frostbite.

Inhalation : Misuse or intentional inhalation abuse may cause death without warning symptoms, due to cardiac effects.
Other symptoms potentially related to misuse or inhalation abuse are: Anaesthetic effects, Light-headedness, dizziness, confusion, incoordination, drowsiness, or unconsciousness, irregular heartbeat with a strange sensation in the chest, heart thumping, apprehension, feeling of fainting, dizziness or weakness.
Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing.

Carcinogenicity
None of the components present in this material at concentrations equal to or greater than 0.1% are listed by IARC, NTP, or OSHA, as a carcinogen.

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Component	CAS-No.	Concentration
1,1,1,2,3,3,3-Heptafluoropropane	431-89-0	100 %

SECTION 4. FIRST AID MEASURES

Skin contact : Treat for frostbite if necessary by gently warming affected area.

Eye contact : In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Consult a physician if necessary.

Inhalation : If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Ingestion : Is not considered a potential route of exposure.

General advice	:	Never give anything by mouth to an unconscious person. When symptoms persist or in all cases of doubt seek medical advice.
Notes to physician	:	Because of possible disturbances of cardiac rhythm, catecholamine drugs, such as epinephrine, that may be used in situations of emergency life support should be used with special caution.

SECTION 5. FIRE-FIGHTING MEASURES

Fire and Explosion Hazard	:	The product is not flammable. Hazardous decomposition products : Hydrogen fluoride, Carbonyl fluoride
Suitable extinguishing media	:	This material is a fire extinguishing agent.

SECTION 6. ACCIDENTAL RELEASE MEASURES

NOTE: Review FIRE FIGHTING MEASURES and HANDLING (PERSONNEL) sections before proceeding with clean-up. Use appropriate PERSONAL PROTECTIVE EQUIPMENT during clean-up.

Safeguards (Personnel)	:	Evacuate personnel, thoroughly ventilate area, use self-contained breathing apparatus. Keep upwind of leak - evacuate until gas has dispersed.
Spill Cleanup	:	Ventilate area using forced ventilation, especially low or enclosed places where heavy vapors might collect.

SECTION 7. HANDLING AND STORAGE

Handling (Personnel)	:	Do not breathe gas. Avoid contact with skin, eyes and clothing. Wash hands thoroughly after handling. Wash clothing after use. Decomposition will occur when product comes in contact with open flame or electrical heating elements. Handle in accordance with good industrial hygiene and safety practice.
Storage	:	Store in a clean, dry place.
Storage temperature	:	< 52 °C (< 126 °F)

SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering controls : Use only with adequate ventilation. Keep container tightly closed.

Personal protective equipment

Respiratory protection : Wear NIOSH approved respiratory protection as appropriate.

Hand protection : Additional protection: Impervious gloves

Eye protection : Wear safety glasses or coverall chemical splash goggles.

Skin and body protection : Where there is potential for skin contact, have available and wear as appropriate, impervious gloves, apron, pants, jacket, hood and boots.

Protective measures : Self-contained breathing apparatus (SCBA) is required if a large release occurs.

Exposure Guidelines

Exposure Limit Values

1,1,1,2,3,3,3-Heptafluoropropane

AEL *	(DUPONT)	1,000 ppm	8 & 12 hr. TWA

* AEL is DuPont's Acceptable Exposure Limit. Where governmentally imposed occupational exposure limits which are lower than the AEL are in effect, such limits shall take precedence.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Form	: Liquefied gas
Odor	: none
Melting point/range	: -131 °C (-204 °F)
Boiling point	: -16.3 °C (2.7 °F)
Vapour Pressure	: 4,547 hPa at 25 °C (77 °F)
Density	: 1.388 g/cm3 at 25 °C (77 °F) (as liquid)

SECTION 10. STABILITY AND REACTIVITY

Conditions to avoid	:	Stable at normal temperatures and storage conditions.
Incompatibility	:	Alkali metals Alkaline earth metals, and, powdered aluminum, or, Zinc
Hazardous decomposition products	:	Hazardous decomposition products , Hydrogen fluoride , Carbonyl fluoride, Carbon monoxide, Carbon dioxide
Hazardous reactions	:	Polymerization will not occur.

SECTION 11. TOXICOLOGICAL INFORMATION

FM-200®

Inhalation 4 h LC50	:	> 788698 ppm , rat
Inhalation	:	dog Cardiac sensitization
Dermal	:	not applicable
Oral	:	not applicable
Skin irritation	:	No skin irritation, Not tested on animals Not expected to cause skin irritation based on expert review of the properties of the substance.
Eye irritation	:	No eye irritation, Not tested on animals Not expected to cause eye irritation based on expert review of the properties of the substance.
Sensitisation	:	Does not cause skin sensitization., Not tested on animals Not expected to cause sensitization based on expert review of the properties of the substance. Did not cause sensitization on laboratory animals. There are no reports of human respiratory sensitization.

Repeated dose toxicity	:	Inhalation rat No toxicologically significant effects were found.
Carcinogenicity	:	Overall weight of evidence indicates that the substance is not carcinogenic.
Mutagenicity	:	Did not cause genetic damage in animals. Did not cause genetic damage in cultured mammalian cells. Did not cause genetic damage in cultured bacterial cells.
Reproductive toxicity	:	Animal testing showed no reproductive toxicity. Information given is based on data obtained from similar substances.
Teratogenicity	:	Animal testing showed no developmental toxicity.
Further information	:	Cardiac sensitisation threshold limit : 730190 mg/m3

SECTION 12. ECOLOGICAL INFORMATION

Aquatic Toxicity
FM-200®

96 h LC50	:	Danio rerio (zebra fish) > 200 mg/l Information given is based on data obtained from similar substances.
96 h LC50	:	Oncorhynchus mykiss (rainbow trout) > 81.8 mg/l Information given is based on data obtained from similar substances.
72 h EC50	:	Pseudokirchneriella subcapitata > 114 mg/l Information given is based on data obtained from similar substances.
72 h EC50	:	Pseudokirchneriella subcapitata > 118 mg/l Information given is based on data obtained from similar substances.
48 h EC50	:	Daphnia magna (Water flea) > 200 mg/l Information given is based on data obtained from similar substances.
48 h EC50	:	Daphnia magna (Water flea) > 97.9 mg/l Information given is based on data obtained from similar substances.

Environmental Fate

FM-200®

Biodegradability aerobic : 1 % OECD Test Guideline 301
Not readily biodegradable.

Biodegradability aerobic : 5 % OECD Test Guideline 301
Not readily biodegradable.

SECTION 13. DISPOSAL CONSIDERATIONS

Waste Disposal : Can be used after re-conditioning. Recover by distillation or remove to a permitted waste disposal facility. Comply with applicable Federal, State/Provincial and Local Regulations.

Environmental Hazards : Empty pressure vessels should be returned to the supplier.

SECTION 14. TRANSPORT INFORMATION

DOT	UN number	: 3296
	Proper shipping name	: Heptafluoropropane
	Class	: 2.2
	Labelling No.	: 2.2
IATA_C	UN number	: 3296
	Proper shipping name	: Heptafluoropropane
	Class	: 2.2
	Labelling No.	: 2.2
IMDG	UN number	: 3296
	Proper shipping name	: Heptafluoropropane
	Class	: 2.2
	Labelling No.	: 2.2

SECTION 15. REGULATORY INFORMATION

SARA 313 Regulated Chemical(s)	:	SARA 313: This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.
California Prop. 65	:	Chemicals known to the State of California to cause cancer, birth defects or any other harm: none known

SECTION 16. OTHER INFORMATION

		HMIS
Health	:	1
Flammability	:	0
Reactivity/Physical hazard	:	0
PPE	:	Personal Protection rating to be supplied by user depending on use conditions.

FM-200 is a registered trademark of E. I. du Po
Before use read DuPont's safety information.
For further information contact the local DuPont office or DuPont's nominated distributors.
® DuPont's registered trademark

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Significant change from previous version is denoted with a double bar.

FK-5-1-12

3M

Material Safety Data Sheet

SECTION 1: PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: 3M™ Novec ™ 1230 Fire Protection Fluid [FK-5-1-12]
MANUFACTURER: 3M
DIVISION: Electronics Markets Materials Division

ADDRESS: 3M Center
St. Paul, MN 55144-1000

EMERGENCY PHONE: 1-800-364-3577 or (651) 737-6501 (24 hours)

Issue Date: 01/21/11
Supercedes Date: 11/09/10

Document Group: 16-3425-2

Product Use:
Intended Use: Streaming and Flooding Fire Protection

SECTION 2: INGREDIENTS

Ingredient	C.A.S. No.	% by Wt
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	756-13-8	> 99.9

SECTION 3: HAZARDS IDENTIFICATION

3.1 EMERGENCY OVERVIEW

Specific Physical Form: Liquid
Odor, Color, Grade: clear colorless, low odor.
General Physical Form: Liquid
Immediate health, physical, and environmental hazards:

3.2 POTENTIAL HEALTH EFFECTS

Eye Contact:
Contact with the eyes during product use is not expected to result in significant irritation.

Skin Contact:
Contact with the skin during product use is not expected to result in significant irritation.

Inhalation:
If thermal decomposition occurs:
May be harmful if inhaled.

Ingestion:
No health effects are expected.

3.3 POTENTIAL ENVIRONMENTAL EFFECTS

This substance has a high Henry's Law constant and therefore will be primarily found in the atmosphere where photolysis will be the dominant reaction pathway. The ultimate degradation products of the photolysis reaction are HF, CO2 and trifluoroacetic acid (TFA).

This substance does not contribute to ozone depletion; it has an atmospheric lifetime of approximately 5 days and a Global Warming Potential (GWP) of 1 (IPCC 2001 Method).

SECTION 4: FIRST AID MEASURES

4.1 FIRST AID PROCEDURES

The following first aid recommendations are based on an assumption that appropriate personal and industrial hygiene practices are followed.

Eye Contact: No need for first aid is anticipated.

Skin Contact: No need for first aid is anticipated.

Inhalation: If signs/symptoms develop, remove person to fresh air. If signs/symptoms persist, get medical attention.

If Swallowed: No need for first aid is anticipated.

SECTION 5: FIRE FIGHTING MEASURES

5.1 FLAMMABLE PROPERTIES

Autoignition temperature	*Not Applicable*
Flash Point	No flash point
Flammable Limits(LEL)	*Not Applicable*
Flammable Limits(LEL)	*Not Applicable*
Flammable Limits(UEL)	*Not Applicable*
Flammable Limits(UEL)	*Not Applicable*

5.2 EXTINGUISHING MEDIA

Product is a fire-extinguishing agent.

5.3 PROTECTION OF FIRE FIGHTERS

Special Fire Fighting Procedures: Wear full protective equipment (Bunker Gear) and a self-contained breathing apparatus (SCBA).

Unusual Fire and Explosion Hazards: Not applicable.

Note: See STABILITY AND REACTIVITY (SECTION 10) for hazardous combustion and thermal decomposition information.

SECTION 6: ACCIDENTAL RELEASE MEASURES

6.1. Personal precautions, protective equipment and emergency procedures
Ventilate the area with fresh air. For large spill, or spills in confined spaces, provide mechanical ventilation to disperse or exhaust vapors, in accordance with good industrial hygiene practice. Warning! A motor could be an ignition source and could cause flammable gases or vapors in the spill area to burn or explode.

6.2. Environmental precautions
For larger spills, cover drains and build dikes to prevent entry into sewer systems or bodies of water. Place in a metal container approved for transportation by appropriate authorities. Dispose of collected material as soon as possible.

Clean-up methods
Observe precautions from other sections. Call 3M- HELPS line (1-800-364-3577) for more information on handling and managing the spill. Contain spill. Working from around the edges of the spill inward, cover with bentonite, vermiculite, or commercially available inorganic absorbent material. Mix in sufficient absorbent until it appears dry. Collect as much of the spilled material as possible. Clean up residue. Seal the container.

In the event of a release of this material, the user should determine if the release qualifies as reportable according to local, state, and federal regulations.

SECTION 7: HANDLING AND STORAGE

7.1 HANDLING
For industrial or professional use only. Contents may be under pressure, open carefully. Do not breathe thermal decomposition products.

7.2 STORAGE
Keep container in well-ventilated area. Store out of direct sunlight. Store away from heat. Store away from strong bases, amines, and alcohols.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 ENGINEERING CONTROLS
Provide appropriate local exhaust ventilation on open containers. For those situations where the fluid might be exposed to extreme overheating due to misuse or equipment failure, use with appropriate local exhaust ventilation sufficient to maintain levels of thermal decomposition products below their exposure guidelines.

8.2 PERSONAL PROTECTIVE EQUIPMENT (PPE)

8.2.1 Eye/Face Protection
Not applicable.

8.2.2 Skin Protection
Not applicable. Gloves are not required.

8.2.3 Respiratory Protection
As a good industrial hygiene practice:
Avoid breathing of vapors, mists or spray.
Under normal use conditions, airborne exposures are not expected to be significant enough to require respiratory protection.
If thermal decomposition occurs:
Do not breathe vapors.

Select one of the following NIOSH approved respirators based on airborne concentration of contaminants and in accordance with OSHA regulations: Half facepiece or fullface supplied-air respirator
. Consult the current 3M Respiratory Selection Guide for additional information or call 1-800-243-4630 for 3M technical assistance.
If thermal decomposition occurs, wear supplied air respiratory protection.

8.2.4 Prevention of Swallowing
Not applicable.

8.3 EXPOSURE GUIDELINES

Ingredient	Authority	Type	Limit	Additional Information
1,1,1,2,2,4,5,5,5-Nonafluoro-4-(trifluoromethyl)-3-pentanone	3M	TWA	150 ppm	

SOURCE OF EXPOSURE LIMIT DATA:
ACGIH: American Conference of Governmental Industrial Hygienists
CMRG: Chemical Manufacturer Recommended Guideline
OSHA: Occupational Safety and Health Administration
AIHA: American Industrial Hygiene Association Workplace Environmental Exposure Level (WEEL)

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Specific Physical Form:	Liquid
Odor, Color, Grade:	clear colorless, low odor.
General Physical Form:	Liquid
Autoignition temperature	*Not Applicable*
Flash Point	No flash point
Flammable Limits(LEL)	*Not Applicable*
Flammable Limits(LEL)	*Not Applicable*
Flammable Limits(UEL)	*Not Applicable*
Flammable Limits(UEL)	*Not Applicable*
Boiling Point	49 °C
Vapor Density	11.6 [*Ref Std:* AIR=1]

Vapor Pressure	244 mmHg [@ 20 °C]
Specific Gravity	1.6 [*Ref Std:* WATER=1]
pH	*Not Applicable*
Melting point	-108 °C
Solubility in Water	Nil
Evaporation rate	> 1 [*Ref Std:* BUOAC=1]
Volatile Organic Compounds	1600 g/l [*Test Method:* calculated SCAQMD rule 443.1]
Kow - Oct/Water partition coef	*No Data Available*
Percent volatile	100 %
VOC Less H2O & Exempt Solvents	1600 g/l [*Test Method:* calculated SCAQMD rule 443.1]
Viscosity	0.6 centipoise [@ 25 °C]
Materials to avoid	Alcohols

SECTION 10: STABILITY AND REACTIVITY

Stability: Stable.

Materials and Conditions to Avoid:
10.1 Conditions to avoid
Light

10.2 Materials to avoid
Strong bases
Amines
Alcohols

Additional Information: Listed materials to avoid should not be mixed with liquid Novec 1230 fluid. Avoid direct sunlight and ultraviolet light.

Hazardous Polymerization: Hazardous polymerization will not occur.

Hazardous Decomposition or By-Products

Substance	Condition
Carbon monoxide	During Combustion
Carbon dioxide	During Combustion
Hydrogen Fluoride	During Combustion

Hazardous Decomposition: Hydrogen fluoride has an ACGIH Threshold Limit Value of 3 parts per million (as fluoride) as a Ceiling Limit and an OSHA PEL of 3 ppm of fluoride as an eight hour Time-Weighted Average and 6 ppm of fluoride as a Short Term Exposure Limit. The odor threshold for HF is 0.04 ppm, providing good warning properties for exposure.

SECTION 11: TOXICOLOGICAL INFORMATION

Please contact the address listed on the first page of the MSDS for Toxicological Information on this material and/or its components.

SECTION 12: ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL INFORMATION

Not determined.
Please refer to existing literature on TFA

CHEMICAL FATE INFORMATION

Not determined.
Photolytic half-life: 3-5 days.
Photolytic degradation products may include Trifluoroacetic acid (TFA)
NOTE: Hydrolysis is not expected to be a significant degradation pathway. Product is highly insoluble in water and volatile, and use as a clean extinguishing agent would not typically result in releases to aquatic environments.

SECTION 13: DISPOSAL CONSIDERATIONS

Waste Disposal Method: Incinerate in an industrial or commercial facility in the presence of a combustible material. Combustion products will include HF. Facility must be capable of handling halogenated materials.
As a disposal alternative, dispose of waste product in a facility permitted to accept chemical waste. Reclaim if feasible. For information on product return, contact your distributor.

EPA Hazardous Waste Number (RCRA): Not regulated

Since regulations vary, consult applicable regulations or authorities before disposal.

SECTION 14:TRANSPORT INFORMATION

ID Number(s):
98-0212-3031-7, 98-0212-3201-6, 98-0212-3203-2, 98-0212-3217-2, 98-0212-3371-7, 98-0212-3414-5, 98-0212-3588-6

For Transport Information, please visit http://3M.com/Transportinfo or call 1-800-364-3577 or 651-737-6501.

SECTION 15: REGULATORY INFORMATION

US FEDERAL REGULATIONS
Contact 3M for more information.

311/312 Hazard Categories:
Fire Hazard - No Pressure Hazard - No Reactivity Hazard - No Immediate Hazard - No Delayed Hazard - No

STATE REGULATIONS
Contact 3M for more information.

CHEMICAL INVENTORIES

The components of this product are in compliance with the chemical notification requirements of TSCA.

All the components of this product are listed on China's Inventory of Chemical Substances.

The components of this material are in compliance with the new chemical notification requirements for the Korean Existing Chemicals Inventory.

Contact 3M for more information.

Additional Information: The components of this product are in compliance with the chemical notification requirements of the National Industrial Chemical Notification and Assessment Scheme (NICNAS) of Australia, the Canadian Environmental Protection Act (CEPA) and the Ministry of Economy, Trade and Industry of Japan. This product is notified in the Philippines as PMPIN-2005-3.

INTERNATIONAL REGULATIONS

Contact 3M for more information.

ADDITIONAL INFORMATION

U.S. EPA. Significant New Alternatives Policy Program (SNAP) approved for uses is streaming and flooding fire protection application.

This MSDS has been prepared to meet the U.S. OSHA Hazard Communication Standard, 29 CFR 1910.1200.

SECTION 16: OTHER INFORMATION

NFPA Hazard Classification

Health: 3 **Flammability:** 0 **Reactivity:** 1 **Special Hazards:** None

National Fire Protection Association (NFPA) hazard ratings are designed for use by emergency response personnel to address the hazards that are presented by short-term, acute exposure to a material under conditions of fire, spill, or similar emergencies. Hazard ratings are primarily based on the inherent physical and toxic properties of the material but also include the toxic properties of combustion or decomposition products that are known to be generated in significant quantities.

HMIS Hazard Classification

Health: 0 **Flammability:** 0 **Reactivity:** 1 **Protection:** X - See PPE section.

Hazardous Material Identification System (HMIS(r)) hazard ratings are designed to inform employees of chemical hazards in the workplace. These

ratings are based on the inherent properties of the material under expected conditions of normal use and are not intended for use in emergency situations. HMIS(r) ratings are to be used with a fully implemented HMIS(r) program. HMIS(r) is a registered mark of the National Paint and Coatings Association (NPCA).

Revision Changes:
Section 1: Product use information was modified.
Copyright was modified.
Section 15: Inventories information was modified.
Section 9: Boiling point information was modified.
Section 5: Flammable limits (UE) information was modified.
Section 5: Flammable limits (LEL) information was modified.
Section 5: Flash point information was modified.
Section 9: Flash point information was modified.
Section 9: Flammable limits (LEL) information was modified.
Section 9: Flammable limits (UEL) information was modified.
Section 2: Ingredient table was modified.
Section 8: Exposure guidelines ingredient information was modified.
Section 6: 6.2. Environmental precautions heading was modified.
Section 6: 6.1. Personal precautions, protective equipment and emergency procedures heading was modified.
Section 14: ID Number Heading Template 1 was added.
Section 14: ID Number(s) Template 1 was added.

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3M MSDSs are available at www.3M.com

IG-55

PRODUCT: **IG-55**

Version: 1.0 Date: March 26, 2007

IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND COMPANY

Product Name	IG-55
Chemical Formula	N_2 / Ar
Company Identification	Local filling station
Emergency Phone Numbers	Local filling station

COMPOSITION / INFORMATION ON INGREDIENTS

Substance / Preparation	Preparation
Components / Impurities	Contains no components or impurities which will influence the classification of the product
CAS No.	N/A
EEC No.	N/A
IG-55 Specifications	Mixture of 50% - 52% N_2 and 48% - 50% Ar. $H_2O \leq 10ppm$ $O_2 \leq 10ppm$ in base components.

HAZARDS IDENTIFICATION

Hazards Identification	In high concentrations may cause asphyxiation. Compressed gas.

FIRST AID MEASURES

Inhalation	In high concentrations may cause asphyxiation at high concentrations. Symptoms may include loss of mobility / consciousness. Victim may not be aware of asphyxiation. Remove victim to an uncontaminated area, wearing self-contained breathing apparatus. Keep person warm and at rest. Seek medical assistance. Apply artificial respiration if breathing has stopped.
Skin / eye contact	Compressed gas directed at the skin can enter the body through small wounds or can even penetrate the skin, causing serious or fatal injuries. Seek medical advice immediately.
Ingestion	Ingestion is not considered a potential route of exposure.

FIRE FIGHTING MEASURES

Specific Hazards	Exposure to fire may cause cylinders to rupture / explode. Call the Fire Department Non flammable.
Hazardous combustion products	None.
Suitable extinguishing media	All known extinguishants can be used.
Specific methods	If possible, stop flow of product. Move cylinder away or cool with water from a protected position.
Special protective equipment for fire fighters	In confined spaces use self-contained breathing apparatus.

ACCIDENTAL RELEASE MEASURES

Personal precautions	Evacuate area. Use self-contained breathing apparatus when entering area unless atmosphere is proved safe. Ensure adequate air ventilation.
Environmental precautions	Provided it is safe to do so, try to stop release. Prevent from entering sewers, basements, and work pits or any place where accumulation can be dangerous.
Clean up methods	Ventilate area.

HANDLING AND STORAGE

Handling and Storage	Backflow of any contaminating substance into cylinder must be prevented. Use only equipment specified as suitable for this product, its supply pressure and temperature. Contact your supplier if in doubt. Compressed gas cylinders are heavy and contain considerable stored energy. Use suitable equipment and handle with appropriate caution. Refer to suppliers. Keep cylinders below 122°F (50°C) in a well-ventilated place.

EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure Limit Value – ELV	No ELV specified, but atmosphere must have minimum 18% free oxygen
Personal Protection	Ensure adequate air ventilation.

PHYSICAL AND CHEMICAL PROPERTIES

Molecular weight	33.95
Melting point	-327.46°F (-199.7°C)
Boiling point	-310.18°F (-190.1°C)
Critical temperature	-210.46°F (-134.7°C)
Relative density gas	Heavier than air
Relative density liquid	N/A
Vapor pressure 20°C	N/A
Solubility in water	Negligible
Appearance / color	Colorless gas
Odor	No odor warning properties
Auto ignition temperature	Not applicable
Flammability range	Non flammable
Other data	Vapor is heavier than air. May accumulate in confined spaces, particularly at or below ground level.

STABILITY AND REACTIVITY

Stability and Reactivity	Stable under normal conditions.

TOXICOLOGICAL INFORMATION

General	No toxicological effects from this product.
LC50/ ih (ppm)	No acute toxicity

ECOLOGICAL INFORMATION

General	No ecological damage is caused by this product. Nitrogen and Argon are natural components of air. Nitrogen constituting approximately 78% and Argon approximately 0.9% of the earth's atmosphere.

DISPOSAL CONSIDERATIONS

General	To atmosphere in well ventilated area. Consider noise and pressure hazards. Do not discharge into any place where its accumulation could be dangerous. Contact your Fike Corporation supplier if guidance is required.

TRANSPORT INFORMATION

UN No.	1956
Class / Div.	2.2
Emergency Action Code	None specified
ADR / RID ITEM No. 1	2.1a
IMDG page	2141
IMO	EMS 2 – 04
ADR / RID Hazard No.	Not specified
Labelling ADR	Non flammable non-toxic gas.
Other transport information	Avoid transport on vehicles where the loads space is not separated from the driver's compartment. Ensure vehicle driver is aware of the potential hazards of the load and knows what to do at an emergency. Before transporting product cylinders ensure: - Cylinder valve is closed and not leaking - Valve outlet cap or plug (where provided) is correctly fitted - Adequate ventilation - Compliance with applicable regulations.

REGULATORY INFORMATION

Number in annex 1 of Dir. 67/548	Not included in Annex 1.
EC Classification	Not classified as a dangerous substance.
EC Labeling (Symbols, R & S phrases)	
- Symbols	Compressed gas.
- Risk Phrases	Asphyxiate in high concentrations.
- Safety Phrases	Do not breathe the gas. Keep cylinders in a well-ventilated place.

OTHER INFORMATION

The hazard of asphyxiation is often overlooked and must be stressed during operator training.

Before using this product in any new process or experiment, a thorough material compatibility and safety study should be carried out.

Details in this document are believed to be correct at present. While great care has been taken in the preparation of this information, no liability for injury, damage or non-compliance with any legislation or directive arising from its use can be accepted.

This sheet does not constitute or substitute for the user's own assessment of workplace risk as required by other health and safety legislation.

IG-541

ANSUL® ANSUL INCORPORATED
MARINETTE, WI 54143-2542

MATERIAL SAFETY DATA SHEET

INERGEN®
QUICK IDENTIFIER (In Plant Common Name)

Manufacturer's Name:	ANSUL INCORPORATED	Emergency Telephone No.:	CHEMTREC (800) 424-9300 or (703) 527-3887
Address:	One Stanton Street, Marinette, WI 54143-2542	Other Information Calls:	(715) 735-7411
Prepared By:	Safety and Health Department	Date Prepared:	June, 2001

SECTION 1 – IDENTITY

Common Name: (used on label) (Trade Name and Synonyms)	INERGEN	CAS No.:	N/A
Chemical Name:	Mixture of Inert Gases and Carbon Dioxide	Chemical Family:	Inert Gases: Nitrogen, Argon Nonmetallic Oxide: Carbon Dioxide
Formula:	52% N_2, 40% Ar and 8% CO_2 (Percent by Volume)		

SECTION 2 – INGREDIENTS

PART A – HAZARDOUS INGREDIENTS

Principal Hazardous Component(s) (chemical and common name(s)):	Wt. %	CAS No.	ACGIH TLV	Acute Toxicity Data
None	N/A	N/A	N/A	N/A

PART B – OTHER INGREDIENTS

Other Component(s) (chemical and common name(s)):	Vol. %	Wt. %	CAS No.	ACGIH TLV	Acute Toxicity Data
Nitrogen	52	42.5	7727-37-9	N/E	NDA
Argon	40	47.0	7440-37-1	N/E	NDA
Carbon Dioxide	8	10.5	124-38-9	5000 ppm	ihl-hmn LC_{LO} 100,000 ppm/1 min

SECTION 3 – PHYSICAL AND CHEMICAL CHARACTERISTICS (Fire and Explosion Data)

Boiling Point:	–320 °C			Specific Gravity (H_2O = 1):	.084 lbs./ft.^{3}	Vapor Pressure (mm Hg):	2205 psi @ 70 °F
Percent Volatile by Volume (%):	100	Vapor Density (Air = 1):	1.0	Evaporation Rate (= 1):	N/A Gas at room temperature.		
Solubility in Water:	Slight			Reactivity in Water:	No		
Appearance and Odor:	Colorless gas with no odor.						
Flash Point:	None	Flammable Limits in Air % by Volume:	N/A	Extinguisher Media:	N/A	Auto-Ignition Temperature:	N/A
Special Fire Fighting Procedures:	Though gas cylinders are equipped with pressure and temperature relief devices, they should be removed from high temperatures or fire to avoid risk of rupture.						
Unusual Fire and Explosion Hazards:	None						

SECTION 4 – PHYSICAL HAZARDS

Stability:	Unstable ☐ Stable ☒	Conditions to Avoid:	None
Incompatibility (Materials to Avoid):	Does not apply		
Hazardous Decomposition Products:	None		
Hazardous Polymerization:	May Occur ☐ Will Not Occur ☒	Conditions to Avoid:	N/A

SECTION 5 – HEALTH HAZARDS

Threshold Limit Value:	No TLV value cited, material can be an asphyxiant
Routes of Entry: Eye Contact:	Non irritating gas
Skin Contact:	Non irritating gas
Inhalation:	Not an asphyxiant at its normal design concentration of 34 – 70% V/V
Ingestion:	Non irritating gas
Signs and Symptoms: Acute Overexposure:	Dizziness, disorientation, loss of motor control
Chronic Overexposure:	Dizziness, disorientation, loss of motor control
Medical Conditions Generally Aggravated by Exposure:	Not determined at this time. Suspect respiratory impairment.
Chemical Listed as Carcinogen or Potential:	National Toxicology Program: Yes ☐ No ☒ I.A.R.C. Monographs: Yes ☐ No ☒ OSHA: Yes ☐ No ☒

SECTION 6 – EMERGENCY AND FIRST AID PROCEDURES

Eye Contact:	Avoid direct contact of high pressure gas discharge – use safety glasses.
Skin Contact:	Avoid direct contact of high pressure, cold gas with skin – wear gloves.
Inhalation:	Avoid direct inhalation of undiluted gas – gas mixture is an asphyxiant.
Ingestion:	N/A

SECTION 7 – SPECIAL PROTECTION INFORMATION

Respiratory Protection (Specify Type):	The normal discharge of INERGEN at its designed concentration between 34 – 70% V/V in a fixed enclosure does not present any hazard. Any exposure outside of these limits should result in the use of self-contained breathing apparatus. Respirators will not function in O_2 deficient atmospheres.		
Ventilation:	Local Exhaust: As required	Mechanical (General):	As required
Protective Gloves:	Loose fitting gloves of impermeable materials such as leather. Leather work gloves are recommended when handling compressed gas cylinders.	Eye Protection:	Chemical goggles or safety glasses recommended.
Other Protective Clothing or Equipment:	None		

SECTION 8 – SPECIAL PRECAUTIONS AND SPILL/LEAK PROCEDURES

Precautions to be Taken in Handling and Storage:	Normal precautions for handling high pressure gas
Other Precautions:	None
Steps to be Taken in Case Material is Released or Spilled:	None, material is a mixture of normal atmospheric gases
Waste Disposal Methods:	Not applicable, material is a mixture of normal atmospheric gases

HAZARDOUS MATERIAL IDENTIFICATION SYSTEM RATINGS

HAZARD INDEX:
4 Severe Hazard
3 Serious Hazard
2 Moderate Hazard
1 Slight Hazard
0 Minimal Hazard

1 HEALTH
0 FLAMMABILITY
0 REACTIVITY

WHMIS RATING:  CLASS A

N/A = Not Applicable NDA = No Data Available N/E = None Established

MSDS AVAILABILITY

MSDS AVAILABLE AT www.ansul.com **MSDS FAX ON DEMAND: 1-800-323-8493 or 715-735-7411, extension 3091**

AGENT	INDEX NUMBER
INERGEN	92130

ANSUL INCORPORATED, ONE STANTON STREET, MARINETTE, WI 54143-2542 715-735-7411 Form No. F-92130-7 ©2001 Ansul Incorporated Litho in U.S.A.

Material Safety Data Sheets for Fire Protection Agents Used in Portable Extinguishers

Halon 1211

MSDS

INDEX

Halon 1211

1. Identification of the Substance

1.1Identification of the preparation

Product Name:	"Halon 1211, BCF"
Chemical Name:	Bromochlorodifluoromethane
CAS No.:	353-59-3
Chemical Formula:	$CBrClF_2$
EINECS Number:	206-537-9

1.2Use of the preparation

The intended or recommended use of this preparation is as a fire extinguishing agent.

1.3Company identification

Manufacturer/Supplier:	Flag Fire
Address:	One Stanton Street, Marinette, WI 54143-2542
Prepared by:	Safety and Health Department
Phone:	715-732-3465
Internet address:	http://www.flagfire.com
Date of issue:	September, 2009
1.4Emergency phone:	CHEMTREC 800-424-9300 or 703-527-3887

2. Composition/Information on Ingredients

Ingredient Name:	Bromochlorodifluoromethane
Chemical Formula:	$CBrClF_2$
CAS No.:	353-59-3
EINECS Number:	206-537-9
Concentration, Wt%:	>99%
Hazard Identification:	See Heading 3

3. Hazards Identification

For Humans:

Product:

EU Classification:	Nonflammable gas
R Phrases:	None
S Phrases:	Keep container in a well ventilated place

Limit Values for Exposure:

None known

Neither this preparation nor the substances contained in it have been listed as carcinogenic by National Toxicology Program, I.A.R.C., or OSHA.

AS PART OF GOOD INDUSTRIAL AND PERSONAL HYGIENE AND SAFETY PROCEDURE, avoid all unnecessary exposure to the chemical substance and ensure prompt removal from skin, eyes, and clothing.

Signs & Symptoms:

Acute Exposure:

Eye Contact:	The liquid form of this material can produce chilling sensations and discomfort.

Skin Contact:	Systemically toxic concentrations are unlikely to be absorbed through the skin. Evaporation from the skin can produce chilling sensations. Skin injury does not result.
Inhalation:	Exposure to concentrations of this material above 4% for longer than one minute can cause toxic side effects. These can include dizziness, impaired coordination, reduced mental acuity and cardiac effects. Higher concentrations with longer exposures can cause unconsciousness or even death.
Ingestion:	Ingestion is not likely to occur since this material is a gas at room temperature.
Chronic Overexposure:	None known.

Medical conditions generally aggravated by exposure: Cardiac problems.

For Environment:	Relative to the environment, this material has an ozone depletion potential and a global warming potential. See Heading 12.

4. First Aid Measures

Eye Contact:	Immediately flush eyes with plenty of water for at least 15 minutes while holding lids open. If redness, itching or a burning sensation develops, get medical attention.
Skin Contact:	Wash the material off the skin with copious amounts of soap and water for at least 15 minutes. If redness, itching or a burning sensation develops, get medical attention.
Inhalation:	Remove victim to fresh air. If cough or other respiratory systems occur, consult medical personnel. If not breathing, give artificial respiration, preferably mouth-to-mouth. If breathing is difficult, give oxygen. Consult medical personnel.
Ingestion:	If patient is conscious, give 1 or 2 glasses of warm water to drink and get medical attention. DO NOT INDUCE VOMITING. Have victim lie down and keep warm.

NOTE TO PHYSICIAN: Product is an asphyxiant and can induce cardiac muscle sensitization to circulating epinephrine-like compounds. Do NOT give adrenalin or similar sympathomimetic drugs. Do NOT allow victim to exercise until 24 hours following specific exposures. Freeze burns of mucosal tissue can develop following specific exposures.

5. Firefighting Measures

This preparation is an extinguishing media.
Use water to cool fire exposed cylinders or other containers.
Containers are equipped with pressure and temperature relief devices, but rupture may occur under fire conditions and toxic decomposition by-products may be formed if used in fires over 900°C.
There are NO extinguishing media which must not be used for safety reasons.
Self-contained breathing apparatus with full facepiece and protective clothing when re-entering unventilated fire areas where product has been used.

6. Accidental Release Measures

For personal protection: Prevent skin and eye contact, see Heading 8.
Evacuate area, ventilate to outside atmosphere.
Cool or remove hot metal surfaces or source of non-extinguished flames.
Clean up: This product will vaporize and dissipate into the atmosphere. See Heading 13.
Relative to the environment, this material has an ozone depletion potential and a global warming potential. See Heading 12.

7. Handling and Storage

7.1Handling

Care should be taken in handling all chemical substances and preparations.
See incompatibility information in Heading 10.

7.2Storage

Store as a liquefied compressed gas in DOT approved pressure vessels away from high temperatures.
If cylinder is not connected to a system, it must be safety capped to protect against actuation of valve and release of agent.
See incompatibility information in Heading 10.
Relative to the environment, this material has an ozone depletion potential and a global warming potential. See Heading 12.

7.3Specific use
The intended or recommended use of this preparation is as a fire extinguishing agent.

8. Exposure Controls/Personal Protection

8.1Exposure limit values
Limit Values for Exposure:
None known.

8.2Exposure controls

8.2.1 Occupational exposure controls
Eye wash and safety showers are good safety practice in work areas when working with liquids.

8.2.1.1. Respiratory protection
Mechanical ventilation is recommended in low areas or indoors where vapours may collect.
Local exhaust is recommended for most exposures.
Not normally necessary if controls are adequate. For high concentrations exceeding 4%, or if exposure is prolonged, use positive pressure air supplied respirator.

8.2.1.2 Hand protection
Use plastic gloves when handling the liquid.

8.2.1.3 Eye protection
Chemical goggles recommended as mechanical barrier.
Full face shield is addition if splashing of liquid form is possible.

8.2.1.4 Skin protection
Standard work clothes should provide all protection which is necessary.

8.2.2 Environmental exposure controls
Relative to the environment, this material has an ozone depletion potential and a global warming potential. See Heading 12.

9. Physical and Chemical Properties

9.1 General information

Appearance:	Colourless gas.
Odour:	Sweet

9.2 Important health, safety and environmental information

pH:	Not applicable.
Boiling point/boiling range:	-4°C (26°F)
Flash point:	None
Flammability (solid/gas):	Not flammable
Explosive properties:	Not explosive
Oxidizing properties:	Not an oxidizer
Vapour pressure:	37.5 psi @ 70°F; 2,270 hPa @ 20°C
Relative Density:	(Water = 1) 1.83
Solubility:	
-Water solubility:	Negligible
-Fat solubility:	Not determined
Partition coefficient n-octanol/water (Log Pow):	Not determined
Viscosity:	Not determined
Vapour density (air=1)	5.7
Evaporation rate:	Not applicable

9.3 Other information

Auto-ignition temperature:	Does not ignite

10. Stability and Reactivity

10.1Conditions to avoid
Can be decomposed under fire conditions above 900°F

10.2Materials to avoid
Active metals and fires involving metal hydrides.

10.3Hazardous decomposition products
Normally stable.
Hazardous polymerization will NOT occur.
Combustion or decomposition products above 900°F include hydrogen bromide, hydrogen chloride, hydrogen fluoride, free halogens, and small amounts of carbonyl halides. These by-products have a sharp irritating odour. They are dangerous even in low concentrations and in sufficient concentrations can result in personal injury or death.

11. Toxicological Information

Product:

Acute Toxicity Data:	Inhalation LC_{50} (rat)	225,000 ppm. Above 6% caused tremors, narcotic paralysis, spasms and respiratory disorders.
	Inhalation LC_{50} (rat)	31,300 ppm/4 hrs.
	Inhalation LC_{50} (rat)	200,000 ppm/15 min.
	Inhalation (rat)	At 50,000 ppm, no effects were noted. At 75,000 ppm, slightly accelerated respiration was noted. At 100,000 ppm, mild excitement was seen. At 200,000 ppm, within 1 to 2 minutes marked excitation and some convulsions were noted. At 60 to 90 minutes, 2 of the 4 animals died. A concentration of 300,000 ppm immediately gave rise to convulsions and narcosis and all animals died within 50 min.
	Inhalation (dog)	At 25,000 to 75,000 ppm for 3.5 hours, there was reversible myocardial lesions and fatty degeneration of the liver.
Acute Irritation Data:	Skin (rabbit)	Not irritating
	Eye (rabbit)	Not irritating
Chronic Toxicity Data:	Inhalation (rat), for 21 days, dosed 6 hours per day, 5 days per week, at 3,300 ppm. No adverse effects of toxicological significance (NOAEL). At 10,000 ppm, there were signs of central nervous system depression. However, there were no signs of toxicity or histopathological changes observed and no potentiation of cardiac sensitization potential.	
Arnes Test:	Negative	
Reproduction Toxicity:	Inhalation (rat), at 5,000, 10,000 and 15,000 pm. Neither maternal or foetal toxicity was observed.	
Other Information:	Inhalation (dog): At 5,000 to 100,000 ppm resulted in cardiac sensitization above 20,000 ppm and in 10 to 0.5 minutes, depending on concentration. Inhalation (human): At 4 to 5% for 1 minute using face mask, subjects at 30 seconds became slightly dizzy and light headed. Over the next few seconds, these symptoms rapidly increased in severity until at 1 minute the subjects felt as though they were about to lose consciousness and exposure was stopped. Paraesthesia of the fingers and other parts of the body was sometimes noted towards the end of the experiment. Heart rate rose by approximately 30% during the early stages of exposure and remained at that level through the experiment. Depression of the T wave was consistently observed on the ECG tracings. The subjects recovered rapidly on cessation of exposure and felt perfectly normal again within 5 minutes. The heart rate and the ECG reverted to normal within 1 minute. There were no delayed after effects.	

12. Ecological Information

12.1 Ecotoxicity

Not determined because of complete partition to the atmosphere.

12.2 Mobility

Bromochlorodifluoromethane is a low boiling point gas and is practically insoluble in water.

12.3 Persistence and degradability

Photodegradation: >50% after 14 years

12.4 Bioaccumulative potential

Not determined.

12.5 Other adverse effects

Ozone depletion potential: Rated as 3 compared to trichlorofluoromethane nominally 1.
Photochemical ozone creation potential: None
Global warming potential: May contribute to global warming.

13. Disposal Considerations

Relative to the environment, this material has an ozone depletion potential and a global warming potential.
See Heading 12
Dispose of in compliance with national, regional and local provisions that may be in force.

14. Transport Information

Hazard Class or Division: Class 2.2, UN1974
Label: Nonflammable gas. Chlorodifluorobromomethane or refrigerant gas, R 12B1

For additional transport information, contact Flag Fire.
Relative to the environment, this material has an ozone depletion potential and a global warming potential. See Heading 12.

15. Regulatory Information

EU Classification:	Nonflammable gas
R Phrases:	None
S Phrases:	Keep container in a well-ventilated place.
Limit Values for Exposure:	None known
EINECS Status:	All components are included in EINECS inventories or are exempt from listing.
EPA TSCA Status:	All components are included in TSCA inventories or are exempt from listing.
Canadian DSL:	All components are included in DSL or are exempt from listing.
Environmental restrictions:	Known to destroy ozone in the upper atmosphere.

Restrictions on Marketing & Use: Check on restrictions because of the environmental effects.
Refer to any other national measures that may be relevant.

16. Other Information

(HMIS) Hazardous Material Identification System Ratings:

Health:	2	4. Severe Hazard
Flammability:	0	3. Serious Hazard
Reactivity:	0	2. Moderate Hazard
		1. Slight Hazard
		0. Minimal Hazard

(WHMIS) Canadian Workplace hazardous Material Identification System Ratings:
This product is rated: **A Compressed Gas.**

Format is from directive 2001/58/EC.
EINECS data is from **http://exb.jrc.it/existing-chemicals/**
The EU Classification has been changed in accordance with Directive 1999/45/EC and information in the EINICS ESIS files (Exisiting Substances Information System).
Toxicological information added from the EINICS ESIS (Existing Substances Information System).
Physical data added from the EINICS ESIS (Existing Substances Information System_.

17. Disclaimer

The above information is believed to be correct, but does not purport to be all inclusive and shall be used only as a guide. Flag Fire shall not be held liable for any damage resulting from handling or from contact with the above product.

Back to Top

Halotron I

1. PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: HALOTRON® I

OTHER/GENERIC NAMES: HCFC Blend B, Halotron® I Pre-Sat Base

PRODUCT USE: Halotron® I is a clean fire-extinguishing agent for streaming and local applications. NFPA 2001, *"Standard on Clean Agent Fire Extinguishing Systems"* defines a "Clean Agent" to be "electrically non-conducting, volatile, or gaseous fire extinguishant that does not leave a residue upon evaporation." Halotron® I is a safe, effective, environmentally acceptable clean agent. It is discharged as a liquid, which rapidly evaporates (i.e. it is volatile). It is a proprietary three component chemical blend based on HCFC-123 that is approved by the U.S. EPA under its Significant New Alternatives Policy (SNAP) program (referred to as "HCFC Blend B") for commercial/industrial, military, and maritime use in streaming applications as a substitute for halon 1211 (bromochlorodifluoromethane or "BCF").

MANUFACTURER: American Pacific Corporation, Halotron Division. 10622 West 6400 North, Cedar City, UT 84721

FOR MORE INFORMATION CALL: (435) 865-5000

IN CASE OF EMERGENCY CALL: (435) 865-5044

2. COMPOSITION/INFORMATION ON INGREDIENTS

INGREDIENT NAME	CAS NUMBER	WEIGHT %
2,2-dichloro-1,1,1-trifluoroethane (HCFC-123)	306-83-2 (EC Number 206-190-3)	Greater than 93%
Proprietary Gas Mixture	Multiple, proprietary	Less than 7%

OSHA Hazard Communication Standard: This product is considered hazardous under the OSHA Hazard Communication Standard.

3. HAZARDS IDENTIFICATION

HMIS

NFPA

HMIS PERSONAL PROTECTIVE EQUIPMENT (PPE) DESIGNATIONS:

A: SAFETY GLASSES
B: SAFETY GLASSES, GLOVES
C: SAFETY GLASSES, GLOVES, SYNTHETIC APRON
D: FACE SHIELD, GLOVES, SYNTHETIC APRON
E: SAFETY GLASSES, GLOVES, DUST RESPIRATOR
F: SAFETY GLASSES, GLOVES, SYNTHETIC APRON, DUST RESPIRATOR
G: SAFETY GLASSES, GLOVES, VAPOR RESPIRATOR
H: SPLASH GOGGLES, GLOVES, SYNTHETIC APRON, VAPOR RESPIRATOR
I: SAFETY GLASSES, GLOVES, COMBINATION DUST AND VAPOR RESPIRATOR
J: SPLASH GOGGLES, GLOVES, SYNTHETIC APRON COMBINATION, DUST AND VAPOR RESPIRATOR
K: AIRLINE HOOD OR MASK, GLOVES, FULL PROTECTIVE SUIT, BOOTS
X: SITUATIONS REQUIRING SPECIALIZED HANDLING

EMERGENCY OVERVIEW:

Halotron I is a colorless volatile, pressurized liquid with a slight ether-like odor. As with any chemical, dose and exposure are critically important variables to understand any potential treatment. Short-term exposure to high concentrations may result in central nervous system and cardiac effects. Long-term exposure to concentrations above those time weighted averages recommended herein may result in liver effects.

HEALTH HAZARDS:

Inhalation: Inhalation of high concentrations of vapor may cause central nervous system effects such as dizziness, drowsiness, anesthesia, or unconsciousness. Anesthetic effects may occur at concentrations of 5000 ppm v/v or above. At concentrations of 20,000 ppm or higher, HCFC-123 may causes increased sensitivity of the heart to adrenaline which might cause irregular heart beats and possible ventricular fibrillation or death. Long-term exposure to concentrations above those time weighted averages recommended may cause liver damage with altered enzyme levels and central nervous system depression. When used on a fire, hazardous decomposition products are formed, but typically are within safe emergency exposure limits.

Eye contact: May cause irritation, tearing, or blurring of vision, which result in part due to the cooling effect of HCFC-123 evaporation.

Skin contact: Evaporative cooling can result in chilling sensations or frostbite effects. Repeated exposure to the skin can result in dermatitis. Prolonged skin contact should be avoided, but short-term contact is not considered hazardous.

Ingestion: Not likely to occur in industrial use. HCFC-123 is a highly volatile liquid.

This material is NOT LISTED by OSHA, NTP, or IARC as a CARCINOGEN.

Additional region specific information

European Union:

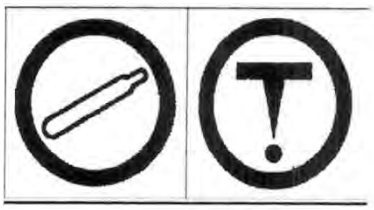
This chemical substance is not classified in the Annex I of Directive 67/548/EEC.

It is listed as a LPV

Canada:

Components are listed on the DSL

WHMIS Hazard Symbols



Halotron® I Fire Extinguishing Agent:

Caution: Contains a compressed gas. High concentrations may cause cardiac arrhythmia and central nervous system depression, and possibly asphyxiation. May produce irritating vapors during use. Use of this material in confined spaces when personnel are present is acceptable only if the volume of the space is sufficiently large, as specified on UL listed fire extinguishers containing this product and guidance contained herein.

First Aid: See other section of this MSDS. Toxicity information is located in other sections of this MSDS.

4. FIRST AID MEASURES

Routes of exposure	Signs and symptoms of exposure:	Emergency and first aid procedures:
SKIN:	Evaporative cooling can result in chilling sensations or frostbite effects. Short exposures, such as when filling equipment or in other situations, should not have a lasting effect. Repeated exposure to the skin, however, can result in dermatitis.	If significant exposure occurs, wash exposed area immediately with large amounts of water. Remove contaminated clothing and footwear. Contact a physician if irritation occurs.
INHALATION:	Significant exposure may cause central nervous system effects such as dizziness, drowsiness, anesthesia, or unconsciousness. Anesthetic effects may occur at concentrations of 5000 ppm (v/v) or above. At concentrations of 20,000 ppm (v/v) or higher, HCFC-123 may cause increased sensitivity of the heart to adrenaline which might cause irregular heartbeats and possibly ventricular fibrillation or death.	If experiencing breathing difficulties, move to fresh air. Apply artificial respiration if necessary. Never give anything by mouth to an unconscious person. Contact a physician if breathing difficulties occur. Note to physician: This material may make the heart more susceptible to arrhythmias. Catecholamines such as adrenaline, and other compounds having similar effects, should be reserved for emergencies and then used only with special caution.
INGESTION:	Not likely to occur in industrial use. Highly volatile liquid.	Do not induce vomiting; Give two glasses of water if ingestion occurs. Contact a physician
EYES:	Irritation and tearing may result from the cooling effect of HCFC-123 evaporation. Mild to moderate reversible eye damage, including irritation and corneal opacity has been seen in testing of undiluted HCFC-123.	Flush eyes with fresh water and move exposed person to a non-contaminated area. Contact a physician for cases where irritation or effects occur

5. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES

FLASH POINT: None.
FLASH POINT METHOD: Not applicable.
AUTOIGNITION TEMPERATURE: Not determined.

UPPER FLAMMABILITY LIMIT (volume % in air): Not applicable.
LOWER FLAMMABILITY LIMIT (volume % in air): Not applicable.

EXTINGUISHING MEDIA: The properties of this chemical make it an ideal extinguishing media its self.

SPECIAL FIRE FIGHTING PROCEDURES: Ensure that the area where the fire occurred is well ventilated before re-entering. Wear protective clothing. Use water spray or fog to cool storage containers to help prevent an uncontrolled pressure release.

UNUSUAL FIRE AND EXPLOSION HAZARDS: The concentrated agent when applied to fire can produce toxic by-products specifically hydrogen halides, which can cause damage. Avoid inhalation of these materials by evacuating and ventilating the area.

6. ACCIDENTAL RELEASE MEASURES

IN CASE OF SPILL OR OTHER RELEASE:

- **In the event of a large spill, allow for adequate ventilation, and do not re-enter an area without an SCBA until adequate ventilation is accomplished.**
- **For spills that might result in overexposure, evacuate the area and use protective gear and SCBA's.**
- **Avoid leakage into waterways because HCFC-123 is damaging to vegetation.**
- **Do not expose storage containers to fire, as uncontrolled pressure releases may result.**
- **The HCFC-123 vapors are heavier than air; therefore use caution when large volume releases occur in low-lying areas where concentrated vapors may accumulate.**
- **Recommended 1 Hr. Emergency Exposure Limit: 1000 ppm (v/v) on the same basis as above.**
- **Recommended 1 Min. Emergency Exposure Limit: 2500 ppm (v/v) on the same basis as above.**
- **Any food items that were directly sprayed by the liquid should be thrown away, and all surfaces that are used for food service should be washed (as normal) before re-use.**
- **WASTE DISPOSAL: Observe all federal, state, and local regulations for products of this type when accomplishing disposal.**
- **SECTION 313 SUPPLIER NOTIFICATION: This product contains more than 93% by weight 2,2-dichloro-1,1,1-trifluoroethane (CAS #306-83-2) which is subject to the reporting requirements of section 313 of the Emergency Planning and Community Right-To-Know Act of 1986 (40CFR372).**

7. HANDLING AND STORAGE

NORMAL HANDLING: (See section 8 for recommended personal protective equipment.) Avoid prolonged contact with the skin and eyes. Avoid inhaling material and ensure that good ventilation is present when handling. Wash after handling and follow good personal hygiene and good housekeeping practices. Keep containers closed and transfer material using closed systems. Handle in a manner to minimize spills.

Additional Note: Approved DOT shipping containers are a normal safe method of storage. Containers should be maintained in good condition. Do not allow material to remain in deteriorating containers. Because this product can volatilize, special care should be taken for over pressurization hazards if the containers are overheated or near a radiant heat source. Protective shoes, such as steel toed shoes, should be worn in addition to the other specified personal protective equipment (PPE) when handling bulk containers. Eye protection with splash protective side shields should be used when any possibility of splash or spray exists

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS: Ventilate as necessary to minimize exposure levels. Inspect and clean ventilation systems regularly. Prolonged use should occur only in areas with adequate ventilation. Keep storage containers tightly closed. Vapors are heavier than air posing a potential hazard if large volumes are trapped in enclosed or low places.

PERSONAL PROTECTIVE EQUIPMENT:

- Wear protective clothing when handling a leak in a storage container (does not apply to fire protection equipment servicing, other than safety goggles and gloves if large volumes can be exposed to skin).
- Neoprene, PVC or PVA gloves should be worn when handling material for prolonged periods. Short exposures to skin are not likely to pose a hazard.•
  Respiratory protection is not normally needed, however, if handled in enclosed spaces where applicable exposure limits might be exceeded, a Self Contained Breathing Apparatus (SCBA) should be used.
- When performing filling or servicing operations, PERFORM THESE ACTIVITIES IN A WELL-VENTILATED AREA.
  If handling materials outside a closed, sealed system such that the possibility of splashing exists, wear safety glasses with side shields. This statement is not intended to apply to use of a fire extinguisher where the nozzle arrangement is intended to direct the discharge away from the user of the extinguisher.

TIME WEIGHTED EXPOSURE LIMITS: (For persons regularly exposed to material)

- Workplace Environmental Exposure Level, WEEL (AIHA) (8 hrs.): 50 ppm (v/v), based on the primary component (HCFC-123). See section 11 for more information.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE: Colorless	**PHYSICAL STATE:** Pressurized liquid	**VAPOR PRESSURE OF LIQUID ALONE:** (68°F, 20°C): approx. 11.2 psig (77 kPa)	**RELATIVE DENSITY (AIR=1):** 5.14	**ODOR:** Slight ether-like odor
OCTANOL/WATER PARTITION COEFFICIENT (Log P_{ow}): 2.0-2.8	**MOLECULAR WEIGHT:** Approx. 150.7	**PRESSURE OF MIXTURE IN CONTAINER:** (70°F, 20°C): 95 psig (655 kPa)	**BOILING POINT AT 1 ATM.:** 27°C (80.6°F)	**GAS DENSITY:** Approx. 6.17 kg/m^3 (0.385 lb./ft^3) **LIQUID DENSITY:** (77°F, 25°C): 92.3 lb./ft^3 (1.48 kg/l)
EVAPORATION RATE: Faster than water, slower than ether		**FLASH POINT:** Not flammable		

10. STABILITY AND REACTIVITY

STABILITY: Normally stable (will decompose if exposed to a high radiant heat source, such as fire). The material is intended for use as a fire extinguishant.

INCOMPATIBILITIES: Incompatible with alkali or alkaline earth metals, and powdered metals Al, Zn, Be, etc.

HAZARDOUS DECOMPOSITION PRODUCTS: Decomposition products are hazardous. This material can be decomposed by high temperatures (open flames, glowing metal surfaces, etc.) forming hydrochloric and hydrofluoric acids, and possibly carbonyl halide.

HAZARDOUS POLYMERIZATION: Will not occur.

11. TOXICOLOGICAL INFORMATION

TOXIC PROPERTIES OF COMPONENTS: Acute toxicity is low.

- **For 2,2-dichloro-1,1,1-trifluoroethane (CAS # 306-83-2):**
  LC50 (4 hr.): 3.2% (32,000 ppm), (Inhalation)
  Oral Approximate Lethal Dose (ALD): 9 g/kg (body weight)
  Cardiotoxic LOAEL (Lowest Observed Adverse Effect Level): 2%vol.
  Cardiotoxic NOAEL (No Observed Adverse Effect Level): 1%vol.
  Toxicological testing was performed on HCFC-123 by the Program for Alternative Fluorocarbon Testing (PAFT). Data from acute toxicity studies in this program demonstrated that HCFC-123 has very low toxicity by skin application or inhalation.

- **For the proprietary gas mixture:**
  The toxic effects of the proprietary gas mixture in the absence of extreme temperature are primarily its ability to function as a simple asphyxiant (i.e. displace oxygen).

OTHER TOXICITY INFORMATION:

- **Animal Studies: For 2,2-dichloro-1,1,1-trifluoroethane (CAS #306-83-2):**

  Long-term exposure in a two year study (6 hours/day, 5 days/week) at concentrations of 300, 1000 and 5000 ppm decreased body weight, serum cholesterol, triglycerides and glucose, and increased urinary fluoride concentrations in rats. However, survival was significantly improved in all exposed groups compared to control animals. Inhalation of 300, 1000 and 5000 ppm caused an increase in benign tumors of the liver, pancreas, and testis. Tumors occurred late in life and none were assessed to be life threatening. Tumor formation is thought to occur through non-genotoxic mechanisms associated with a peroxisome proliferating potential or with hormonal disturbances in older rats.

  Exposure to dogs, guinea pigs or monkeys at 1000 ppm or greater for 6 hrs. /day, 7 days per week, for a total of 3 weeks, induced slight or mild liver damage with altered enzyme levels.

  Rodent studies indicate HCFC-123 is easily absorbed via inhalation. It distributes in all organs, more so in the liver. About 90% of inhaled HCFC-123 is eliminated via the lungs unchanged. The remaining amount is metabolized to trifluoroacetic acid and excreted in the urine. Small amounts of trifluoroacetylated proteins were detected in rats in laboratory studies.

  HCFC-123 did not affect reproductive performance in rats or harm the unborn animals in rats or rabbits at 5000 and 10,000 ppm.

  HCFC-123 was inactive in several test-tube genetic damage studies except the human lymphocyte chromosome aberration assay. HCFC-123 is also inactive in live animal genetic damage studies. Therefore, it is not considered genotoxic.

  Carcinogen: IARC: NO NTP: NO OSHA: NO

12. ECOLOGICAL INFORMATION

Aquatic toxicity:

Slightly toxic, 96 hour LC_{50} –Fathead minnow's > 77mg/l

13. DISPOSAL CONSIDERATIONS

Observe all federal, state, and local regulations for products of this type when accomplishing disposal.

The manufacturer assumes no liability for the use of this product in a manner that causes environmental or other harm.

14. TRANSPORT INFORMATION

DOT SHIPPING NAME: Compressed Gases, N.O.S., (contains tetrafluoromethane, argon), 2.2, UN1956
DOT SHIPPING LABEL: Nonflammable Gas
IMCO CLASS: 2.2

It is recommended that DOT approved transport containers and carriers be used for shipment of this product.

NOTE: The transportation information above covers the Halotron I fire extinguishing agent as shipped in bulk containers, and not when contained in fire extinguishers or fire extinguishing systems. When shipped in a stored-pressure type fire extinguisher, and pressurized with argon gas, the fire extinguisher is considered a hazardous material by the US Department of Transportation and Transport Canada. The proper shipping name shall be FIRE EXTINGUISHER and the UN designation is UN 1044. The DOT hazard class/division is 2.2 Non-Flammable Gas. Packing Group – N/A.

15. REGULATORY INFORMATION

TOXIC SUBSTANCES CONTROL ACT (TSCA)
TSCA INVENTORY STATUS: All components Listed on the TSCA Inventory.
OTHER TSCA ISSUES: None

SARA TITLE III/CERCLA "Reportable Quantities" (RQs) and/or "Threshold Planning Quantities" (TPQs) exist for the following ingredients. Listed only for Section 313 notification

INGREDIENT NAME	SARA/CERCLA RQ (lb)	SARA EHS TPQ (lb)

SECTION 313 SUPPLIER NOTIFICATION: This product contains more than 93% by weight 2,2-dichloro-1,1,1-trifluoroethane (CAS #306-83-2) which is subject to the reporting requirements of section 313 of the Emergency Planning and Community Right-To-Know Act of 1986 (40CFR372).

Spills or releases resulting in the loss of any ingredient at or above its RQ (For those compounds where an RQ exists) require immediate notification to the National Response Center [(800) 424-8802], to the state where you are located, and to your Local Emergency Planning Committee or Fire Department.

SARA 313 TOXIC CHEMICALS: The following ingredients are SARA 313 "Toxic Chemicals" and may be subject to annual reporting requirements. CAS numbers and weight percents are found in Section 2

INGREDIENT NAME	SARA/CERCLA RQ (lb)	SARA EHS TPQ (lb)
2,2-dichloro-1,1,1-trifluoroethane (HCFC-123)	Not listed, Section 313 only	Section 313

No ingredients listed in this section.

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

None of the components are listed under California Proposition 65. Tetrafluoromethane is listed under some US state's right to know act or lists

INGREDIENT NAME Halotron I Pre-Sat Base	SARA/CERCLA RQ (lb) Examine local regulations to determine	SARA EHS TPQ (lb)Examine local regulations to determine

ADDITIONAL REGULATORY INFORMATION:

Regulations

Listed in the Toxic Substances Control Act (TSCA) Inventory.: Yes , all components are on the TSCA Inventory
Listed on EPA SARA (313) Hazard Class, **Subject to reporting requirements of EPCRA Section 313**
All components listed in Canadian DSL.
HCFC 123 is listed under EINECS EC Number 206-190-3 as a low production volume chemical. All components of the proprietary gas mixture are listed in Einecs based on ESIS lookup.

Information about limitation of use: This blend is intended solely for use as a fire extinguishing agent and should not be used for other purposes without contact and technical discussion with the manufacturer.

16. OTHER INFORMATION

CURRENT ISSUE DATE: 23 April 2010

PREVIOUS ISSUE DATE: 24 September 2009

CHANGES TO MSDS FROM PREVIOUS ISSUE DATE ARE DUE TO THE FOLLOWING: Section 14, Transportation Information.

NOTE: The transportation information above covers the Halotron I fire extinguishing agent as shipped in bulk containers, and not when contained in fire extinguishers or fire extinguishing systems. When shipped in a stored-pressure type fire extinguisher, and pressurized with argon gas, the fire extinguisher is considered a hazardous material by the US Department of Transportation and Transport Canada. The proper shipping name shall be FIRE EXTINGUISHER and the UN designation is UN 1044. The DOT hazard class/division is 2.2 Non-Flammable Gas. Packing Group – N/A.

OTHER INFORMATION: The user is responsible to evaluate the safety and environmental consequences of any intended uses. The manufacturer assumes no liability for any usages that result in adverse consequences.

HFC-236fa

Material Safety Data Sheet

DuPont™ FE-36™ fire extinguishing agent

Version 2.0

Revision Date 11/30/2010 Ref. 130000000697

This SDS adheres to the standards and regulatory requirements of the United States and may not meet the regulatory requirements in other countries.

SECTION 1. PRODUCT AND COMPANY IDENTIFICATION

Product name	:	DuPont™ FE-36™ fire extinguishing agent
Tradename/Synonym	:	HFC-236fa HEXAFLUOROPROPANE
MSDS Number	:	130000000697
Product Use	:	Fire extinguishing agent
Manufacturer	:	DuPont 1007 Market Street Wilmington, DE 19898
Product Information	:	1-800-441-7515 (outside the U.S. 1-302-774-1000)
Medical Emergency	:	1-800-441-3637 (outside the U.S. 1-302-774-1139)
Transport Emergency	:	CHEMTREC: 1-800-424-9300 (outside the U.S. 1-703-527-3887)

SECTION 2. HAZARDS IDENTIFICATION

Emergency Overview

Misuse or intentional inhalation abuse may lead to death without warning.
Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing.
Rapid evaporation of the liquid may cause frostbite.

Potential Health Effects

Skin	:	Contact with liquid or refrigerated gas can cause cold burns and frostbite.
Eyes	:	Contact with liquid or refrigerated gas can cause cold burns and frostbite.

Inhalation : Misuse or intentional inhalation abuse may cause death without warning symptoms, due to cardiac effects.
Other symptoms potentially related to misuse or inhalation abuse are: Anaesthetic effects, Light-headedness, dizziness, confusion, incoordination, drowsiness, or unconsciousness, irregular heartbeat with a strange sensation in the chest, heart thumping, apprehension, feeling of fainting, dizziness or weakness.
Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing.

Repeated exposure : Adverse effects from repeated inhalation may include:
Altered response to stimuli

Carcinogenicity
None of the components present in this material at concentrations equal to or greater than 0.1% are listed by IARC, NTP, or OSHA, as a carcinogen.

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Component	CAS-No.	Concentration
1,1,1,3,3,3-Hexafluoropropane	690-39-1	>=99%

SECTION 4. FIRST AID MEASURES

Skin contact : Flush area with lukewarm water. Do not use hot water. If frostbite has occurred, call a physician.

Eye contact : In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Call a physician.

Inhalation : If inhaled, remove to fresh air. Keep person calm. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Ingestion : Is not considered a potential route of exposure.

Notes to physician	:	Because of possible disturbances of cardiac rhythm, catecholamine drugs, such as epinephrine, that may be used in situations of emergency life support should be used with special caution.

SECTION 5. FIRE-FIGHTING MEASURES

Fire and Explosion Hazard	:	Not a fire or explosion hazard. Hazardous gases/vapors produced are: Hydrogen fluoride
Suitable extinguishing media	:	This material is a fire extinguishing agent.
Firefighting Instructions	:	Wear self-contained breathing apparatus (SCBA). Wear full protective equipment.

SECTION 6. ACCIDENTAL RELEASE MEASURES

NOTE: Review FIRE FIGHTING MEASURES and HANDLING (PERSONNEL) sections before proceeding with clean-up. Use appropriate PERSONAL PROTECTIVE EQUIPMENT during clean-up.

Safeguards (Personnel)	:	Keep upwind of leak - evacuate until gas has dispersed.
Accidental Release Measures	:	Do not enter places where used or stored until adequately ventilated.

SECTION 7. HANDLING AND STORAGE

Handling (Personnel)	:	Do not breathe gas. Avoid contact with skin, eyes and clothing. Wash hands thoroughly after handling. Decomposition will occur when product comes in contact with open flame or electrical heating elements.
Storage	:	Valve protection caps and valve cutlet threaded plugs must remain in place unless container is secured with valve outlet piped to use point. Do not drag, slide or roll cylinders. Use a suitable hand truck for cylinder movement. Never attempt to lift cylinder by its cap. Use a pressure reducing regulator when connecting cylinder to lower pressure (>3000 psig) piping or systems. Use a check valve or trap in the discharge line to prevent hazardous

back flow into the cylinder. Cylinders should be stored upright and firmly secured to
prevent falling or being knocked over.
Separate full containers from empty containers. Keep at temperature not exceeding 52°C. Avoid area where salt or other corrosive materials are present.

SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering controls	:	Use only with adequate ventilation especially for enclosed and low area where vapors can accumulate. Keep container tightly closed.
Personal protective equipment		
Respiratory protection	:	Wear NIOSH approved respiratory protection as appropriate.
Eye protection	:	Wear safety glasses or coverall chemical splash goggles.
Skin and body protection	:	Where there is potential for skin contact, have available and wear as appropriate, impervious gloves, apron, pants, jacket, hood and boots.

Exposure Guidelines
Exposure Limit Values
1,1,1,3,3,3-Hexafluoropropane

AEL *	(DUPONT)	1,000 ppm	8 & 12 hr. TWA

* AEL is DuPont's Acceptable Exposure Limit. Where governmentally imposed occupational exposure limits which are lower than the AEL are in effect, such limits shall take precedence.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Form	:	Liquefied gas
Color	:	colourless
Odor	:	slight, ether-like
Freezing point	:	-94 °C (-137 °F)
Boiling point	:	-1.44 °C (29.41 °F)
Vapour Pressure	:	2,724 hPa at 25 °C (77 °F)
Density	:	1.3598 g/cm3 at 25 °C (77 °F) (as liquid)

Specific Gravity : 1.36 at 25 °C (77 °F)

SECTION 10. STABILITY AND REACTIVITY

Incompatibility : Strong bases metallic sodium, Potassium, lithium

Hazardous decomposition products : Hazardous gases/vapors produced are:, Hydrogen fluoride

Hazardous reactions : Polymerization will not occur.

SECTION 11. TOXICOLOGICAL INFORMATION

1,1,1,3,3,3-Hexafluoropropane

Dermal	:	not applicable
Oral	:	not applicable
Inhalation 4 h LC50	:	> 457000 ppm , rat
Inhalation	:	dog Cardiac sensitization
Skin irritation	:	No skin irritation, Not tested on animals Not expected to cause skin irritation based on expert review of the properties of the substance.
Eye irritation	:	No eye irritation, Not tested on animals Not expected to cause eye irritation based on expert review of the properties of the substance.
Skin sensitization	:	Does not cause skin sensitization., Not tested on animals Not expected to cause sensitization based on expert review of the properties of the substance. There are no reports of human respiratory sensitization.
Repeated dose toxicity	:	Inhalation rat

Reversible, Altered response to stimuli

Carcinogenicity	:	Overall weight of evidence indicates that the substance is not carcinogenic.
Mutagenicity	:	Did not cause genetic damage in animals. Did not cause genetic damage in cultured mammalian cells. Did not cause genetic damage in cultured bacterial cells.
Teratogenicity	:	Animal testing showed no developmental toxicity.
Further information	:	Cardiac sensitisation threshold limit : 932751 mg/m3

SECTION 12. ECOLOGICAL INFORMATION

Aquatic Toxicity
1,1,1,3,3,3-Hexafluoropropane

96 h LC50	:	Zebra fish 292 mg/l
96 h ErC50	:	Pseudokirchneriella subcapitata > 186 mg/l
48 h EC50	:	Daphnia magna (Water flea) 299 mg/l

Environmental Fate
DuPont™ FE-36™ fire extinguishing agent

Biodegradability	:	16 % According to the results of tests of biodegradability this product is not readily biodegradable.

SECTION 13. DISPOSAL CONSIDERATIONS

Waste Disposal	:	Can be used after re-conditioning. Reclaim by distillation, incinerate, or remove to permitted waste facility. Comply with applicable Federal, State/Provincial and Local Regulations.
Environmental Hazards	:	Empty pressure vessels should be returned to the supplier.

DuPont™ FE-36™ fire extinguishing agent

Version 2.0

Revision Date 11/30/2010 Ref. 130000000697

SECTION 14. TRANSPORT INFORMATION

DOT	UN number	: 3163
	Proper shipping name	: Liquefied gas, n.o.s. (1,1,1,3,3,3-Hexafluoropropane)
	Class	: 2.2
	Labelling No.	: 2.2
IATA_C	UN number	: 3163
	Proper shipping name	: Liquefied gas, n.o.s. (1,1,1,3,3,3-Hexafluoropropane)
	Class	: 2.2
	Labelling No.	: 2.2
IMDG	UN number	: 3163
	Proper shipping name	: Liquefied gas, n.o.s. (1,1,1,3,3,3-Hexafluoropropane)
	Class	: 2.2
	Labelling No.	: 2.2

SECTION 15. REGULATORY INFORMATION

SARA 313 Regulated Chemical(s) : SARA 313: This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

California Prop. 65 : Chemicals known to the State of California to cause cancer, birth defects or any other harm: none known

SECTION 16. OTHER INFORMATION

		HMIS
Health	:	1
Flammability	:	0
Reactivity/Physical hazard	:	1

DuPont™ FE-36™ fire extinguishing agent

Version 2.0

Revision Date 11/30/2010 Ref. 130000000697

Before use read DuPont's safety information.
For further information contact the local DuPont office or DuPont's nominated distributors.
® DuPont's registered trademark

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

Significant change from previous version is denoted with a double bar.

Appendix C
Acronyms

ATCM	Airborne Toxic Control Measure
BAU	Business as Usual
CAAA	Clean Air Act Amendments
CARB	California Air Resources Board
CBI	Confidential Business Information
CFC	Chlorofluorocarbon
DCE	1,2,trans-Dichloroethylene
FK	Fluoroketone
GHG	Greenhouse gas
GWP	Global Warming Potential
HAP	Hazardous Air Pollutant
HARC	Halon Alternatives Research Corporation
HCFC	Hydrochlorofluorocarbon
HEEP	HFC Emissions Estimating Program
HFC	Hydrofluorocarbon
HFE	Hydrofluoroether
HRC	Halon Recycling Corporation
IG	Inert Gas
IPA	Isopropyl Alcohol
IRTA	Institute for Research and Technical Assistance
METH	Methylene Chloride
NF3	Nitrogen Trifluoride
NFPA	National Fire Protection Association
nPB	n-Propyl Bromide
PERC	Perchloroethylene
PFC	Perfluorocarbon
PFPE	Perfluoropolyether
RTI	Research Technology International
SCAQMD	South Coast Air Quality Management District
SF6	Sulfur Hexafluoride
TAC	Toxic Air Contaminant
TCA	1,1,1-Trichloroethane
TCE	Trichloroethylene
UNEP	United Nations Environment Programme

Appendix D
List of Company and Organization Contacts

Amerex
Ansul
Bay Area Air Quality Management District
Carbon Resources
CSI Fire Equipment Co., Inc.
Coast Fire Extinguishing
DuPont Fluoroproducts
Environmental Protection Agency
F1 Service Company
Facilities Protection Systems
Fike Corporation
Halon Alternatives Research Corporation
Halon Recycling Corporation
Lipsner Smith
3M
Marx Brothers
Orange County Fire Protection
Pacific Scientific
PSC Environmental Services
San Diego County Air Pollution Control District
South Coast Air Quality Management District
Tyco
Ventura County Air Pollution Control District
Wesco