

Authors: Charles Salocks, PhD, DABT and Karlyn Black Kaley, PhD, DABT Reviewers: Page Painter, MD, PhD and David Siegel, PhD, DABT Editor: Karlyn Black Kaley, PhD, DABT Staff Support: Caron Poole

Introduction

The clandestine synthesis of methamphetamine (meth) and other illegal drugs is a growing public health and environmental concern. For every pound of meth synthesized there are six or more pounds of hazardous materials or chemicals produced. These are often left on the premises, dumped down local septic systems, or illegally dumped in backyards, open spaces, in ditches along roadways or down municipal sewer systems. In addition to concerns for peace officer safety and health, there is increasing concern about potential health impacts on the public and on unknowing inhabitants, including children and the elderly, who subsequently occupy dwellings where illegal drug labs have been located.

The Office of Environmental Health Hazard Assessment (OEHHA), in cooperation with the Department of Toxic Substances Control (DTSC), has been charged with assisting in identifying and characterizing chemicals used or produced in the illegal manufacturing of methamphetamine, which pose the greatest potential human health concerns. To address in part this growing environmental problem and the need for public health and safety professionals to make appropriate risk management decisions for the remediation of former methamphetamine laboratory sites, OEHHA has developed two types of chemical-specific information documents.

The first set, technical support documents (TSDs), are referenced, multi-page publications, which contain important health and safety data, exposure limits, and key information for recognizing chemicals used or produced during the manufacturing of methamphetamine. These documents will likely be most helpful to health and safety officers, industrial hygienists, or others interested in more detailed toxicological information. The second set, two-page fact sheets, contain much of the same information as the corresponding TSDs; however, the details are presented in a more succinct, graphical format. The fact sheets will be helpful to individuals, including the public, who want to be able to quickly recognize potential chemicals of concern found in illegal methamphetamine labs in order to avoid inadvertent exposures and resulting health impacts.

For more information or to obtain copies of these and other documents, contact:

DEPARTMENT OF TOXIC SUBSTANCES CONTROL

P.O. Box 806 Sacramento, CA 95812-0806

www.dtsc.ca.gov/SiteCleanup/

OFFICE OF ENVIRONMENTAL HEALTH HAZARD ASSESSMENT

P.O. Box 4010 Sacramento, CA 95812-4010

www.oehha.ca.gov

I. Chemical Name

A. FREON®

"Freon" is a registered trademark of Dupont and refers to chlorinated and fluorinated hydrocarbon solvents. Note: This document summarizes health and safety information for three fully halogenated solvents; Freons 11, 12, and 113. The term "Freon(s)" collectively refers to Freons 11, 12, and 113.

B. Synonyms

Freon 11: Trichloromonofluoromethane, CFC-11 (Hazardtext, 2003B; Meditext, 2003).

Freon 12: Dichlorodifluoromethane, CFC-12 (Hazardtext, 2003A).

Freon 113: 1, 1, 2-trichloro-1, 2, 2-trifluoroethane, CFC-113, TTE, flush (Turkington, 2000; OSHA, 1998; Dupont, 1996C).

II. Role in Clandestine Drug Synthesis: Methamphetamine

Liquid Freon is used as a solvent for methamphetamine base extraction. It is most frequently used by Mexican National labs (Turkington, 2000).

III. Chemical Description

A. Appearance

Freon is a clear, colorless liquid or gas (Hazardtext, 2003B; Reprotext, 2003; Dupont, 1996A; Dupont, 1996C). Freon is sold in five-gallon cylinders with left-handed threads and a pressure vent, as well as aerosol cans used to recharge automobile air conditioning systems. Freon has also been sold in plastic one-gallon containers.

B. Taste

Not available. If Freon is ingested, the primary sensation is likely to be coldness.

C. Odor

Freon 11: Nearly odorless. Slight ethereal odor at high concentrations (NIOSH, 2001B; Dupont, 1996B).

Freon 12: Ether-like odor (NIOSH, 2003A).

Freon 113: Similar to the odor of carbon tetrachloride. Slight ethereal odor (NIOSH, 2001F; Dupont, 1996C).

D. Odor Threshold

Freon 11: 5 ppm (Amoore & Hautala, 1983).

Freon 113: 45 ppm (air) (Amoore & Hautala, 1983).

E. Irritancy Threshold

Not available.

F. Odor Safety Class

Freon 11: B (Amoore & Hautala, 1983); 50-90% of distracted persons perceive warning of threshold limit value.

Freon 113: C (Amoore & Hautala, 1983); less than 50% of distracted persons perceive warning of threshold limit value.

NOTE: Odor is not an adequate indicator of the presence of Freon and does not provide reliable warning of hazardous concentrations (NIOSH, 2001E; NIOSH, 2001C; NIOSH, 2001D).

G. Vapor Density

Freon 11: 4.7-5.04 (NIOSH, 2001D; Hazardtext, 2003B; Dupont, 1996B).

Freon 12: 4.1- 4.28 (Hazardtext, 2003A; Ansul, 2002; Dupont, 1996A; NIOSH, 2001C).

Freon 113: 2.9-6.5 (Dupont, 1996C; Dupont, 1996D; OPPT, 1994B; NIOSH, 2001E).

NOTE: Freon vapor is heavier than air and may accumulate in low-lying areas, i.e., along the ground, displacing oxygen and posing an asphyxiation hazard (NIOSH, 2001A; NIOSH, 2001E; NIOSH, 2001C; NIOSH, 2001D).

H. Vapor Pressure

Freon 11: 690 mmHg at 20° C (68° F). Freon 11 is a gas at temperatures above 75° F (NIOSH, 2003B).

Freon 12: 4886 mmHg at 25° C (77° F) (Dupont, 1996A).

Freon 113: 334 mmHg at 25° C (77° F). Freon 113 is a gas at temperatures above 118° F (Dupont, 1996C; NIOSH, 2003C).

IV. Containers and Packaging

A. Commercial Products

Freons are used as refrigerants, fire extinguishing agents, local anesthetics, aerosol propellants, blowing agents for foams, chemical/synthetic intermediates, and heat transfer mediums. They are also used as solvents for oils and gums, for degreasing, and for dry-cleaning (Meditext, 2003; Hazardtext, 2003A; OSHA, 1998; Hazardtext, 2003B; Lewis, 1997A; OPPT, 1994A; OPPT, 1994B; Lewis, 1997B). Trade names of commercial products that contain chlorofluorocarbon solvents include Genetron® (Honeywell International, Inc.), Isotron, Ucon, and Arcton (HVAC, 1995; Meditext, 2003).

B. Pharmaceutical Use

No pharmaceutical uses for Freons 11, 12, or 113 were identified.

A number of halogenated hydrocarbons and ethers are used as general inhalation anesthetics. Among them is halothane (2-bromo-2-chloro-1,1,1-trifluoroethane), which has a chemical structure that is similar to that of Freon 113. Due to the unpredictable occurrence of serious side effects and the availability of more effective anesthetic agents, medical use of halothane has declined dramatically in recent years (Hardman et al., 1996).

V. Chemical Hazards

A. Reactivity

Freons are stable under normal conditions (Dupont, 1996A; Dupont, 1996B; Dupont, 1996C).

B. Flammability

Freons are generally nonflammable and noncombustible, but Freon 113 will ignite and burn weakly at 1256° F. Freon vapor is heavier than air and will spread along the ground and collect in low or confined areas (Hazardtext, 2003A; NIOSH, 2003C; Dupont, 1996B; NIOSH, 1997; Reprotext, 2003). When involved in a fire or in contact with heated surfaces (>900°F), Freons decompose producing hydrogen chloride, hydrogen fluoride, phosgene, and chlorine. All of these decomposition products are acutely toxic and are very hazardous even in low concentrations (NIOSH, 2001A; NIOSH, 2001E; NIOSH, 2001C).

C. Chemical Incompatibilities

Freons are incompatible with perchloric acid, chromium trioxide, nitric acid, chemically active metals (e.g., aluminum and zinc), alkali metals (e.g., sodium and potassium), and alkaline earth metals (e.g., beryllium, magnesium, and calcium) (Turkington, 2000; NIOSH, 2003A; NIOSH, 2003B; NIOSH, 2001F). Freon 113 decomposes on contact with alloys containing at least 2% magnesium (NIOSH, 2003C).

VI. Health Hazards

A. General

Freons generally have a low order of toxicity. However, exposure to relatively high concentrations (>100 ppm) may produce adverse effects on health. Possible exposure routes include inhalation, ingestion, skin and eye contact (NIOSH, 2003B; NIOSH, 2003C).

Freon vapor may cause irritation of the eyes, nose, throat, and mucous membrane at low concentrations (Meditext, 2003; Hazardtext, 2003B). At high concentrations, Freon vapor may cause pulmonary edema and neurological problems such as central nervous system depression, dizziness, headache, drowsiness, tremors, seizures, confusion, in-coordination, loss of consciousness, and paralysis (Hazardtext, 2003B; Dupont, 1996A; OSHA, 1998; NIOSH, 2003C). Inhalation of high concentrations may also result in temporary alteration of the heart's electrical activity by increasing the sensitivity of the heart to the arrhythmogenic action of epinephrine, causing irregular pulse, palpitations, or inadequate circulation (Dupont, 1996A; Dupont, 1996F; OSHA, 1998; Reprotext, 2003). Deliberate inhalation ("sniffing") may cause death without warning (Dupont, 1996A; Dupont, 1996F; OSHA, 1998).

At extremely high concentrations (several thousand ppm), Freon vapor has the potential to reduce the amount of oxygen available for breathing, especially in confined spaces, which can lead to suffocation (Dupont, 1996A; Dupont, 1996F; OSHA, 1998; Reprotext, 2003).

Ingestion of liquid Freon 11 may cause nausea, headache, or weakness (Dupont, 1996B); ingestion of larger volumes may also cause stomach perforation and necrosis (Hazardtext, 2003B; Lewis, 1997A). Direct eye contact with liquid Freon may cause irritation with discomfort, tearing, or blurring of vision. Skin contact with liquid Freon can cause frostbite. Repeated skin contact with liquid Freon may also cause drying of the skin resulting in mild skin irritation with discomfort or rash (Dupont, 1996A; Dupont, 1996F; OSHA, 1998).

Chronic exposure to Freon 113 may produce weakness, pain, and paresthesias (a sensation of numbness, tingling, or burning) in the legs (NIOSH, 2003C). Chronic fluorocarbon exposure has been linked with motor, memory, and learning deficits (Reprotext, 2003). Long-term inhalation of high concentrations may also lead to abnormal liver function with hepatic lesions (Dupont, 1996E; Hazardtext, 2003B).

B. Acute Effects

Acute exposure to Freon vapor can result in eye, nose and throat irritation, palpitations, lightheadedness, dizziness, disorientation, headaches, and tachycardia (Meditext, 2003; Reprotext, 2003). Impaired coordination, reduced mental acuity, unconsciousness, or death can occur at very high concentrations (Ansul, 2002). Freons may cause cerebral edema, psychosis, anxiety, seizures, peripheral neuropathy, nausea, hepatic necrosis, rhabdomyolysis (disintegration of muscle), and an anaphylactic (hypersensitivity) reaction (Meditext, 2003).

Inhalation: Inhalation of high concentrations of Freon vapor may produce a "high," followed by agitation, fear, and sudden collapse. Acute inhalation exposure may cause pulmonary irritation, bronchial constriction, chest tightness, cough, difficulty breathing, adult respiratory distress syndrome, and pulmonary edema (Meditext, 2003). Extremely high concentrations of Freon vapor may reduce the availability of oxygen, especially in confined spaces, possibly leading to suffocation (Hazardtext, 2003B). Inhalation of high concentrations (~5,000 ppm) is associated with the development of arrhythmias and sudden death due to myocardial sensitization to endogenous catecholamines (e.g., epinephrine).

Ingestion: Ingestion of Freon may cause frostbite to the upper airway and gastrointestinal tract, and may result in perforation and necrosis of the stomach (Meditext, 2003). The major ingestion hazard is liquid entering the lungs (aspiration) during ingestion or vomiting, which may result in "chemical pneumonia," a potentially fatal condition. Symptoms of Freon 113 ingestion include dizziness, headache, confusion, in-coordination, coughing, gasping, choking, shortness of breath, bluish discoloration of the skin, rapid breathing and heart rate, loss of consciousness, and fever. In more serious cases, pulmonary edema or bleeding, drowsiness, coma, and seizures may occur (Dupont, 1996C).

Skin contact: Contact with liquid Freon may result in defatting, irritation, frostbite, dermatitis, or contact dermatitis (Meditext, 2003).

C. Chronic Effects

Chronic use of Freon 11 has been linked to diseases of the mucous membranes, lungs, and central nervous system (Hazardtext, 2003B). In the occupational setting, chronic fluorocarbon exposure has been associated with a syndrome of impaired psychomotor speed, impaired memory and learning, and emotional instability (Reprotext, 2003). Repeated or prolonged skin contact may cause dermatitis (NIOSH, 2001E; NIOSH, 2001D).

D. Skin Contact

Skin contact with liquid Freon may cause drying of the skin and irritation; discomfort or rash are also possible. Contact is likely to cause a sensation of coldness due to rapid evaporation of Freon (Ansul, 2002; Dupont, 1996C). Prolonged contact may cause temporary tingling, numbness, coldness, or dermatitis (Dupont, 1996C). Frostbite can occur on contact with liquid

Freon, particularly with Freon 12 (NIOSH, 2001C; NIOSH, 2001D; Dupont, 1996C). When contact is brief or inadvertent, Freons will evaporate quickly from the skin surface. As a result, significant dermal absorption and resultant systemic toxicity are unlikely (Dupont, 1996C).

E. Eye Contact

Contact with the eyes may result in irritation, burning, redness, tearing, blurring of vision, and pain (Meditext, 2003; NIOSH, 2001E; NIOSH, 2001C; NIOSH, 2001D; Dupont, 1996C). Frostbite of the lids may also occur (Meditext, 2003).

F. Inhalation

Nasal irritation and frostbite may occur following acute inhalation exposures (Meditext, 2003). Inhalation of very high concentrations may cause confusion, cough, shortness of breath, drowsiness, light-headedness, and giddiness, and may lead to narcosis, cardiac irregularities, unconsciousness, or death (Ansul, 2002; NIOSH, 2001E; NIOSH, 2001C; NIOSH, 2001D). Inhalation at concentrations greater than 2500 ppm of Freon 113 may adversely affect psychomotor performance (OPPT, 1994B). Inhalation of high concentrations (~5,000 ppm) is associated with the development of arrhythmias and sudden death due to myocardial sensitization to endogenous catecholamines (e.g., epinephrine) (Hazardtext, 2003B; Meditext, 2003). At extremely high concentrations (several thousand ppm), Freon vapor has the potential to reduce the amount of oxygen available for breathing, especially in confined spaces, which can lead to unconsciousness and suffocation (Ansul, 2002; NIOSH, 2001E; NIOSH, 2001C; NIOSH, 2001D). Chronic inhalation of vapor concentrations below 100 ppm is unlikely to produce any adverse effects (Dupont, 1996C).

G. Ingestion

Ingestion of liquid Freon may cause frostbite to the upper airway and gastrointestinal tract (Meditext, 2003). The major ingestion hazard is liquid entering the lungs (aspiration) during ingestion or vomiting, which may result in "chemical pneumonia," a potentially fatal condition. For this reason, vomiting should <u>not</u> be induced if Freon is ingested. Symptoms of Freon 113 ingestion include dizziness, headache, confusion, in-coordination, coughing, gasping, choking, shortness of breath, bluish discoloration of the skin, rapid breathing and heart rate, loss of consciousness, and fever. In more serious cases, pulmonary edema or bleeding, drowsiness, coma, and seizures may occur (Dupont, 1996C).

H. Predisposing Conditions

Individuals with pre-existing diseases of the central nervous or cardiovascular system may have increased susceptibility to the effects of Freons (Dupont, 1996A; OSHA, 1998; Dupont, 1996B; Dupont, 1996D). Persons exposed to epinephrine or other sympathomimetic amines, e.g., bronchodilators and nasal decongestants (e.g., Sudafed®), might be at increased risk for the cardiotoxic effects of Freons (Reprotext, 2003).

I. Special Concerns for Children

Children may inhale relatively larger doses of Freon because, relative to their body weight, they have a greater lung surface area and larger minute volume than adults. Since Freon has a high vapor density, children could also receive high doses due to their short stature and the higher levels of Freon vapor that may be present near the ground when Freon is spilled.

VII. First Aid

A. Eyes

If eye tissue is frozen, obtain medical attention immediately. If eye tissue is not frozen, immediately flush eyes with large amounts of water for at least fifteen minutes, occasionally lifting the lower and upper eyelids. If irritation, pain, swelling, tearing, or sensitization to light persists, obtain medical attention as soon as possible (NIOSH, 2003A; Meditext, 2003).

B. Skin

If frostbite has occurred, do not rub the affected area. Flush with water or remove frozen clothing from frostbitten area; seek medical attention immediately. Otherwise, immediately remove contaminated clothing and wash contaminated area with soap and water for at least fifteen minutes. Seek medical attention if redness, itching, or burning occurs (NIOSH, 2003A; NIOSH, 2003C; NIOSH, 2003B; NIOSH, 2001A).

C. Ingestion

If Freons are ingested, do not induce vomiting, as the hazard of aspirating the material into the lungs is greater than allowing it to progress through the intestinal tract. Drink 1-2 glasses of warm water and obtain medical attention if necessary (Ansul, 2002; Dupont, 1996B; Dupont, 1996C).

D. Inhalation

Move exposed individual to fresh air immediately. If person is not breathing, give artificial respiration. If person has difficulty breathing, give oxygen. Seek medical attention (NIOSH, 2003A; Dupont, 1996B; Dupont, 1996C; NIOSH, 2001A).

VIII. Standards for Inhalation Exposure

A. Occupational Exposure Limits (NIOSH, 1997; ACGIH, 1994)

Freon 11

1.	Ceiling Limit (C) (not to be exceeded at any time):	1,000 ppm (5,600 mg/m ³)		
2.	Short-Term Exposure Limit (STEL or ST):	Not established.		
3.	8-Hour Time Weighted Average (TWA):	1,000 ppm (5,600 mg/m ³)		
4.	10-Hour Time Weighted Average (TWA):	Not established.		
5.	Immediately Dangerous to Life & Health (IDLH):	2,000 ppm (11,240 mg/m ³)		
Freon 12				
1.	Ceiling Limit (C) (not to be exceeded at any time):	Not established.		
2.	Short-Term Exposure Limit (STEL or ST):	Not established.		
3.	8-Hour Time Weighted Average (TWA):	1,000 ppm (4,950 mg/m ³)		
4.	10-Hour Time Weighted Average (TWA):	1,000 ppm (4,950 mg/m ³)		
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5.	Immediately Dangerous to Life & Health (IDLH):	15,000 ppm (74,250 mg/m°)		

Freon 113

- 1. Ceiling Limit (C) (not to be exceeded at any time):
- 2. Short-Term Exposure Limit (STEL or ST):
- 3. 8-Hour Time Weighted Average (TWA):
- 4. 10-Hour Time Weighted Average (TWA):
- 5. Immediately Dangerous to Life & Health (IDLH):

Important Definitions Follow:

Ceiling Limit (C) is a concentration that must not be exceeded during any part of the workday.

<u>Short-Term Exposure Limit (STEL or ST)</u> is a 15-minute time-weighted average concentration that should not be exceeded during any part of the workday.

<u>8-Hour Time Weighted Average</u> (8-hour TWA) concentration is an exposure standard that must not be exceeded during any 8-hour work shift of a 40-hour workweek. 8-Hour TWA exposure standards established by the Occupational Safety and Health Administration (OSHA) are called <u>Permissible Exposure Limits</u> (PELs). 8-Hour TWA exposure standards established by the American Conference of Governmental Industrial Hygienists (ACGIH) are called <u>Threshold Limit Values</u> (TLVs).

<u>10-Hour Time Weighted Average</u> (10-hour TWA) concentration is an exposure standard that must not be exceeded during a 10-hour workday of a 40-hour workweek. 10-Hour TWA exposure standards developed by the National Institute for Occupational Safety and Health (NIOSH) are called <u>Recommended Exposure Limits</u> (RELs).

Immediately Dangerous to Life & Health (IDLH) defines a concentration which poses a threat of death or immediate or delayed permanent health effects, or is likely to prevent escape from such an environment in the event of failure of respiratory protection equipment. IDLH values are developed by the National Institute for Occupational Safety and Health (NIOSH).

"Skin" notation (NIOSH): significant uptake may occur as a result of skin contact. Therefore, appropriate personal protective clothing should be worn to prevent dermal exposure.

B. Emergency Response Planning Guidelines (1 hour or less) (AIHA, 2002)

ERPG-1 (protective against mild, transient effects): Not established.
ERPG-2 (protective against serious adverse effects): Not established.
ERPG-3 (protective against life-threatening effects): Not established.

Emergency Response Planning Guidelines (ERPGs) are developed by the American Industrial Hygiene Association (AIHA) to assist in planning and preparation for catastrophic accidental chemical releases. ERPGs allow emergency response planners to estimate the consequences of large-scale chemical releases on human health, and evaluate the effectiveness of prevention strategies and response capabilities. ERPGs assume that the duration of exposure is one hour

Not established. 1,250 ppm (9,590 mg/m³) 1,000 ppm (7,670 mg/m³)

1,000 ppm (7,670 mg/m³)

2,000 ppm (15,340 mg/m³)

or less. They are not intended to be used as limits for routine operations and are not legally enforceable.

Definitions for the three ERPG levels are:

<u>ERPG-1</u>: an estimate of the maximum airborne concentration below which nearly all individuals could be exposed for up to one hour without experiencing more than mild, transient adverse health effects or without perceiving a clearly defined objectionable odor.

<u>ERPG-2</u>: an estimate of the maximum airborne concentration below which nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair an individual's ability to take protective action.

<u>ERPG-3</u>: an estimate of the maximum airborne concentration below which nearly all individuals could be exposed for up to one hour without experiencing or developing life-threatening health effects.

C. Acute Reference Exposure Levels (1-hour exposure) (OEHHA, 1999)

- 1. Level protective against mild adverse effects:
- 2. Level protective against severe adverse effects:
- 3. Level protective against mild adverse effects:

D. Chronic Reference Exposure Level (multiple years) (OEHHA, 2002A)

Level protective of adverse health effects:

Reference Exposure Levels (RELs) are developed by the California EPA's Office of Environmental Health Hazard Assessment (OEHHA). A REL is a concentration at or below which no adverse health effects are anticipated, even in the most sensitive members of the general population (for example, persons with pre-existing respiratory disease). RELs incorporate uncertainty factors to account for information gaps and uncertainties in the toxicological data. Therefore, exceeding a REL does not necessarily indicate an adverse health impact will occur in an exposed population. Acute RELs are based on an assumption that the duration of exposure is one hour or less. Chronic RELs are intended to be protective for individuals exposed continuously over at least a significant fraction of a lifetime (defined as 12 years).

E. Chronic Reference Concentration (lifetime exposure) (IRIS, 2003)

Level protective of adverse health effects:

Not established.

IX. Environmental Contamination Concerns

A. Surface Water

Volatilization from water surfaces is expected to be an important fate process with estimated volatilization half-lives for a model river and a model lake being four hours and five days, respectively. Hydrolysis is not expected to occur. Bioconcentration in organisms is low to moderate; BCF (Bioconcentration factor: the ratio of the chemical concentration in the organism to that in surrounding water) is from 11-86. Biodegradation, adsorption to sediment, and abiotic degradation are insignificant. Large volumes of Freon may sink to the bottom and gradually bubble up to the surface if the water is not too cold (Hazardtext, 2003B; HSDB, 2001A; HSDB, 2001B).

Not established.

Not established.

Not established.

Not established.

B. Groundwater

In general, Freons that are spilled onto soil have the potential to leach into groundwater, because they do not bind well to soil (Hazardtext, 2003B; HSDB, 2001A; HSDB, 2001B). Fully halogenated hydrocarbons such as Freons 11, 12, and 113 are very resistant to chemical and biological degradation and are likely to be persistent contaminants if they reach groundwater.

C. Drinking Water

No information available.

Suggested No Adverse Response Levels (NAS, 1980):

Freon 11

24-hour exposure:	88,000 ppb (88 mg/l)
7-day exposure:	8,000 ppb (8 mg/l)
Freon 12	
24-hour exposure:	350,000 ppb (350 mg/l)
7-day exposure:	150,000 ppb (150 mg/l)
Chronic exposure:	5,600 ppb (5.6 mg/l)
Freon 113	Not established.
Public Health Goals for Drinking Water (OEHHA, 2002B)	
Freon 11	700 ppb (0.7 mg/l)
Freon 12	Not established.
Freon 113	4,000 ppb (4.0 mg/l)
Preliminary Remediation Goals for Tap Water (U.S. EPA, 20	002, Region IX):
Freon 11	1,300 ppb (1.3 mg/l)
Freon 12	390 ppb (0.4 mg/l)
Freon 113	59,000 ppb (59 mg/l)

D. Soil

If Freon is spilled onto soil, a portion may evaporate from the surface and the remainder will leach downward into the soil. Mobility through the soil is expected to be moderate based on estimated K_{oc} values. Freon does not bind well to soil, and leaching to groundwater is possible (Hazardtext, 2003B; HSDB, 2001B).

Preliminary Remediation Goals for Residential Soil (U.S. EPA, 2002, Region IX):

Freon 11	390 mg/kg
Freon 12	94 mg/kg
Freon 113	5600 mg/kg

E. Air

Once released to air, Freon exists solely as a gas. In the atmosphere, fully halogenated Freons diffuse to the troposphere, where they are very stable and can be transported great distances.

Technical Support Document: Toxicology Clandestine Drug Labs/ Meth.:

Wet deposition may result in some loss, but re-volatilization into the atmosphere is likely. The only degradation process is diffusion to the stratosphere, where photolytic destruction of Freons results in depletion of stratospheric ozone, thereby increasing the amount of ultraviolet-B (UV-B) radiation reaching the earth's surface (Hazardtext, 2003B; HSDB, 2001A; HSDB, 2001B).

Preliminary Remediation Goals for Ambient Air (U.S. EPA, 2002, Region IX):

Freon 11	0.73 mg/m ³
Freon 12	0.21 mg/m ³
Freon 113	31 mg/m ³

F. Indoor Surface Contamination

Freon 12 is a gas at room temperature and will not contaminate interior surfaces. Freons 11 and 113 both have a very high vapor pressure and will evaporate from surfaces quickly.

X. Personal Protective Equipment

Wear lined (cold-insulating) butyl gloves when handling liquid Freon. Wear chemical splash goggles and a full-face shield if splashing of liquid is likely to occur. Contaminated clothing should be removed promptly and replaced. Wear personal protective clothing to prevent skin contact. In an emergency or entry into areas of unknown concentration, wear a self-contained breathing apparatus (SCBA) that has a full face-piece and is operated in a pressure demand or other positive pressure mode. Do not wear contact lenses when working with Freon (NIOSH, 2003A; Dupont, 1996D; NIOSH, 2003B; NIOSH, 2001A).

XI. References

<u>ACGIH, 1994</u>: American Conference of Governmental Industrial Hygienists (1994). *1994-1995 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices.* American Conference of Governmental Industrial Hygienists; Cincinnati, OH.

<u>AIHA, 2002</u>: American Industrial Hygiene Association (2002). *The AIHA 2002 Emergency Response Planning Guidelines and Workplace Environmental Exposure Level Guides Handbook*. American Industrial Hygiene Association; Fairfax, VA.

<u>Amoore & Hautala, 1983</u>: Amoore, J.E., and Hautala, E. (1983). Odor as an aid to chemical safety: Odor thresholds compared with threshold limit values and volatilities for 214 industrial chemicals in air and water dilution. Journal of Applied Toxicology 3: 272-290.

<u>Ansul, 2002</u>: Ansul Inc. (2002). *Material Safety Data Sheet for Dichlorodifluoromethane*. Marinette, WI.

Dupont, 1996A: Dupont (1996). Material Safety Data Sheet for "Freon" 12. Wilmington, DE.

Dupont, 1996B: Dupont (1996). Material Safety Data Sheet for "Freon" 11. Wilmington, DE.

<u>Dupont, 1996C</u>: Dupont (1996). *Material Safety Data Sheet for "Freon" 113 Refrigerant*. Wilmington, DE.

Dupont, 1996D: Dupont (1996). Material Safety Data Sheet for "Freon" 113 RC. Wilmington, DE.

Technical Support Document: Toxicology Clandestine Drug Labs/ Meth.:

<u>Dupont, 1996E</u>: Dupont (1996). *Material Safety Data Sheet for "Freon" 11/ "Freon" 113 Fluorocarbon Blends*. Wilmington, DE.

<u>Dupont, 1996F</u>: Dupont (1996). *Material Safety Data Sheet for "Freon" 12/ "Freon" 11 Blends*. Wilmington, DE.

<u>Hardman et al., 1996</u>: Hardman, J.G., Limbird, L.E., Molinoff, P.B., Ruddon, R.W., and Gilman, A.G. (1996). *Goodman and Gilman's The Pharmacological Basis of Therapeutics.* Ninth Edition. McGraw-Hill Companies, Inc.; New York, NY.

<u>Hazardtext, 2003A</u>: Hazardtext® Hazard Management (2003). *Dichlorodifluoromethane*. In: Hurlburt, KM (Ed.): TOMES® System. Micromedex. Greenwood Village, CO (Edition expires October 7, 2003).

<u>Hazardtext, 2003B</u>: Hazardtext® Hazard Management (2003). *Trichloromonofluoromethane*. In: Hurlburt, KM (Ed.): TOMES® System. Micromedex. Greenwood Village, CO (Edition expires October 7, 2003).

<u>HSDB, 2001A</u>: Hazardous Substances Data Bank, National Library of Medicine (2001). TOXNET (Toxicology Data Network). *Trichlorofluoromethane*. Retrieved from: http://toxnet.nlm.nih.gov/

<u>HSDB, 2001B</u>: Hazardous Substances Data Bank, National Library of Medicine (2001). TOXNET (Toxicology Data Network). *1,1,2-Trichloro-1,2,2-Trifluoroethane*. Retrieved from: http://toxnet.nlm.nih.gov/

<u>HVAC, 1995</u>: HVAC Web Tech (1995). *Freons.* Retrieved from: http://www.hvacwebtech.com/freons.htm

IRIS, 2003: Integrated Risk Information System, National Library of Medicine (2003). TOXNET (Toxicology Data Network). Retrieved from: http://toxnet.nlm.nih.gov/

<u>Lewis, 1997A</u>: Lewis, D. (1997). *Public Health Goal for Trichlorofluoromethane (FC-11) in Drinking Water.* Office of Environmental Health Hazard Assessment, California Environmental Protection Agency.

<u>Lewis, 1997B</u>: Lewis, D. (1997). *Public Health Goal for 1,1,2-Trichloro-1,2,2-Trifluoroethane in Drinking Water*. Office of Environmental Health Hazard Assessment, Environmental Protection Agency.

<u>Meditext, 2003</u>: Meditext® Medical Management (2003). *Fluorinated Hydrocarbons*. In: Hurlburt, KM (Ed.): TOMES® System. Micromedex. Greenwood Village, CO (Edition expires October 7, 2003).

<u>NAS, 1980</u>: National Academy of Sciences (1980). *Volume 3: Drinking Water and Health.* National Research Council, Safe Drinking Water Committee. National Academy Press; Washington, D.C.

<u>NIOSH, 1997</u>: National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services (1997). *NIOSH Pocket Guide to Chemical Hazards*. DHHS (NIOSH) Publication No. 97-140. NIOSH Publications; Cincinnati, OH.

Technical Support Document: Toxicology Clandestine Drug Labs/ Meth.:

<u>NIOSH, 2001A</u>: National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services (2001). NIOSH Pocket Guide to Chemical Hazards and Other Databases (Compact Disc). *Emergency Response Guidebook*. Guide 160 Halogenated Solvents (Freon 141b). DHHS (NIOSH) Publication No. 2001-145. NIOSH Publications; Cincinnati, OH.

<u>NIOSH, 2001B</u>: National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services (2001). NIOSH Pocket Guide to Chemical Hazards and Other Databases (Compact Disc). *Fluorotrichloromethane*. DHHS (NIOSH) Publication No. 2001-145. NIOSH Publications; Cincinnati, OH.

<u>NIOSH, 2001C</u>: National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services (2001). NIOSH Pocket Guide to Chemical Hazards and Other Databases (Compact Disc). *International Chemical Safety Card for Dichlorodifluoromethane*. DHHS (NIOSH) Publication No. 2001-145. NIOSH Publications; Cincinnati, OH.

<u>NIOSH, 2001D</u>: National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services (2001). NIOSH Pocket Guide to Chemical Hazards and Other Databases (Compact Disc). *International Chemical Safety Card for Trichlorofluoromethane*. DHHS (NIOSH) Publication No. 2001-145. NIOSH Publications; Cincinnati, OH.

<u>NIOSH, 2001E</u>: National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services (2001). NIOSH Pocket Guide to Chemical Hazards and Other Databases (Compact Disc). *International Chemical Safety Card for 1,1,2-Trichloro-1,2,2-Trifluoroethane*. DHHS (NIOSH) Publication No. 2001-145. NIOSH Publications; Cincinnati, OH.

<u>NIOSH, 2001F</u>: National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services (2001). NIOSH Pocket Guide to Chemical Hazards and Other Databases (Compact Disc). *1,1,2-Trichloro-1,2,2-Trifluoroethane*. DHHS (NIOSH) Publication No. 2001-145. NIOSH Publications; Cincinnati, OH.

<u>NIOSH, 2003A</u>: National Institute for Occupational Safety and Health (2003). NIOSH Pocket Guide to Chemical Hazards. *Dichlorodifluoromethane*. In: Hurlburt, KM (Ed.): TOMES® System. Micromedex. Greenwood Village, CO (Edition expires October 7, 2003).

<u>NIOSH, 2003B</u>: National Institute for Occupational Safety and Health (2003). NIOSH Pocket Guide to Chemical Hazards. *Fluorotrichloromethane*. In: Hurlburt, KM (Ed.): TOMES® System. Micromedex. Greenwood Village, CO (Edition expires October 7, 2003).

<u>NIOSH, 2003C</u>: National Institute for Occupational Safety and Health (2003). NIOSH Pocket Guide to Chemical Hazards. *1,1,2-Trichloro-1,2,2-Trifluoroethane*. In: Hurlburt, KM (Ed.): TOMES® System. Micromedex. Greenwood Village, CO (Edition expires October 7, 2003).

<u>OEHHA, 1999</u>: Office of Environmental Health Hazard Assessment, California Environmental Protection Agency (1999). *Determination of Acute Reference Exposure Levels for Airborne Toxicants*. *Acute Toxicity Summary*.

<u>OEHHA, 2002A</u>: Office of Environmental Health Hazard Assessment, California Environmental Protection Agency (2002). *All Chronic Reference Exposure Levels Adopted by OEHHA as of September 2002*. Retrieved from: http://www.oehha.ca.gov/air/chronic_rels/pdf/allchrels.pdf

Technical Support Document: Toxicology Clandestine Drug Labs/ Meth.:

<u>OEHHA, 2002B</u>: Office of Environmental Health Hazard Assessment, California Environmental Protection Agency (2002). *Water- Public Health Goals (PHGs).* Retrieved from: http://www.oehha.org/water/phg/allphgs.html

<u>OPPT, 1994A</u>: Office of Pollution Prevention and Toxics, U.S. Environmental Protection Agency (1994). OPPT Chemical Fact Sheet. *Chemicals in the Environment: Freon 113*. Retrieved from: http://www.epa.gov/opptintr/chemfact/f_freon.txt

<u>OPPT, 1994B</u>: Office of Pollution Prevention and Toxics, U.S. Environmental Protection Agency (1994). *Chemical Summary for Freon 113*. Retrieved from: http://www.epa.gov/opptintr/chemfact/s_freon.txt

<u>OSHA, 1998</u>: Occupational Safety and Health Administration (1998). *Sampling and Analytical Method for 1,1-Dichloro-1-fluoroethane (Freon 141b) 1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 143)*. Retrieved from: http://www.osha-slc.gov/dts/sltc/methods/organic/org113/org113.html

<u>Reprotext, 2003</u>: Reprotext® Document (2003). *1,1-Dichloro-1-Fluoroethane*. In: Hurlburt, KM (Ed.): TOMES® System. Micromedex. Greenwood Village, CO (Edition expires October 7, 2003).

<u>Turkington, 2000</u>: Turkington, R. (2000). *HazCat*® *Methamphetamine Chemical/Waste Identification System*. Haztech Systems, Inc.; San Francisco, CA.

<u>U.S. EPA, 2002</u>: United States Environmental Protection Agency, Region IX (2002). *Preliminary Remediation Goals*, *Freon.* Retrieved from: http://www.epa.gov/Region9/waste/sfund/prg/files/02table.pdf