

Occupational Health Guideline for Fluorotrichloromethane

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: CCl_2F
- Synonyms: Refrigerant 11; Freon 11; monofluorotrichloromethane; trichlorofluoromethane; trichloromonofluoromethane
- Appearance and odor: Colorless liquid or gas with a chlorinated-solvent odor that is detectable only at concentrations well above the permissible exposure (above 20% by volume).

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for fluorotrichloromethane is 1000 parts of fluorotrichloromethane per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 5600 milligrams of fluorotrichloromethane per cubic meter of air (mg/m^3). The American Conference of Governmental Industrial Hygienists has issued a Notice of Intended Changes of their recommended Threshold Limit Value for fluorotrichloromethane from 1000 ppm as a time-weighted average value to 1000 ppm as a ceiling value.

HEALTH HAZARD INFORMATION

- **Routes of exposure**
Fluorotrichloromethane can affect the body if it is inhaled or if it comes in contact with the eyes or skin. It can also affect the body if it is swallowed.
- **Effects of overexposure**
 1. **Short-term Exposure:** Fluorotrichloromethane may

cause drowsiness, unconsciousness, and death. Breathing high concentrations of this material may also cause the heart to beat irregularly or to stop suddenly.

2. **Long-term Exposure:** Prolonged overexposure to fluorotrichloromethane may cause skin irritation.

3. **Reporting Signs and Symptoms:** A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to fluorotrichloromethane.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to fluorotrichloromethane at potentially hazardous levels:

1. **Initial Medical Screening:** Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from fluorotrichloromethane exposure.

—**Cardiovascular disease:** In persons with impaired cardiovascular function, especially those with a history of cardiac arrhythmias, the inhalation of fluorotrichloromethane might cause exacerbation of disorders of the conduction mechanism due to its sensitizing effects on the myocardium.

2. **Periodic Medical Examination:** Any employee developing the above-listed conditions should be referred for further medical examination.

- **Summary of toxicology**

Fluorotrichloromethane vapor is a narcotic and may cause asphyxia at high concentrations. The approximate lethal concentration for rats exposed for 4 hours was 66,000 ppm; guinea pigs exhibited stupor and incoordination after exposure to 50,000 ppm for 2 hours, while animals breathing concentrations of 22,000 ppm showed only occasional tremors. Repeated exposure of several species to 4,000 ppm for 7 hours daily resulted in no toxic effects. Sniffing aerosols of fluorochlorinated hydrocarbons has caused sudden death by cardiac arrest,

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

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probably due to sensitization of the myocardium. No instances of toxic effects from industrial exposure have been reported, but since the substance can dissolve the natural oils of the skin, dermatitis may be expected to result from repeated contact.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 137.4
2. Boiling point (760 mm Hg): 23.8 C (74.8 F)
3. Specific gravity (water = 1): 1.49
4. Vapor density (air = 1 at boiling point of fluorotrichloromethane): 4.7
5. Melting point: -111 C (-168 F)
6. Vapor pressure at 20 C (68 F): 690 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 0.11
8. Evaporation rate (butyl acetate = 1): 63

• Reactivity

1. Conditions contributing to instability: Heat
2. Incompatibilities: Fluorotrichloromethane reacts with chemically active metals such as sodium, potassium, calcium, powdered aluminum, zinc, and magnesium.

3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen chloride, phosgene, and hydrogen fluoride) may be released when fluorotrichloromethane decomposes.

4. Special precautions: Liquid fluorotrichloromethane will attack some forms of plastics, rubber, and coatings.

• Flammability

1. Not combustible

• Warning properties

According to Patty, fluorotrichloromethane is odorless; therefore, for the purposes of this guideline, it is treated as a material with poor warning properties.

Fluorotrichloromethane is not a known eye irritant.

MONITORING AND MEASUREMENT PROCEDURES

• General

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• Method

At the time of publication of this guideline, no measurement method for fluorotrichloromethane had been published by NIOSH.

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid fluorotrichloromethane.

• Non-impervious clothing which becomes wet with liquid fluorotrichloromethane should be removed promptly and not reworn until the fluorotrichloromethane has evaporated.

• Employees should be provided with and required to use splash-proof safety goggles where liquid fluorotrichloromethane may contact the eyes.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to fluorotrichloromethane may occur and control methods which may be effective in each case:

Operation	Controls
Use as a propellant in aerosols for insecticides, floor waxes, paint, cosmetics, and perfumes	General dilution ventilation; local exhaust ventilation; personal protective equipment
Use as a refrigerant; as a blowing agent in foam plastics; as a solvent and degreaser; in production of polymeric	General dilution ventilation; local exhaust ventilation; personal protective equipment

resins; as a dielectric fluid in bubble chambers, and in wind tunnels; use as a sulfonation solvent in chemical synthesis

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• Eye Exposure

If liquid fluorotrichloromethane gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention immediately. Contact lenses should not be worn when working with this chemical.

• Skin Exposure

If liquid fluorotrichloromethane gets on the skin, immediately flush the contaminated skin with water if the liquid fluorotrichloromethane has already evaporated. If liquid fluorotrichloromethane soaks through the clothing, remove the clothing immediately and flush the skin with water. If irritation is present after washing, get medical attention.

• Breathing

If a person breathes in large amounts of fluorotrichloromethane, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention immediately.

• Swallowing

When fluorotrichloromethane has been swallowed, get medical attention immediately. If medical attention is not immediately available, get the afflicted person to vomit by having him touch the back of his throat with his finger or by giving him syrup of ipecac as directed on the package. This non-prescription drug is available at most drug stores and drug counters and should be kept with emergency medical supplies in the workplace. Do not make an unconscious person vomit.

• Rescue

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL AND LEAK PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of spills until cleanup has been completed.
- If fluorotrichloromethane is spilled or leaked, the following steps should be taken:
 1. Ventilate area of spill or leak.
 2. If the gas is leaking, stop the flow of gas.
 3. If in the liquid form, allow to vaporize.

REFERENCES

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RESPIRATORY PROTECTION FOR FLUOROTRICHLOROMETHANE

Condition	Minimum Respiratory Protection* Required Above 1000 ppm
Vapor Concentration	
10,000 ppm or less	Any supplied-air respirator. Any self-contained breathing apparatus.
Greater than 10,000 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.