

OSHA Hazard Information Bulletins  
1,1,2-Trichloro-1,2,2-trifluoroethane  
April 23, 1984

MEMORANDUM FOR:  
REGIONAL ADMINISTRATORS

THRU:

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Director  
Directorate of Field Operations  
FROM:

EDWARD J. BAIER  
Director  
Directorate of Technical Support  
SUBJECT:

Health Hazard Information - 1,1,2-Trichloro-1,2,2-trifluoroethane  
1,1,2-Trichloro-1,2,2-trifluoroethane is generally used as a refrigerant, a dry cleaning solvent and an intermediate. It is also referred as Fluorocarbon 113, Freon 113, FC-113, Refrigerant 113, Ucon 113, or Arklone R-113. The OSHA permissible exposure limit for fluorocarbon 113 is 1,000 parts per million (ppm) or 7,600 mg/M<sup>3</sup> for an eight-hour, time-weighted average.

As with most fluorocarbons, the fluorocarbon 113 is considered low to moderately toxic and its major health effect is narcosis at moderate concentrations. However, exposure to elevated concentrations of fluorocarbon 113 in confined spaces can rapidly cause serious irregular heart beats or heart stoppage especially for persons with cardiovascular disease.

The attached bulletin issued by the Michigan State Division of Occupational Health provides additional information on Fluorocarbon 113. Please assure that all area offices will receive this information.

Attachment

SPECIAL BULLETIN

1,1,2-Trichloro-1,2,2-Trifluoroethane (Fluorocarbon 113, Freon 113, FC-113, Refrigerant 113, UCON 113, Arklone R-113)

## FLUOROCARBON 113...DON'T BE CAUGHT...DEAD!

In November of 1983 a man entered a military vehicle. He found himself in trouble and signaled for help. Although rescuers assisted him and administered oxygen almost immediately, it was not soon enough. Diagnosis: cardiac arrhythmia (irregular heart beats) followed by sudden death.

Two months earlier, a man entered into a confined space and was subsequently overcome. He was found unconscious by fellow workers, was taken to the hospital and remained hospitalized for a period of seven days. Medical tests confirmed cardiac arrhythmia.

Although neither of the above men had previous heart conditions, both experienced life threatening heart problems. The common elements in these two cases, as well as a number of similar incidents, include the following:

The areas were insufficiently ventilated,  
The air within the areas was not tested,  
Personal protective equipment was not used,  
None of the persons experienced warning signs or symptoms (such as strong odors or irritations) to alert them of a hazard, and  
**SIGNIFICANT AMOUNTS OF FLUOROCARBON 113 WERE USED OR PRESENT IN THE AREAS PRIOR TO THE INCIDENTS.**

Although most fluorocarbons are considered low to moderately toxic, exposure to elevated concentrations of fluorocarbon 113 can rapidly cause serious irregular heart beats or heart stoppage.

The Maximum Allowable Concentration (MAC) value for fluorocarbon 113, as specified in the Michigan Occupational Health Standards, is 1,000 parts of fluorocarbon 113 per million parts of air (ppm) based upon an eight-hour, time-weighted average. Exposures above this MAC value may cause drowsiness, irritation of the throat and eyes or mild lethargy. fluorocarbon 113 has been promoted as a "safety solvent" for cold degreasing operations because its MAC is considerably greater than other commonly used chlorinated hydrocarbon solvents. The compound does not appear to cause significant chronic effects from short term exposures which are less than 4,000 ppm. However, animal research data<sup>1</sup> indicate that concentrations of fluorocarbon 113 which exceed 4,500 ppm are immediately dangerous to life and health and may cause the cardiac abnormalities noted above. Additional precautions are indicated for persons with cardiovascular disease.

Fluorocarbon 113 can be safely used if appropriate precautions and procedures are implemented. The following are recommended:

Local exhaust ventilation, general dilution ventilation or process enclosure must be provided when feasible to maintain exposures within the MAC value of 1,000 ppm.

Fluorocarbon 113 should be used in a manner which minimizes airborne concentrations (i.e., use sparingly, keep containers covered, etc.).

The odor of fluorocarbon 113 must not be used as an indicator of exposure. Concentrations at the MAC value do not provide adequate or recognizable warning for most individuals.

If exposures cannot be maintained within the MAC value through engineering and/or workpractice controls, a self-contained breathing apparatus (SCBA) or a supplied air respirator must be used. Rule 3502: General Respiratory Protection is also applicable whenever respirators are provided. (Due to the inadequate warning properties noted above, organic vapor respirators do not provide satisfactory protection.)

If the operation involves a confined or process space, the provisions of Rule 3301: Control Methods for Process Spaces Containing a Known or Suspected Non-respirable Atmosphere and Rule 3302: Use of Respirators in Dangerous Atmospheres--General must be followed.

These provisions include ventilation, air testing and/or respirator use requirements.

Occupational Health Guide C: Confined or Process Space Entry also provides additional information.

Additional information regarding toxicity, chemical and physical properties, monitoring, respirators, personal protective equipment, emergencies and spills or leaks can be found in Occupational Health Guide No. 16: 1,1,2-Trichloro-1,2,2-Trifluoroethane.

Animal studies have indicated that some other fluorocarbons may cause similar heart irregularities. These include the following:

Fluorocarbon 12 (dichlorodifluoromethane),  
Fluorocarbon 11 (trichlorofluoromethane),  
Fluorocarbon 21 (dichlorofluoromethane),  
Fluorocarbon 22 (chlorodifluoromethane),  
Fluorocarbon 114 (dichlorotetrafluoroethane),  
Fluorocarbon 112 (tetrachlorodifluoroethane),  
Fluorocarbon 113 (trichlorotrifluoroethane),  
Fluorocarbon 13B1 (bromotrifluoromethane), and  
Fluorocarbon 13 (chlorotrifluoromethane).

This list may not contain all of the fluorocarbons which can cause heart abnormalities (check with the manufacturer of your particular material).

This guide is intended for the benefit of the public and may not contain all of the information pertinent to a specific hazard identification and/or control of personnel exposure. For further information, consult the Michigan Department of Public Health, Occupation Health Services Division, 3500 North Logan Street, P.O. Box 30035, Lansing, MI 48909. Phone:

517/373-1410.

MICHIGAN DEPARTMENT OF PUBLIC HEALTH  
DIVISION OF OCCUPATIONAL HEALTH

OCCUPATIONAL HEALTH GUIDE NO. 16

1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE

(Fluorocarbon 113, Freon 113, FC-113, Refrigerant 113, UCON 113, Arklone R-113)  
CCl<sub>2</sub>FCFClF<sub>2</sub>, MW=187.4

PROPERTIES:

Fluorocarbon 113 is a colorless, nonflammable liquid with a slight, carbon tetrachloride-like odor at elevated concentrations. It decomposes at high temperatures to toxic gases such as hydrogen chloride, phosgene, hydrogen fluoride and carbon monoxide. Fluorocarbon 113 also reacts with chemically active metals such as calcium, powdered aluminum, zinc, magnesium and beryllium. The boiling point is 117.6°F (47.6°C); specific gravity is 1.55 (H<sub>2</sub>O=1); vapor density is 6.5 (air=1); vapor pressure is 284 mm Hg at 20°C; solubility in water at 20°C is 0.017g/100g water; and evaporation rate is greater than 1 (butyl acetate=1).

Fluorocarbon 113 is used as a cold degreasing agent, dry cleaning solvent, refrigerant, blowing agent, chemical intermediate and drying agent.

MAXIMUM ALLOWABLE CONCENTRATION: (eight-hour, time-weighted average)

1,000 parts per million parts of air (ppm); 7600 milligrams per cubic meter of air (mg/m<sup>3</sup>).

CEILING LIMIT:

None established by regulation.

SHORT TERM LIMIT:

None established by regulation.

The American conference of Governmental Industrial Hygienists (ACGIH) has recommended a short term exposure limit of 1250 ppm for a 15-minute period.

The National Institute of Occupational Safety and Health (NIOSH) has indicated that

concentrations of 4500 ppm or greater are immediately dangerous to life and health.

#### TOXIC EFFECTS:

Short term exposure to fluorocarbon 113 at concentrations between 1000 and 4000 ppm may cause irritation of the eyes and throat, drowsiness or significant impairment of manual dexterity and vigilance. Breathing concentrations greater than 4500 ppm may cause the heart to beat irregularly (cardiac arrhythmia) or to stop.

The liquid dissolves the natural oils of the skin. Prolonged or repeated skin contact may cause dermatitis.

Adverse long term (chronic) effects from a brief elevated exposure or repeated exposures at concentrations which are within the MAC have not been reported. An Ames bacterial mutagen test was negative. There are no reports of carcinogenic studies regarding fluorocarbon 113.

#### MEDICAL SURVEILLANCE:

Replacement: Employees should be screened for history of skin or cardiovascular diseases. Since fluorocarbon 113 is a defatting agent, persons with pre-existing skin disorders may be more susceptible to these effects. Persons with impaired cardiovascular function, especially those with a history of cardiac arrhythmias, may experience more severe symptoms upon exposure to fluorocarbon 113.

Periodic: Any persons developing the above conditions should be referred to a physician for further medical evaluation.

#### 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 fluorocarbon 113 gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.

Skin Exposures: If fluorocarbon 113 gets on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If it soaks through the clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.

**Breathing:** If a person breathes in large amounts of fluorocarbon 113, 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 as soon as possible.

**Swallowing:** When fluorocarbon 113 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.

#### EXPOSURE CONTROL:

In operations where significant airborne concentrations of fluorocarbon 113 may be produced, general and/or local exhaust ventilation or process enclosure must be provided when feasible to maintain exposures within the MAC value of 1000 ppm. fluorocarbon 113 should also be handled in a manner which minimizes airborne concentrations (use as little as possible, store in closed containers, etc.).

Respirators may be used to control exposures when engineering or workpractice controls are not feasible, when such controls are in the process of being installed, when such controls fail or in emergencies. Table 1 describes the appropriate respirators. A complete respiratory protection program must also be implemented which includes training, maintenance, inspection, cleaning and evaluation.

Employees must be provided with and required to use impervious clothing, gloves or face shields as appropriate to prevent repeated or prolonged skin contact. Gloves or clothing made of polyvinyl alcohol are recommended because fluorocarbon 113 may readily degrade natural rubber. Safety goggles must be provided and worn where there is a potential of liquid fluorocarbon 113 contacting the eyes.

If fluorocarbon 113 is spilled or leaked, persons without protective equipment should be evacuated. The area should be ventilated. Wearing protective equipment, the material should be collected using an absorbent material and placed in closed metal drums.

#### LIMITATIONS:

As with all halogenated hydrocarbons, fluorocarbon 113 vapors readily decompose into more hazardous substances when in contact with very hot surfaces. Accordingly, caution is needed to avoid using it near welding, heat treating, other hot operations or into air that enters

combustion equipment.

#### MONITORING:

Occupational exposures to fluorocarbon 113 may be monitored using activated charcoal tubes followed by desorption and analysis by gas chromatographic procedures. Direct reading monitors for fluorocarbon 113 are also available. However, they must be properly calibrated and other halogenated hydrocarbons may cause interferences in measurement.

TABLE 1

#### RESPIRATORY PROTECTION FOR FLUOROCARBON 113

Condition	Minimum Respiratory Protection <sup>2</sup>
Required Above 1000 ppm Vapor Concentration	
4500 ppm or less	Any supplied-air respirator. Any self-contained breathing apparatus.
Greater than 4500 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 <sup>3</sup> which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow 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.

<sup>1</sup>Reinhardt, C.F. et al., Journal of Occupational Medicine 15:953 (1973).

<sup>2</sup>Only NIOSH-approved or MSHA-approved equipment should be used.

<sup>3</sup>A supplied-air respirator equipped with an auxiliary self-contained breathing apparatus for escape.

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