Occupational Health Guideline for Dichloromonofluoromethane (Refrigerant 21)

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: $CHCl_2F$
- Synonyms: Refrigerant 21; Freon 21; Halon 112; dichlorofluoromethane
- Appearance and odor: Colorless liquid or gas with a slight ether-like odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for Refrigerant 21 is 1000 parts of Refrigerant 21 per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 4200 milligrams of Refrigerant 21 per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Refrigerant 21 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: Exposure to Refrigerant 21 may cause drowsiness, unconsciousness, and death. Exposure to Refrigerant 21 may cause the heart to beat irregularly. If the liquid is spilled on the skin, it may cause frostbite.

2. Long-term Exposure: None known

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 Refrigerant 21.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to Refrigerant 21 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 Refrigerant 21 exposure.

—Chronic respiratory disease: In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of Refrigerant 21 might cause exacerbation of symptoms due to its irritant properties.

—Cardiovascular disease: In persons with impaired cardiovascular function, especially those with a history of cardiac arrhythmias, the inhalation of Refrigerant 21 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**

Refrigerant 21 vapor is a respiratory irritant and causes asphyxia at extremely high concentrations. Exposure to 400,000 ppm with 18% oxygen was fatal to guinea pigs; death was preceded by dyspnea, tremors, and convulsive movements but not narcosis. Animals died at 102,000 ppm with congested lungs, kidneys, and liver, but survived 52,000 ppm showing tremors, incoordination, and irregular breathing. In liquid form this substance may cause frostbite. Sniffing aerosols of fluorochlorinated hydrocarbons has caused sudden death by cardiac arrest, probably due to sensitization of the myocardium. Acute or chronic effects from human exposure have not been reported.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**

1. Molecular weight: 102.9

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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Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

2. Boiling point (760 mm Hg): 8.9 C (48.1 F)
3. Specific gravity (water = 1): 1.37
4. Vapor density (air = 1 at boiling point of Refrigerant 21): 3.82
5. Melting point: −135 C (−211 F)
6. Vapor pressure at 20 C (68 F): Data not available
7. Solubility in water, g/100 g water at 20 C (68 F): 1
8. Evaporation rate (butyl acetate = 1): Much higher than 1

• **Reactivity**

1. Conditions contributing to instability: Heat
2. Incompatibilities: Refrigerant 21 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 Refrigerant 21 decomposes.
4. Special precautions: Liquid Refrigerant 21 will attack some forms of plastics, rubber, and coatings.

• **Flammability**

1. Not combustible

• **Warning properties**

Since there is no available quantitative information relating warning properties to air concentrations of Refrigerant 21, this substance is treated as a material with poor warning properties.
Refrigerant 21 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**

An analytical method for Refrigerant 21 is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 2, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00260-6).

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 the skin from becoming wet with liquid Refrigerant 21.

• Any clothing which becomes wet with liquid Refrigerant 21 should be removed immediately and not reworn until the Refrigerant 21 has evaporated.

• Employees should be provided with and required to use splash-proof safety goggles where liquid Refrigerant 21 may contact the eyes.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to Refrigerant 21 may occur and control methods which may be effective in each case:

Operation	Controls
Manufacture and use as an aerosol propellant in pharmaceuticals; use as a refrigerating agent; use as an industrial solvent in separation of fatty acids, of polymers	General dilution ventilation; local exhaust ventilation; personal protective equipment
Use as a blowing agent for rigid foams and insulating foams	General dilution ventilation; local exhaust ventilation; personal protective equipment
Use as a working fluid in Rankine cycle turbogenerators; use in water purification; use in organic synthesis in preparation of other Freons	General dilution ventilation; local exhaust ventilation; personal protective equipment

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 Refrigerant 21 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 Exposure**

If liquid Refrigerant 21 gets on the skin, immediately flush the contaminated skin with water if the Refrigerant 21 has not already evaporated. If liquid Refrigerant 21 soaks through the clothing, remove the clothing immediately and flush the skin with water. Do not use hot water for skin flushing. If irritation persists after washing, get medical attention.

• **Breathing**

If a person breathes in large amounts of Refrigerant 21, 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 Refrigerant 21 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 Refrigerant 21 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.
3. If the liquid is spilled or leaked, allow to vaporize.

REFERENCES

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RESPIRATORY PROTECTION FOR REFRIGERANT 21

Condition	Minimum Respiratory Protection* Required Above 1000 ppm
Gas Concentration	
10,000 ppm or less	Any supplied-air respirator. Any self-contained breathing apparatus.
50,000 ppm or less	Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece. A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode.
Greater than 50,000 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.