



PADMANAB MAFATLAL GROUP

1,1,1,2-TETRAFLUOROETHANE

Navin Fluorine International Limited

Chemwatch: 3159
Version No: 10.1
Safety Data Sheet

Chemwatch Hazard Alert Code: 1

Issue Date: 23/12/2022
Print Date: 08/04/2024
L.GHS.IND.EN

SECTION 1 Identification of the substance / mixture and of the company / undertaking

Product Identifier

| | |
|-------------------------------|---|
| Product name | 1,1,1,2-TETRAFLUOROETHANE |
| Chemical Name | Not Available |
| Synonyms | C2H2F4; CF3CFH2; 1,1,1,2-tetrafluoroethane; propellant R 134A Fluorocarbon HFC HFA 134a; Amerfrost A-134a; Blow Hard O.S. Extra; Dust-Pro Pressurized Duster; BOC R134A; DuPont SUVA 134a Refrigerant; Freon 134a; Koudemiddel R-134a |
| Proper shipping name | 1,1,1,2-TETRAFLUOROETHANE (REFRIGERANT GAS R 134a) |
| Chemical formula | C2H2F4 |
| Other means of identification | Not Available |
| CAS number | 811-97-2 |

Relevant identified uses of the substance or mixture and uses advised against

| | |
|--------------------------|---|
| Relevant identified uses | <p>Wide use in household and commercial refrigeration and automotive air conditioning. Suitable for use in medium temperature food cabinets, water chillers and fountains, heat pumps and dehumidifiers and as a blowing agent for various foams. Other uses include as a propellant for aerosol pharmaceuticals, lacquers, deodorants, perfumes, mousses, air fresheners, insecticides, cleaning products and other household products.</p> <p>Hydrofluorocarbons (HFCs) are organic compounds that contain fluorine and hydrogen atoms, and are the most common type of organofluorine compounds. They are frequently used in air conditioning and as refrigerants in place of the older chlorofluorocarbons. Fluorocarbons with few C-F bonds behave similarly to the parent hydrocarbons, but their reactivity can be altered significantly. Packed as liquid under pressure and remains liquid only under pressure. Sudden release of pressure or leakage may result in rapid vapourisation with generation of large volumes of gas.</p> <p>The use of a quantity of material in an unventilated or confined space may result in increased exposure and an irritating atmosphere developing. Before starting consider control of exposure by mechanical ventilation.</p> |
|--------------------------|---|

Details of the manufacturer or supplier of the safety data sheet

| | |
|-------------------------|--|
| Registered company name | Navin Fluorine International Limited |
| Address | Surat-Navsari- Road, PO : Bhestan, near Udhna, SURAT Gujarat 395 023 India |
| Telephone | +91-261- 6715 340 |
| Fax | +91-22-66509800 |
| Website | www.nfil.in |
| Email | subodh.kumar@nfil.in |

Emergency telephone number

| | | |
|-----------------------------------|-------------------|-------------------------------------|
| Association / Organisation | +91-261- 6715 301 | CHEMWATCH EMERGENCY RESPONSE (24/7) |
| Emergency telephone numbers | +91-261- 6715 301 | +918000403230 |
| Other emergency telephone numbers | +91-9714755221 | +61 3 9573 3188 |

Once connected and if the message is not in your preferred language then please dial 01

SECTION 2 Hazards identification

Classification of the substance or mixture

Chemwatch Hazard Ratings

1,1,1,2-TETRAFLUOROETHANE

| | Min | Max |
|--------------|-----|-----|
| Flammability | 0 | |
| Toxicity | 1 | |
| Body Contact | 1 | |
| Reactivity | 1 | |
| Chronic | 0 | |

0 = Minimum
 1 = Low
 2 = Moderate
 3 = High
 4 = Extreme

| | |
|-----------------------|--|
| Classification | Gases Under Pressure (Liquefied Gas), Skin Corrosion/Irritation Category 3, Acute Toxicity (Inhalation) Category 5 |
|-----------------------|--|

Label elements

Hazard pictogram(s)



| | |
|--------------------|----------------|
| Signal word | Warning |
|--------------------|----------------|

Hazard statement(s)

| | |
|-------------|---|
| H280 | Contains gas under pressure; may explode if heated. |
| H316 | Causes mild skin irritation. |
| H333 | May be harmful if inhaled. |

Precautionary statement(s) Prevention

Not Applicable

Precautionary statement(s) Response

| | |
|------------------|---|
| P304+P312 | IF INHALED: Call a POISON CENTER/doctor/physician/first aider if you feel unwell. |
| P332+P313 | If skin irritation occurs: Get medical advice/attention. |

Precautionary statement(s) Storage

| | |
|------------------|--|
| P410+P403 | Protect from sunlight. Store in a well-ventilated place. |
|------------------|--|

Precautionary statement(s) Disposal

Not Applicable

SECTION 3 Composition / information on ingredients

Substances

| CAS No | %[weight] | Name |
|----------|-----------|----------------------------------|
| 811-97-2 | >=99 | <u>1,1,1,2-tetrafluoroethane</u> |

Mixtures

See section above for composition of Substances

SECTION 4 First aid measures

Description of first aid measures

| | |
|---------------------|--|
| Eye Contact | <ul style="list-style-type: none"> ▶ If product comes in contact with eyes remove the patient from gas source or contaminated area. ▶ Take the patient to the nearest eye wash, shower or other source of clean water. ▶ Open the eyelid(s) wide to allow the material to evaporate. ▶ Gently rinse the affected eye(s) with clean, cool water for at least 15 minutes. Have the patient lie or sit down and tilt the head back. Hold the eyelid(s) open and pour water slowly over the eyeball(s) at the inner corners, letting the water run out of the outer corners. ▶ The patient may be in great pain and wish to keep the eyes closed. It is important that the material is rinsed from the eyes to prevent further damage. ▶ Ensure that the patient looks up, and side to side as the eye is rinsed in order to better reach all parts of the eye(s) ▶ Transport to hospital or doctor. ▶ Even when no pain persists and vision is good, a doctor should examine the eye as delayed damage may occur. ▶ If the patient cannot tolerate light, protect the eyes with a clean, loosely tied bandage. ▶ Ensure verbal communication and physical contact with the patient. <p> DO NOT allow the patient to rub the eyes DO NOT allow the patient to tightly shut the eyes DO NOT introduce oil or ointment into the eye(s) without medical advice DO NOT use hot or tepid water. </p> |
| Skin Contact | <p>If skin contact occurs:</p> <ul style="list-style-type: none"> ▶ Immediately remove all contaminated clothing, including footwear. ▶ Flush skin and hair with running water (and soap if available). ▶ Seek medical attention in event of irritation. <p>In case of cold burns (frost-bite):</p> <ul style="list-style-type: none"> ▶ Move casualty into warmth before thawing the affected part; if feet are affected carry if possible ▶ Bathe the affected area immediately in luke-warm water (not more than 35 deg C) for 10 to 15 minutes, immersing if possible and without rubbing ▶ DO NOT apply hot water or radiant heat. ▶ Apply a clean, dry, light dressing of "fluffed-up" dry gauze bandage ▶ If a limb is involved, raise and support this to reduce swelling ▶ If an adult is involved and where intense pain occurs provide pain killers such as paracetamol ▶ Transport to hospital, or doctor ▶ Subsequent blackening of the exposed tissue indicates potential of necrosis, which may require amputation. |

Continued...

1,1,1,2-TETRAFLUOROETHANE

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|------------|--|
| Inhalation | <ul style="list-style-type: none"> Following exposure to gas, remove the patient from the gas source or contaminated area. NOTE: Personal Protective Equipment (PPE), including positive pressure self-contained breathing apparatus may be required to assure the safety of the rescuer. Prostheses such as false teeth, which may block the airway, should be removed, where possible, prior to initiating first aid procedures. If the patient is not breathing spontaneously, administer rescue breathing. If the patient does not have a pulse, administer CPR. If medical oxygen and appropriately trained personnel are available, administer 100% oxygen. Summon an emergency ambulance. If an ambulance is not available, contact a physician, hospital, or Poison Control Centre for further instruction. Keep the patient warm, comfortable and at rest while awaiting medical care. MONITOR THE BREATHING AND PULSE, CONTINUOUSLY. Administer rescue breathing (preferably with a demand-valve resuscitator, bag-valve mask-device, or pocket mask as trained) or CPR if necessary. |
| Ingestion | <ul style="list-style-type: none"> Not considered a normal route of entry. Avoid giving milk or oils. Avoid giving alcohol. If spontaneous vomiting appears imminent or occurs, hold patient's head down, lower than their hips to help avoid possible aspiration of vomitus. |

Indication of any immediate medical attention and special treatment needed

Cardiac sensitisation possible following exposure to the gas.

for intoxication due to Freons/ Halons;

A: Emergency and Supportive Measures

- Maintain an open airway and assist ventilation if necessary
- Treat coma and arrhythmias if they occur. Avoid (adrenaline) epinephrine or other sympathomimetic amines that may precipitate ventricular arrhythmias. Tachyarrhythmias caused by increased myocardial sensitisation may be treated with propranolol, 1-2 mg IV or esmolol 25-100 microgm/kg/min IV.
- Monitor the ECG for 4-6 hours

B: Specific drugs and antidotes:

- There is no specific antidote

C: Decontamination

- Inhalation; remove victim from exposure, and give supplemental oxygen if available.
- Ingestion; (a) Prehospital: Administer activated charcoal, if available. **DO NOT** induce vomiting because of rapid absorption and the risk of abrupt onset CNS depression. (b) Hospital: Administer activated charcoal, although the efficacy of charcoal is unknown. Perform gastric lavage only if the ingestion was very large and recent (less than 30 minutes)

D: Enhanced elimination:

- There is no documented efficacy for diuresis, haemodialysis, haemoperfusion, or repeat-dose charcoal.

POISONING and DRUG OVERDOSE, Californian Poison Control System Ed. Kent R Olson; 3rd Edition

- Do not administer sympathomimetic drugs unless absolutely necessary as material may increase myocardial irritability.
 - No specific antidote.
 - Because rapid absorption may occur through lungs if aspirated and cause systematic effects, the decision of whether to induce vomiting or not should be made by an attending physician.
 - If lavage is performed, suggest endotracheal and/or esophageal control.
 - Danger from lung aspiration must be weighed against toxicity when considering emptying the stomach.
 - Treatment based on judgment of the physician in response to reactions of the patient
- For frost-bite caused by liquefied petroleum gas:
- If part has not thawed, place in warm water bath (41-46 C) for 15-20 minutes, until the skin turns pink or red.
 - Analgesia may be necessary while thawing.
 - If there has been a massive exposure, the general body temperature must be depressed, and the patient must be immediately rewarmed by whole-body immersion, in a bath at the above temperature.
 - Shock may occur during rewarming.
 - Administer tetanus toxoid booster after hospitalization.
 - Prophylactic antibiotics may be useful.
 - The patient may require anticoagulants and oxygen.

[Shell Australia 22/12/87]

For gas exposures:

BASIC TREATMENT

- Establish a patent airway with suction where necessary.
- Watch for signs of respiratory insufficiency and assist ventilation as necessary.
- Administer oxygen by non-rebreather mask at 10 to 15 l/min.
- Monitor and treat, where necessary, for pulmonary oedema.
- Monitor and treat, where necessary, for shock.
- Anticipate seizures.

ADVANCED TREATMENT

- Consider orotracheal or nasotracheal intubation for airway control in unconscious patient or where respiratory arrest has occurred.
- Positive-pressure ventilation using a bag-valve mask might be of use.
- Monitor and treat, where necessary, for arrhythmias.
- Start an IV D5W TKO. If signs of hypovolaemia are present use lactated Ringers solution. Fluid overload might create complications.
- Drug therapy should be considered for pulmonary oedema.
- Hypotension with signs of hypovolaemia requires the cautious administration of fluids. Fluid overload might create complications.
- Treat seizures with diazepam.
- Proparacaine hydrochloride should be used to assist eye irrigation.

BRONSTEIN, A.C. and CURRANCE, P.L.

EMERGENCY CARE FOR HAZARDOUS MATERIALS EXPOSURE: 2nd Ed. 1994

SECTION 5 Firefighting measures**Extinguishing media**

SMALL FIRE: Use extinguishing agent suitable for type of surrounding fire.

LARGE FIRE: Cool cylinder.

DO NOT direct water at source of leak or venting safety devices as icing may occur.

Special hazards arising from the substrate or mixture**Fire Incompatibility**

- Avoid contamination with oxidising agents i.e. nitrates, oxidising acids, chlorine bleaches, pool chlorine etc. as ignition may result

Advice for firefighters

Continued...

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| Fire Fighting | <p>GENERAL</p> <ul style="list-style-type: none"> Alert Fire Brigade and tell them location and nature of hazard. Wear breathing apparatus and protective gloves. Fight fire from a safe distance, with adequate cover. Use water delivered as a fine spray to control fire and cool adjacent area. DO NOT approach cylinders suspected to be hot. Cool fire exposed cylinders with water spray from a protected location. If safe to do so, remove cylinders from path of fire. <p>SPECIAL REQUIREMENTS:</p> <ul style="list-style-type: none"> Excessive pressures may develop in a gas cylinder exposed in a fire; this may result in explosion. Cylinders with pressure relief devices may release their contents as a result of fire and the released gas may constitute a further source of hazard for the fire-fighter. Cylinders without pressure-relief valves have no provision for controlled release and are therefore more likely to explode if exposed to fire. <p>FIRE FIGHTING REQUIREMENTS:</p> <p>The need for proximity, entry and special protective clothing should be determined for each incident, by a competent fire-fighting safety professional.</p> |
| Fire/Explosion Hazard | <p>Although not flammable in air at temperatures up to 100 deg. C at atmospheric temperature, mixtures with high concentrations of air at elevated pressure and / or temperature can become combustible in the presence of an ignition source. The material can also become combustible in an oxygen enriched environment (oxygen concentrations greater than in air). Whether air-mixtures or oxygen-mixtures become combustible depends on temperature, pressure and oxygen concentration. In general the material should not be allowed to exist with air above atmospheric pressure or at high temperatures, or in an oxygen enriched environment. For example do NOT mix with air under pressure for leak testing or other purposes.</p> <ul style="list-style-type: none"> Containers may explode when heated - Ruptured cylinders may rocket Fire exposed containers may vent contents through pressure relief devices. High concentrations of gas may cause asphyxiation without warning. May decompose explosively when heated or involved in fire. Contact with gas may cause burns, severe injury and/ or frostbite. <p>Decomposition may produce toxic fumes of: carbon monoxide (CO) Combustion products include: carbon dioxide (CO₂) hydrogen fluoride other pyrolysis products typical of burning organic material.</p> <p>Contains low boiling substance: Closed containers may rupture due to pressure buildup under fire conditions.</p> <ul style="list-style-type: none"> Vented gas is more dense than air and may collect in pits, basements. |

SECTION 6 Accidental release measures

Personal precautions, protective equipment and emergency procedures

See section 8

Environmental precautions

See section 12

Methods and material for containment and cleaning up

| | |
|--------------|--|
| Minor Spills | <ul style="list-style-type: none"> Avoid breathing vapour and any contact with liquid or gas. Protective equipment including respirator should be used. DO NOT enter confined spaces where gas may have accumulated. Increase ventilation. Clear area of personnel. Stop leak only if safe to do so. Remove leaking cylinders to safe place. Release pressure under safe controlled conditions by opening valve. Do not exert excessive pressure on the valve; do not attempt to operate a damaged valve Orientate cylinder so that the leak is gas, not liquid, to minimise rate of leakage Keep area clear of personnel until gas has dispersed. |
| Major Spills | <ul style="list-style-type: none"> Clear area of all unprotected personnel and move upwind. Alert Emergency Authority and advise them of the location and nature of hazard. Wear breathing apparatus and protective gloves. Prevent by any means available, spillage from entering drains and water-courses. Consider evacuation. Increase ventilation. No smoking or naked lights within area. Stop leak only if safe to do so. Water spray or fog may be used to disperse vapour. DO NOT enter confined space where gas may have collected. Keep area clear until gas has dispersed. Remove leaking cylinders to a safe place. Fit vent pipes. Release pressure under safe, controlled conditions Burn issuing gas at vent pipes. DO NOT exert excessive pressure on valve; DO NOT attempt to operate damaged valve. |

Personal Protective Equipment advice is contained in Section 8 of the SDS.

SECTION 7 Handling and storage

Precautions for safe handling

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| Safe handling | <p>Contact of welding or soldering torch flame with high concentration of refrigerant can result in visible changes in the size and colour of torch flames. This flame effect will only occur in concentrations of product well above the recommended exposure limit.; therefore stop all work and ventilate to disperse refrigerant vapours from the work area before using any open flames.</p> <ul style="list-style-type: none"> Consider use in closed pressurised systems, fitted with temperature, pressure and safety relief valves which are vented for safe dispersal. <p>Use only properly specified equipment which is suitable for this product, its supply pressure and temperature</p> |
|---------------|--|

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| | |
|-------------------|---|
| | <ul style="list-style-type: none">• The tubing network design connecting gas cylinders to the delivery system should include appropriate pressure indicators and vacuum or suction lines.• Fully-welded types of pressure gauges, where the bourdon tube sensing element is welded to the gauge body, are recommended.• Before connecting gas cylinders, ensure manifold is mechanically secure and does not containing another gas. Before disconnecting gas cylinder, isolate supply line segment proximal to cylinder, remove trapped gas in supply line with aid of vacuum pump• When connecting or replacing cylinders take care to avoid airborne particulates violently ejected when system pressurises.• Consider the use of doubly-contained piping; diaphragm or bellows sealed, soft seat valves; backflow prevention devices; flash arrestors; and flow monitoring or limiting devices. Gas cabinets, with appropriate exhaust treatment, are recommended, as is automatic monitoring of the secondary enclosures and work areas for release.• Use a pressure reducing regulator when connecting cylinder to lower pressure (<100 psig) piping or systems• Use a check valve or trap in the discharge line to prevent hazardous back-flow into the cylinder• Check regularly for spills or leaks. Keep valves tightly closed but do not apply extra leverage to hand wheels or cylinder keys.• Open valve slowly. If valve is resistant to opening then contact your supervisor• Valve protection caps must remain in place must remain in place unless container is secured with valve outlet piped to use point.• Never insert a pointed object (e.g hooks) into cylinder cap openings as a means to open cap or move cylinder. Such action can inadvertently turn the valve and gas a gas leak. Use an adjustable strap instead of wrench to free an over-tight or rusted cap.• A bubble of gas may buildup behind the outlet dust cap during transportation, after prolonged storage, due to defective cylinder valve or if a dust cap is inserted without adequate evacuation of gas from the line. When loosening dust cap, preferably stand cylinder in a suitable enclosure and take cap off slowly. Never face the dust cap directly when removing it; point cap away from any personnel or any object that may pose a hazard. under negative pressure (relative to atmospheric gas)• Suck back of water into the container must be prevented. Do not allow backfeed into the container.• Do NOT drag, slide or roll cylinders - use a suitable hand truck for cylinder movement• Test for leakage with brush and detergent - NEVER use a naked flame.• Do NOT heat cylinder by any means to increase the discharge rate of product from cylinder.• Leaking gland nuts may be tightened if necessary.• If a cylinder valve will not close completely, remove the cylinder to a well ventilated location (e.g. outside) and, when empty, tag as FAULTY and return to supplier.• Obtain a work permit before attempting any repairs.• DO NOT attempt repair work on lines, vessels under pressure.• Atmospheres must be tested and O.K. before work resumes after leakage.<ul style="list-style-type: none">▸ DO NOT transfer gas from one cylinder to another. |
| Other information | <ul style="list-style-type: none">▸ Cylinders should be stored in a purpose-built compound with good ventilation, preferably in the open.▸ Such compounds should be sited and built in accordance with statutory requirements.▸ The storage compound should be kept clear and access restricted to authorised personnel only.▸ Cylinders stored in the open should be protected against rust and extremes of weather.▸ Cylinders in storage should be properly secured to prevent toppling or rolling.▸ Cylinder valves should be closed when not in use.▸ Where cylinders are fitted with valve protection this should be in place and properly secured.▸ Gas cylinders should be segregated according to the requirements of the Dangerous Goods Act.▸ Preferably store full and empty cylinders separately.▸ Check storage areas for hazardous concentrations of gases prior to entry.▸ Full cylinders should be arranged so that the oldest stock is used first.▸ Cylinders in storage should be checked periodically for general condition and leakage.▸ Protect cylinders against physical damage. Move and store cylinders correctly as instructed for their manual handling. <p>NOTE: A 'G' size cylinder is usually too heavy for an inexperienced operator to raise or lower.</p> |

Conditions for safe storage, including any incompatibilities

| | |
|-------------------------|---|
| Suitable container | <ul style="list-style-type: none">▸ DO NOT use aluminium or galvanised containers▸ Cylinder:▸ Ensure the use of equipment rated for cylinder pressure.▸ Ensure the use of compatible materials of construction.▸ Valve protection cap to be in place until cylinder is secured, connected.▸ Cylinder must be properly secured either in use or in storage.▸ Cylinder valve must be closed when not in use or when empty.▸ Segregate full from empty cylinders. <p>WARNING: Suckback into cylinder may result in rupture. Use back-flow preventive device in piping.</p> |
| Storage incompatibility | <p>Avoid reaction with alkali metals, zinc, aluminium alloys (> 2% magnesium). Avoid contact with plastics such as methacrylate polymers, polyethylene and polystyrene.</p> <p>Haloalkanes:</p> <ul style="list-style-type: none">▸ are highly reactive:some of the more lightly substituted lower members are highly flammable; the more highly substituted may be used as fire suppressants, not always with the anticipated results.▸ may react with the lighter divalent metals to produce more reactive compounds analogous to Grignard reagents.▸ may produce explosive compounds following prolonged contact with metallic or other azides▸ may react on contact with potassium or its alloys - although apparently stable on contact with a wide rage of halocarbons, reaction products may be shock-sensitive and may explode with great violence on light impact; severity generally increases with the degree of halocarbon substitution and potassium-sodium alloys give extremely sensitive mixtures . <p>BREITHERICK L.: Handbook of Reactive Chemical Hazards</p> <ul style="list-style-type: none">▸ react with metal halides and active metals, eg. sodium (Na), potassium (K), lithium (Li),calcium (Ca), zinc (Zn), powdered aluminium (Al) and aluminium alloys, magnesium (Mg) and magnesium alloys.▸ may react with brass and steel.▸ may react explosively with strong oxidisers▸ may degrade rubber, and plastics such as methacrylate polymers, polyethylene and polystyrene, paint and coatings <p>As a general rule, hydrofluorocarbons tend to be flammable unless they contain more fluorine atoms than hydrogen atoms.</p> <ul style="list-style-type: none">▸ Compressed gases may contain a large amount of kinetic energy over and above that potentially available from the energy of reaction produced by the gas in chemical reaction with other substances |

SECTION 8 Exposure controls / personal protection

Control parameters

Occupational Exposure Limits (OEL)

INGREDIENT DATA

Not Available

Emergency Limits

| Ingredient | TEEL-1 | TEEL-2 | TEEL-3 |
|---------------------------|---------------|---------------|---------------|
| 1,1,1,2-tetrafluoroethane | Not Available | Not Available | Not Available |

| Ingredient | Original IDLH | Revised IDLH |
|---------------------------|---------------|---------------|
| 1,1,1,2-tetrafluoroethane | Not Available | Not Available |

MATERIAL DATA

Studies show that HFC 134a is practically nontoxic by inhalation. The acute lethal effects occur at levels exceeding 500000 ppm whilst the threshold for cardiac sensitisation occurs at about 75000 ppm. Repeated exposures at 50000 ppm for 13 weeks did not produce significant toxicity in animals. Limited studies have shown the substance not to be a carcinogen, or to exhibit mutagenic effects. Exposures up to 300000 ppm and 40000 ppm did not produce teratogenic effects in rats and rabbits respectively. The workplace environmental exposure level (WEEL), recommended by the AIHA, is thought to be protective against cardiac sensitisation and systemic injury.

Sensory irritants are chemicals that produce temporary and undesirable side-effects on the eyes, nose or throat. Historically occupational exposure standards for these irritants have been based on observation of workers' responses to various airborne concentrations. Present day expectations require that nearly every individual should be protected against even minor sensory irritation and exposure standards are established using uncertainty factors or safety factors of 5 to 10 or more. On occasion animal no-observable-effect-levels (NOEL) are used to determine these limits where human results are unavailable. An additional approach, typically used by the TLV committee (USA) in determining respiratory standards for this group of chemicals, has been to assign ceiling values (TLV C) to rapidly acting irritants and to assign short-term exposure limits (TLV STELs) when the weight of evidence from irritation, bioaccumulation and other endpoints combine to warrant such a limit. In contrast the MAK Commission (Germany) uses a five-category system based on intensive odour, local irritation, and elimination half-life. However this system is being replaced to be consistent with the European Union (EU) Scientific Committee for Occupational Exposure Limits (SCOEL); this is more closely allied to that of the USA.


OSHA (USA) concluded that exposure to sensory irritants can:

- ▶ cause inflammation
- ▶ cause increased susceptibility to other irritants and infectious agents
- ▶ lead to permanent injury or dysfunction
- ▶ permit greater absorption of hazardous substances and
- ▶ acclimate the worker to the irritant warning properties of these substances thus increasing the risk of overexposure.

May act as a simple asphyxiants; these are gases which, when present in high concentrations, reduce the oxygen content in air below that required to support breathing, consciousness and life; loss of consciousness, with death by suffocation may rapidly occur in an oxygen deficient atmosphere.

CARE: Most simple asphyxiants are odourless or possess low odour and there is no warning on entry into an oxygen deficient atmosphere. If there is any doubt, oxygen content can be checked simply and quickly. It may not be appropriate to only recommend an exposure standard for simple asphyxiants rather it is essential that sufficient oxygen be maintained. Air normally has 21 percent oxygen by volume, with 18 percent regarded as minimum under normal atmospheric pressure to maintain consciousness / life. At pressures significantly higher or lower than normal atmospheric pressure, expert guidance should be sought.

Exposure controls

| | | |
|---|--|----------------------------------|
| Appropriate engineering controls | Engineering controls are used to remove a hazard or place a barrier between the worker and the hazard. Well-designed engineering controls can be highly effective in protecting workers and will typically be independent of worker interactions to provide this high level of protection. The basic types of engineering controls are: Process controls which involve changing the way a job activity or process is done to reduce the risk. Enclosure and/or isolation of emission source which keeps a selected hazard "physically" away from the worker and ventilation that strategically "adds" and "removes" air in the work environment. Ventilation can remove or dilute an air contaminant if designed properly. The design of a ventilation system must match the particular process and chemical or contaminant in use. Employers may need to use multiple types of controls to prevent employee overexposure. | |
| | <ul style="list-style-type: none">▶ Areas where cylinders are stored require good ventilation and, if enclosed, need discrete/controlled exhaust ventilation.▶ Secondary containment and exhaust gas treatment may be required by certain jurisdictions.▶ Local exhaust ventilation may be required in work areas.▶ Consideration should be given to the use of diaphragm or bellows-sealed, soft-seat valves; backflow prevention devices and flow-monitoring or limiting devices.▶ Automated alerting systems with automatic shutdown of gas-flow may be appropriate and may in fact be mandatory in certain jurisdictions.▶ Respiratory protection in the form of air-supplied or self-contained breathing equipment must be worn if the oxygen concentration in the workplace air is less than 19%.▶ Cartridge respirators do NOT give protection and may result in rapid suffocation. Air contaminants generated in the workplace possess varying "escape" velocities which, in turn, determine the "capture velocities" of fresh circulating air required to effectively remove the contaminant. | |
| | Type of Contaminant: | Air Speed: |
| | gas discharge (active generation into zone of rapid air motion) | 1-2.5 m/s (200-500 f/min.) |
| | Within each range the appropriate value depends on: | |
| Individual protection measures, such as personal protective equipment | Lower end of the range | Upper end of the range |
| | 1: Room air currents minimal or favourable to capture | 1: Disturbing room air currents |
| | 2: Contaminants of low toxicity or of nuisance value only. | 2: Contaminants of high toxicity |
| | 3: Intermittent, low production. | 3: High production, heavy use |
| | 4: Large hood or large air mass in motion | 4: Small hood-local control only |
| Eye and face protection | Simple theory shows that air velocity falls rapidly with distance away from the opening of a simple extraction pipe. Velocity generally decreases with the square of distance from the extraction point (in simple cases). Therefore the air speed at the extraction point should be adjusted, accordingly, after reference to distance from the contaminating source. The air velocity at the extraction fan, for example, should be a minimum of 1-2.5 m/s (200-500 f/min.) for extraction of gases discharged 2 meters distant from the extraction point. Other mechanical considerations, producing performance deficits within the extraction apparatus, make it essential that theoretical air velocities are multiplied by factors of 10 or more when extraction systems are installed or used. | |
| |  | |
| | <ul style="list-style-type: none">▶ Chemical goggles.▶ Full face shield may be required for supplementary but never for primary protection of eyes.▶ Contact lenses may pose a special hazard; soft contact lenses may absorb and concentrate irritants. A written policy document, describing the wearing of lenses or restrictions on use, should be created for each workplace or task. This should include a review of lens absorption and adsorption for the class of chemicals in use and an account of injury experience. Medical and first-aid personnel should be trained in their removal and suitable equipment should be readily available. In the event of chemical exposure, begin eye irrigation immediately and remove contact lens as soon as practicable. Lens should be removed at the first signs of eye redness or irritation - lens should be removed in a clean environment only after workers have washed hands thoroughly. [CDC NIOSH Current Intelligence Bulletin 59], [AS/NZS 1336 or national equivalent] | |
| | See Hand protection below | |
| | <ul style="list-style-type: none">▶ When handling sealed and suitably insulated cylinders wear cloth or leather gloves.▶ Insulated gloves: | |

| | |
|------------------|--|
| | ▶ NOTE: Insulated gloves should be loose fitting so that they may be removed quickly if liquid is spilled upon them. Insulated gloves are not made to permit hands to be placed in the liquid; they provide only short-term protection from accidental contact with the liquid. |
| Body protection | See Other protection below |
| Other protection | <div>▶ Protective overalls, closely fitted at neck and wrist.</div> <div>▶ Eye-wash unit.</div> <div>▶ Ensure availability of lifeline in confined spaces.</div> <div>▶ Staff should be trained in all aspects of rescue work.</div> <div>▶ Rescue gear: Two sets of SCBA breathing apparatus Rescue Harness, lines etc.</div> |

Respiratory protection

Type AX Filter of sufficient capacity. (AS/NZS 1716 & 1715, EN 143:2000 & 149:2001, ANSI Z88 or national equivalent)

Selection of the Class and Type of respirator will depend upon the level of breathing zone contaminant and the chemical nature of the contaminant. Protection Factors (defined as the ratio of contaminant outside and inside the mask) may also be important.

| Required minimum protection factor | Maximum gas/vapour concentration present in air p.p.m. (by volume) | Half-face Respirator | Full-Face Respirator |
|------------------------------------|--|----------------------|----------------------|
| up to 10 | 1000 | AX-AUS / Class 1 | - |
| up to 50 | 1000 | - | AX-AUS / Class 1 |
| up to 50 | 5000 | Airline * | - |
| up to 100 | 5000 | - | AX-2 |
| up to 100 | 10000 | - | AX-3 |
| 100+ | | | Airline** |

* - Continuous Flow ** - Continuous-flow or positive pressure demand
A(All classes) = Organic vapours, B AUS or B1 = Acid gasses, B2 = Acid gas or hydrogen cyanide(HCN), B3 = Acid gas or hydrogen cyanide(HCN), E = Sulfur dioxide(SO2), G = Agricultural chemicals, K = Ammonia(NH3), Hg = Mercury, NO = Oxides of nitrogen, MB = Methyl bromide, AX = Low boiling point organic compounds(below 65 degC)

- ▶ Cartridge respirators should never be used for emergency ingress or in areas of unknown vapour concentrations or oxygen content.
- ▶ The wearer must be warned to leave the contaminated area immediately on detecting any odours through the respirator. The odour may indicate that the mask is not functioning properly, that the vapour concentration is too high, or that the mask is not properly fitted. Because of these limitations, only restricted use of cartridge respirators is considered appropriate.
- ▶ Cartridge performance is affected by humidity. Cartridges should be changed after 2 hr of continuous use unless it is determined that the humidity is less than 75%, in which case, cartridges can be used for 4 hr. Used cartridges should be discarded daily, regardless of the length of time used

Selection of the Class and Type of respirator will depend upon the level of breathing zone contaminant and the chemical nature of the contaminant. Protection Factors (defined as the ratio of contaminant outside and inside the mask) may also be important.

| Required minimum protection factor | Maximum gas/vapour concentration present in air p.p.m. (by volume) | Half-face Respirator | Full-Face Respirator |
|------------------------------------|--|----------------------|----------------------|
| up to 10 | 1000 | AX-AUS / Class 1 | - |
| up to 50 | 1000 | - | AX-AUS / Class 1 |
| up to 50 | 5000 | Airline * | - |
| up to 100 | 5000 | - | AX-2 |
| up to 100 | 10000 | - | AX-3 |
| 100+ | | - | Airline** |

** - Continuous-flow or positive pressure demand.
A(All classes) = Organic vapours, B AUS or B1 = Acid gasses, B2 = Acid gas or hydrogen cyanide(HCN), B3 = Acid gas or hydrogen cyanide(HCN), E = Sulfur dioxide(SO2), G = Agricultural chemicals, K = Ammonia(NH3), Hg = Mercury, NO = Oxides of nitrogen, MB = Methyl bromide, AX = Low boiling point organic compounds(below 65 deg C)

- ▶ Positive pressure, full face, air-supplied breathing apparatus should be used for work in enclosed spaces if a leak is suspected or the primary containment is to be opened (e.g. for a cylinder change)
- ▶ Air-supplied breathing apparatus is required where release of gas from primary containment is either suspected or demonstrated.

SECTION 9 Physical and chemical properties

Information on basic physical and chemical properties

| | | | |
|--|---|---|----------------|
| Appearance | Colourless gas with slight ethereal odour; does not mix well with water (0.09 wt %, 25 C, 1 Bar). | | |
| Physical state | Liquified Gas | Relative density (Water = 1) | 1.21 |
| Odour | Not Available | Partition coefficient n-octanol / water | Not Available |
| Odour threshold | Not Available | Auto-ignition temperature (°C) | > 743 |
| pH (as supplied) | Not Applicable | Decomposition temperature (°C) | Not Available |
| Melting point / freezing point (°C) | -101 | Viscosity (cSt) | 0.210 |
| Initial boiling point and boiling range (°C) | -26.2 | Molecular weight (g/mol) | 102.03 |
| Flash point (°C) | Not Available | Taste | Not Available |
| Evaporation rate | Not Available | Explosive properties | Not Available |
| Flammability | Not Available | Oxidising properties | Not Available |
| Upper Explosive Limit (%) | Not Applicable | Surface Tension (dyn/cm or mN/m) | Not Available |
| Lower Explosive Limit (%) | Not Applicable | Volatile Component (%vol) | 100 |
| Vapour pressure (kPa) | 560.5 | Gas group | Not Available |
| Solubility in water | Immiscible | pH as a solution (1%) | Not Applicable |
| Vapour density (Air = 1) | 3.5 | VOC g/L | 1210 |

1,1,1,2-TETRAFLUOROETHANE

SECTION 10 Stability and reactivity

| | |
|---|--|
| Reactivity | See section 7 |
| Chemical stability | <ul style="list-style-type: none"> ▶ Unstable in the presence of incompatible materials. ▶ Product is considered stable. ▶ Hazardous polymerisation will not occur. |
| Possibility of hazardous reactions | See section 7 |
| Conditions to avoid | See section 7 |
| Incompatible materials | See section 7 |
| Hazardous decomposition products | See section 5 |

SECTION 11 Toxicological information

Information on toxicological effects

| | |
|---------------------|--|
| Inhaled | <p>Inhalation of vapours may cause drowsiness and dizziness. This may be accompanied by narcosis, reduced alertness, loss of reflexes, lack of coordination and vertigo.</p> <p>Inhalation of vapours or aerosols (mists, fumes), generated by the material during the course of normal handling, may be damaging to the health of the individual.</p> <p>Limited evidence or practical experience suggests that the material may produce irritation of the respiratory system, in a significant number of individuals, following inhalation. In contrast to most organs, the lung is able to respond to a chemical insult by first removing or neutralising the irritant and then repairing the damage. The repair process, which initially evolved to protect mammalian lungs from foreign matter and antigens, may however, produce further lung damage resulting in the impairment of gas exchange, the primary function of the lungs. Respiratory tract irritation often results in an inflammatory response involving the recruitment and activation of many cell types, mainly derived from the vascular system.</p> <p>Exposure to high concentrations of fluorocarbons may produce cardiac arrhythmias or cardiac arrest due sensitisation of the heart to adrenalin or noradrenalin. Deaths associated with exposures to fluorocarbons (specifically halogenated aliphatics) have occurred in occupational settings and in inhalation of bronchodilator drugs.</p> <p>Bronchospasm consistently occurs in human subjects inhaling fluorocarbons. At a measured concentration of 1700 ppm of one of the commercially available aerosols there is a biphasic change in ventilatory capacity, the first reduction occurring within a few minutes and the second delayed up to 30 minutes. Most subjects developed bradycardia (reduced pulse rate).</p> <p>Bradycardia is encountered in dogs when administration is limited to upper respiratory tract (oropharyngeal and nasal areas). Cardiac arrhythmias can be experimentally induced in animals (species dependency is pronounced with dogs and monkeys requiring lesser amounts of fluorocarbon FC-11 than rats or mice). Sensitivity is increased by injection of adrenalin or cardiac ischaemia/necrosis or pulmonary thrombosis/bronchitis. The cardiotoxic effects of the fluorocarbons originate from irritation of the respiratory tract which in turn reflexively influences the heart rate (even prior to absorption of the fluorocarbon) followed by direct depression of the heart after absorption.</p> <p>Exposure to fluorocarbon thermal decomposition products may produce flu-like symptoms including chills, fever, weakness, muscular aches, headache, chest discomfort, sore throat and dry cough. Complete recovery usually occurs within 24 hours of exposure.</p> <p>Material is highly volatile and may quickly form a concentrated atmosphere in confined or unventilated areas. The vapour may displace and replace air in breathing zone, acting as a simple asphyxiant. This may happen with little warning of overexposure.</p> <p>Symptoms of asphyxia (suffocation) may include headache, dizziness, shortness of breath, muscular weakness, drowsiness and ringing in the ears. If the asphyxia is allowed to progress, there may be nausea and vomiting, further physical weakness and unconsciousness and, finally, convulsions, coma and death. Significant concentrations of the non-toxic gas reduce the oxygen level in the air. As the amount of oxygen is reduced from 21 to 14 volume %, the pulse rate accelerates and the rate and volume of breathing increase. The ability to maintain attention and think clearly is diminished and muscular coordination is somewhat disturbed. As oxygen decreases from 14-10% judgement becomes faulty; severe injuries may cause no pain. Muscular exertion leads to rapid fatigue. Further reduction to 6% may produce nausea and vomiting and the ability to move may be lost. Permanent brain damage may result even after resuscitation at exposures to this lower oxygen level. Below 6% breathing is in gasps and convulsions may occur. Inhalation of a mixture containing no oxygen may result in unconsciousness from the first breath and death will follow in a few minutes.</p> <p>The use of a quantity of material in an unventilated or confined space may result in increased exposure and an irritating atmosphere developing. Before starting consider control of exposure by mechanical ventilation.</p> <p>Acute intoxication by halogenated aliphatic hydrocarbons appears to take place over two stages. Signs of a reversible narcosis are evident in the first stage and in the second stage signs of injury to organs may become evident, a single organ alone is (almost) never involved.</p> |
| Ingestion | <p>Overexposure is unlikely in this form.</p> <p>Not normally a hazard due to physical form of product.</p> <p>Considered an unlikely route of entry in commercial/industrial environments</p> <p>Swallowing of the liquid may cause aspiration of vomit into the lungs with the risk of haemorrhaging, pulmonary oedema, progressing to chemical pneumonitis; serious consequences may result.</p> <p>Signs and symptoms of chemical (aspiration) pneumonitis may include coughing, gasping, choking, burning of the mouth, difficult breathing, and bluish coloured skin (cyanosis).</p> |
| Skin Contact | <p>Skin contact is not thought to have harmful health effects (as classified under EC Directives); the material may still produce health damage following entry through wounds, lesions or abrasions.</p> <p>Repeated exposure may cause skin cracking, flaking or drying following normal handling and use.</p> <p>Limited evidence exists, or practical experience predicts, that the material either produces inflammation of the skin in a substantial number of individuals following direct contact, and/or produces significant inflammation when applied to the healthy intact skin of animals, for up to four hours, such inflammation being present twenty-four hours or more after the end of the exposure period. Skin irritation may also be present after prolonged or repeated exposure; this may result in a form of contact dermatitis (nonallergic). The dermatitis is often characterised by skin redness (erythema) and swelling (oedema) which may progress to blistering (vesiculation), scaling and thickening of the epidermis. At the microscopic level there may be intercellular oedema of the spongy layer of the skin (spongiosis) and intracellular oedema of the epidermis.</p> <p>In common with other halogenated aliphatics, fluorocarbons may cause dermal problems due to a tendency to remove natural oils from the skin causing irritation and the development of dry, sensitive skin. They do not appear to be appreciably absorbed.</p> <p>Open cuts, abraded or irritated skin should not be exposed to this material</p> <p>Entry into the blood-stream through, for example, cuts, abrasions, puncture wounds or lesions, may produce systemic injury with harmful effects. Examine the skin prior to the use of the material and ensure that any external damage is suitably protected.</p> <p>Vapourising liquid causes rapid cooling and contact may cause cold burns, frostbite, even through normal gloves. Frozen skin tissues are painless and appear waxy and yellow. Signs and symptoms of frost-bite may include "pins and needles", paleness followed by numbness, a hardening and stiffening of the skin, a progression of colour changes in the affected area, (first white, then mottled and blue and eventually black; on recovery, red, hot, painful and blistered).</p> |
| Eye | <p>Although the material is not thought to be an irritant (as classified by EC Directives), direct contact with the eye may produce transient discomfort characterised by tearing or conjunctival redness (as with windburn).</p> <p>Direct contact with the eye may not cause irritation because of the extreme volatility of the gas; however concentrated atmospheres may produce irritation after brief exposures..</p> |

1,1,1,2-TETRAFLUOROETHANE

| | | |
|----------------------------------|---|-------------------|
| Chronic | No effects have been seen in rats exposed to up to 50,000 ppm for 90 days. It is not teratogenic in rats or rabbits. Short term screening tests for carcinogenicity have proved negative. No long term effects were noted when administered by gavage to rats at a dose of 300 mg/kg/day for one year and the rats held for the remainder of their life span. [CIC] Limited evidence suggests that repeated or long-term occupational exposure may produce cumulative health effects involving organs or biochemical systems. | |
| | It is generally accepted that the fluorocarbons are less toxic than the corresponding halogenated aliphatic based on chlorine. Repeated inhalation exposure to the fluorocarbon FC-11 does not produce pathologic lesions of the liver and other visceral organs in experimental animals. There has been conjecture in non-scientific publications that fluorocarbons may cause leukemia, cancer, sterility and birth defects; these have not been verified by current research. The high incidence of cancer, spontaneous abortion and congenital anomalies amongst hospital personnel, repeatedly exposed to fluorine-containing general anaesthetics, has caused some scientists to call for a lowering of the fluorocarbon exposure standard to 5 ppm since some are mutagens. Principal route of occupational exposure to the gas is by inhalation. | |
| 1,1,1,2-tetrafluoroethane | TOXICITY | IRRITATION |
| | Inhalation (Rat) LC50: 359453.102 ppm4h ^[2] | Not Available |
| Legend: | 1. Value obtained from Europe ECHA Registered Substances - Acute toxicity 2. Value obtained from manufacturer's SDS. Unless otherwise specified data extracted from RTECS - Register of Toxic Effect of chemical Substances | |

| | | |
|--|---|-----------------------------------|
| 1,1,1,2-TETRAFLUOROETHANE | * with added oxygen - ZhongHao New Chemical Materials MSDS Excessive concentration can have a narcotic effect; inhalation of high concentrations of decomposition products can cause lung oedema. Disinfection by products (DBPs) re formed when disinfectants such as chlorine, chloramine, and ozone react with organic and inorganic matter in water. The observations that some DBPs such as trihalomethanes (THMs), di-/trichloroacetic acids, and 3-chloro-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone (MX) are carcinogenic in animal studies have raised public concern over the possible adverse health effects of DBPs. To date, several hundred DBPs have been identified. Numerous haloalkanes and haloalkenes have been tested for carcinogenic and mutagenic activities. In general, the genotoxic potential is dependent on the nature, number, and position of halogen(s) and the molecular size of the compound. Short-chain monohalogenated (excluding fluorine) alkanes and alkenes are potential direct-acting alkylating agents, particularly if the halogen is at the terminal end of the carbon chain or at an allylic position. Dihalogenated alkanes are also potential alkylating or cross-linking agents (either directly or after GSH conjugation), particularly if they are vicinally substituted (e.g., 1,2-dihaloalkane) or substituted at the two terminal ends of a short to medium-size (e.g., 2-7) alkyl moiety (i.e., alpha, omega-dihaloalkane). Fully halogenated haloalkanes tend to act by free radical or nongenotoxic mechanisms (such as generating peroxisome-proliferative intermediates) or undergo reductive dehalogenation to yield haloalkenes that in turn could be activated to epoxides. Haloalkenes are of concern because of potential to generate genotoxic intermediates after epoxidation. The concern for haloalkenes may be diminished if the double bond is internal or sterically hindered. The cancer concern levels of the 14 haloalkanes and haloalkenes, have been rated based on available screening cancer bioassay (pulmonary adenoma assay) and genotoxicity data. Five brominated and iodinated methane and ethane derivatives are given a moderate rating. Beyond the fact that bromine and iodine are better leaving groups than chlorine, there is also evidence that brominated THMs may be preferentially activated by a theta-class glutathione S-transferase (GSTT1-1) to mutagens in Salmonella even at low substrate concentrations Furthermore, there are human carcinogenicity implications because of polymorphism in GSTT1-1. Human subpopulations with expressed GSTT1-1 may be at a greater risk to brominate THMs than humans who lack the gene. Six, two, and one haloalkanes/ haloalkene(s) are given low-moderate, marginal, and low concern, respectively. | |
| | | |
| Acute Toxicity | ✓ | Carcinogenicity ✗ |
| Skin Irritation/Corrosion | ✓ | Reproductivity ✗ |
| Serious Eye Damage/Irritation | ✗ | STOT - Single Exposure ✗ |
| Respiratory or Skin sensitisation | ✗ | STOT - Repeated Exposure ✗ |
| Mutagenicity | ✗ | Aspiration Hazard ✗ |
| Legend: ✗ – Data either not available or does not fill the criteria for classification ✓ – Data available to make classification | | |

SECTION 12 Ecological information

Toxicity

| | | | | | |
|----------------------------------|--|---------------------------|-------------------------------|--------------|---------------|
| 1,1,1,2-tetrafluoroethane | Endpoint | Test Duration (hr) | Species | Value | Source |
| | EC50 | 48h | Crustacea | 980mg/l | Not Available |
| | EC50 | 96h | Algae or other aquatic plants | 142mg/l | 2 |
| | EC50 | 72h | Algae or other aquatic plants | >114mg/l | 2 |
| | NOEC(ECx) | 96h | Fish | 300mg/l | Not Available |
| | LC50 | 96h | Fish | 450mg/l | Not Available |
| Legend: | Extracted from 1. IUCLID Toxicity Data 2. Europe ECHA Registered Substances - Ecotoxicological Information - Aquatic Toxicity 4. US EPA, Ecotox database - Aquatic Toxicity Data 5. ECETOC Aquatic Hazard Assessment Data 6. NITE (Japan) - Bioconcentration Data 7. METI (Japan) - Bioconcentration Data 8. Vendor Data | | | | |

Persistence and Degradation: Ozone Destruction Potential PDO = 0 (R11=1) Greenhouse Effect Potential (ESP) = 0.27 (R11=1) Decomposed comparatively rapidly in the lower atmosphere (troposphere). Atmospheric lifetime is 15.6 years. Products of decomposition will be highly dispersed and hence will have a very low concentration. Does not influence photochemical smog (i.e. is not a VOC under the terms of the UNECE agreement). Does not deplete ozone. Effect on Effluent Treatment: Discharges of the product will enter the atmosphere and will not result in long term aqueous contamination. [IC] Ecotoxicity: Fish LC50 (96 h): Salmo gairdneri 450 mg/l ; NOEC 300 mg/l (mortality) (semi-static tests) Daphnia EC50 (48 h): 980 mg/l Bacteria EC10 (6 h): Pseudomonas putida >730 mg/l (growth) Mobility Air: Henry's Law constant (H): 65 kPa.m³/ml (20 °C/calculation) - considerable volatility Soil/ sediment log Koc 1.5 approx (adsorption - calculated) Persistence and biodegradability Abiotic degradation Air, indirect photo-oxidation t1/2=10.9 years Conditions: sensitiser: OH radicals Degradation products: carbon dioxide/ fluorhydric acid/ trichloroacetic acid Air, photolysis, ODP=0 No effect on stratospheric ozone Reference value for CFC 11: ODP=1 Air, greenhouse effect, GWP=0.25 Reference value for CFC 11: GWP=1 Biotic degradation Aerobic, test ready biodegradability/ closed bottle, degradation from 2-3% 28 days Result: not readily biodegradable Aerobic, test biodegradation by methane oxidation Result: non-biodegradable Conditions: inoculum: Methylosinus trichosporium OB3b Bioaccumulative potential; bioconcentration log PoW=1.06 Product is persistent in air (atmospheric lifetime: 15.7 years) Product is not significantly hazardous for the aquatic environment as: very low toxicity for aquatic organisms considerable volatility no bioaccumulation

Continued...

HFCs (hydrofluorocarbons) have been widely used as replacements for Ozone Depletion Substances (ODSs.) Because they do not contain chlorine or bromine, they have an ozone Depletion Potential (ODP) of 0. However, certain HFCs have high Global warming Potential (GWPs). Perfluorinated fluorocarbons (PFCs) have extremely high GWPs and long atmospheric lifetimes. They do not deplete stratospheric ozone, but the U.S. Environmental Protection Agency (EPA) is concerned about their impact on global warming. Unlike other greenhouse gases in the Paris Agreement, hydrofluorocarbons have other international negotiations. In September 2016, the New York Declaration on Forests urged a global reduction in the use of HFCs. On 15 October 2016, due to these chemicals' contribution to climate change, negotiators from 197 nations meeting at the summit of the United Nations Environment Programme in Kigali, Rwanda reached a legally-binding accord to phase out hydrofluorocarbons (HFCs) in an amendment to the Montreal Protocol:

The final deal will divide the world economy into three tracks.

- The richest countries, including the United States and those in the European Union, will freeze the production and consumption of HFCs by 2018, reducing them to about 15 percent of 2012 levels by 2036.
- Much of the rest of the world, including China, Brazil and all of Africa, will freeze HFC use by 2024, reducing it to 20 percent of 2021 levels by 2045.
- A small group of the world's hottest countries — India, Pakistan, Iran, Saudi Arabia and Kuwait — will have the most lenient schedule, freezing HFC use by 2028 and reducing it to about 15 percent of 2025 levels by 2047..

90halkane

In addition to carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O), the greenhouse gases mentioned in the Kyoto Protocol include synthetic substances that share the common feature of being highly persistent in the atmosphere and exhibiting very high specific radiative forcing (radiative forcing is the change in the balance between radiation coming into the atmosphere and radiation out; a positive radiative forcing tends on average to warm the surface of the earth). These synthetic substances include hydrocarbons that are partially fluorinated (HCFs) or totally fluorinated (PFCs) as well as sulfur hexafluoride (SF₆).

The greenhouse potential of these substances, expressed as multiples of that of CO₂, are within the range of 140 to 11,700 for HFCs, from 6500 to 9,200 for PFCs and 23,900 for SF₆. Once emitted into the atmosphere, these substances have an impact on the environment for decades, centuries, or in certain instances, for thousands of years. Many of these substances have only been commercialised for a few years, and still only contribute only a small percentage of those gases released to the atmosphere by humans (anthropogenic) which increase the greenhouse effect. However, a rapid increase can be seen in their consumption and emission, and therefore in their contribution to the anthropogenic increase in the greenhouse effect.

Since the adoption of the Kyoto Protocol, new fluorinated substances have appeared on the market, which are stable in air and have a high greenhouse potential; these include nitrogen trifluoride (NF₃) and fluoroethers.

DO NOT discharge into sewer or waterways.

Persistence and degradability

| Ingredient | Persistence: Water/Soil | Persistence: Air |
|---------------------------|-------------------------|------------------|
| 1,1,1,2-tetrafluoroethane | HIGH | HIGH |

Bioaccumulative potential

| Ingredient | Bioaccumulation |
|---------------------------|---------------------|
| 1,1,1,2-tetrafluoroethane | LOW (LogKOW = 1.68) |

Mobility in soil

| Ingredient | Mobility |
|---------------------------|-----------------------|
| 1,1,1,2-tetrafluoroethane | LOW (Log KOC = 96.63) |

SECTION 13 Disposal considerations

Waste treatment methods

| | |
|------------------------------|---|
| Product / Packaging disposal | <ul style="list-style-type: none">▶ Evaporate residue at an approved site.▶ Return empty containers to supplier. If containers are marked non-returnable establish means of disposal with manufacturer prior to purchase.▶ Ensure damaged or non-returnable cylinders are gas-free before disposal. |
|------------------------------|---|

SECTION 14 Transport information

Labels Required

| | |
|------------------|---|
| |  |
| Marine Pollutant | NO |

Land transport (UN)

| | | | | | |
|------------------------------------|---|--------------------|----------------|-------------------|----------------|
| 14.1. UN number or ID number | 3159 | | | | |
| 14.2. UN proper shipping name | 1,1,1,2-TETRAFLUOROETHANE (REFRIGERANT GAS R 134a) | | | | |
| 14.3. Transport hazard class(es) | <table><tr><td>Class</td><td>2.2</td></tr><tr><td>Subsidiary Hazard</td><td>Not Applicable</td></tr></table> | Class | 2.2 | Subsidiary Hazard | Not Applicable |
| Class | 2.2 | | | | |
| Subsidiary Hazard | Not Applicable | | | | |
| 14.4. Packing group | Not Applicable | | | | |
| 14.5. Environmental hazard | Not Applicable | | | | |
| 14.6. Special precautions for user | <table><tr><td>Special provisions</td><td>Not Applicable</td></tr><tr><td>Limited quantity</td><td>120 ml</td></tr></table> | Special provisions | Not Applicable | Limited quantity | 120 ml |
| Special provisions | Not Applicable | | | | |
| Limited quantity | 120 ml | | | | |

Air transport (ICAO-IATA / DGR)

| | |
|-------------------------------|---|
| 14.1. UN number | 3159 |
| 14.2. UN proper shipping name | 1,1,1,2-Tetrafluoroethane; Refrigerant gas R 134a |

| | | |
|------------------------------------|---|----------------|
| 14.3. Transport hazard class(es) | ICAO/IATA Class | 2.2 |
| | ICAO / IATA Subsidiary Hazard | Not Applicable |
| | ERG Code | 2L |
| 14.4. Packing group | Not Applicable | |
| 14.5. Environmental hazard | Not Applicable | |
| 14.6. Special precautions for user | Special provisions | Not Applicable |
| | Cargo Only Packing Instructions | 200 |
| | Cargo Only Maximum Qty / Pack | 150 kg |
| | Passenger and Cargo Packing Instructions | 200 |
| | Passenger and Cargo Maximum Qty / Pack | 75 kg |
| | Passenger and Cargo Limited Quantity Packing Instructions | Forbidden |
| | Passenger and Cargo Limited Maximum Qty / Pack | Forbidden |

Sea transport (IMDG-Code / GGVSee)

| | | |
|------------------------------------|---|----------------|
| 14.1. UN number | 3159 | |
| 14.2. UN proper shipping name | REFRIGERANT GAS R 134a; 1,1,1,2-TETRAFLUOROETHANE | |
| 14.3. Transport hazard class(es) | IMDG Class | 2.2 |
| | IMDG Subsidiary Hazard | Not Applicable |
| 14.4. Packing group | Not Applicable | |
| 14.5. Environmental hazard | Not Applicable | |
| 14.6. Special precautions for user | EMS Number | F-C , S-V |
| | Special provisions | Not Applicable |
| | Limited Quantities | 120 mL |

14.7.1. Transport in bulk according to Annex II of MARPOL and the IBC code
Not Applicable

14.7.2. Transport in bulk in accordance with MARPOL Annex V and the IMSBC Code

| Product name | Group |
|---------------------------|---------------|
| 1,1,1,2-tetrafluoroethane | Not Available |

14.7.3. Transport in bulk in accordance with the IGC Code

| Product name | Ship Type |
|---------------------------|---------------|
| 1,1,1,2-tetrafluoroethane | Not Available |

SECTION 15 Regulatory information

Safety, health and environmental regulations / legislation specific for the substance or mixture

1,1,1,2-tetrafluoroethane is found on the following regulatory lists
International Agency for Research on Cancer (IARC) - Agents Classified by the IARC Monographs - Not Classified as Carcinogenic

Additional Regulatory Information

Not Applicable

National Inventory Status

| National Inventory | Status |
|--|--------------------------------|
| Australia - AIC / Australia Non-Industrial Use | Yes |
| Canada - DSL | Yes |
| Canada - NDSL | No (1,1,1,2-tetrafluoroethane) |
| China - IECSC | Yes |
| Europe - EINEC / ELINCS / NLP | Yes |
| Japan - ENCS | Yes |
| Korea - KECI | Yes |
| New Zealand - NZIoC | Yes |
| Philippines - PICCS | Yes |
| USA - TSCA | Yes |
| Taiwan - TCSI | Yes |
| Mexico - INSQ | Yes |
| Vietnam - NCI | Yes |
| Russia - FBEPH | Yes |

1,1,1,2-TETRAFLUOROETHANE

| National Inventory | Status |
|--------------------|---|
| Legend: | Yes = All CAS declared ingredients are on the inventory No = One or more of the CAS listed ingredients are not on the inventory. These ingredients may be exempt or will require registration. |

SECTION 16 Other information

| | |
|---------------|------------|
| Revision Date | 23/12/2022 |
| Initial Date | 16/08/2006 |

CONTACT POINT

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. NFIL shall not be held liable for any damage resulting from handling or from contact with the above product.

SDS Version Summary

| Version | Date of Update | Sections Updated |
|---------|----------------|--|
| 9.1 | 31/10/2018 | Toxicological information - Acute Health (skin), Toxicological information - Acute Health (swallowed), First Aid measures - Advice to Doctor, Physical and chemical properties - Appearance, CAS Number, Toxicological information - Chronic Health, Exposure controls / personal protection - Personal Protection (Respirator), Handling and storage - Storage (storage incompatibility), Handling and storage - Storage (storage requirement), Toxicological information - Toxicity and Irritation (Other) |
| 10.1 | 23/12/2022 | Classification review due to GHS Revision change. |

Other information

Classification of the preparation and its individual components has drawn on official and authoritative sources as well as independent review by the Chemwatch Classification committee using available literature references.

The SDS is a Hazard Communication tool and should be used to assist in the Risk Assessment. Many factors determine whether the reported Hazards are Risks in the workplace or other settings. Risks may be determined by reference to Exposures Scenarios. Scale of use, frequency of use and current or available engineering controls must be considered.

Definitions and abbreviations

- ▶ PC - TWA: Permissible Concentration-Time Weighted Average
- ▶ PC - STEL: Permissible Concentration-Short Term Exposure Limit
- ▶ IARC: International Agency for Research on Cancer
- ▶ ACGIH: American Conference of Governmental Industrial Hygienists
- ▶ STEL: Short Term Exposure Limit
- ▶ TEEL: Temporary Emergency Exposure Limit,
- ▶ IDLH: Immediately Dangerous to Life or Health Concentrations
- ▶ ES: Exposure Standard
- ▶ OSF: Odour Safety Factor
- ▶ NOAEL: No Observed Adverse Effect Level
- ▶ LOAEL: Lowest Observed Adverse Effect Level
- ▶ TLV: Threshold Limit Value
- ▶ LOD: Limit Of Detection
- ▶ OTV: Odour Threshold Value
- ▶ BCF: BioConcentration Factors
- ▶ BEI: Biological Exposure Index
- ▶ DNEL: Derived No-Effect Level
- ▶ PNEC: Predicted no-effect concentration

- ▶ AIIC: Australian Inventory of Industrial Chemicals
- ▶ DSL: Domestic Substances List
- ▶ NDSL: Non-Domestic Substances List
- ▶ IECSC: Inventory of Existing Chemical Substance in China
- ▶ EINECS: European INventory of Existing Commercial chemical Substances
- ▶ ELINCS: European List of Notified Chemical Substances
- ▶ NLP: No-Longer Polymers
- ▶ ENCS: Existing and New Chemical Substances Inventory
- ▶ KECI: Korea Existing Chemicals Inventory
- ▶ NZIoC: New Zealand Inventory of Chemicals
- ▶ PICCS: Philippine Inventory of Chemicals and Chemical Substances
- ▶ TSCA: Toxic Substances Control Act
- ▶ TCSI: Taiwan Chemical Substance Inventory
- ▶ INSQ: Inventario Nacional de Sustancias Químicas
- ▶ NCI: National Chemical Inventory
- ▶ FBEPH: Russian Register of Potentially Hazardous Chemical and Biological Substances

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