

R448A

Greenchem Industries

Chemwatch Hazard Alert Code: 1

Chemwatch: 5601-55

Version No: 2.1

Safety Data Sheet according to WHS Regulations (Hazardous Chemicals) Amendment 2020 and ADG requirements

Issue Date: 15/05/2023

Print Date: 15/05/2023

L.GHS.AUS.EN.E

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

Product Identifier

Product name	R448A
Chemical Name	Not Applicable
Synonyms	Not Available
Proper shipping name	LIQUEFIED GAS, N.O.S. (contains pentafluoroethane, difluoromethane and 1,1,1,2-tetrafluoroethane)
Chemical formula	Not Applicable
Other means of identification	Not Available

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

Relevant identified uses	<p>Refrigerant Use according to manufacturer's directions. 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. 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>
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Details of the manufacturer or supplier of the safety data sheet

Registered company name	Greenchem Industries
Address	22-24 Waldaree Street Gepps Cross SA 5094 Australia
Telephone	+61 8 7228 5885
Fax	+61 8 7228 5886
Website	http://www.greenchemindustries.com.au/
Email	info@greenchemindustries.com.au

Emergency telephone number

Association / Organisation	CHEMWATCH EMERGENCY RESPONSE (24/7)
Emergency telephone numbers	+61 1800 951 288
Other emergency telephone numbers	+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

Poisons Schedule	Not Applicable
Classification [1]	Gases Under Pressure (Liquefied Gas)
Legend:	1. Classified by Chemwatch; 2. Classification drawn from HCIS; 3. Classification drawn from Regulation (EU) No 1272/2008 - Annex VI

Label elements

Hazard pictogram(s)	
Signal word	Warning

Hazard statement(s)

H280	Contains gas under pressure; may explode if heated.
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Precautionary statement(s) Prevention

Not Applicable

Precautionary statement(s) Response

Not Applicable

Precautionary statement(s) Storage

P410+P403	Protect from sunlight. Store in a well-ventilated place.
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Precautionary statement(s) Disposal

Not Applicable

SECTION 3 Composition / information on ingredients**Substances**

See section below for composition of Mixtures

Mixtures

CAS No	%[weight]	Name
75-10-5	20-30	difluoromethane
354-33-6	20-30	pentafluoroethane
811-97-2	20-30	1,1,1,2-tetrafluoroethane
754-12-1	10-20	2,3,3,3-tetrafluoropropene
29118-24-9	1-10	1,3,3,3-tetrafluoropropene
Legend:	1. Classified by Chemwatch; 2. Classification drawn from HCIS; 3. Classification drawn from Regulation (EU) No 1272/2008 - Annex VI; 4. Classification drawn from C&L; * EU IOELVs available	

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.
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. ▶ For advice, contact a Poisons Information Centre or a doctor. ▶ Avoid giving milk or oils. ▶ Avoid giving alcohol.

Indication of any immediate medical attention and special treatment needed

Treat symptomatically.

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	<ul style="list-style-type: none"> ▸ Avoid contamination with oxidising agents i.e. nitrates, oxidising acids, chlorine bleaches, pool chlorine etc. as ignition may result
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Advice for firefighters

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	<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) 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>
HAZCHEM	2TE

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

Safe handling	<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. Use only properly specified equipment which is suitable for this product, its supply pressure and temperature · 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 contain 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 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. ▶ DO NOT transfer gas from one cylinder to another.
Other information	<ul style="list-style-type: none"> · Do NOT store halogenated aliphatics in areas containing alkali or alkaline earth metals such as powdered aluminum, zinc, or beryllium ▶ 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	<ul style="list-style-type: none"> ▶ Avoid reaction with oxidising agents metals

SECTION 8 Exposure controls / personal protection

Control parameters

Occupational Exposure Limits (OEL)

INGREDIENT DATA

Source	Ingredient	Material name	TWA	STEL	Peak	Notes
Australia Exposure Standards	1,1,1,2-tetrafluoroethane	1,1,1,2-Tetrafluoroethane	1000 ppm / 4240 mg/m3	Not Available	Not Available	Not Available


Emergency Limits

Ingredient	TEEL-1	TEEL-2	TEEL-3
difluoromethane	3,000 ppm	6,500 ppm	39,000 ppm
1,1,1,2-tetrafluoroethane	Not Available	Not Available	Not Available
2,3,3,3-tetrafluoropropene	2,200 ppm	Not Available	1.40E+05 ppm
1,3,3,3-tetrafluoropropene	1,400 ppm	Not Available	Not Available

Ingredient	Original IDLH	Revised IDLH
difluoromethane	Not Available	Not Available
pentafluoroethane	Not Available	Not Available
1,1,1,2-tetrafluoroethane	Not Available	Not Available
2,3,3,3-tetrafluoropropene	Not Available	Not Available
1,3,3,3-tetrafluoropropene	Not Available	Not Available

MATERIAL DATA

Exposure controls

Appropriate engineering controls	<p>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:</p> <p>Process controls which involve changing the way a job activity or process is done to reduce the risk.</p> <p>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.</p> <p>Employers may need to use multiple types of controls to prevent employee overexposure.</p> <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. <p>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.</p> <table border="1" style="width: 100%;"> <thead> <tr> <th>Type of Contaminant:</th> <th>Air Speed:</th> </tr> </thead> <tbody> <tr> <td>gas discharge (active generation into zone of rapid air motion)</td> <td>1-2.5 m/s (200-500 f/min.)</td> </tr> </tbody> </table> <p>Within each range the appropriate value depends on:</p> <table border="1" style="width: 100%;"> <thead> <tr> <th>Lower end of the range</th> <th>Upper end of the range</th> </tr> </thead> <tbody> <tr> <td>1: Room air currents minimal or favourable to capture</td> <td>1: Disturbing room air currents</td> </tr> <tr> <td>2: Contaminants of low toxicity or of nuisance value only.</td> <td>2: Contaminants of high toxicity</td> </tr> <tr> <td>3: Intermittent, low production.</td> <td>3: High production, heavy use</td> </tr> <tr> <td>4: Large hood or large air mass in motion</td> <td>4: Small hood-local control only</td> </tr> </tbody> </table> <p>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.</p>	Type of Contaminant:	Air Speed:	gas discharge (active generation into zone of rapid air motion)	1-2.5 m/s (200-500 f/min.)	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
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Individual protection measures, such as personal protective equipment															
Eye and face protection	<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] 														
Skin protection	See Hand protection below														
Hands/feet protection	<ul style="list-style-type: none"> ▶ Butyl rubber gloves <ul style="list-style-type: none"> • Butyl rubber gloves should be used when handling halogenated aliphatics . • Nitrile, PVC-coated nitrile, and PVC protective equipment are not recommended ▶ When handling sealed and suitably insulated cylinders wear cloth or leather gloves. ▶ Insulated gloves: <p>NOTE: Insulated gloves should be loose fitting so that 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.</p>														
Body protection	See Other protection below														

Other protection

- Halogen-selective detectors use a specialized sensor that allows the monitor to detect compounds containing fluorine, chlorine, bromine, and iodine with-out interference from other species. These detectors are typically easy to use, feature higher sensitivity than the nonselective detectors (detection limits are typically <5 ppm when used as an area monitor and <1.4 gm/yr [<0.05 oz/yr] when used as a leak pinpointer).
- Compound-Specific Detectors are typically capable of detecting the presence of a single compound without interference from other compounds.
- ▶ Protective overalls, closely fitted at neck and wrist.
- ▶ Eye-wash unit.
- ▶ Ensure availability of lifeline in confined spaces.
- ▶ Staff should be trained in all aspects of rescue work.
- ▶ Rescue gear: Two sets of SCBA breathing apparatus Rescue Harness, lines etc.

Respiratory protection

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

Where the concentration of gas/particulates in the breathing zone, approaches or exceeds the "Exposure Standard" (or ES), respiratory protection is required.

Degree of protection varies with both face-piece and Class of filter; the nature of protection varies with Type of filter.

Required Minimum Protection Factor	Half-Face Respirator	Full-Face Respirator	Powered Air Respirator
up to 5 x ES	Air-line*	AX-2 P3	AX-PAPR-2 P3 ^
up to 10 x ES	-	AX-3 P3	-
10+ x ES	-	Air-line**	-

* - Continuous Flow; ** - Continuous-flow or positive pressure demand

^ - Full-face

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)

SECTION 9 Physical and chemical properties**Information on basic physical and chemical properties**

Appearance	Clear colourless gas with mild ether like odour.		
Physical state	Liquified Gas	Relative density (Water = 1)	1.11
Odour	Not Available	Partition coefficient n-octanol / water	Not Available
Odour threshold	Not Available	Auto-ignition temperature (°C)	628
pH (as supplied)	7	Decomposition temperature (°C)	>250
Melting point / freezing point (°C)	Not Available	Viscosity (cSt)	Not Applicable
Initial boiling point and boiling range (°C)	-45.9 - -39.8	Molecular weight (g/mol)	Not Applicable
Flash point (°C)	Not Applicable	Taste	Not Available
Evaporation rate	Not Available	Explosive properties	Not Available
Flammability	Not Applicable	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)	Not Available
Vapour pressure (kPa)	2,588 @54.4C	Gas group	Not Available
Solubility in water	Not Available	pH as a solution (1%)	Not Available
Vapour density (Air = 1)	>1	VOC g/L	Not Available

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	Inhalation of vapours may cause drowsiness and dizziness. This may be accompanied by narcosis, reduced alertness, loss of reflexes, lack of coordination and vertigo. Inhalation of vapours or aerosols (mists, fumes), generated by the material during the course of normal handling, may be damaging to the health
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	<p>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>
Ingestion	<p>Not normally a hazard due to physical form of product.</p> <p>Considered an unlikely route of entry in commercial/industrial environments</p>
Skin Contact	<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. 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>
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>
Chronic	<p>On the basis, primarily, of animal experiments, concern has been expressed by at least one classification body that the material may produce carcinogenic or mutagenic effects; in respect of the available information, however, there presently exists inadequate data for making a satisfactory assessment.</p> <p>Limited evidence suggests that repeated or long-term occupational exposure may produce cumulative health effects involving organs or biochemical systems.</p>

R448A	TOXICITY	IRRITATION
	Not Available	Not Available
difluoromethane	TOXICITY	IRRITATION
	Inhalation(Rat) LC50: >760000 ppm4h ^[2]	Not Available
	Oral (Mouse) LD50; 1810 mg/kg ^[2]	
pentafluoroethane	TOXICITY	IRRITATION
	Inhalation(Rat) LC50: >709000 ppm4h ^[2]	Not Available
1,1,1,2-tetrafluoroethane	TOXICITY	IRRITATION
	Inhalation(Rat) LC50: 359453.102 ppm4h ^[2]	Not Available
2,3,3,3-tetrafluoropropene	TOXICITY	IRRITATION
	Inhalation(Rat) LC50: >86.831 ppm4h ^[2]	Not Available
1,3,3,3-tetrafluoropropene	TOXICITY	IRRITATION
	Inhalation(Rat) LC50: >1157.752 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

PENTAFLUOROETHANE	Cardiac sensitisation threshold limit >245400 mg/m3 Anaesthetic effects threshold limit 490800 mg/m3 * DuPont SDS
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.
2,3,3,3-TETRAFLUOROPROPENE	Mutagenicity : Did not cause genetic damage in animals. Did not cause genetic damage in cultured mammalian cells. Experiments showed mutagenic effects in cultured bacterial cells. Reproductive toxicity : Animal testing showed no reproductive toxicity. Teratogenicity : Animal testing showed effects on embryo-fetal development at levels equal to or above those causing maternal toxicity. For similar product, 1,3,3,3-tetrafluoropropene HFO-1234ze is practically non-toxic. Short-term exposures at levels higher than 10% have not induced cardiac sensitization to adrenalin nor induced serious toxic effects. Rats and rabbits did not exhibit any serious toxic, developmental or reproductive effects even with exposures to high levels of HFO-1234ze. Based on a series of mutagenicity and genomics studies, the cancer risk for HFO-1234ze is LOW
1,3,3,3-TETRAFLUOROPROPENE	Inhalation (rat) NOEL (28 days): >1.5 mg/l * HFO-1234ze is practically non-toxic. Short-term exposures at levels higher than 10% have not induced cardiac sensitization to adrenalin nor induced serious toxic effects. Rats and rabbits did not exhibit any serious toxic, developmental or reproductive effects even with exposures to high levels of HFO-1234ze. Based on a series of mutagenicity and genomics studies, the cancer risk for HFO-1234ze is low, no cardiac sensitisation was observed in dogs with exposures up to 120,000 ppm; repeated dose toxicity in rats (13-wk) found mild effects on the heart (NOEL 5,000ppm); in vitro genotoxicity findings include negative Ames Test and negative human lymphocyte chromosome aberration test; in vivo genotoxicity findings in the mouse micronucleus test were negative (inhalation, mammalian bone-marrow cytogenetic test with chromosomal analysis).
1,1,1,2-TETRAFLUOROETHANE & 2,3,3,3-TETRAFLUOROPROPENE & 1,3,3,3-TETRAFLUOROPROPENE	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.

* Vendor HFO-1234ze is not likely to accumulate in the bodies of humans or animals

The fluoroalkenes vary widely in acute inhalation toxicity. Those, such as perfluoroisobutylene, PFIB, the most highly toxic member, attacks the pulmonary epithelium of rats eventuating in edema and death after a delay of about one day. Other fluoroalkenes, such as hexafluoropropylene (HFP) or chlorotrifluoroethylene (CTFE), also cause pulmonary injury but at lower concentrations produce concentration dependent changes in the renal concentrating mechanism of the rat. Changes in the CNS of rats and rabbits have also been reported for CTFE. CTFE, in repeated exposures, has produced blood pressure changes in dogs, CNS effects and changes in the erythropoietic system.

Mechanisms of action research for fluoroalkenes is an important area of need. . The nucleophilic sensitivity of the fluoroalkenes and the potential carcinogenic effects stemming are the subject of speculation.

Fluoroalkanes, in contrast, are amongst the least toxic of all substances.

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

R448A	Endpoint	Test Duration (hr)	Species	Value	Source
	Not Available	Not Available	Not Available	Not Available	Not Available

difluoromethane	Endpoint	Test Duration (hr)	Species	Value	Source
	NOEC(ECx)	96h	Fish	10mg/l	2
	EC50	96h	Algae or other aquatic plants	142mg/l	2
	EC50	72h	Algae or other aquatic plants	>114mg/l	2
	LC50	96h	Fish	>81.8mg/l	2
	EC50	48h	Crustacea	>97.9mg/l	2

pentafluoroethane	Endpoint	Test Duration (hr)	Species	Value	Source
	LC50	96h	Fish	>81.8mg/l	2
	NOEC(ECx)	96h	Fish	10mg/l	2
	EC50	96h	Algae or other aquatic plants	142mg/l	2
	EC50	72h	Algae or other aquatic plants	>114mg/l	2
	EC50	48h	Crustacea	>97.9mg/l	2

1,1,1,2-tetrafluoroethane	Endpoint	Test Duration (hr)	Species	Value	Source
	NOEC(ECx)	96h	Fish	300mg/l	Not Available
	EC50	96h	Algae or other aquatic plants	142mg/l	2
	EC50	72h	Algae or other aquatic plants	>114mg/l	2
	LC50	96h	Fish	450mg/l	Not Available
	EC50	48h	Crustacea	980mg/l	Not Available

2,3,3,3-tetrafluoropropene	Endpoint	Test Duration (hr)	Species	Value	Source
	ErC50	72h	Algae or other aquatic plants	>100mg/l	2
	NOEC(ECx)	72h	Algae or other aquatic plants	>100mg/l	Not Available
	EC50	72h	Algae or other aquatic plants	>2.5mg/l	2

Continued...

	LC50	96h	Fish	>197mg/l	Not Available
	EC50	48h	Crustacea	65mg/l	2
1,3,3,3-tetrafluoropropene	Endpoint	Test Duration (hr)	Species	Value	Source
	LC50	96h	Fish	>117mg/l	2
	EC50	72h	Algae or other aquatic plants	>170mg/l	2
	EC50	48h	Crustacea	>160mg/l	2
	EC50(ECx)	48h	Crustacea	>160mg/l	2
	EC50(ECx)	72h	Algae or other aquatic plants	>10mg/l	2
	EC50	72h	Algae or other aquatic plants	>10mg/l	2
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				

DO NOT discharge into sewer or waterways.

Persistence and degradability

Ingredient	Persistence: Water/Soil	Persistence: Air
difluoromethane	LOW	LOW
pentafluoroethane	HIGH	HIGH
1,1,1,2-tetrafluoroethane	HIGH	HIGH
2,3,3,3-tetrafluoropropene	HIGH	HIGH

Bioaccumulative potential

Ingredient	Bioaccumulation
difluoromethane	LOW (LogKOW = 0.2)
pentafluoroethane	LOW (LogKOW = 1.5472)
1,1,1,2-tetrafluoroethane	LOW (LogKOW = 1.68)
2,3,3,3-tetrafluoropropene	LOW (LogKOW = 2.1485)

Mobility in soil

Ingredient	Mobility
difluoromethane	LOW (KOC = 23.74)
pentafluoroethane	LOW (KOC = 154.4)
1,1,1,2-tetrafluoroethane	LOW (KOC = 96.63)
2,3,3,3-tetrafluoropropene	LOW (KOC = 154.4)


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.
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SECTION 14 Transport information

Labels Required

	
Marine Pollutant	NO
HAZCHEM	2TE

Land transport (ADG)

UN number or ID number	3163
UN proper shipping name	LIQUEFIED GAS, N.O.S. (contains pentafluoroethane, difluoromethane and 1,1,1,2-tetrafluoroethane)
Transport hazard class(es)	Class 2.2
	Subsidiary risk Not Applicable
Packing group	Not Applicable

Environmental hazard	Not Applicable	
Special precautions for user	Special provisions	274 392
	Limited quantity	120 ml

Air transport (ICAO-IATA / DGR)

UN number	3163	
UN proper shipping name	Liquefied gas, n.o.s. * (contains pentafluoroethane, difluoromethane and 1,1,1,2-tetrafluoroethane)	
Transport hazard class(es)	ICAO/IATA Class	2.2
	ICAO / IATA Subrisk	Not Applicable
	ERG Code	2L
Packing group	Not Applicable	
Environmental hazard	Not Applicable	
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)

UN number	3163	
UN proper shipping name	LIQUEFIED GAS, N.O.S. (contains pentafluoroethane, difluoromethane and 1,1,1,2-tetrafluoroethane)	
Transport hazard class(es)	IMDG Class	2.2
	IMDG Subrisk	Not Applicable
Packing group	Not Applicable	
Environmental hazard	Not Applicable	
Special precautions for user	EMS Number	F-C, S-V
	Special provisions	274 392
	Limited Quantities	120 mL

Transport in bulk according to Annex II of MARPOL and the IBC code

Not Applicable

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

Product name	Group
difluoromethane	Not Available
pentafluoroethane	Not Available
1,1,1,2-tetrafluoroethane	Not Available
2,3,3,3-tetrafluoropropene	Not Available
1,3,3,3-tetrafluoropropene	Not Available

Transport in bulk in accordance with the IGC Code

Product name	Ship Type
difluoromethane	Not Available
pentafluoroethane	Not Available
1,1,1,2-tetrafluoroethane	Not Available
2,3,3,3-tetrafluoropropene	Not Available
1,3,3,3-tetrafluoropropene	Not Available

SECTION 15 Regulatory information**Safety, health and environmental regulations / legislation specific for the substance or mixture****difluoromethane is found on the following regulatory lists**

Australian Inventory of Industrial Chemicals (AIIC)

pentafluoroethane is found on the following regulatory lists

Australian Inventory of Industrial Chemicals (AIIC)

1,1,1,2-tetrafluoroethane is found on the following regulatory lists

Australia Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP) - Schedule 4

Australian Inventory of Industrial Chemicals (AIIC)

International Agency for Research on Cancer (IARC) - Agents Classified by the IARC Monographs - Not Classified as Carcinogenic

2,3,3,3-tetrafluoropropene is found on the following regulatory lists

Australian Inventory of Industrial Chemicals (AIIC)

1,3,3,3-tetrafluoropropene is found on the following regulatory lists

Australian Inventory of Industrial Chemicals (AIIC)

National Inventory Status

National Inventory	Status
Australia - AIIC / Australia Non-Industrial Use	Yes
Canada - DSL	Yes
Canada - NDSL	No (difluoromethane; pentafluoroethane; 1,1,1,2-tetrafluoroethane; 2,3,3,3-tetrafluoropropene)
China - IECSC	No (difluoromethane; 2,3,3,3-tetrafluoropropene)
Europe - EINEC / ELINCS / NLP	No (2,3,3,3-tetrafluoropropene; 1,3,3,3-tetrafluoropropene)
Japan - ENCS	Yes
Korea - KECI	Yes
New Zealand - NZIoC	No (1,3,3,3-tetrafluoropropene)
Philippines - PICCS	No (1,3,3,3-tetrafluoropropene)
USA - TSCA	Yes
Taiwan - TCSI	Yes
Mexico - INSQ	No (2,3,3,3-tetrafluoropropene; 1,3,3,3-tetrafluoropropene)
Vietnam - NCI	Yes
Russia - FBEPH	No (2,3,3,3-tetrafluoropropene; 1,3,3,3-tetrafluoropropene)
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	15/05/2023
Initial Date	15/05/2023

SDS Version Summary

Version	Date of Update	Sections Updated
2.1	15/05/2023	Hazards identification - Classification, Composition / information on ingredients - Ingredients, Handling and storage - Storage (storage incompatibility)

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
 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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