Xiamen Juda Trading Co.,Ltd.

Material Safety Data Sheet

R1234YF

Safety Data Sheet (Conforms to Regulation (EC) No 2015/830)

Current Issue Date: April, 2016

SECTION 1 IDENTIFICATION OF THE SUBSTANCE / MIXTURE AND OF THE COMPANY / UNDERTAKING

1.1.Product Identifier

Product name	R1234YF
Chemical Name	2,3,3,3-tetrafluoropropene
Synonyms	(E)-CF3CH=CHF, (Z)-CF3CH=CHF, 1,1,1,2-tetrafluoro-2-propene, 1234-yf, 1H,1H-perfluoroprop-1-ene, 2,3,3,3-tetrafluopropene, 2,3,3,3-tetrafluoro-1-propene, 2,3,3,3-tetrafluoroprop-1-ene, 2,3,3,3-tetrafluoropropene-1, 2,3,3,3-tetrafluoropropylene, C3-H2-F4, CF3CH=CHF, HCFC-1234yf, HFC-1234yf, HFO-1234ze, Opteon YF, R 1234yf, blowing agent, fluoropropene, tetrafluorpropene
Proper shipping name	LIQUEFIED GAS, FLAMMABLE, N.O.S. (contains 2,3,3,3-tetrafluoropropene)
Chemical formula	C3H2F4
Other means of identification	Not Available
CAS number	754-12-1
REACH registration number	01-0000019665-61-XXXX

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

Relevant identified uses	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. Has been proposed as a replacement for R-134a as a refrigerant in automobile air conditioners Although the product is classified slightly flammable several years of testing by SAE proved that the product could not be ignited under conditions normally experienced by a vehicle. In addition several independent authorities evaluated the safety of the product in vehicles and some of them concluded that it was as safe to use as as a substitute R-134a, a product used in many cars.. However it was reported that tests by Mercedes-Benz showed that the substance ignited when researchers sprayed it and A/C compressor oil onto a cars hot engine. Combustion occurred in more than two thirds of simulated head-on collisions. The engineers also noticed etching on the windshield caused by the corrosive gases. BMW, and VW-Audi agreed with Mercedes and left the SAE R-1234yf CRP Team, stating that the performed tests are not sufficient to fully judge the safety of their vehicles. HFO-1234yf, which has a 100 year GWP of 4, could be used as a "near drop-in replacement" for R-134a, a product used in automobile AC systems, which has a 100 year GWP of 1430. This means that automakers would not have to make significant modifications in assembly lines or in vehicle system designs to accommodate the product. HFO-1234yf has the lowest switching cost for automakers among the currently proposed alternatives, although the initial cost of the product is much higher than that of R-134a. The product could be handled in repair shops in the same way as R-134a, although it would require different, specialized equipment to perform the service.
Uses advised against	Not Applicable

1.3. Details of the supplier of the safety data sheet

Registered company name	Xiamen Juda Trading Co.,Ltd.
Address	NO.1007 ROOM, XINJING CENTER, NO. 25 JIAHE ROAD, XIAMEN, CHINA
Telephone	86-592-5803997
Fax	86-592-5852511
Website	www.fluorined-chemicals.com
Email	susan@xmjuda.com

1.4. Emergency telephone number

Association / Organisation	Not Available
Emergency telephone numbers	86-592-5803997
Other emergency telephone numbers	Not Available

SECTION 2 HAZARDS IDENTIFICATION

2.1.Classification of the substance or mixture

Considered a dangerous substance according to Reg. (EC) No 1272/2008 and its amendments. Classified as Dangerous Goods for transport purposes.

CHEMWATCH HAZARD RATINGS

		Min	Max
Flammability	4		
Toxicity	1		
Body Contact	1		
Reactivity	1		
Chronic	0		

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

DSD classification [1]	R12	Extremely flammable.
	R19	May form explosive peroxides.
	R44	Risk of explosion if heated under confinement.
Legend:	*Classification drawn from EC Directive 67/548/EEC - Annex I ; Classification drawn from EC Directive 1272/2008 - Annex VI*	
DPD classification	In case of substances classification has been prepared by following DSD (Directive 67/548/EEC) and CLP Regulation (EC) No 1272/2008 regulations	
Classification according to regulation (EC) No 1272/2008 [CLP] [1]	Flammable Gas Category 1, Gas under Pressure (Liquefied gas)	
Legend:	*Classification drawn from EC Directive 67/548/EEC - Annex I ; Classification drawn from EC Directive 1272/2008 - Annex VI*	

2.2. Label elements

CLP label elements

SIGNAL WORD	**DANGER**

Hazard statement(s)

H220	Extremely flammable gas.
H280	Contains gas under pressure; may explode if heated.

Supplementary statement(s)

EUH019	May form explosive peroxides.
EUH044	Risk of explosion if heated under confinement.

Precautionary statement(s) Prevention

P210	Keep away from heat/sparks/open flames/hot surfaces. No smoking.

Precautionary statement(s) Response

P377	Leaking gas fire: Do not extinguish, unless leak can be stopped safely.
P381	Eliminate all ignition sources if safe to do so.

Precautionary statement(s) Storage

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

Precautionary statement(s) Disposal

Not Applicable

2.3. Other hazards

Inhalation may produce health damage*.

Cumulative effects may result following exposure*.

May produce discomfort of the respiratory system and skin*.

Limited evidence of a carcinogenic effect*.

Repeated exposure potentially causes skin dryness and cracking*.

Vapours potentially cause drowsiness and dizziness*.

REACh - Art.57-59: The mixture does not contain Substances of Very High Concern (SVHC) at the SDS print date.

SECTION 3 COMPOSITION / INFORMATION ON INGREDIENTS

3.1.Substances

1.754-12-1
2.Not Available
3.Not Available
4.01-0000019665-61-XXXX

1.CAS No 2.EC No 3.Index No 4.REACH No	%[weight]	Name	Classification according to directive 67/548/EEC [DSD]	Classification according to regulation (EC) No 1272/2008 [CLP]
>99.5	R1234yf	R12, R19, R44 [1]	Flammable Gas Category 1, Gas under Pressure (Liquefied gas); H220, H280, EUH019, EUH044 [1]	

Legend: *Classification drawn from EC Directive 67/548/EEC - Annex I ; Classification drawn from EC Directive 1272/2008 - Annex VI .*

3.2.Mixtures

See 'Information on ingredients' in section 3.1

SECTION 4 FIRST AID MEASURES

4.1. Description of first aid measures

General	If skin contact occurs: ▸ 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. ▸ 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. **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. ▸ 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. Not considered a normal route of entry. ▸ Avoid giving milk or oils. ▸ Avoid giving alcohol.
Eye Contact	▸ 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.

	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.
Skin Contact	If skin contact occurs: ▸ 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.
Inhalation	▸ 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	Not considered a normal route of entry. ▸ Avoid giving milk or oils. ▸ Avoid giving alcohol.

4.2 Most important symptoms and effects, both acute and delayed

See Section 11

4.3. Indication of any immediate medical attention and special treatment needed

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

5.1. Extinguishing media

DO NOT EXTINGUISH BURNING GAS UNLESS LEAK CAN BE STOPPED SAFELY:
OTHERWISE: LEAVE GAS TO BURN.

FOR SMALL FIRE:

- Dry chemical, CO2 or water spray to extinguish gas (only if absolutely necessary and safe to do so).
- **DO NOT** use water jets.

FOR LARGE FIRE:

- Cool cylinder by direct flooding quantities of water onto upper surface until well after fire is out.

5.2. 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

5.3. Advice for firefighters

Fire Fighting	FOR FIRES INVOLVING MANY GAS CYLINDERS: ‣ To stop the flow of gas, specifically trained personnel may inert the atmosphere to reduce oxygen levels thus allowing the capping of leaking container(s). ‣ Reduce the rate of flow and inject an inert gas, if possible, before completely stopping the flow to prevent flashback. ‣ **DO NOT extinguish the fire until the supply is shut off** otherwise an explosive re-ignition may occur. ‣ If the fire is extinguished and the flow of gas continues, used increased ventilation to prevent build-up, of explosive atmosphere. ---------- GENERAL ---------- ‣ Alert Fire Brigade and tell them location and nature of hazard. ‣ May be violently or explosively reactive. ‣ Wear breathing apparatus plus protective gloves. ‣ Consider evacuation ‣ Fight fire from a safe distance, with adequate cover.
Fire/Explosion Hazard	‣ HIGHLY FLAMMABLE: will be easily ignited by heat, sparks or flames. ‣ Will form explosive mixtures with air ‣ Fire exposed containers may vent contents through pressure relief valves thereby increasing fire intensity and/ or vapour concentration. ‣ Vapours may travel to source of ignition and flash back. ‣ Containers may explode when heated - Ruptured cylinders may rocket ‣ Fire may produce irritating, poisonous or corrosive gases. Combustion products include; carbon monoxide (CO) carbon dioxide (CO2) hydrogen fluoride, other pyrolysis products typical of burning organic material**Contains low boiling substance:** Closed containers may rupture due to pressure buildup under fire conditions. ‣ Vented gas is more dense than air and may collect in pits, basements.

SECTION 6 ACCIDENTAL RELEASE MEASURES

6.1. Personal precautions, protective equipment and emergency procedures

See section 8

6.2. Environmental precautions

See section 12

6.3. Methods and material for containment and cleaning up

Minor Spills	‣ 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. ‣ Shut off all sources of possible ignition and increase ventilation.
Major Spills	‣ Clear area of all unprotected personnel and move upwind. ‣ Alert Emergency Authority and advise them of the location and nature of hazard. ‣ May be violently or explosively reactive. ‣ Wear full body clothing with breathing apparatus. ‣ 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.

6.4. Reference to other sections

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

SECTION 7 HANDLING AND STORAGE

7.1. Precautions for safe handling

Safe handling	‣ Consider use in closed pressurised systems, fitted with temperature, pressure and safety relief valves which are vented for safe dispersal. ‣ 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. ‣ Avoid generation of static electricity. Earth all lines and equipment. ‣ **DO NOT** transfer gas from one cylinder to another.
Fire and explosion protection	See section 5
Other information	‣ Polymerisation may occur slowly at room temperature. ‣ 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.

7.2. Conditions for safe storage, including any incompatibilities

Suitable container	‣ **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.
Storage incompatibility	As a general rule, hydrofluorocarbons tend to be flammable unless they contain more fluorine atoms than hydrogen atoms. ‣ Haloalkenes are highly reactive. ‣ Some of the more lightly substituted lower members are highly flammable; many members of the group are peroxidisable and polymerisable. ‣ Avoid reaction or 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. ‣ 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

7.3. Specific end use(s)

See section 1.2

SECTION 8 EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1. Control parameters

DERIVED NO EFFECT LEVEL (DNEL)

Not Available

PREDICTED NO EFFECT LEVEL (PNEC)

Not Available

OCCUPATIONAL EXPOSURE LIMITS (OEL)

INGREDIENT DATA

Source	Ingredient	Material name	TWA	STEL	Peak	Notes
Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available

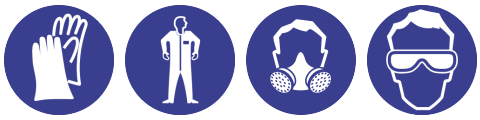
EMERGENCY LIMITS

Ingredient	Material name	TEEL-1	TEEL-2	TEEL-3
R1234YF	Not Available	Not Available	Not Available	Not Available

Ingredient	Original IDLH	Revised IDLH
R1234yf	Not Available	Not Available

8.2. Exposure controls

8.2.1. 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.

8.2.2. Personal protection	
Eye and face protection	‣ Safety glasses with side shields. ‣ Chemical goggles. ‣ 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.
Skin protection	See Hand protection below
Hands/feet protection	‣ When handling sealed and suitably insulated cylinders wear cloth or leather gloves.
Body protection	See Other protection below
Other protection	‣ The clothing worn by process operators insulated from earth may develop static charges far higher (up to 100 times) than the minimum ignition energies for various flammable gas-air mixtures. This holds true for a wide range of clothing materials including cotton. ‣ Avoid dangerous levels of charge by ensuring a low resistivity of the surface material worn outermost. BRETHERICK: Handbook of Reactive Chemical Hazards. ‣ Protective overalls, closely fitted at neck and wrist. ‣ Eye-wash unit. **IN CONFINED SPACES:** ‣ Non-sparking protective boots ‣ Static-free clothing. ‣ Ensure availability of lifeline. · Some plastic personal protective equipment (PPE) (e.g. gloves, aprons, overshoes) are not recommended as they may produce static electricity. · For large scale or continuous use wear tight-weave non-static clothing (no metallic fasteners, cuffs or pockets). · Non sparking safety or conductive footwear should be considered. Conductive footwear describes a boot or shoe with a sole made from a conductive compound chemically bound to the bottom components, for permanent control to electrically ground the foot an shall dissipate static electricity from the body to reduce the possibility of ignition of volatile compounds.
Thermal hazards	Not Available

Respiratory protection

Type A 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 10 x ES	A-AUS	-	A-PAPR-AUS / Class 1
up to 50 x ES	-	A-AUS / Class 1	-
up to 100 x ES	-	A-2	A-PAPR-2 ^

^ - 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)

8.2.3. Environmental exposure controls

See section 12

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

9.1. Information on basic physical and chemical properties

Appearance	Liquefied colourless, ether-like, gas; does not mix well with water (0.1982 g/l, 24 C).

Physical state	Liquified Gas	**Relative density (Water = 1)**	0.0048 (20 C)
Odour	Not Available	**Partition coefficient n-octanol / water**	2.0
Odour threshold	Not Available	**Auto-ignition temperature (°C)**	405
pH (as supplied)	Not Applicable	**Decomposition temperature**	Not Available
Melting point / freezing point (°C)	-152.2	**Viscosity (cSt)**	Not Applicable
Initial boiling point and boiling range (°C)	-29.4	**Molecular weight (g/mol)**	114.04
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 (%)	12.3 (21 C)	**Surface Tension (dyn/cm or mN/m)**	Not Available

Lower Explosive Limit (%)	6.2 (21 C)	**Volatile Component (%vol)**	100
Vapour pressure (kPa)	5.83	**Gas group**	Not Available
Solubility in water (g/L)	Partly miscible	**pH as a solution (1%)**	Not Applicable
Vapour density (Air = 1)	4	**VOC g/L**	Not Available

9.2. Other information

Not Available

SECTION 10 STABILITY AND REACTIVITY

10.1.Reactivity	See section 7.2
10.2.Chemical stability	▸ Unstable in the presence of incompatible materials. ▸ Product is considered stable. ▸ Hazardous polymerisation will not occur.
10.3. Possibility of hazardous reactions	See section 7.2
10.4. Conditions to avoid	See section 7.2
10.5. Incompatible materials	See section 7.2
10.6. Hazardous decomposition products	See section 5.3

SECTION 11 TOXICOLOGICAL INFORMATION

11.1. Information on toxicological effects

Inhaled	Inhalation of vapours may cause drowsiness and dizziness. This may be accompanied by sleepiness, reduced alertness, loss of reflexes, lack of co-ordination, 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 of the individual. There is some evidence to suggest that the material can cause respiratory irritation in some persons. The body's response to such irritation can cause further lung damage. Exposure to fluorocarbons can produce non-specific flu-like symptoms such as chills, fever, weakness, muscle pain, headache, chest discomfort, sore throat and dry cough with rapid recovery. High concentrations can cause irregular heartbeats and a stepwise reduction in lung capacity. 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. 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. 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. Inhalation of non-toxic gases may cause: ▸ CNS effects: headache, confusion, dizziness, stupor, seizures and coma; ▸ respiratory: shortness of breath and rapid breathing; ▸ cardiovascular: collapse and irregular heart beats; ▸ gastrointestinal: mucous membrane irritation, nausea and vomiting.
Ingestion	Overexposure is unlikely in this form. Not normally a hazard due to physical form of product. Considered an unlikely route of entry in commercial/industrial environments
Skin Contact	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. Repeated exposure may cause skin cracking, flaking or drying following normal handling and use. There is some evidence to suggest that this material can cause inflammation of the skin on contact in some persons. Fluorocarbons remove natural oils from the skin, causing irritation, dryness and sensitivity. Open cuts, abraded or irritated skin should not be exposed to this material Entry into the blood-stream, through, for example, cuts, abrasions 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.
Eye	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). Not considered to be a risk because of the extreme volatility of the gas.
Chronic	There has been some concern that this material can cause cancer or mutations but there is not enough data to make an assessment. Substance accumulation, in the human body, may occur and may cause some concern following repeated or long-term occupational exposure. The reactivity of an epoxide intermediate may be the reason for the cancer-causing properties of halogenated oxiranes. It is reported that 1,1-dichloroethyne, vinyl chloride, trichloroethylene, tetrachloroethylene and chloroprene all cause cancer. Generally speaking, substances with one halogen substitution show higher potential to cause cancer compared to substances with two. Principal route of occupational exposure to the gas is by inhalation. Fluorocarbons can cause an increased risk of cancer, spontaneous abortion and birth defects.

	TOXICITY	IRRITATION
R1234yf	Not Available	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*	

R1234YF	Inhalation of perfluoroalkenes can cause lung injury, kidney damage, brain changes and death. Repeated exposures may alter blood pressure and the production of blood cells.The potential for causing cancer is the subject of speculation. Fluoroalkanes, in contrast, are less toxic. 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. 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. * Vendor For similar product, 1,3,3,3-tetrafluoropropene HFO-1234ze is not likely to accumulate in the bodies of humans or animals 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

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 available but does not fill the criteria for classification*
✓ *– Data required to make classification available*
⊘ *– Data Not Available to make classification*

SECTION 12 ECOLOGICAL INFORMATION

12.1. Toxicity

Ingredient	Endpoint	Test Duration (hr)	Species	Value	Source
R1234yf	EC50	384	Crustacea	3.623mg/L	3
R1234yf	LC50	96	Fish	15.051mg/L	3
R1234yf	EC50	48	Crustacea	65mg/L	2
R1234yf	EC50	72	Algae or other aquatic plants	>2.5mg/L	2
R1234yf	NOEC	72	Algae or other aquatic plants	>=2.5mg/L	2
Legend:	*Extracted from 1. IUCLID Toxicity Data 2. Europe ECHA Registered Substances - Ecotoxicological Information - Aquatic Toxicity 3. EPIWIN Suite V3.12 - Aquatic Toxicity Data (Estimated) 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*				

Substances containing unsaturated carbons are ubiquitous in indoor environments. They result from many sources (see below). Most are reactive with environmental ozone and many produce stable products which are thought to adversely affect human health.The potential for surfaces in an enclosed space to facilitate reactions should be considered.

Source of unsaturated substances	Unsaturated substances (Reactive Emissions)	Major Stable Products produced following reaction with ozone.

In addition to carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), the greenhouse gases mentioned in the Kyoto Protocol include synthetic substances that share the common feature of being highly persistent in the atmosphere and inhibit radiation from escaping out of the atmosphere. These synthetic substances include hydrocarbons that are partially fluorinated (HCFs) or totally fluorinated (PFCs) as well as sulfur hexafluoride (SF_6). The greenhouse potential of these substances, expressed as multiples of that of CO_2, are within the range of 140 to 11,700 for HFCs, from 6500 to 9,200 for PFCs and 23,900 for SF_6. Once emitted into the atmosphere, these substances have an impact on the environment for decades, centuries, or even for thousands of years.

DO NOT discharge into sewer or waterways.

|HFO-1234yf is the first in a new class of refrigerants acquiring a global warming potential (GWP) rating 335 times less than that of R-134a (and only 4 times higher than carbon dioxide, which can also be used as a refrigerant but has significantly different properties to R134A, especially requiring operation at around 5 times higher pressure) and an atmospheric lifetime of about 400 times shorter. It was developed to meet the European directive 2006/40/EC that went into effect in 2011 requiring that all new car platforms for sale in Europe use a refrigerant in its AC system with a GWP below 150|In the atmosphere, HFO-1234yf degrades to trifluoroacetic acid which is a mildly phytotoxic strong organic acid with no known degradation mechanism in water.|GWP 1000 less than SF_6|Fish LC50 (96 h): carp (Cyprinus carpio) gt;197 mg/l|Algae NOEC (72 h): gt;100 mg/l|Daphnia magna (EC50 (48 h): gt;100 mg/l|Not readily biodegradable.|Although practically non-biodegradable, HFO-1234ze is unlikely to impact the aquatic environment because of its high volatility and low toxicity to aquatic organisms. It will migrate almost exclusively into the atmosphere where it will have a lifetime of less than 2 weeks.

12.2. Persistence and degradability

Ingredient	Persistence: Water/Soil	Persistence: Air
R1234yf	HIGH	HIGH

12.3. Bioaccumulative potential

Ingredient	Bioaccumulation
R1234yf	LOW (LogKOW = 2.1485)

12.4. Mobility in soil

Ingredient	Mobility
R1234yf	LOW (KOC = 154.4)

12.5.Results of PBT and vPvB assessment

	P	B	T
Relevant available data	Not Available	Not Available	Not Available
PBT Criteria fulfilled?	Not Available	Not Available	Not Available

12.6. Other adverse effects

No data available

SECTION 13 DISPOSAL CONSIDERATIONS

13.1. Waste treatment methods

Product / Packaging disposal	▸ Evaporate or incinerate residue at an approved site. ▸ Return empty containers to supplier. ▸ Ensure damaged or non-returnable cylinders are gas-free before disposal.
Waste treatment options	Not Available
Sewage disposal options	Not Available

SECTION 14 TRANSPORT INFORMATION

Labels Required

	
Marine Pollutant	NO
HAZCHEM	Not Applicable

Land transport (ADR)

14.1.UN number	3161
14.2.Packing group	Not Applicable
14.3.UN proper shipping name	LIQUEFIED GAS, FLAMMABLE, N.O.S. (contains 2,3,3,3-tetrafluoropropene)
14.4.Environmental hazard	Not Applicable
14.5. Transport hazard class(es)	Class: 2.1 Subrisk: Not Applicable
14.6. Special precautions for user	Hazard identification (Kemler): 23 Classification code: 2F Hazard Label: 2.1 Special provisions: 274 662 Limited quantity: 0

Air transport (ICAO-IATA / DGR)

14.1. UN number	3161
14.2. Packing group	Not Applicable
14.3. UN proper shipping name	Liquefied gas, flammable, n.o.s. * (contains 2,3,3,3-tetrafluoropropene)
14.4. Environmental hazard	Not Applicable
14.5. Transport hazard class(es)	ICAO/IATA Class: 2.1 ICAO / IATA Subrisk: Not Applicable

	ERG Code	10L
14.6. Special precautions for user	Special provisions	A1
	Cargo Only Packing Instructions	200
	Cargo Only Maximum Qty / Pack	150 kg
	Passenger and Cargo Packing Instructions	Forbidden
	Passenger and Cargo Maximum Qty / Pack	Forbidden
	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	3161
14.2. Packing group	Not Applicable
14.3. UN proper shipping name	LIQUEFIED GAS, FLAMMABLE, N.O.S. (contains 2,3,3,3-tetrafluoropropene)
14.4. Environmental hazard	Not Applicable
14.5. Transport hazard class(es)	IMDG Class: 2.1
	IMDG Subrisk: Not Applicable
14.6. Special precautions for user	EMS Number: F-D, S-U
	Special provisions: 274
	Limited Quantities: 0

Inland waterways transport (ADN)

14.1. UN number	3161
14.2. Packing group	Not Applicable
14.3. UN proper shipping name	LIQUEFIED GAS, FLAMMABLE, N.O.S. (contains 2,3,3,3-tetrafluoropropene)
14.4. Environmental hazard	Not Applicable
14.5. Transport hazard class(es)	2.1 | Not Applicable
14.6. Special precautions for user	Classification code: 2F
	Special provisions: 274; 662
	Limited quantity: 0
	Equipment required: PP, EX, A
	Fire cones number: 1

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

Not Applicable

SECTION 15 REGULATORY INFORMATION

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

R1234YF(754-12-1) IS FOUND ON THE FOLLOWING REGULATORY LISTS

EU European Chemicals Agency (ECHA) Community Rolling Action Plan (CoRAP) List of Substances

International Air Transport Association (IATA) Dangerous Goods Regulations - Prohibited List Passenger and Cargo Aircraft

European Customs Inventory of Chemical Substances ECICS (English)

This safety data sheet is in compliance with the following EU legislation and its adaptations - as far as applicable - : 67/548/EEC, 1999/45/EC, 98/24/EC, 92/85/EC, 94/33/EC, 91/689/EEC, 1999/13/EC, Commission Regulation (EU) 2015/830, Regulation (EC) No 1272/2008 and their amendments as well as the following British legislation: - The Control of Substances Hazardous to Health Regulations (COSHH) 2002 - COSHH Essentials - The Management of Health and Safety at Work Regulations 1999

15.2. Chemical safety assessment

For further information please look at the Chemical Safety Assessment and Exposure Scenarios prepared by your Supply Chain if available.

ECHA SUMMARY

Ingredient	CAS number	Index No	ECHA Dossier
R1234yf	754-12-1	Not Available	01-0000019665-61-XXXX

Harmonisation (C&L Inventory)	Hazard Class and Category Code(s)	Pictograms Signal Word Code(s)	Hazard Statement Code(s)
1	Flam. Gas 1, Press. Gas.	GHS02, GHS04, Dgr	H220, H280
2	Flam. Gas 1, Press. Gas., Liq. Gas	GHS02, GHS04, Dgr	H220, H280

Harmonisation Code 1 = The most prevalent classification. Harmonisation Code 2 = The most severe classification.

National Inventory	Status
Australia - AICS	N (R1234yf)
Canada - DSL	Y
Canada - NDSL	N (R1234yf)
China - IECSC	N (R1234yf)
Europe - EINEC / ELINCS / NLP	N (R1234yf)
Japan - ENCS	N (R1234yf)
Korea - KECI	Y
New Zealand - NZIoC	N (R1234yf)
Philippines - PICCS	N (R1234yf)
USA - TSCA	Y
Legend:	*Y = All ingredients are on the inventory* *N = Not determined or one or more ingredients are not on the inventory and are not exempt from listing(see specific ingredients in brackets)*

SECTION 16 OTHER INFORMATION

Full text Risk and Hazard codes

Other information

DSD / DPD label elements

Relevant risk statements are found in section 2.1

Indication(s) of danger	F+

SAFETY ADVICE

S02	Keep out of reach of children.
S03	Keep in a cool place.
S09	Keep container in a well ventilated place.
S15	Keep away from heat.
S16	Keep away from sources of ignition. No smoking.
S18	Handle and open container with care.
S33	Take precautionary measures against static discharges.
S35	This material and its container must be disposed of in a safe way.
S41	In case of fire and/or explosion, DO NOT BREATHE FUMES.
S43	In case of fire use the extinguishing media detailed in section 5 of this SDS.
S51	Use only in well ventilated areas.
S56	Dispose of this material and its container at hazardous or special waste collection point.

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.

For detailed advice on Personal Protective Equipment, refer to the following EU CEN Standards:

EN 166 Personal eye-protection
EN 340 Protective clothing
EN 374 Protective gloves against chemicals and micro-organisms
EN 13832 Footwear protecting against chemicals
EN 133 Respiratory protective devices

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
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