SECTION 1: Product and Company Identification

1.1 Product identifier

Product name	:	1,1,1,2- Tetrafluoroethane
Trade name	:	R-134a

1.2 Other means of identification

Chemical Name	:	1,1,1,2- Tetrafluoroethane
Chemical Formula	:	CH_2FCF_3; HFC-134a

1.3 Recommended use and restrictions on use

Product use	:	Semiconductor Processes Industrial & Professional use Synthetic/Analytical chemistry Photovoltaic Processes

1.4 Details of supplier of the safety data sheet

Company identification	:	Iwatani Corporation (Singapore) Pte. Ltd.
Address	:	6 Shenton Way, OUE Downtown 2 #13-11, Singapore 068809
Phone	:	+65 6862 2111

1.5 Emergency contact

Emergency phone number	:	+65 6220 8347

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Physical hazards	:	Gases under pressure- liquefied gas (Simply asphyxiants).
Characteristic	:	Non-flammable.
Acute toxicity (inhalation)	:	Not classified.
Skin corrosion/irritation	:	Not classified.
Serious eye damage/eye irritation	:	Not classified.
Acute aquatic toxicity	:	Not classified.

2.2 GHS label elements, including precautionary statements

Pictogram(s) :

Signal word(s)	:	Warning
Hazard statement(s)	:	H280 – Contains gas under pressure; may explode if heated H380 - May displace oxygen and cause rapid suffocation

Precautionary statements

Prevention	:	None.
Response	:	None.

Storage	:	P403+P410 - Store in a well-ventilated place. Protect from sunlight.
Disposal	:	None.

EMERGENCY OVERVIEW	:	**Colourless, volatile liquid with ethereal and faint sweetish odour. Non-flammable material. Overexposure may cause dizziness and loss of concentration. At higher levels, CNS depression and cardiac arrhythmia may result from exposure. Vapors displace air and can cause asphyxiation in confined spaces. At higher temperatures, (>250°C), decomposition products may include Hydrofluoric Acid (HF) and carbonyl halides.**

2.3 Other hazards which do not result in classification

Potential Health Hazard

Inhalation	:	R-134a is low in acute toxicity in animals. When oxygen levels in air are reduced to 12-14% by displacement, symptoms of asphyxiation, loss of coordination, increased pulse rate and deeper respiration will occur. At high levels, cardiac arrhythmia may occur.

SECTION 3. Composition/Information on ingredients

3.1 Substances / 3.2. Mixture

Substance name	**Contents**	**CAS No.**
1,1,1,2- Tetrafluoroethane, CH_2FCF_3	100 %	811-97-2

There are no impurities or stabilizers that contribute to the classification of the material identified in Section 2.

SECTION 4. First-aid measures

4.1 Description of first aid measures

Inhalation	:	Immediately move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. Use oxygen as required, provided a qualified operator is available. Get medical attention immediately. DO NOT give epinephrine (adrenaline).
Skin contact	:	Promptly flush skin with water until all chemical is removed. If water is not available, cover with a clean, soft cloth or similar covering. For dermal contact or suspected frostbite, remove contaminated clothing and flush affected areas with lukewarm water. DO NOT USE HOT WATER. Get medical attention if symptoms persist. A physician should see the patient promptly if contact with the product has resulted in blistering of the dermal surface or in deep tissue freezing.
Eye contact	:	Immediately flush eyes with large amounts of water for at least 15 minutes (in case of frostbite, water should be lukewarm, not hot) lifting eyelids occasionally to facilitate irrigation.

		Remove contact lenses if present and easy to do. Continue rinsing. Flush thoroughly with water for at least 15 minutes. Get immediate medical assistance. If medical assistance is not immediately available, flush an additional 15 minutes.
Ingestion	:	Ingestion is not considered a potential route of exposure. DO NOT induce vomiting unless instructed to do so by a physician.

4.2 Most important symptoms/effect, acute and delayed

High concentrations may cause asphyxia from lack of oxygen or act as a narcotic causing central nervous system depression. May cause nausea, dizziness, headaches, shortness of breath, lethargy, narcosis, unconsciousness and possibly cardiac arrhythmias. Contact with evaporating liquid may cause cold burns/frostbite.

4.3 Indication of immediate medical attention and special treatment needed, if necessary

Note to physicians	:	Because of the possible disturbances of cardiac rhythm, a patient adversely affected by exposure to this product should not be given adrenaline (epinephrine) or similar heart stimulant since these would increase the risk of cardiac arrhythmias. Treatment of overexposure should be directed at the control of symptoms and the clinical conditions. Thaw frosted parts with lukewarm water. Do not rub affected area. Get immediate medical advice/attention.

SECTION 5. Fire-fighting measures

General Fire Hazards	:	Heat may cause the containers to explode.

5.1 Extinguishing media

Suitable extinguishing media	:	Use any standard agent – choose the one most appropriate for type of surrounding fire (material itself is not flammable).
Unsuitable extinguishing media	:	None.

5.2 Special hazards arising from the substance or mixture

R-134a is not flammable at ambient temperatures and atmospheric pressure. However, this material will become combustible when mixed with air under pressure and exposed to strong ignition sources.

Hazardous combustion products	:	Contact with certain reactive metals may result in formation of explosive or exothermic reactions under specific conditions (e.g. very high temperatures and/or appropriate pressures).

5.3 Advice for fire-fighters

Special fire fighting procedures	:	Move container away or cool with water from a protected position. If possible, stop flow of product.
Special protective equipment for fire-fighters	:	Wear self-contained breathing apparatus for firefighting if necessary. Firefighters must use standard protective equipment including flame retardant coat, helmet with face shield, gloves, rubber boots, and in enclosed spaces, SCBA.

Guideline:
EN 469 - Protective clothing for firefighters. Performance requirements for protective clothing for firefighting.
EN 15090 - Footwear for firefighters.
EN 659 - Protective gloves for firefighters.
EN 443 - Helmets for fire fighting in buildings and other structures.
EN 137 - Respiratory protective devices - Self-contained open circuit compressed air breathing apparatus with full face mask - Requirements, testing, marking.

SECTION 6. Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

(Always wear recommended personal protective equipment.)
Evacuate unprotected personnel. Product dissipates upon release.
Protected personnel should remove ignition sources and shut off leak, if without risk, and provide ventilation.
Unprotected personnel should not return to the affected area until air has been tested and determined safe, including low-lying areas.
EN 137 - Respiratory protective devices - Self-contained open circuit compressed air breathing apparatus with full face mask - Requirements, testing, marking.

6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so.

6.3 Methods and materials for containment and cleaning up

Methods for containment	:	Stop the flow of gas or remove cylinder to outdoor location if this can be done without risk. Provide adequate ventilation.
Methods for cleaning up	:	Spills and releases may have to be reported to Federal and/or local authorities. Return cylinder to Iwatani or an authorized distributor.

6.4 Reference to other sections

See Section 15 regarding reporting requirements.

SECTION 7. Handling and storage

7.1 Precautions for safe handling

(Always wear recommended personal protective equipment.)
Avoid breathing vapours and liquid contact with eyes, skin or clothing.
Do not puncture or drop cylinders, expose them to open flame or excessive heat.
Use authorized cylinders only. Follow standard safety precautions for handling and use of compressed gas cylinders.
For additional recommendations consult Compressed Gas Association's (CGA) Safety Bulletin SB-2, Oxygen-Deficient Atmospheres.
R-134a should not be mixed with air above atmospheric pressure for leak testing or any other purpose.

7.2 Conditions for safe storage, including any incompatibilities

Storage Conditions : Store in a cool, well-ventilated area of low fire risk and out of direct sunlight.
Protect cylinder and its fittings from physical damage.
Storage in subsurface locations should be avoided.
Close valve tightly after use and when empty.

Incompatible materials : Freshly abraded aluminum surfaces at specific temperatures and pressures may cause a strong exothermic reaction.
Chemically reactive metals: potassium, calcium, powdered aluminum, magnesium, and zinc.

SECTION 8. Exposure controls/personal protection

8.1 Control parameters/Occupational exposure limits

Components	CAS-No.	Value type (form of exposure)	Control parameters/permissible concentration	Basis
1,1,1,2-Tetrafluoroethane (R-134a)	811-97-2	TLV	None.	ACGIH
		PEL	None.	OSHA
		TWA	1000 ppm (8hr)	AIHA

Other exposure limits for potential decomposition products:

Components	CAS-No.	Value type (form of exposure)	Control parameters/permissible concentration	Basis
Hydrogen Fluoride	7664-39-3	TLV TLV-TWA	2 ppm ceiling 0.5 ppm	ACGIH

TWA=Time weighted average; PEL= Permissible Exposure Limit; TLV= threshold limit value

8.2 Appropriate engineering control measures

Provide local ventilation at filling zones and areas where leakage is probable. Mechanical (general) ventilation may be adequate for other operating and storage areas.

8.3 Personal protection

Individual protection measures, such as personal protective equipment (PPE) : A risk assessment should be conducted and documented in each work area to assess the risks related to the use of the product and to select the PPE that matches the relevant risk. The following recommendations should be considered: Protect eyes, face and skin from liquid splashes. PPE compliant to the recommended EN/ISO standards should be selected.

Hand protection : Wear appropriate protective chemical-resistant gloves that protect chemicals directly.
Standard EN 388 – Protective gloves against mechanical risk.

Eye/face protection : Wear facepiece with goggles to protect from scattering dust or toxic liquid. Further eye protection such as chemical goggles and/or protecting glasses must be worn when the possibility exists for eye contact due to splashing or

		spraying liquid or airborne particle. EN 166 - Personal Eye Protection.
Skin or Body protection	:	Skin contact with refrigerant may cause frostbite. General work clothing and gloves (leather) should provide adequate protection. If prolonged contact with the liquid or gas is anticipated, insulated gloves constructed of PVA, neoprene or butyl rubber should be used. Any contaminated clothing should be promptly removed and washed before reuse. Wear safety shoes while handling containers ISO 20345 - Personal protective equipment - Safety footwear.
Respiratory protection	:	None generally required for adequately ventilated work situations. For accidental release or non-ventilated situations, or release into confined space, where the concentration may be above the PEL of 1,000 ppm, use a self-contained, NIOSH approved breathing apparatus or supplied air respirator. For escape: use the former or a NIOSH-approved gas mask with organic vapor canister.
Others		Where contact with liquid is likely, such as in a spill or leak, impervious boots and clothing should be worn. High dose-level warning signs are recommended for areas of principle exposure. Provide eyewash stations and quick-drench shower facilities at convenient locations. For tank cleaning operations, see OSHA regulations, 29 CFR 1910.132 and 29 CFR 1910.133.
Hygiene measures	:	Specific risk management measures are not required beyond good industrial hygiene and safety procedures. Handle in accordance with good industrial hygiene and safety practice.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance

Physical state	:	Gas
Colour	:	Colourless.
Odour	:	Faint ethereal odour.
Odour threshold	:	Not established.
pH	:	Neutral.
Melting point	:	-100.7 °C (-149 °F)
Boiling point	:	-26.2 °C (-15.1 °F)
Freezing point	:	-92.5 °C (-141.9 °F)
Flash point	:	Not applicable.
Critical Temperature	:	19.79 °C (67.62 °F)
Flammability (solid, gas)	:	This product is not flammable.
Lower explosive limit	:	Not applicable.
Upper explosive limit	:	Not applicable.
Vapour pressure	:	85.8 psia @ 70 °F

		213.4 psia @ 130 °F
Vapour density (air=1)	:	3.5
Specific gravity (water=1)	:	<1.22
Gas density @ 20°C	:	5.59 kg/m^3
Molecular mass	:	102 g/mol
Solubility	:	Water 0.15 wt%
Viscosity	:	Not applicable.
Partition coefficient: n-octanol/water	:	Log Pow: 1.06
Evaporation rate	:	>1 compared to: CCL4=1
Decomposition temperature	:	>250 °C (482 °F)
Autoignition temperature	:	>750 °C (>1382 °F).

Section 10. Stability and reactivity

10.1 Reactivity

No reactivity hazard other than the effects described in sub-section below.

10.2 Chemical stability

Stable under normal conditions.

10.3 Possibility of hazardous reactions

None.

10.4 Conditions to avoid

The product is stable.

Do not mix with oxygen or air above atmospheric pressure.

Any source of high temperature, such as lighted cigarettes, flames, hot spots or welding may yield toxic and/or corrosive decomposition products.

10.5 Incompatible materials

(Under specific conditions: e.g. very high temperatures and/or appropriate pressures) – Freshly abraded aluminum surfaces (may cause strong exothermic reaction).
Chemically active metals: potassium, calcium, powdered aluminum, magnesium and zinc.

10.6 Hazardous decomposition products

Halogens, halogen acids and possibly carbonyl halides.

Hazardous polymerization will not occur.

SECTION 11. Toxicology information

11.1 Information on toxicological effects

Not classified.

11.2 Delayed and immediate effects and also chronic effects from short- and long-term exposure

Immediate effects

Acute (Inhalation)	:	
1,1,1,2- Tetrafluoroethane (HFC-134a)	:	Rat, LC50 = > 500,000 ppm. 4hrs.
Cardiac Sensitization threshold		
1,1,1,2- Tetrafluoroethane (HFC-134a)	:	Dog, > 80,000 ppm

Delayed effects

1,1,1,2- Tetrafluoroethane (HFC-134a)	:	Teratogenic NOEL (rat and rabbit) – 40,000 ppm Sub chronic inhalation (rat) NOEL – 50,000 ppm Chronic NOEL – 10,000 ppm
Repeated dose toxicity	:	Lifetime inhalation exposure of male rats was associated with a small increase in salivary gland fibrosarcoma's.

11.3 Other Relevant Toxicity Information

Other data	:	Metabolism <0.5% as CO2 in tests at 50,000 ppm, late developing benign tumors were found.
Further information	:	Acute effects of rapid evaporation of the liquid may cause frostbite. Vapors are heavier than air and can displace oxygen causing difficulty breathing or suffocation. May cause cardiac arrhythmia.

SECTION 12. Ecological information

12.1 Persistence and degradability

R-1434a is a gas at room temperature; therefore, it is unlikely to remain in water.

SECTION 13. Disposal information

13.1 Disposal methods

General	:	Not a RCRA hazardous waste.
Disposal methods	:	Discharge, treatment, or disposal may be subject to national, state, or local laws. R-134a is subject to U.S. Environmental Protection Agency Clean Air Act Regulations Section 608 in 40 CFR Part 82 regarding refrigerant recycling.

The information offered here is for the product as shipped. Use and/or alterations to the product such as mixing with other materials may significantly change the characteristics of the material and alter the RCRA classification and the proper disposal method.

SECTION 14. Transport information

14.1 UN number

: UN3159

14.2 UN proper shipping name

: 1,1,1,2-TETRAFLUOROETHANE OR REFRIGERANT GAS R 134A

14.3 Transport Hazard Class(es)

UNRTDG (United Nations Recommendations Transport Dangerous Goods)

Class : 2.2
Subsidiary risk : Not classified.

IATA-DGR (International Air Transport Association – Dangerous Goods)

Class : 2.2
Subsidiary risk : Not classified.

IMDG (International Maritime Dangerous Goods) – Code

Class : 2.2
Subsidiary risk : Not classified.

14.4 Packing group

Not assigned by regulation.

14.5 Environmental hazards

None.

14.6 Special precaution for user

Avoid transport on vehicles where the load space is not separated from the driver's compartment.
Ensure vehicle driver is aware of the potential hazards of the load and knows what to do in the event of an accident or an emergency.
Before transporting product containers:

- Ensure there is adequate ventilation.
- Ensure that containers are firmly secured.
- Ensure valve is closed and not leaking.
- Ensure valve outlet cap nut or plug (where provided) is correctly fitted.
- Ensure valve protection device (where provided) is correctly fitted.

SECTION 15. Regulatory information

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

Restrictions on use : None.
Other information, restriction and prohibition regulations : Ensure all national/local regulations are observed.
Applicable national regulations : Safety, health and environmental regulations/legislation specific for the substance or mixture are observed.

SECTION 16. Other information

16.1 Other information

Indication of changes	:	Ensure all national/local regulations are observed.
Disclaimer of liability	:	Before using this product in any new process or experiment, a thorough material combability and safety study should be carried out. Details given in this document are believed to be correct at the time of going to press. Whilst proper care has been taken in the preparation of this document, no liability for injury or damage resulting from its use ca be accepted.

End of Safety Data Sheet