

Safety Data Sheet (SDS)

2,2-Dichloro-1,1,1-trifluoroethane (R123 / HCFC-123)

CAS No.: 306-83-8 UN No.: 2517 Date of issue: Aug 29, 2026 Version: 1.0

1 Identification

1.1 Product identifier

Chemical name	2,2-Dichloro-1,1,1-trifluoroethane
Common names / synonyms	R123, HCFC-123, HCFC123, Dichlorotrifluoroethane, Freon 123, Genetron 123, SUVA 123 (CHCl ₂ CF ₃)
CAS number	306-83-8
UN number	2517 (liquefied gas, pressurized)
Dangerous goods code	Class 2.2 Non-flammable, non-toxic gas
Molecular formula	C ₂ HCl ₂ F ₃ (CHCl ₂ CF ₃)
Molecular weight	152.93 g/mol
Recommended use	Low-pressure centrifugal chiller refrigerant, blowing agent, cleaning solvent, fire extinguishing agent component, etc.

1.2 Details of the supplier of the safety data sheet

Supplier name	Hangzhou Wula Chemical Co., Ltd.
Address	No. 7 Longtan Road, Yuhang District, Hangzhou, Zhejiang Province, China
Postal code	311100
Telephone	+86-571-87024025
Fax	+86-571-87024025
E-mail	safety@wulachem.cn

1.3 Emergency telephone number

National Chemical Emergency Hotline (China): +86-532-83889090 (24 hours)

2 Hazards identification

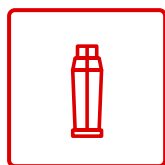
2.1 GHS classification

Hazard classification:

- Compressed gas (Physical hazard) — Liquefied gas
- Skin irritation (Health hazard) — Category 2
- Specific target organ toxicity - repeated exposure (Health hazard, heart) — Category 2
- Carcinogenicity (Health hazard) — Category 2 (suspected carcinogen)

Note: This substance is ASHRAE Group B1 (higher toxicity, non-flammable) and classified by IARC as Group 2B (possibly carcinogenic to humans). Special protective measures are required. Frostbite from liquid contact is a physical low-temperature injury.

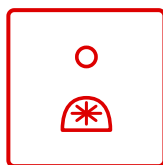
2.2 GHS label elements



GHS04 Gas cylinder



GHS07 Exclamation mark



GHS08 Health hazard

Signal word: **WARNING**

Hazard statements:

- H280** Contains gas under pressure; may explode if heated.
- H315** Causes skin irritation (Note: cryogenic frostbite from rapid liquid evaporation, not chemical irritation).
- H373** May cause damage to organs (heart) through prolonged or repeated exposure.
- H351** Suspected of causing cancer (IARC Group 2B).

Precautionary statements:

- P102** Read and understand all safety precautions before handling.
- P271** Use only outdoors or in a well-ventilated area.
- P280** Wear protective gloves/protective clothing/eye protection/face protection.
- P305+P351+P338** IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
- P309+P311** IF exposed or if you feel unwell: Call a POISON CENTER or doctor/physician.
- P403** Store in a well-ventilated place.

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

P405 Store locked up.

2.3 Other hazards

- Vapor is heavier than air (~5.3 times) and may spread long distances along the ground, creating an oxygen-deficient environment in low-lying areas.
- Non-flammable, but decomposes at high temperatures (>250°C) producing toxic and corrosive gases (hydrogen fluoride, hydrogen chloride, phosgene, etc.).
- Cylinders may rupture or burst when heated due to increased internal pressure.
- HCFC-class ozone-depleting substance (ODP=0.02); controlled under the Montreal Protocol and being phased out globally.
- Cardiac sensitization threshold ~20,000 ppm; high-concentration exposure can precipitate cardiac arrhythmia.

3 Composition/information on ingredients

3.1 Substance/mixture

This product is a pure substance.

3.2 Composition information

Component name	CAS No.	Concentration (by mass)
2,2-Dichloro-1,1,1-trifluoroethane	306-83-8	≥99.5%

3.3 Impurity information

Impurity	Superior Grade	First Grade
Acidity (as HCl)	≤0.1 ppm	≤1 ppm
Moisture	≤10 ppm	≤20 ppm
Evaporation residue	≤100 ppm	≤100 ppm
Non-condensable gas (25°C, vol%)	≤1.5%	≤1.5%
Chloride	Pass	Pass

4 First aid measures

4.1 Description of necessary first aid measures

General advice: Remove victim from contaminated area immediately. Keep warm and at rest. Show this SDS to attending physician.

Inhalation:

- Move victim to fresh air immediately. Keep airway clear.
- Administer oxygen if breathing is difficult.
- If not breathing, give artificial respiration (preferably with bag-valve-mask or pocket mask; avoid mouth-to-mouth).
- If no pulse, start cardiopulmonary resuscitation (CPR) immediately.
- Keep victim warm and at rest. Monitor condition closely.
- Seek medical attention immediately. This substance has higher toxicity; medical observation is required even if symptoms are mild.

Skin contact (frostbite):

- Immediately flush affected area with large amounts of lukewarm water (37–40°C) to promote rewarming.
- Do NOT use hot water (>40°C) or direct heat (e.g., electric heaters).
- Do NOT rub or massage frostbitten area; this may worsen tissue damage.
- Carefully remove frozen clothing. If clothing sticks to skin, do NOT pull it off; cut around it.
- Cover with sterile dressing.
- Seek medical attention immediately.

Eye contact:

- Immediately hold eyelids open and rinse thoroughly with plenty of water or normal saline for at least 15 minutes.
- Ensure complete irrigation of all eye surfaces by lifting upper and lower lids.
- Remove contact lenses if present and easily removable.
- Seek medical attention immediately, preferably from an ophthalmologist.

Ingestion:

Not applicable. This substance is a volatile liquid at ambient temperature; ingestion exposure is not expected.

4.2 Most important symptoms and effects, both acute and delayed

- Acute inhalation: dizziness, drowsiness, headache, nausea, ataxia, loss of consciousness, cardiac arrhythmia (cardiac sensitization).
- Skin contact (liquid): frostbite (pale, hard skin, pain, blistering); chemical skin irritation.
- Eye contact (liquid): severe frostbite, corneal damage, visual impairment.
- Repeated exposure: may cause damage to the heart (myocardial sensitization, arrhythmia).
- Long-term exposure: suspected carcinogen (IARC 2B); may increase tumor risk.

4.3 Indication of any immediate medical attention and special treatment needed

Notes for physicians:

- Symptomatic and supportive therapy. Maintain airway; administer oxygen if needed.
- Monitor cardiac function; this substance has higher toxicity and exposure may precipitate arrhythmias (cardiac sensitization threshold ~20,000 ppm).
- Avoid catecholamine drugs (e.g., epinephrine/adrenaline) — they may increase myocardial sensitivity to fluorocarbons and precipitate ventricular fibrillation.
- Treat frostbite with standard protocols: lukewarm water (37–40°C) rewarming. Do NOT use dry heat or massage.
- This substance is an IARC Group 2B possible carcinogen. Workers with long-term exposure should undergo periodic health examinations including liver function and cardiac function tests.
- If significant inhalation is suspected, monitor liver function and ECG for at least 24 hours.

5 Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media: This substance is non-flammable. Use extinguishing agent appropriate for surrounding fire. Carbon dioxide, dry chemical, water fog, and foam are acceptable.

Unsuitable extinguishing media: No specific contraindications.

5.2 Special hazards arising from the substance or mixture

- Non-flammable. No flash point. No explosive limits.
- Thermal decomposition at high temperatures (>250°C) produces toxic and corrosive gases: hydrogen fluoride (HF), hydrogen chloride (HCl), and phosgene (COCl₂).
- Cylinders may rupture or burst when heated due to increased internal pressure.
- May react with alkali metals, alkaline earth metals, and aluminum powder under certain conditions.

5.3 Hazardous combustion products

Hydrogen fluoride (HF), hydrogen chloride (HCl), phosgene (COCl₂), carbon monoxide (CO), and other fluorinated/chlorinated compounds.

5.4 Advice for firefighters

- Firefighters must wear positive-pressure self-contained breathing apparatus (SCBA) and full protective fire-resistant clothing.
- If possible, move containers from fire area to a safe location.
- Cool containers with water spray from a safe distance until fire is extinguished.
- Immediately evacuate if containers show discoloration or if pressure relief devices begin to vent.

- Isolate the area; keep unauthorized personnel out.
- Avoid direct water spray on leaking liquefied gas, as this will accelerate evaporation and dispersion.
- Phosgene from thermal decomposition is highly toxic; firefighters must ensure adequate respiratory protection.

6 Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

- Evacuate personnel from the leak area to upwind locations immediately. Establish a perimeter and restrict access.
- Emergency responders should wear SCBA, standard work clothing, cryogenic gloves, and eye protection.
- Enter from upwind direction.
- Stop leak if it can be done safely.
- Do not touch or walk through spilled material.
- Maintain emergency contact personnel for external support.

6.2 Environmental precautions

- Prevent gas from entering sewers, basements, or confined spaces.
- Ventilate the area to accelerate dispersion.
- Minimize releases to control ozone-depleting and greenhouse gas emissions; recover whenever possible.
- Avoid release to atmosphere, waterways, or soil.

6.3 Methods and materials for containment and cleaning up

- **Small leak:** Increase ventilation to accelerate gas dispersion. Monitor oxygen levels to prevent asphyxiation.
- **Large leak:**
 - Close source valve if safe to do so.
 - Recover using dedicated gas recovery equipment.
 - If recovery is not possible, use water fog/mist to dilute and dissolve gas (prevent water pollution).
 - If cylinder valve cannot be closed, immerse cylinder in alkaline water solution for absorption.
- **Cylinder leak:** Move cylinder to a well-ventilated safe area and vent slowly. If valve cannot be closed, contact supplier for professional handling.

6.4 Reference

See Section 8 (Exposure controls/personal protection) and Section 13 (Disposal considerations).

Critical hazard: R123 vapor is approximately 5.3 times heavier than air and will accumulate in low-lying and confined areas, creating an oxygen-deficient atmosphere. Always check oxygen levels (must

be $\geq 19.5\%$) and use a buddy system before entering confined spaces or low-lying areas. This substance has higher toxicity (Group B1); concentration monitoring is required in the leak area.

7 Handling and storage

7.1 Precautions for safe handling

- Handle in closed systems with adequate natural ventilation or local exhaust.
- Personnel must be specially trained and strictly follow operating procedures. Certified personnel only.
- Prevent gas leakage into workplace atmosphere.
- Avoid contact with reactive metals and strong oxidizing agents.
- Handle cylinders carefully; do not drop, slide, roll, or bump cylinders. Use proper lifting equipment.
- Equip area with leak emergency response equipment.
- No smoking, eating, or drinking in work areas.
- Wear insulated gloves and eye/face protection when handling liquid to prevent frostbite.
- Use explosion-proof ventilation systems and equipment.
- Periodically inspect cylinders, valves, and piping for leaks.
- This substance is a suspected carcinogen; minimize exposure and enhance personal protection during handling.

7.2 Conditions for safe storage, including any incompatibilities

- Store in a cool, dry, well-ventilated non-flammable gas warehouse.
- Storage temperature should not exceed 45°C. Keep away from fire, heat sources, and direct sunlight.
- Store separately from oxidizers and reactive metals. Do not co-store with incompatible materials.
- Storage area should be equipped with leak emergency response equipment.
- Cylinders must be stored upright with valve caps and safety rings in place, properly secured to prevent falling.
- Use explosion-proof lighting and ventilation systems.
- Prohibit use of equipment and tools that can generate sparks.
- Post clear safety warning signs in storage areas.
- Implement two-person receiving/issuing and two-person custody system.

7.3 Specific end uses

For industrial use only. Personnel must be professionally trained. Primarily used as a low-pressure centrifugal chiller refrigerant. Do not use for direct food contact, medical inhalation, or other unapproved applications. Note: This substance is a controlled HCFC under the Montreal Protocol and is being phased out globally; use is restricted to specific servicing and maintenance applications.

8.1 Control parameters

China OEL (Occupational Exposure Limit)	No established legal limit. Recommended reference: ACGIH TLV 50 ppm (TWA, 8 hr)
ACGIH TLV-TWA (USA)	50 ppm (approx. 308 mg/m ³), 8-hour time-weighted average
OSHA PEL-TWA (USA)	Not established (refer to ACGIH)
Cardiac sensitization threshold	~20,000 ppm
Biological limit value	Not established

Note: The ACGIH TLV for R123 is 50 ppm, far lower than common refrigerants such as R134a (1000 ppm), indicating higher toxicity. Exposure concentration must be strictly controlled to ensure workplace levels remain below 50 ppm.

8.2 Exposure monitoring methods

Gas chromatography with flame ionization detection (GC-FID) or mass spectrometry (GC-MS); non-dispersive infrared (NDIR) analysis.

8.3 Appropriate engineering controls

- Enclosed process design with general ventilation or local exhaust.
- Provide safety shower and eyewash station.
- Install toxic gas detection alarms in areas where large leaks may occur.
- Use explosion-proof electrical equipment.

8.4 Individual protection measures

Respiratory protection:

- Normal conditions (below exposure limit): half-face respirator with organic vapor cartridge is recommended.
- Elevated concentrations: full-face respirator or positive-pressure SCBA should be worn.
- High concentration or emergency rescue/evacuation: positive-pressure self-contained breathing apparatus (SCBA) must be worn.

Eye/face protection:

- Chemical safety goggles or face shield must be worn at all times.
- When handling liquid: full face shield recommended to prevent frostbite.

Skin protection:

- Hand protection: cryogenic-insulated gloves (e.g., dry ice gloves, leather cold gloves) for liquid contact.
- Body protection: standard work uniform; cold-resistant clothing for liquid contact.
- Other: no smoking in work areas; avoid high-concentration inhalation; use a buddy system when entering tanks, confined spaces, or other high-concentration areas.

8.5 Hygiene measures

- Remove contaminated clothing and wash skin thoroughly after work.
- Maintain good personal hygiene.
- Ensure eyewash and emergency shower are available in the workplace.
- Workers with long-term exposure should undergo periodic occupational health examinations (including liver function and ECG tests).

9 Physical and chemical properties

9.1 Basic physical and chemical properties

Appearance and odor	Colorless liquid/gas with a faint ethereal odor; boiling point 27.6°C at ambient pressure; colorless transparent liquid under pressure
Odor threshold	Not available (faint ether-like odor)
pH	Not applicable (gas/liquid)
Melting point / Freezing point	-107 °C (-160.6 °F)
Boiling point / Boiling range (101.3 kPa)	27.6 °C (81.7 °F)
Flash point	None (non-flammable gas)
Evaporation rate	Not available
Flammability (gas)	Non-flammable
Explosive limits (upper/lower)	Not applicable (non-flammable gas)
Vapor pressure (25°C)	90 kPa (saturated vapor pressure)
Vapor density (air = 1)	~5.3 (heavier than air)
Relative density (liquid, 25°C)	1.464 g/cm ³

Solubility	Slightly soluble in water; soluble in ethanol, ether, and other organic solvents
Octanol/water partition coefficient (log P)	~2.5
Auto-ignition temperature	Not applicable (non-flammable)
Decomposition temperature	>250 °C onset of thermal decomposition
Viscosity (liquid, 25°C)	~0.46 mPa·s
Surface tension (liquid, 25°C)	~15.5 mN/m

9.2 Thermodynamic properties

Critical temperature	183.7 °C (362.7 °F)
Critical pressure	3662 kPa (3.66 MPa / 531 psia)
Critical density	0.55 g/cm ³
Heat of vaporization (at boiling point)	170 kJ/kg
Liquid specific heat (25°C)	0.98 kJ/(kg·°C)
Henry's Law constant (25°C)	Not available

9.3 Other safety data

ASHRAE safety group	B1 (higher toxicity, non-flammable)
Ozone Depletion Potential (ODP)	0.02 (ozone-depleting substance; see Section 12.6)
Global Warming Potential (GWP, 100-yr)	79 (greenhouse gas; see Section 12.6)

10 Stability and reactivity

10.1 Reactivity

Chemically stable under normal temperature and pressure conditions; not readily reactive.

10.2 Chemical stability

Stable under normal conditions of temperature and pressure.

10.3 Possibility of hazardous reactions

- Thermal decomposition at high temperatures (>250°C) produces toxic hydrogen fluoride, hydrogen chloride, and phosgene.
- May react with alkali metals, alkaline earth metals, and aluminum powder under high temperature or specific conditions.
- May undergo oxidation-reduction reactions with strong oxidizing agents.

10.4 Conditions to avoid

High temperature, open flame, direct heat sources, cylinder overpressure

10.5 Incompatible materials

Reactive metals (sodium, potassium, calcium, aluminum powder, magnesium powder, etc.), strong oxidizing agents

10.6 Hazardous decomposition products

Hydrogen fluoride (HF), hydrogen chloride (HCl), phosgene (COCl₂), carbon monoxide (CO), and other fluorinated/chlorinated compounds

10.7 Hazardous polymerization

Will not occur.

11 Toxicological information

11.1 Information on toxicological effects

Acute toxicity:

Rat inhalation LC ₅₀ (4 hr)	32,000 ppm (higher toxicity)
Cardiac sensitization threshold	~20,000 ppm
Rabbit dermal LD ₅₀	Not available (gaseous/volatile liquid)

Note: The LC₅₀ of R123 is 32,000 ppm, far lower than low-toxicity refrigerants such as R134a (>500,000 ppm), indicating higher toxicity. Exposure must be strictly controlled.

11.2 Skin irritation/corrosion

Liquid contact can cause frostbite (physical injury) and chemical skin irritation. GHS classification: Skin irritation Category 2.

11.3 Eye irritation/corrosion

Liquid contact can cause severe frostbite and corneal damage.

11.4 Respiratory or skin sensitization

No sensitization reported. Available animal test data and human epidemiology data show no sensitization effect.

11.5 Germ cell mutagenicity

In vitro and in vivo tests (Ames test, chromosome aberration test, etc.) show no significant mutagenic effect.

11.6 Carcinogenicity

Carcinogenicity assessment:

- IARC (International Agency for Research on Cancer): Group 2B (Possibly carcinogenic to humans)
- ACGIH (American Conference of Governmental Industrial Hygienists): Category A4 (Not classifiable as a human carcinogen)
- EPA (U.S. Environmental Protection Agency): Group R (Inadequate data for classification)

GHS classification: Carcinogenicity Category 2 (suspected carcinogen, H351). Prolonged or repeated exposure may increase tumor risk; minimize exposure.

11.7 Reproductive toxicity

Animal studies show no significant reproductive or developmental toxicity at high concentrations. No human reproductive toxicity data available.

11.8 STOT-single exposure

- Inhalation of high concentrations may cause central nervous system depression, manifested as dizziness, drowsiness, headache, and impaired consciousness.
- Cardiac effects: High-concentration exposure may cause cardiac arrhythmia (cardiac sensitization, threshold ~20,000 ppm), especially under stress or exercise.

11.9 STOT-repeated exposure

GHS classification: STOT-repeated exposure Category 2 (heart). Prolonged or repeated exposure may cause damage to the heart, manifested as myocardial sensitization and arrhythmia. Long-term animal inhalation studies showed reversible pathological changes in the liver and heart.

11.10 Aspiration hazard

Not expected to cause aspiration pneumonia in gaseous/vapor form. However, high-concentration inhalation can cause CNS depression and cardiac sensitization. The relatively high boiling point (27.6°C) reduces the risk of liquid aspiration.

12

Ecological information

12.1 Ecotoxicity

Fish acute toxicity (LC ₅₀ , 96 hr)	> 100 mg/L (low toxicity to fish)
Daphnia acute toxicity (EC ₅₀ , 48 hr)	> 100 mg/L
Algae growth inhibition (EC ₅₀ , 72 hr)	Not available
Bacterial toxicity	Not available

12.2 Persistence and degradability

- Atmospheric degradation: Primarily degraded by reaction with hydroxyl radicals; atmospheric lifetime ~1.4 years.
- Biodegradability: Poorly biodegradable (not readily degraded by microorganisms).
- Hydrolysis: Not readily hydrolyzed at ambient temperature.
- Photodegradation: Can be photochemically degraded in the atmosphere.

12.3 Bioaccumulative potential

log P = 2.5. Low to moderate bioaccumulation potential (below the bioconcentration threshold of log P = 4.5).

12.4 Mobility in soil

Highly volatile in gaseous form. Low water solubility. High mobility. Volatilizes readily to atmosphere when released to soil.

12.5 Results of PBT and vPvB assessment

Does not meet PBT (persistent, bioaccumulative, and toxic) / vPvB (very persistent and very bioaccumulative) criteria.

12.6 Other adverse effects

- **Ozone Depletion Potential (ODP):** 0.02 (HCFC-class ozone-depleting substance; causes slight ozone layer damage)
- **Global Warming Potential (GWP, 100-year time horizon):** 79 (relative to CO₂ = 1, relatively low greenhouse effect)
- This substance is a controlled substance under the Montreal Protocol (HCFC class). Developed countries phased out production in 2020; developing countries must phase out by 2030.
- Large releases impact the ozone layer and global warming; emissions should be strictly controlled with priority on recovery and reuse.

13.1 Waste treatment methods

Product/residues:

- Do NOT release directly to atmosphere (ozone-depleting substance).
- Recovery and recycling (purification and reuse) is the preferred approach.
- If recovery is not feasible, dispose of through a licensed hazardous waste treatment facility.
- High-temperature incineration with alkaline scrubber for fluoride and chloride removal is an acceptable method.
- Do not discharge to sewers, waterways, or soil.

Contaminated packaging:

- Empty cylinders must be returned to supplier or a qualified facility for disposal. Do not discard or cut empty cylinders.
- Empty cylinders with residual pressure are managed as hazardous waste.

13.2 Special precautions for disposal

- Refer to national and local regulations before disposal (e.g., Solid Waste Pollution Prevention and Control Law, Ozone-Depleting Substances Management Regulations, Hazardous Waste Storage Pollution Control Standards, etc.).
- Personnel should wear appropriate personal protective equipment (see Section 8).
- Ensure good ventilation to prevent asphyxiation.
- Disposal must be performed by a qualified and licensed facility.
- Disposal records should be maintained.

14 Transport information

14.1 UN number

2517 (2,2-Dichloro-1,1,1-trifluoroethane, compressed/liquefied gas)

14.2 UN proper shipping name

2,2-DICHLORO-1,1,1-TRIFLUOROETHANE

14.3 Transport hazard class(es)

Class 2.2 Non-flammable, non-toxic gas

14.4 Packing group

Not applicable (Class 2 gases are not assigned a packing group)

14.5 Packing mark / Hazard label

- Primary hazard label: Non-flammable non-toxic gas (green, Class 2.2)

- Subsidiary hazard label: None

14.6 Methods and materials for containment and packaging

- Seamless steel cylinders. Cylinders must comply with applicable national standards (e.g., GB 5099).
- Common package sizes: 13.6 kg, 50 kg, 100 kg, 400 kg, 800 kg cylinders and ISO tank containers.
- Cylinder valve outlet thread direction: right-hand thread for non-flammable non-toxic gases.

14.7 Special requirements for different modes of transport

Road transport:

- Vehicles must have hazardous cargo transport license.
- Cylinders must have valve caps and safety rings in place.
- Cylinders generally laid flat with valves pointing in same direction; do not stack crosswise. Height must not exceed vehicle guardrail.
- Transport during early morning/evening in summer to avoid direct sunlight.
- Follow designated routes; do not stop in residential or densely populated areas.

Rail transport:

- Prohibit hump shunting (no free-roll classification).
- Transport in boxcars; cylinders upright or laid flat and secured.

Marine transport (IMDG Code):

- UN 2517, Class 2.2
- Marine pollutant: No
- Stowage category: A (on deck or under deck)

Air transport (ICAO/IATA DGR):

- UN 2517, Class 2.2
- Non-flammable non-toxic gas
- Acceptable on passenger and cargo aircraft (subject to quantity limits)

14.8 Special precautions for user

- Do not co-transport with oxidizers, reactive metals, or food/feed products.
- Vehicles must be equipped with appropriate fire extinguishing equipment and leak emergency response gear.
- Transport personnel must be specially trained and certified.
- Protect from sunlight, rain, and high temperature during transit.
- When stopping en route, stay away from fire, heat sources, and high-temperature areas.
- Exhaust pipes of vehicles carrying this product must be fitted with spark arrestors.
- Load and unload carefully to prevent damage to cylinders and fittings.

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

International regulations:

- **UN GHS (Globally Harmonized System of Classification and Labelling of Chemicals):** 8th revised edition
- **Montreal Protocol:** Controlled ozone-depleting substance (HCFC class, ODP=0.02). Developed countries phased out production in 2020; developing countries must phase out by 2030.
- **Kyoto Protocol / Paris Agreement:** Listed as greenhouse gas
- **EU REACH Regulation (EC 1907/2006):** Registered substance
- **EU CLP Regulation (EC 1272/2008):** Classification, labelling and packaging regulation
- **EU F-Gas Regulation (EC 517/2014):** Fluorinated greenhouse gas control
- **US EPA SNAP Program:** Approved for specific refrigeration applications (being phased out)
- **US OSHA HCS 2012:** Hazard Communication Standard
- **US DOT 49 CFR:** Hazardous Materials Transportation Regulations
- **ADR/RID:** European Agreement concerning the International Carriage of Dangerous Goods by Road/Rail
- **IMDG Code:** International Maritime Dangerous Goods Code
- **IATA DGR:** International Air Transport Association Dangerous Goods Regulations
- **IARC:** Group 2B (Possibly carcinogenic to humans)

15.2 Chemical safety assessment

Chemical Safety Assessment has not been carried out for this substance in the context of this SDS. Users should conduct their own assessment based on specific use conditions.

16.1 References

- NIOSH Pocket Guide to Chemical Hazards
- International Chemical Safety Card (ICSC)
- NOAA CAMEO Chemicals Database
- PubChem Compound Database (CID 9307)
- ASHRAE Handbook - Refrigeration Systems and Applications
- IARC Monographs on the Evaluation of Carcinogenic Risks to Humans
- GB/T 16483-2008 (Content and order of sections in safety data sheet for chemical products)
- GB 30000 series (Rules for classification and labelling of chemicals)

- United Nations GHS (Globally Harmonized System of Classification and Labelling of Chemicals), 8th revised edition
- Montreal Protocol on Substances that Deplete the Ozone Layer and its amendments

16.2 Abbreviations

Abbreviation	Full term
SDS / MSDS	Safety Data Sheet / Material Safety Data Sheet
GHS	Globally Harmonized System of Classification and Labelling of Chemicals
CAS	Chemical Abstracts Service (registry number)
UN	United Nations (dangerous goods number)
ODP	Ozone Depletion Potential
GWP	Global Warming Potential
HCFC	Hydrochlorofluorocarbon
LC ₅₀	Lethal Concentration, 50%
LD ₅₀	Lethal Dose, 50%
TLV-TWA	Threshold Limit Value - Time-Weighted Average
PEL	Permissible Exposure Limit
SCBA	Self-Contained Breathing Apparatus
PBT	Persistent, Bioaccumulative, and Toxic
IARC	International Agency for Research on Cancer
STOT	Specific Target Organ Toxicity

16.3 Disclaimer

This Safety Data Sheet (SDS) has been prepared in accordance with the UN GHS standard and applicable regulatory requirements. The information contained herein is based on publicly available chemical databases, technical literature, and national standards, and is believed to be accurate and complete as of the date of issuance. However, no warranty, express or implied, is made as to the absolute accuracy, completeness, or reliability of the information. Users should verify the applicability of the information for their specific use conditions and refer to the official SDS provided by the manufacturer/supplier for compliance purposes. The information in this document may be updated as new research findings and regulatory changes become available; periodic review of the latest version is recommended.

