

Safety Data Sheet (SDS)

Refrigerant R513A (HFO/HFC Blend, R1234yf/R134a = 56/44)

CAS No.: No single CAS (mixture) UN No.: 3161 Date of issue: Aug 29, 2026 Version: 1.0

1 Identification

1.1 Product identifier

Chemical name	Refrigerant R513A (HFO/HFC blend)
Common names / synonyms	R513A, R-513A, Opteon XP5 (Chemours brand), HFO/HFC blend
CAS number	No single CAS number (mixture; see composition information)
UN number	3161 (liquefied flammable gas)
Dangerous goods code	Class 2.1 Flammable gas
Composition	R1234yf (56% by mass) + R134a (44% by mass)
Molecular weight	108.6 g/mol (weighted average of mixture)
Recommended use	Direct replacement refrigerant for R134a, commercial refrigeration, automotive air conditioning, chillers, vending machines, 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)

Supplier Emergency Contact: +86-571-87024025

2.1 GHS classification

Hazard classification:

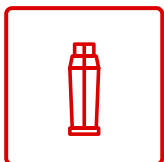
- Flammable gas (Physical hazard) — Category 2
- Compressed gas (Physical hazard) — Liquefied gas
- Serious eye damage/eye irritation (Health hazard) — Category 2B
- Specific target organ toxicity - single exposure (Health hazard, narcotic effect) — Category 3

Note: R513A is classified as ASHRAE safety group A2L (lower toxicity, lower flammability). The flammability is inherited from the R1234yf component (56%). It is only flammable under specific concentration conditions (~8.7%-12.0% by volume in air) and with a strong ignition source. Burning velocity is extremely low (<10 cm/s), making it far more difficult to ignite than conventional flammable gases. Frostbite from liquid contact is a physical low-temperature injury.

2.2 GHS label elements



GHS02 Flammable



GHS04 Gas cylinder



GHS07 Exclamation mark

Signal word: **WARNING**

Hazard statements:

- H221** Flammable gas.
- H280** Contains gas under pressure; may explode if heated.
- H316** Causes mild skin irritation (Note: cryogenic frostbite from rapid liquid evaporation, a physical injury).
- H320** Causes eye irritation (Note: cryogenic frostbite from rapid liquid evaporation, a physical injury).
- H336** May cause drowsiness or dizziness.

Note: H316/H320 are standard GHS hazard statement codes. The skin/eye injury mechanism is physical cryogenic frostbite; the codes are used to represent similar hazard effects. Flammability is inherited from the R1234yf component (56%); the R134a component (44%) is itself non-flammable.

Precautionary statements:

- P102** Keep out of reach of children. Read label before use.
- P210** Keep away from heat, sparks, open flames, and hot surfaces. No smoking.
- P264** Wash hands thoroughly after 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.

P332+P313 If skin irritation occurs: Get medical advice/attention.

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

P381 In case of leakage, eliminate all ignition sources.

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 (~3.75 times air density) and may spread long distances along the ground, creating an oxygen-deficient environment in low-lying areas.
- Classified as A2L (low-flammability) refrigerant; flammability inherited from the R1234yf component. Difficult to ignite at room temperature; combustion requires a strong ignition source and concentration within flammability limits (~8.7%-12.0% by volume in air).
- Thermal decomposition at high temperatures (>400°C) produces toxic and corrosive gases (hydrogen fluoride, carbon monoxide, carbonyl fluoride, etc.).
- Cylinders may rupture or burst when heated due to increased internal pressure.
- Near-azeotropic mixture (temperature glide <0.5°C); thermodynamic properties similar to R134a, suitable as a direct replacement.

3 Composition/information on ingredients

3.1 Substance/mixture

This product is a mixture, blended from two refrigerants in a fixed ratio.

3.2 Composition information

Component name	CAS No.	Molecular formula	Concentration (by mass)
2,3,3,3-Tetrafluoropropene (R1234yf / HFO-1234yf)	754-12-1	CF ₃ CF=CH ₂ (C ₃ H ₂ F ₄)	56%
1,1,1,2-Tetrafluoroethane (R134a / HFC-134a)	811-97-2	CH ₂ FCF ₃ (C ₂ H ₂ F ₄)	44%

3.3 Mixture characteristics

Mixture type	Near-azeotropic blend (near-azeotropic refrigerant)
Temperature glide	<0.5°C (minimal; near-azeotropic behavior)
Composition stability	Composition ratio remains nearly constant in both liquid and vapor phases; suitable for direct-expansion refrigeration systems

3.4 Impurity information

Impurity	Specification limit
Acidity (as HCl)	≤1 ppm
Moisture	≤10 ppm
Evaporation residue	≤100 ppm
Non-condensable gas (25°C, vol%)	≤1.5%
Chloride	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. Eliminate all ignition sources.

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.

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 gas 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.
- Skin contact (liquid): frostbite (pale, hard skin, pain, blistering), mild skin irritation.
- Eye contact (liquid): severe frostbite, corneal damage, visual impairment.
- High-concentration exposure can cause central nervous system depression and cardiac sensitization.

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; high-concentration exposure may cause arrhythmias.
- 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.
- If thermal decomposition products (hydrogen fluoride) exposure is suspected, monitor blood calcium and potassium levels; administer calcium gluconate if needed.

5**Firefighting measures****5.1 Extinguishing media**

Suitable extinguishing media: This substance is an A2L (low-flammability) gas and is only combustible under specific conditions. Dry chemical powder, carbon dioxide, water fog, and foam are acceptable.

Unsuitable extinguishing media: Avoid direct water jets on leaking gas (may accelerate dispersion and evaporation). Water spray may be used to cool containers.

5.2 Special hazards arising from the substance or mixture

A2L low-flammability characteristics:

- R513A is classified as ASHRAE A2L (low-flammability); flammability is inherited from the R1234yf component (56%), while the R134a component (44%) is itself non-flammable.
 - Narrow flammability range (~8.7%-12.0% by volume in air), high minimum ignition energy, and extremely low burning velocity (~3-4 cm/s), far lower than common flammable gases.
 - Under normal use conditions without a strong ignition source, ignition is highly unlikely.
 - However, in confined spaces where concentration falls within flammability limits and a strong ignition source (e.g., electrical arc, open flame) is present, combustion is possible.
- Thermal decomposition at high temperatures (>400°C) produces toxic and corrosive gases: hydrogen fluoride, carbon monoxide, carbonyl fluoride, etc.
 - 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), carbon monoxide (CO), carbonyl fluoride (COF₂), and other fluorinated 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.
- For leaking gas fire: do not extinguish unless leak can be stopped safely (P377 principle); shut off gas source first.
- Avoid direct water jets on leaking liquefied gas, as this will accelerate evaporation and dispersion.

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.
- Eliminate all ignition sources, heat sources, and electrical sparks immediately (P381 principle).

- 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; 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 and combustible gas concentration to prevent asphyxiation and combustion. Eliminate all ignition sources.
- **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, move cylinder to a safe ventilated area and vent slowly; ensure no ignition sources.
- **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: R513A vapor is approximately 3.75 times heavier than air and will accumulate in low-lying and confined areas, creating an oxygen-deficient atmosphere and potentially reaching flammable concentrations. Always check oxygen levels (must be $\geq 19.5\%$) and combustible gas concentration before entering confined spaces or low-lying areas, and use a buddy system. Eliminate all ignition sources.

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.
- Keep away from fire, heat sources, and open flames. No smoking in work areas. Use explosion-proof ventilation systems and electrical equipment.

- 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 and combustible gas detectors.
- Wear insulated gloves and eye/face protection when handling liquid to prevent frostbite.
- Prohibit use of equipment and tools that can generate sparks.
- Periodically inspect cylinders, valves, and piping for leaks.

7.2 Conditions for safe storage, including any incompatibilities

- Store in a cool, dry, well-ventilated 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 and combustible gas detectors.
- 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.
- Filling coefficient must not exceed 1.1 kg/L.
- Post clear safety warning signs and "Flammable Gas" labels 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. Suitable for commercial refrigeration, automotive air conditioning, chillers, vending machines, supermarket refrigeration/freezing, etc. As a direct replacement for R134a, it can be charged directly into existing R134a systems (56% GWP reduction compared to R134a). Do not use for direct food contact, medical inhalation, or other unapproved applications.

8 Exposure controls/personal protection

8.1 Control parameters

China OEL (Occupational Exposure Limit)	No established legal limit. Recommended to reference international standards for each component.
R1234yf component — AIHA WEEL-TWA	500 ppm (approx. 2400 mg/m ³), 8-hour time-weighted average
R134a component — ACGIH TLV-TWA	1000 ppm (approx. 4170 mg/m ³), 8-hour time-weighted average

Mixture recommended limit	Use the more conservative R1234yf limit of 500 ppm as the operational reference for the mixture
Biological limit value	Not established

Note: Per GBZ 2.1-2019 (Occupational exposure limits for hazardous agents in the workplace — Part 1: Chemical agents), this mixture is not currently listed in the Chinese OEL table. International standards for each component are recommended as reference.

8.2 Exposure monitoring methods

Gas chromatography with flame ionization detection (GC-FID) or mass spectrometry (GC-MS), or infrared gas analyzers and electrochemical sensors for field monitoring.

8.3 Appropriate engineering controls

- Enclosed process design with general ventilation or local exhaust.
- Provide safety shower and eyewash station.
- Install combustible 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): no special protection required.
- Elevated concentrations: half-face respirator with organic vapor/acid gas cartridge is recommended.
- High concentration or emergency rescue/evacuation: positive-pressure self-contained breathing apparatus (SCBA) must be worn.

Eye/face protection:

- General handling: no special protection required.
- When handling liquid or potential liquid exposure: chemical safety goggles or face shield must be worn to prevent frostbite.

Skin protection:

- Hand protection: general work gloves for normal handling; 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.

9 Physical and chemical properties

9.1 Basic physical and chemical properties

Appearance and odor	Colorless gas with a faint ethereal odor; gaseous at ambient temperature and pressure; colorless transparent liquid under pressure
Odor threshold	Not available (faint ether-like odor)
pH	Not applicable (gas)
Melting point / Freezing point	Not applicable (mixture, near-azeotropic)
Boiling point / Boiling range (101.3 kPa)	-29.2 °C (-20.6 °F) (near-azeotropic; temperature glide <0.5°C)
Flash point	None (gas, but has flammability range)
Evaporation rate	Not available
Flammability (gas)	Flammable (A2L low-flammability; limits ~8.7%-12.0%)
Explosive limits (upper/lower)	Upper: ~12.0% (vol); Lower: ~8.7% (vol)
Vapor pressure (25°C)	580 kPa (saturated vapor pressure)
Vapor density (air = 1)	~3.75 (heavier than air)
Relative density (liquid, 25°C)	1.155 g/cm ³
Solubility	Slightly soluble in water; soluble in ethanol, ether, and other organic solvents
Octanol/water partition coefficient (log P)	~0.9 (estimated, weighted by components)
Auto-ignition temperature	~630 °C (inherited from R1234yf component)
Decomposition temperature	>400 °C onset of thermal decomposition
Burning velocity	~3-4 cm/s (extremely low, A2L characteristic)
Temperature glide	<0.5°C (near-azeotropic mixture characteristic)

9.2 Thermodynamic properties

Critical temperature	99.6 °C (211.3 °F)
Critical pressure	3588 kPa (3.59 MPa / 520.3 psia)
Critical density	0.489 g/cm ³
Heat of vaporization (at boiling point)	~172 kJ/kg
Liquid specific heat (25°C)	1.40 kJ/(kg·°C)
Gas specific heat (25°C, constant pressure)	0.95 kJ/(kg·°C)

9.3 Other safety data

ASHRAE safety group	A2L (lower toxicity, lower flammability)
Ozone Depletion Potential (ODP)	0 (does not deplete ozone layer; see Section 12.6)
Global Warming Potential (GWP, 100-yr)	~573 (weighted average of R134a and R1234yf; see Section 12.6)
Atmospheric lifetime	R1234yf component: ~12 days; R134a component: ~14 years (components degrade independently)

10 Stability and reactivity

10.1 Reactivity

Chemically stable under normal temperature and pressure conditions; not readily reactive. Not easily ignited under normal operating conditions.

10.2 Chemical stability

Stable under normal conditions of temperature and pressure. As a near-azeotropic mixture, the components do not chemically react with each other.

10.3 Possibility of hazardous reactions

- Thermal decomposition at high temperatures (>400°C) produces toxic hydrogen fluoride, carbon monoxide, and carbonyl fluoride.
- 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.
- Combustion possible at specific concentrations (~8.7%-12.0%) with a strong ignition source (flammability inherited from R1234yf component).

10.4 Conditions to avoid

High temperature, open flame, direct heat sources, electrical arcs, electrostatic sparks, 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), carbon monoxide (CO), carbonyl fluoride (COF₂), and other fluorinated 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) — mixture	>500,000 ppm (highest concentration tested for the mixture; no lethality observed)
R1234yf component — Rat inhalation LC ₅₀ (4 hr)	>500,000 ppm
R134a component — Rat inhalation LC ₅₀ (4 hr)	>500,000 ppm
Rabbit dermal LD ₅₀	Not available (gaseous substance)

11.2 Skin irritation/corrosion

Liquid contact can cause frostbite (physical injury), but chemical irritation is mild. GHS classification: Skin irritation Category 3 (mild irritation, H316).

11.3 Eye irritation/corrosion

Liquid contact can cause severe frostbite and corneal damage. GHS classification: Serious eye damage/eye irritation Category 2B (H320).

11.4 Respiratory or skin sensitization

No sensitization reported. Both components (R1234yf and R134a) show no sensitization effect in available animal test data and human epidemiology data.

11.5 Germ cell mutagenicity

In vitro and in vivo tests (Ames test, chromosome aberration test, mouse micronucleus test, etc.) for both components show no mutagenic effect.

11.6 Carcinogenicity

Neither component has sufficient evidence of carcinogenicity.

- IARC (International Agency for Research on Cancer): Both components not listed
- ACGIH (American Conference of Governmental Industrial Hygienists): Both R1234yf and R134a are Category A4 (Not classifiable as a human carcinogen)
- EPA (U.S. Environmental Protection Agency): Both components are Group D (Not classifiable as to human carcinogenicity)

11.7 Reproductive toxicity

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

11.8 STOT-single exposure

- Narcotic effect (Category 3, H336): 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, especially under stress or exercise (catecholamine sensitization).

11.9 STOT-repeated exposure

Both components show no significant target organ toxicity from repeated low-concentration exposure. Long-term animal inhalation studies have not shown clear organ damage.

11.10 Aspiration hazard

Not expected to cause aspiration pneumonia in gaseous form. However, high-concentration inhalation can cause CNS depression and cardiac sensitization.

12 Ecological information

12.1 Ecotoxicity

Fish acute toxicity (LC ₅₀ , 96 hr)	> 100 mg/L (low toxicity to fish; both components are low toxicity)
Daphnia acute toxicity (EC ₅₀ , 48 hr)	> 100 mg/L

Algae growth inhibition (EC ₅₀ , 72 hr)	> 100 mg/L
Bacterial toxicity	Not available

12.2 Persistence and degradability

- R1234yf component: Atmospheric degradation primarily by reaction with hydroxyl radicals (OH·); atmospheric lifetime ~12 days; rapid degradation.
- R134a component: Atmospheric lifetime ~14 years; slower degradation.
- Biodegradability: Both components are poorly biodegradable (not readily degraded by microorganisms).
- Hydrolysis: Not readily hydrolyzed at ambient temperature.
- Photodegradation: R1234yf component is rapidly photochemically degraded in the atmosphere; R134a component degrades more slowly.

12.3 Bioaccumulative potential

log P ≈ 0.9 (weighted estimate). Low 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 (both components have ODP = 0; do not deplete the ozone layer)
- **Global Warming Potential (GWP, 100-year time horizon):** ~573 (weighted average of R1234yf GWP <1 and R134a GWP ≈ 1300: $0.56 \times 1 + 0.44 \times 1300 \approx 573$), relative to CO₂ = 1
- Compared to R134a (GWP ≈ 1300), the GWP is reduced by approximately 56%, making R513A a lower-GWP alternative to R134a.
- Not a controlled substance under the Montreal Protocol. The R134a component is listed as a greenhouse gas under the Kyoto Protocol and Paris Agreement, but the overall mixture GWP is relatively low.
- Large releases should still be controlled; recovery and reuse are preferred.

13 Disposal considerations

13.1 Waste treatment methods

Product/residues:

- Direct release to atmosphere is not recommended (contains R134a component, which has greenhouse effect). Recovery and reuse is preferred.
- 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 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, Hazardous Waste Storage Pollution Control Standards, etc.).
- Personnel should wear appropriate personal protective equipment (see Section 8).
- Ensure good ventilation to prevent asphyxiation. Eliminate all ignition sources.
- Disposal must be performed by a qualified and licensed facility.
- Disposal records should be maintained.

14 Transport information

14.1 UN number

3161 (flammable liquefied gas, N.O.S.)

14.2 UN proper shipping name

FLAMMABLE LIQUEFIED GAS, N.O.S. (Refrigerant R513A)

14.3 Transport hazard class(es)

Class 2.1 Flammable 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: Flammable gas (red, Class 2.1)
- 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, 100 kg, 400 kg, 800 kg cylinders and ISO tank containers.
- Filling coefficient must not exceed 1.1 kg/L.
- Cylinder valve outlet thread direction: left-hand thread for flammable 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.
- Exhaust pipes must be fitted with spark arrestors.

Rail transport:

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

Marine transport (IMDG Code):

- UN 3161, Class 2.1
- Marine pollutant: No
- Stowage category: D (on deck only for flammable gases)

Air transport (ICAO/IATA DGR):

- UN 3161, Class 2.1
- Flammable liquefied gas
- Acceptable on passenger and cargo aircraft (subject to quantity limits and IATA packing requirements)

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:** Not a controlled ozone-depleting substance (ODP = 0)
- **Kyoto Protocol / Paris Agreement:** R134a component listed as greenhouse gas (mixture GWP $\approx$ 573)
- **EU REACH Regulation (EC 1907/2006):** Both components are registered substances
- **EU CLP Regulation (EC 1272/2008):** Classification, labelling and packaging regulation
- **EU F-Gas Regulation (EC 517/2014):** GWP <750; some applications not subject to HFC quota restrictions
- **US EPA SNAP Program:** Approved for commercial refrigeration, chillers, and other applications (as R134a replacement)
- **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

Chinese regulations:

- Regulation on the Safety Management of Hazardous Chemicals (State Council Decree No. 591)
- Catalog of Hazardous Chemicals (2015 Edition) — R134a component listed
- GB 30000 series: Rules for classification and labelling of chemicals
- GB/T 16483-2008: Safety data sheet for chemical products — Content and order of sections
- GBZ 2.1-2019: Occupational exposure limits for hazardous agents in the workplace
- TSG 23-2021: Safety technical regulation for gas cylinders

15.2 Chemical safety assessment

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

16 Other information

16.1 References

- Chemours Safety Data Sheet for Opteon XP5 (R513A)

- Chemours Technical Information for R513A
- ASHRAE Handbook - Refrigeration Systems and Applications
- ASHRAE Standard 34-2019: Designation and Safety Classification of Refrigerants
- 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
- AIHA (American Industrial Hygiene Association) WEEL Guide (R1234yf)
- ACGIH TLV Guide (R134a)

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
LC ₅₀	Lethal Concentration, 50%
LD ₅₀	Lethal Dose, 50%
NOAEL	No Observed Adverse Effect Level
WEEL	Workplace Environmental Exposure Level
TLV-TWA	Threshold Limit Value - Time-Weighted Average
PEL	Permissible Exposure Limit
SCBA	Self-Contained Breathing Apparatus
PBT	Persistent, Bioaccumulative, and Toxic
HFO	Hydrofluoroolefin
HFC	Hydrofluorocarbon

IARC	International Agency for Research on Cancer
ACGIH	American Conference of Governmental Industrial Hygienists
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.