Solstice® 449A (R-449A)

10666781

SECTION 1. IDENTIFICATION

Product name	:	Solstice® 449A (R-449A)
Number	:	000000023760
Product Use Description	:	Refrigerant
Manufacturer or supplier's details	:	Solstice Advanced Materials US, Inc. 115 Tabor Road Morris Plains, NJ 07950-2546
For more information call	:	800-522-8001 +1-973-455-6300(Monday-Friday, 9:00am-5:00pm)
In case of emergency call	:	**Medical: 1-800-498-5701 or +1-303-389-1414**
	:	**Transportation (CHEMTREC): 1-800-424-9300 or +1-703-527-3887**
	:	
	:	(24 hours/day, 7 days/week)

SECTION 2. HAZARDS IDENTIFICATION

Emergency Overview

Form	:	Liquefied gas
Color	:	clear colourless
Odor	:	slight ether-like

Classification of the substance or mixture

Classification of the substance or mixture	:	Gases under pressure, Liquefied gas Simple Asphyxiant

GHS Label elements, including precautionary statements

Symbol(s)	:		
Signal word	:	Warning	
Hazard statements	:	H280	Contains gas under pressure; may explode if heated.
		None	May displace oxygen and cause rapid suffocation.
Precautionary statements	:	**Storage:**	
		P410 + P403	Protect from sunlight. Store in a well-ventilated place.
Hazards not otherwise classified	:	May cause frostbite. Excessive exposure may cause central nervous system effects including drowsiness and dizziness. Excessive exposure may also cause cardiac arrhythmia. May cause eye and skin irritation.	

Carcinogenicity

No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP, IARC, or OSHA.

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical nature : Mixture

Chemical name	CAS-No.	Concentration
1,1,1,2-Tetrafluoroethane	811-97-2	25.70 %
2,3,3,3-Tetrafluoroprop-1-ene	754-12-1	25.30 %
Pentafluoroethane	354-33-6	24.70 %

Difluoromethane	75-10-5	24.30 %

SECTION 4. FIRST AID MEASURES

General advice : First aider needs to protect himself. Move out of dangerous area. Take off all contaminated clothing immediately.

Inhalation : Move to fresh air. If breathing is irregular or stopped, administer artificial respiration. Use oxygen as required, provided a qualified operator is present. Call a physician. Do not give drugs from adrenaline-ephedrine group.

Skin contact : After contact with skin, wash immediately with plenty of water. If there is evidence of frostbite, bathe (do not rub) with lukewarm (not hot) water. If water is not available, cover with a clean, soft cloth or similar covering. If symptoms persist, call a physician.

Eye contact : Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. In case of frostbite water should be lukewarm, not hot. If symptoms persist, call a physician.

Ingestion : Unlikely route of exposure. As this product is a gas, refer to the inhalation section. Do not induce vomiting without medical advice. Call a physician immediately.

Notes to physician

Indication of immediate medical attention and special treatment needed, if necessary : Because of the possible disturbances of cardiac rhythm, catecholamine drugs, such as epinephrine, should be used with special caution and only in situations of emergency life support. Treatment of overexposure should be directed at the control of symptoms and the clinical conditions. Treat frost-bitten areas as needed.

SECTION 5. FIREFIGHTING MEASURES

Suitable extinguishing media : The product is not flammable.
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
Use extinguishing measures that are appropriate to local

circumstances and the surrounding environment.

Specific hazards during firefighting	:	Contents under pressure. This product is not flammable at ambient temperatures and atmospheric pressure. However, this material can ignite when mixed with air under pressure and exposed to strong ignition sources. Container may rupture on heating. Cool closed containers exposed to fire with water spray. Do not allow run-off from fire fighting to enter drains or water courses. Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing. Fire may cause evolution of: Halogenated compounds Hydrogen fluoride Carbon oxides Carbonyl halides
Special protective equipment for firefighters	:	In the event of fire and/or explosion do not breathe fumes. Wear self-contained breathing apparatus and protective suit. No unprotected exposed skin areas.

SECTION 6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures	:	Immediately evacuate personnel to safe areas. Keep people away from and upwind of spill/leak. Wear personal protective equipment. Unprotected persons must be kept away. Remove all sources of ignition. Avoid skin contact with leaking liquid (danger of frostbite). Ventilate the area. After release, disperses into the air. Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing. Avoid accumulation of vapours in low areas. Unprotected personnel should not return until air has been tested and determined safe. Ensure that the oxygen content is >= 19.5%.
Environmental precautions	:	Prevent further leakage or spillage if safe to do so. The product evaporates readily.

Methods and materials for containment and cleaning up	:	Ventilate the area.

SECTION 7. HANDLING AND STORAGE

Handling

Precautions for safe handling	:	Handle with care. Avoid inhalation of vapour or mist. Do not get in eyes, on skin, or on clothing. Wear personal protective equipment. Use only in well-ventilated areas. Pressurized container. Protect from sunlight and do not expose to temperatures exceeding 50 °C. Follow all standard safety precautions for handling and use of compressed gas cylinders. Use authorized cylinders only. Protect cylinders from physical damage. Do not puncture or drop cylinders, or expose them to open flame or excessive heat. Do not pierce or burn, even after use. Do not spray on a naked flame or any incandescent material. Do not remove screw cap until immediately ready for use. Always replace cap after use.
Advice on protection against fire and explosion	:	The product is not flammable. Can form a combustible mixture with air at pressures above atmospheric pressure.

Storage

Conditions for safe storage, including any incompatibilities	:	Pressurized container: protect from sunlight and do not expose to temperatures exceeding 50 °C. Do not pierce or burn, even after use. Keep containers tightly closed in a dry, cool and well-ventilated place. Storage rooms must be properly ventilated. Ensure adequate ventilation, especially in confined areas. Protect cylinders from physical damage.

SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Protective measures	:	Do not breathe vapor. Avoid contact with skin, eyes and clothing. Ensure that eyewash stations and safety showers are close to the workstation location.
Engineering measures	:	General room ventilation is adequate for storage and handling. Perform filling operations only at stations with exhaust ventilation facilities.
Eye protection	:	Wear as appropriate: Safety glasses with side-shields If splashes are likely to occur, wear: Goggles or face shield, giving complete protection to eyes
Hand protection	:	Leather gloves In case of contact through splashing: Protective gloves Neoprene gloves Polyvinyl alcohol or nitrile- butyl-rubber gloves
Skin and body protection	:	Avoid skin contact with leaking liquid (danger of frostbite). Wear cold insulating gloves/ face shield/ eye protection.
Respiratory protection	:	In case of insufficient ventilation, wear suitable respiratory equipment. Wear a positive-pressure supplied-air respirator. Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing. For rescue and maintenance work in storage tanks use self-contained breathing apparatus.
Hygiene measures	:	Handle in accordance with good industrial hygiene and safety practice. Ensure adequate ventilation, especially in confined areas. Avoid contact with skin, eyes and clothing. Remove and wash contaminated clothing before re-use. Keep working clothes separately.

Exposure Guidelines

Components	CAS-No.	Value	Control parameters	Update	Basis

1,1,1,2-Tetrafluoroethane	811-97-2	TWA : Time weighted average	(1,000 ppm)		Honeywell:Limit established by Honeywell International Inc.
1,1,1,2-Tetrafluoroethane	811-97-2	TWA : Time weighted average	4,240 mg/m3 (1,000 ppm)	2020	WEEL:US Workplace Environmental Exposure Level
2,3,3,3-Tetrafluoroprop-1-ene	754-12-1	TWA : Time weighted average	(500 ppm)	03 15 2010	Honeywell:Limit established by Honeywell International Inc.
2,3,3,3-Tetrafluoroprop-1-ene	754-12-1	TWA : Time weighted average	(500 ppm)	2020	WEEL:US Workplace Environmental Exposure Level
2,3,3,3-Tetrafluoroprop-1-ene	754-12-1	STEL : Short term exposure limit	(1,500 ppm)	03 15 2010	Honeywell:Limit established by Honeywell International Inc.
Pentafluoroethane	354-33-6	TWA : Time weighted average	(1,000 ppm)		Honeywell:Limit established by Honeywell International Inc.
Pentafluoroethane	354-33-6	TWA : Time weighted average	4,900 mg/m3 (1,000 ppm)	2020	WEEL:US Workplace Environmental Exposure Level

Difluoromethane	75-10-5	TWA : Time weighted average	2,200 mg/m3 (1,000 ppm)	2007	WEEL:US Workplace Environmental Exposure Level

Difluoromethane	75-10-5	TWA : Time weighted average	(1,000 ppm)	1994	Honeywell:Limit established by Honeywell International Inc.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Physical state	:	Liquefied gas
Color	:	clear colourless
Odor	:	slight ether-like
Odor threshold	:	Note: No data available
pH	:	Note: neutral
Melting point/ range	:	Note: No data available
Boiling point/boiling range	:	Note: No data available
Flash point	:	Note: Not applicable
Evaporation rate	:	Note: No data available
Lower explosion limit	:	NoteNone
Upper explosion limit	:	Note: None

Vapor pressure	:	1,142 kPa at 21.1 °C(70.0 °F)
Vapor density	:	Note: No data available, (Air = 1.0)
Density	:	1.11 g/cm3
Water solubility	:	Note: No data available
Partition coefficient: n-octanol/water	:	Note: No data available
Ignition temperature	:	Note: No data available
Decomposition temperature	:	> 250 °C Note: To avoid thermal decomposition, do not overheat.
Viscosity, dynamic	:	Note: No data available
Viscosity, kinematic	:	Note: No data available

SECTION 10. STABILITY AND REACTIVITY

Reactivity	:	Not classified as a reactivity hazard.
Chemical stability	:	Stable under normal conditions.
Possibility of hazardous reactions	:	Hazardous polymerisation does not occur.
Conditions to avoid	:	Pressurized container. Protect from sunlight and do not expose to temperatures exceeding 50 °C. Decomposes under high temperature. Some risk may be expected of corrosive and toxic decomposition products. Can form a combustible mixture with air at pressures above atmospheric pressure. Do not mix with oxygen or air above atmospheric pressure.

Incompatible materials	:	Potassium Calcium Powdered metals Finely divided aluminium Finely divided magnesium Zinc
Hazardous decomposition products	:	Halogenated compounds Hydrogen fluoride Carbonyl halides Carbon oxides

SECTION 11. TOXICOLOGICAL INFORMATION

Acute inhalation toxicity

1,1,1,2-Tetrafluoroethane	:	LC50: > 500000 ppm, gas Exposure time: 4 h Species: Rat
2,3,3,3-Tetrafluoroprop-1-ene	:	LC50: > 400000 ppm, vapour Exposure time: 4 h Species: Rat Method: OECD Test Guideline 403
Pentafluoroethane	:	> 769000 ppm Exposure time: 4 h Species: Rat
Difluoromethane	:	LC50: > 520000 ppm Exposure time: 4 h Species: Rat

Skin irritation

2,3,3,3-Tetrafluoroprop-1-ene	:	Note: Not applicable study technically not feasible

Eye irritation

2,3,3,3-Tetrafluoroprop-1-ene	:	Note: Not applicable

study technically not feasible

Sensitisation

1,1,1,2-Tetrafluoroethane	:	Cardiac sensitization Species: dogs Note: No-observed-effect level 50 000 ppm Lowest observed effect level 75 000 ppm
2,3,3,3-Tetrafluoroprop-1-ene	:	Dermal Note: Not applicable, as this product is a gas. study technically not feasible
Pentafluoroethane	:	Cardiac sensitization Species: dogs Note: No-observed-effect level 75 000 ppm Lowest observed effect level 100 000 ppm
Difluoromethane	:	Cardiac sensitization Species: dogs Note: No-observed-effect level >350 000 ppm

Repeated dose toxicity

1,1,1,2-Tetrafluoroethane	:	Species: Rat NOEL: 40000 ppm
2,3,3,3-Tetrafluoroprop-1-ene	:	Species: Rat Application Route: Inhalation Exposure time: (2 Weeks) No-observed-effect level: 50000 ppm Method: OECD Test Guideline 412 Species: Rat Application Route: Inhalation Exposure time: (4 Weeks) NOAEL (No observed adverse effect level): 50000 ppm Method: OECD Test Guideline 412 Species: Rat Application Route: Inhalation

Exposure time: (13 Weeks)
NOAEL (No observed adverse effect level): 50000 ppm
Method: OECD Test Guideline 413

Species: Rabbit, male
Application Route: Inhalation
Exposure time: (28 d)
No-observed-effect level: 500 ppm
Method: OECD Test Guideline 412
There are no observed toxicological effects, which result in classification as a specific target organ toxicant.

Species: Rabbit, female
Application Route: Inhalation
Exposure time: (28 d)
No-observed-effect level: 1000 ppm
Method: OECD Test Guideline 412
There are no observed toxicological effects, which result in classification as a specific target organ toxicant.

Species: Mini-pig
Application Route: Inhalation
Exposure time: (28 d)
NOAEL (No observed adverse effect level): 10000 ppm
highest exposure tested

Pentafluoroethane : Species: Rat
Application Route: Inhalation
Exposure time: (4 Weeks)
NOEL: 50000 ppm
Subchronic toxicity

Difluoromethane : Species: Rat
Application Route: Inhalation
Exposure time: (90 d)
NOEL: 50000 ppm
Subchronic toxicity

Genotoxicity in vitro

1,1,1,2-Tetrafluoroethane : Note: In vitro tests did not show mutagenic effects

2,3,3,3-Tetrafluoroprop-1-ene : Test Method: Ames test
Result: 20% and higher, positive in TA 100 and e. coli WP2

		uvrA, negative in TA98, TA100, and TA1535. Method: OECD Test Guideline 471
Pentafluoroethane	:	Test Method: Ames test Result: negative
Difluoromethane	:	Test Method: Ames test Result: negative
	:	Test Method: Chromosome aberration test in vitro Cell type: Human lymphocytes Result: negative Method: OECD Test Guideline 473 Note: Dose 760,000 ppm
	:	Cell type: Human lymphocytes Result: negative
	:	Cell type: Chinese Hamster Ovary Cells Result: negative
	:	Cell type: Human lymphocytes Result: negative Method: Mutagenicity (in vitro mammalian cytogenetic test)
	:	Test Method: Chromosome aberration test in vitro Result: negative
Genotoxicity in vivo		
2,3,3,3-Tetrafluoroprop-1-ene	:	Species: Mouse Cell type: Micronucleus Dose: up to 200,000 ppm (4 hour) Method: OECD Test Guideline 474 Result: negative
	:	Test Method: Unscheduled DNA synthesis Dose: up to 50,000 ppm (4 weeks) Method: OECD Test Guideline 486 Result: negative
	:	Species: Rat Cell type: Micronucleus Dose: up to 50,000 ppm (4 weeks) Method: OECD Test Guideline 474 Result: negative

Difluoromethane	:	Species: Mouse Cell type: Bone marrow Method: Mutagenicity (micronucleus test) Result: negative
Carcinogenicity		
2,3,3,3-Tetrafluoroprop-1-ene	:	Species: Rat Note: Not classified as a human carcinogen. Substance not expected to be a carcinogen based on available data.
Teratogenicity		
Pentafluoroethane	:	Species: Rabbit Application Route: Inhalation exposure NOAEL,Teratog: 50,000 ppm NOAEL,Maternal: 50,000 ppm Note: Did not show teratogenic effects in animal experiments. Species: Rat Application Route: Inhalation exposure NOAEL,Teratog: 50,000 ppm NOAEL,Maternal: 50,000 ppm Note: Did not show teratogenic effects in animal experiments.
Difluoromethane	:	Species: Rat Dose: NOEL - 50,000 ppm Note: Did not show teratogenic effects in animal experiments. Species: Rabbit Dose: NOEL - 50,000 ppm Note: Did not show teratogenic effects in animal experiments.
Further information	:	Note: Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing. Rapid evaporation of the liquid may cause frostbite. Avoid skin contact with leaking liquid (danger of frostbite).

SECTION 12. ECOLOGICAL INFORMATION

Toxicity to fish

2,3,3,3-Tetrafluoroprop-1-ene : LC50: > 197 mg/l
Exposure time: 96 h
Species: Cyprinus carpio (Carp)
Method: OECD Test Guideline 203
Note: No demonstrable toxic effect in saturated solution.

Toxicity to daphnia and other aquatic invertebrates

2,3,3,3-Tetrafluoroprop-1-ene : EC50: > 83 mg/l
Exposure time: 48 h
Species: Daphnia magna (Water flea)
Method: OECD Test Guideline 202

Toxicity to algae

2,3,3,3-Tetrafluoroprop-1-ene : EC50: > 100 mg/l
Species: Scenedesmus capricornutum (fresh water algae)
Method: OECD Test Guideline 201

Bioaccumulation

2,3,3,3-Tetrafluoroprop-1-ene : Note: Due to the distribution coefficient n-octanol/water, accumulation in organisms is not expected.

Biodegradability

2,3,3,3-Tetrafluoroprop-1-ene : Result: Not readily biodegradable.
Method: OECD Test Guideline 301F

Pentafluoroethane : Result: Not readily biodegradable.
Value: 5 %
Method: OECD 301 D

Difluoromethane : Note: Minimal

Further information on ecology

Additional ecological information : This product is subject to U.S. Environmental Protection Agency Clean Air Act Regulations at 40 CFR Part 82.

This product contains greenhouse gases which may contribute to global warming. Do NOT vent to the atmosphere. To comply with provisions of the U.S. Clean Air Act, any residual must be recovered.

SECTION 13. DISPOSAL CONSIDERATIONS

Disposal methods : Observe all Federal, State, and Local Environmental regulations.

SECTION 14. TRANSPORT INFORMATION

DOT	UN/ID No.	:	UN 3163
	Proper shipping name	:	LIQUEFIED GAS, N.O.S. (1,1,1,2-Tetrafluoroethane, R-1234yf, Pentafluoroethane)
	Class		2.2
	Packing group		
	Hazard Labels		2.2
IATA	UN/ID No.	:	UN 3163
	Description of the goods	:	LIQUEFIED GAS, N.O.S. (1,1,1,2-Tetrafluoroethane, R-1234yf, Pentafluoroethane)
	Class	:	2.2
	Hazard Labels	:	2.2
	Packing instruction (cargo aircraft)	:	200
	Packing instruction (passenger aircraft)	:	200
IMDG	UN/ID No.	:	UN 3163
	Description of the goods	:	LIQUEFIED GAS, N.O.S. (1,1,1,2-TETRAFLUOROETHANE, R-1234yf, PENTAFLUOROETHANE)
	Class	:	2.2
	Hazard Labels	:	2.2
	EmS Number	:	F-C, S-V
	Marine pollutant	:	no

IMDG Code segregation group according chapter 3.1.4.4 : NONE,

SECTION 15. REGULATORY INFORMATION

Inventories

USA. List of Active Substances on the Toxic Substances Control Act (TSCA) Chemical Substances Inventory, as amended	:	All substances listed as active on the TSCA inventory
Australian Inventory of Industrial Chemicals	:	All components are listed on the inventory, regulatory obligations/restrictions apply
Canada. Domestic Substances List (DSL), as amended	:	All components of this product are on the Canadian DSL
Japan. Kashin-Hou Law List	:	On the inventory, or in compliance with the inventory
Korea. Existing Chemicals Inventory (KECI)	:	On the inventory, or in compliance with the inventory
Philippines. Inventory of Chemicals and Chemical Substances (PICCS)	:	On the inventory, or in compliance with the inventory
China. Inventory of Existing Chemical Substances (IECSC)	:	On the inventory, or in compliance with the inventory
Thailand. Existing Chemicals Inventory from FDA (TECI List)	:	On the inventory, or in compliance with the inventory
Taiwan Chemical Substance Inventory (TCSI)	:	On the inventory, or in compliance with the inventory
TSCA 5A	:	US. Toxic Substances Control Act (TSCA) Section 5(a)(2) Proposed Significant New Use Rules (SNURs) (40 CFR 721 and 725) The following substance(s) is/are subject to a Significant New Use Rule:

		2,3,3,3-Tetrafluoroprop-1-ene	754-12-1
TSCA 12B	:	US. Toxic Substances Control Act (TSCA) Section 12(b) Export Notification (40 CFR 707, Subpt D) The following substance(s) is/are subject to TSCA 12(b) export notification requirements:	
		2,3,3,3-Tetrafluoroprop-1-ene	754-12-1

National regulatory information

US. Toxic Substances Control Act (TSCA) Section 5(a)(2) Final Significant New Use Rules (SNURs) (40 CFR 721 and 725, Subpt E)	:	: Issued.	
	:	2,3,3,3-Tetrafluoroprop-1-ene	754-12-1
SARA 302 Components	:	No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.	
SARA 313 Components	:	This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.	
SARA 311/312 Hazards	:	Sudden Release of Pressure Hazard Acute Health Hazard	
California Prop. 65	:	**WARNING:**This product can expose you to chemicals, listed below, known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov.	
		Dichloromethane	75-09-2
		Chloromethane	74-87-3
Massachusetts RTK	:	Dichloromethane	75-09-2
Pennsylvania RTK	:	Difluoromethane	75-10-5

SECTION 16. OTHER INFORMATION

		HMIS III	NFPA
Health hazard	:	1	2
Flammability	:	1	1
Physical Hazard	:	0	
Instability	:		0

Hazard rating and rating systems (e.g. HMIS® III, NFPA): This information is intended solely for the use of individuals trained in the particular system.

Further information

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text. Final determination of suitability of any material is the sole responsibility of the user. This information should not constitute a guarantee for any specific product properties.

Changes since the last version are highlighted in the margin. This version replaces all previous versions.
Previous Issue Date: 07/28/2025
Prepared by Solstice Product Stewardship Group