Solstice® 452A

000000022311

Version 2.4 Revision Date 06.11.2025 Supersedes 1

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Product name	:	Solstice® 452A
SDS-number	:	000000022311
Type of product	:	Mixture
Remarks	:	SDS according to Art. 31 of Regulation (EC) 1907/2006.

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

Use of the Substance/Mixture	:	Refrigerant
Uses advised against	:	none

1.3. Details of the supplier of the safety data sheet

Company	:	SOLSTICE ADVANCED MATERIALS IRELAND LIMITED 1st Floor, Liffey Trust Centre, 117-126 Sheriff Street Upper D01 YC43 Dublin Ireland	Solstice Advanced Materials US, Inc. 115 Tabor Road Morris Plains, NJ 07950-2546 USA
Telephone	:	+353 1 447 9350	
For further information, please contact:	:	SafetyDataSheet@solstice.com	

1.4. Emergency telephone number

Emergency telephone number	:	+1-703-527-3887 (ChemTrec-Transport) +1 303-739-1378 (Medical)
	:	Poison Control Center: United Kingdom: (+44) 844 892 0111

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

REGULATION (EC) No 1272/2008

Gases under pressure Liquefied gas
H280 Contains gas under pressure; may explode if heated.

2.2. Label elements

REGULATION (EC) No 1272/2008

Hazard pictograms	:		
Signal word	:	Warning	
Hazard statements	:	H280	Contains gas under pressure; may explode if heated.
Precautionary statements	:	P260	Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
		P410 + P403	Protect from sunlight. Store in a well-ventilated place.
Special labelling of certain products:	:	Contains fluorinated greenhouse gases	

2.3. Other hazards

Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing. Rapid evaporation of the liquid may cause frostbite. This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher. The substance/mixture does not contain components considered to have endocrine disrupting properties according to REACH Article 57(f) or Commission Delegated regulation (EU) 2017/2100 or Commission Regulation (EU) 2018/605 at levels of 0.1% or higher.

SECTION 3: Composition/information on ingredients

3.1. Substances

Not applicable

3.2. Mixtures

Chemical name	CAS-No. Index-No. EC-No.	Classification 1272/2008	Concentration	Remarks
Pentafluoroethane	354-33-6 206-557-8	Press. Gas ; H280	59 %	
2,3,3,3-Tetrafluoroprop-1-ene	754-12-1 468-710-7	Press. Gas Liquefied gas; H280 Flam. Gas 1B; H221	30 %	
Difluoromethane	75-10-5 200-839-4	Flam. Gas 1B; H221 Press. Gas ; H280	11 %	

Remaining components of this product are non-hazardous and/or are present at concentrations below reportable limits.

Occupational Exposure Limit(s), if available, are listed in Section 8.
For the full text of the H-Statements mentioned in this Section, see Section 16.

SECTION 4: First aid measures

4.1 Description of 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:
Remove contact lenses. Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. If eye irritation persists, consult a specialist.

Ingestion:
Ingestion is unlikely because of the physical properties and is not expected to be hazardous. As this product is a gas, refer to the inhalation section.

4.2. Most important symptoms and effects, both acute and delayed

No data available

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

Do not give adrenaline or similar drugs.

See Section 11 for more detailed information on health effects and symptoms. :

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media:
The product is not flammable.
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2. Special hazards arising from the substance or mixture

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
Carbonyl halides
Carbon oxides

5.3. Advice for firefighters

Wear full protective clothing and self-contained breathing apparatus.
Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Immediately contact emergency personnel. Wear personal protective equipment. Unprotected persons must be kept away. Ensure adequate ventilation. In case of insufficient ventilation wear suitable respiratory equipment. Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing. Ensure that the oxygen content is >= 19.5%.

6.2. Environmental precautions

Prevent further leakage or spillage if safe to do so. The product evaporates readily.

6.3. Methods and materials for containment and cleaning up

Ventilate the area.

6.4. Reference to other sections

For personal protection see section 8.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Advice on safe handling:
Open drum carefully as content may be under pressure. The product should only be used in areas from which all naked lights and other sources of ignition have been excluded. Pressurized container. Protect from sunlight and do not expose to temperatures exceeding 50 °C. Do not pierce or burn, even after use. Do not spray on a naked flame or any incandescent material. Do not use in areas without adequate ventilation. Contaminated equipment (brushes, rags) must be cleaned immediately with water.

Advice on protection against fire and explosion:
The product is not flammable. Can form a combustible mixture with air at pressures above atmospheric pressure. Normal measures for preventive fire protection.

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. When using, do not eat, drink or smoke.

7.2. Conditions for safe storage, including any incompatibilities

Further information on storage conditions:
Store in original container. Keep away from direct sunlight. Keep containers tightly closed in a cool, well-ventilated place.

7.3. Specific end use(s)

no additional data available

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Occupational exposure limits:

Components	Basis / Value type	Value / Form of exposure	Exceeding Factor	Remarks
Pentafluoroethane	HONEYWELL TWA	1.000 ppm		We are not aware of any national exposure limit.
2,3,3,3-Tetrafluoroprop-1-ene	WEEL TWA	500 ppm		
2,3,3,3-Tetrafluoroprop-1-ene	HONEYWELL TWA	500 ppm		
Difluoromethane	HONEYWELL TWA	2.200 mg/m3 1.000 ppm		We are not aware of any national exposure limit.

HONEYWELL - Limit established by Solstice Advanced Materials
TWA - Time weighted average

DNEL/ PNEC-Values

Component	End-	Exposure duration	Value	Exposure routes	Remarks

	use/impact				
Pentafluoroethane	Workers / Long-term systemic effects		16444 mg/m3	Inhalation	
Pentafluoroethane	Consumers / Long-term systemic effects		1753 mg/m3	Inhalation	
2,3,3,3-Tetrafluoroprop-1-ene	Workers / Long-term systemic effects		950 mg/m3	Inhalation	
2,3,3,3-Tetrafluoroprop-1-ene	Consumers / Long-term systemic effects		113,1 mg/m3	Inhalation	
2,3,3,3-Tetrafluoroprop-1-ene	Workers / Acute systemic effects		186400 mg/m3	Inhalation	
2,3,3,3-Tetrafluoroprop-1-ene	Consumers / Acute systemic effects		186400 mg/m3	Inhalation	
Difluoromethane	Workers / Long-term systemic effects		7035 mg/m3	Inhalation	
Difluoromethane	Consumers / Long-term systemic effects		750 mg/m3	Inhalation	

Component	Environmental compartment / Value	Remarks
Pentafluoroethane	Fresh water: 0,1 mg/l	Assessment factor: 1000
Pentafluoroethane	Fresh water sediment: 0,6 mg/kg dw	
2,3,3,3-Tetrafluoroprop-1-ene	Fresh water: 0,1 mg/l	

2,3,3,3-Tetrafluoroprop-1-ene	Marine water: 0,01 mg/l	
2,3,3,3-Tetrafluoroprop-1-ene	Fresh water sediment: 1,51 mg/kg	
2,3,3,3-Tetrafluoroprop-1-ene	Marine sediment: 0,151 mg/kg	
2,3,3,3-Tetrafluoroprop-1-ene	Soil: 1,49 mg/kg	
Difluoromethane	Fresh water: 0,142 mg/l	Assessment factor: 1000
Difluoromethane	Fresh water sediment: 0,534 mg/kg dw	

8.2. Exposure controls

Occupational exposure controls

The Personal Protective Equipment must be in accordance with EN standards:respirator EN 136, 140, 149; safety glasses EN 166; protective suit: EN 340, 463, 468, 943-1, 943-2; gloves EN 374, 511; safety shoes EN-ISO 20345.
Do not breathe gas.

Engineering measures
General room ventilation is adequate for storage and handling.
Perform filling operations only at stations with exhaust ventilation facilities.

Personal protective equipment
Respiratory protection:
In case of insufficient ventilation wear suitable respiratory equipment.
Self-contained breathing apparatus (EN 133)

Hand protection:
Glove material: Viton®
Protective gloves against cold
(EN 511)

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

Skin and body protection:
Wear suitable protective equipment.

Wear as appropriate:
Protective suit

Environmental exposure controls

Handle in accordance with local environmental regulations and good industrial practices.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

(a) Physical state	:	gaseous
(b) Colour	:	clear colourless
(c) Odour	:	slight ether-like
(d) Melting point/freezing point	:	No data available
(e) Boiling point/boiling range	:	No data available
(f) Flammability	:	does not ignite
(g) Lower and upper explosion limit	:	Lower explosion limit Not applicable
	:	Upper explosion limit Not applicable
(h) Flash point	:	Not applicable
(i) Auto-ignition temperature	:	No data available
(j) Decomposition temperature	:	No data available
(k) pH	:	No data available
(m) Solubility(ies)	:	Water solubility:

		negligible
(n) Partition coefficient: n-octanol/water	:	No data available
(o) Vapour pressure	:	1,07 MPa at 21,1 °C
(p) Density and / or relative density	:	1,14 g/cm3
(q) Relative vapour density	:	No data available
(r) Particle characteristics	:	No data available

9.2 Other Information

Polymer characteristics	:	No data available

no additional data available

SECTION 10: Stability and reactivity

10.1. Reactivity

Stable under normal conditions.

10.2. Chemical stability

No data available

10.3. Possibility of hazardous reactions

Hazardous polymerisation does not occur.

10.4. Conditions to avoid

Heating will cause pressure rise with risk of bursting
Pressurized container. Protect from sunlight and do not expose to temperatures exceeding 50 °C.
Do not pierce or burn, even after use. Do not spray on a naked flame or any incandescent material.
Can form a combustible mixture with air at pressures above atmospheric pressure.

10.5. Incompatible materials

Alkali metals
Oxidizers (e.g. peroxide residues present in insufficiently cured rubbers)
Finely divided metal powders such as aluminum, magnesium, or zinc.

10.6. Hazardous decomposition products

In case of fire hazardous decomposition products may be produced such as:
Halogenated compounds
Hydrogen fluoride
Carbonyl halides
Carbon monoxide
Carbon dioxide (CO2)

SECTION 11: Toxicological information

11.1. Information on hazard classes as defined in Regulation (EC) No 1272/2008

(a) Acute toxicity

Acute oral toxicity:
Not applicable

Acute dermal toxicity:
No data available

Acute inhalation toxicity:
LC50
Species: Rat
Value: > 520000 ppm
Exposure time: 4 h
Test substance: Difluoromethane (HFC-32)

LC50
Species: Rat
Value: > 400000 ppm
Exposure time: 4 h
Test substance: 2,3,3,3-Tetrafluoroprop-1-ene

Species: Rat
Value: > 769000 ppm
Exposure time: 4 h

Test substance: Ethane, pentafluoro- (HFC-125)

Acute toxicity (other routes of administration):
No data available

(b) Skin corrosion/irritation:
No data available

(c) Serious eye damage/eye irritation:
No data available

(d) Respiratory or skin sensitisation:
Cardiac sensitization
Species: dogs
Test substance: Difluoromethane (HFC-32)
No-observed-effect level
>350 000 ppm

Cardiac sensitization
Species: dogs
Result: No effects observed for exposures up to 12% (120,189 ppm).
Test substance: 2,3,3,3-Tetrafluoroprop-1-ene

Cardiac sensitization
Species: dogs
Test substance: Ethane, pentafluoro- (HFC-125)
No-observed-effect level
75 000 ppm
Lowest observed effect level
100 000 ppm

(e) Germ cell mutagenicity:
Test Method: Ames test
Result: 20% and higher, positive in TA 100 and e. coli WP2 uvrA, negative in TA98, TA100, and TA1535.
Test substance: 2,3,3,3-Tetrafluoroprop-1-ene

Test Method: Ames test
Result: negative
Test substance: Difluoromethane (HFC-32)

Test Method: Ames test
Result: negative

Test substance: Ethane, pentafluoro- (HFC-125)

Species: Mouse
Cell type: Bone marrow
Method: Mutagenicity (micronucleus test)
Test substance: Difluoromethane (HFC-32)
Result: negative

Test Method: Unscheduled DNA synthesis
Dose: up to 50,000 ppm (4 weeks)
Test substance: 2,3,3,3-Tetrafluoroprop-1-ene
Result: negative

Species: Mouse
Cell type: Micronucleus
Dose: up to 200,000 ppm (4 hour)
Test substance: 2,3,3,3-Tetrafluoroprop-1-ene
Result: negative

Species: Rat
Cell type: Micronucleus
Dose: up to 50,000 ppm (4 weeks)
Test substance: 2,3,3,3-Tetrafluoroprop-1-ene
Result: negative

(g) Reproductive toxicity:
Species: Rat
Application Route: Inhalation exposure
Exposure time: Two-generation reproductive toxicity
NOAEL,parent: 50,000 ppm
NOAEL,F1: 50,000 ppm
NOAEL,F2: 50,000 ppm
Test substance: 2,3,3,3-Tetrafluoroprop-1-ene
Species: Rabbit
Dose: NOAEL (No observed adverse effect level) - 4,000 ppm
Test substance: 2,3,3,3-Tetrafluoroprop-1-ene
Species: Rat
Dose: NOAEL (No observed adverse effect level) - 50,000 ppm
Test substance: 2,3,3,3-Tetrafluoroprop-1-ene
Species: Rabbit
Dose: NOEL - 50,000 ppm
Test substance: Difluoromethane (HFC-32)
Note: Did not show teratogenic effects in animal experiments.

Species: Rat
Dose: NOEL - 50,000 ppm
Test substance: Difluoromethane (HFC-32)
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
Test substance: Ethane, pentafluoro- (HFC-125)
Note: Did not show teratogenic effects in animal experiments.
Species: Rabbit
Application Route: Inhalation exposure
NOAEL,Teratog: >= 50,000 ppm
NOAEL,Maternal: >= 50,000 ppm
Test substance: Ethane, pentafluoro- (HFC-125)
Note: Did not show teratogenic effects in animal experiments.

(h) STOT-single exposure:
No data available

(i) STOT - repeated exposure:
Species: Rat
Application Route: Inhalation
Exposure time: 90 d
NOEL: 50000
Test substance: Difluoromethane (HFC-32)
Note: Subchronic toxicity
Species: Rat
Application Route: Inhalation
Exposure time: 4 Weeks
NOEL: 50000
Test substance: Ethane, pentafluoro- (HFC-125)
Note: Subchronic toxicity
Species: Rat
Application Route: Inhalation
Exposure time: 2 Weeks
NOEL: 50000
Test substance: 2,3,3,3-Tetrafluoroprop-1-ene
Species: Rat
Application Route: Inhalation
Exposure time: 4 Weeks
NOAEL: 50000 ppm
Test substance: 2,3,3,3-Tetrafluoroprop-1-ene

Species: Rat
Application Route: Inhalation
Exposure time: 13 Weeks
NOAEL: 50000 ppm
Test substance: 2,3,3,3-Tetrafluoroprop-1-ene
Species: Rabbit, male
Application Route: Inhalation
Exposure time: 28 d
NOEL: 500
Test substance: 2,3,3,3-Tetrafluoroprop-1-ene
Species: Rabbit, female
Application Route: Inhalation
Exposure time: 28 d
NOEL: 1000
Test substance: 2,3,3,3-Tetrafluoroprop-1-ene
Species: Mini-pig
Application Route: Inhalation
Exposure time: 28 d
NOAEL: 10,000 ppm
Test substance: 2,3,3,3-Tetrafluoroprop-1-ene
Note: highest exposure tested

(j) Aspiration hazard:
No data available

11.2. Information on other hazards

Endocrine disrupting properties
No data available

Other information:
No data available

SECTION 12: Ecological information

12.1. Toxicity

Toxicity to fish:
LC50
Species: Cyprinus carpio (Carp)
Value: > 197 mg/l
Exposure time: 96 h
Method: OECD Test Guideline 203
Test substance: 2,3,3,3-Tetrafluoroprop-1-ene

No demonstrable toxic effect in saturated solution.

Toxicity to aquatic plants:
EC50
Species: Scenedesmus capricornutum (fresh water algae)
Value: > 100 mg/l
Test substance: 2,3,3,3-Tetrafluoroprop-1-ene

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

12.2. Persistence and degradability

Biodegradability:
Result: Not readily biodegradable.
Test substance: Ethane, pentafluoro- (HFC-125)

Biodegradability:
Biodegradation: 5 %
Result: Not readily biodegradable.
Method: OECD 301 D
Test substance: 2,3,3,3-Tetrafluoroprop-1-ene

12.3. Bioaccumulative potential

No data available

12.4. Mobility in soil

No data available

12.5. Results of PBT and vPvB assessment

No data available

12.6. Endocrine disrupting properties

No data available

12.7. Other adverse effects

Accumulation in aquatic organisms is unlikely.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Product:
Dispose according to legal requirements.

Packaging:
Legal requirements are to be considered in regard of reuse or disposal of used packaging materials

Further information:
Provisions relating to waste:
EC Directive 2006/12/EC; 2008/98/EEC
Regulation No. 1013/2006
For personal protection see section 8.

SECTION 14: Transport information

14.1 UN number or ID number

ADR/RID:3163 IMDG:3163 IATA:3163

14.2 UN proper shipping name

ADR/RID:LIQUEFIED GAS, N.O.S.(PENTAFLUOROETHANE, R-1234yf, DIFLUOROMETHANE)
IMDG:LIQUEFIED GAS, N.O.S.(PENTAFLUOROETHANE, R-1234yf,DIFLUOROMETHANE)
IATA:Liquefied gas, n.o.s.(Pentafluoroethane, R-1234yf, Difluoromethane)

14.3 Transport hazard class(es)

ADR/RID:2.2 IMDG: 2.2 IATA: 2.2

14.4 Packaging group

No data available

14.5 Environmental hazards

ADR/RID:no Marine pollutant: no

14.6 Special precautions for user

IMDG Code segregation group according chapter 3.1.4.4 : NONE,

14.7 Maritime transport in bulk according to IMO instruments
No data available

SECTION 15: Regulatory information

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

Basis	Value	Remarks
Substances of very high concern (SVHC)		This product does not contain substances of very high concern according to Regulation (EC) No Article 57 above the respective regulatory 1907/2006 (REACH), concentration limit of ≥ 0.1 % (w/w).

Global warming potential :
2.140

Other inventory information

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

15.2 Chemical safety assessment

A Chemical Safety Assessment has not been carried out.

SECTION 16: Other information

Text of H-statements referred to under heading 3

Pentafluoroethane	:	H280	Contains gas under pressure; may explode if heated.
2,3,3,3-Tetrafluoroprop-1-ene	:	H280	Contains gas under pressure; may explode if heated.
		H221	Flammable gas.
Difluoromethane	:	H221	Flammable gas.
		H280	Contains gas under pressure; may explode if heated.

Further information

All directives and regulations refer to amended versions.
Vertical lines in the left hand margin indicate a relevant amendment from the previous version.

Abbreviations:
EC European Community
CAS Chemical Abstracts Service
DNEL Derived no effect level
PNEC Predicted no effect level
vPvB Very persistent and very biaccumulative substance
PBT Persistent, bioaccmulative und toxic substance

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.
This document is not a UK REACH-compliant SDS, and the Great Britain importer bears full responsibility for UK REACH compliance. This document is provided to assist the Great Britain importers in ensuring their own compliance.