



Opteon™ XL10 (R-1234yf) Refrigerant

Version 2.0

Revision Date 06.12.2016

Ref. 130000143548

This Safety Data Sheet adheres to the standards and regulatory requirements of Great Britain and may not meet the regulatory requirements in other countries.

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

1.1. Product identifier

Product name : Opteon™ XL10 (R-1234yf) Refrigerant

Registration number : 01-0000019665-61-0001

Synonyms : R-1234yf

Identification number : CAS-No. 754-12-1 EC-No. 468-710-7

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

Use of the Substance/Mixture : For professional and industrial installation end use only., Heat transfer fluids - Refrigerants, coolants, Formulation of preparations

Uses advised against : Open evaporation applications., Direct use of the substance by consumers., Consumer filling of mobile air conditioning units.

1.3. Details of the supplier of the safety data sheet

Company : Chemours Netherlands B.V.
Baanhoekweg 22
NL-3313 LA Dordrecht
Netherlands

Telephone : +31-(0)-78-630-1011

Telefax : +31-78-6163737

E-mail address : sds-support@chemours.com

1.4. Emergency telephone number

Emergency telephone number : +(44)-870-8200418 (CHEMTREC - Recommended)

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Flammable gases, Category 1 H220: Extremely flammable gas.
Gases under pressure, H280: Contains gas under pressure; may explode if heated.
Liquefied gas

2.2. Label elements



Opteon™ XL10 (R-1234yf) Refrigerant

Version 2.0

Revision Date 06.12.2016

Ref. 130000143548



Danger

H220

Extremely flammable gas.

H280

Contains gas under pressure; may explode if heated.

P210

Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.

P377

Leaking gas fire: Do not extinguish, unless leak can be stopped safely.

P381

Eliminate all ignition sources if safe to do so.

P410 + P403

Protect from sunlight. Store in a well-ventilated place.

2.3. Other hazards

This substance is not considered to be persistent, bioaccumulating and toxic (PBT).

This substance is not considered to be very persistent and very bioaccumulating (vPvB).

Misuse or intentional inhalation abuse may cause death without warning symptoms, due to cardiac effects.

Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing.

Rapid evaporation of the liquid may cause frostbite.

SECTION 3: Composition/information on ingredients

3.1. Substances

Not applicable

3.2. Mixtures

Registration number	Classification according to Regulation (EU) 1272/2008 (CLP)	Concentration (% w/w)
---------------------	---	-----------------------

2,3,3,3-Tetrafluoropropene (CAS-No.754-12-1) (EC-No.468-710-7)

01-0000019665-61-0001	Flam. Gas 1; H220 Press. Gas Liquefied gas; H280	>= 99.5 %
-----------------------	---	-----------

The above products are compliant to REACH registration obligations; Registration number(s) may not be provided because substance(s) are exempted, not yet registered under REACH or are registered under another regulatory process (biocide uses, plant protection products), etc.



Opteon™ XL10 (R-1234yf) Refrigerant

Version 2.0

Revision Date 06.12.2016

Ref. 130000143548

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 : If unconscious place in recovery position and seek medical advice. Never give anything by mouth to an unconscious person. If breathing is irregular or stopped, administer artificial respiration.
- : First aider needs to protect himself.
- : If symptoms persist, call a physician.
- Inhalation : Remove from exposure, lie down. Move to fresh air. Keep patient warm and at rest. Artificial respiration and/or oxygen may be necessary. Consult a physician.
- Skin contact : Take off all contaminated clothing immediately. Flush area with lukewarm water. Do not use hot water. If frostbite has occurred, call a physician.
- Eye contact : Hold eyelids apart and flush eyes with plenty of water for at least 15 minutes. Get medical attention.
- Ingestion : Is not considered a potential route of exposure.

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

- Symptoms : Misuse or intentional inhalation abuse may cause death without warning symptoms, due to cardiac effects., Other symptoms potentially related to misuse or inhalation abuse are:, Anaesthetic effects, Light-headedness, Dizziness, Confusion, Incoordination, Drowsiness, Unconsciousness
- : Contact with liquid or refrigerated gas can cause cold burns and frostbite.

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

- Treatment : Remove from exposure, lie down. Move to fresh air. Keep patient warm and at rest. Artificial respiration and/or oxygen may be necessary. Consult a physician.

SECTION 5: Firefighting measures

5.1. Extinguishing media

- Suitable extinguishing media : Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.
- : Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.



Opteon™ XL10 (R-1234yf) Refrigerant

Version 2.0

Revision Date 06.12.2016

Ref. 130000143548

5.2. Special hazards arising from the substance or mixture

Specific hazards during firefighting : Vapours may form flammable mixture with air. Pressure build-up. Fire or intense heat may cause violent rupture of packages.
: Hazardous combustion products:
: Hydrogen fluoride
: Fluorinated compounds
: Carbon oxides
: Exposure to decomposition products may be a hazard to health.

5.3. Advice for firefighters

Special protective equipment for firefighters : In the event of fire, wear self-contained breathing apparatus. Use personal protective equipment. Wear neoprene gloves during cleaning up work after a fire.

Further information : Cool containers/tanks with water spray. Allow to burn until flow can be stopped.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Personal precautions : Evacuate personnel to safe areas, if necessary. Ventilate area, especially low or enclosed places where heavy vapours might collect. Refer to protective measures listed in sections 7 and 8.

6.2. Environmental precautions

Environmental precautions : Should not be released into the environment. In accordance with local and national regulations.

6.3. Methods and materials for containment and cleaning up

Methods for cleaning up : Evaporates.

6.4. Reference to other sections

For disposal instructions see section 13.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Advice on safe handling : Avoid breathing vapours or mist. Avoid contact with skin, eyes and clothing. Provide sufficient air exchange and/or exhaust in work rooms. For personal protection see section 8.

For further information see Annex - Exposure scenario.



Opteon™ XL10 (R-1234yf) Refrigerant

Version 2.0

Revision Date 06.12.2016

Ref. 130000143548

Advice on protection against fire and explosion : Vapours are heavier than air and may spread along floors. Vapours may form flammable mixture with air. The product should only be used in areas from which all naked lights and effective sources of ignition have been excluded. Electrical equipment should be protected to the appropriate standard. Take measures to prevent the build up of electrostatic charge. Keep away from heat and effective sources of ignition. When using do not smoke.

7.2. Conditions for safe storage, including any incompatibilities

Requirements for storage areas and containers : Gas cylinder : Do not drag, slide or roll cylinders. Never attempt to lift cylinder by its cap. Use a check valve or trap in the discharge line to prevent hazardous back flow into the cylinder. Keep at temperature not exceeding 52°C. Keep containers tightly closed in a dry, cool and well-ventilated place. Store in original container. Protect cylinders from damage. Keep away from direct sunlight. Protect from contamination.

Advice on common storage : No materials to be especially mentioned.

7.3. Specific end use(s)

For further information see Annex - Exposure scenario.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

If sub-section is empty then no values are applicable.

Derived No Effect Level (DNEL)

- 2,3,3,3-Tetrafluoropropene : Type of Application (Use): Workers
Exposure routes: Inhalation
Health Effect: Long-term - systemic effects
Value: 950 mg/m³

Predicted No Effect Concentration (PNEC)

- 2,3,3,3-Tetrafluoropropene : Value: 0.1 mg/l
Compartment: Fresh water
- : Value: 1 mg/l
Compartment: Water
Remarks: Intermittent use/release
- : Value: 1.77 mg/kg dry weight (d.w.)
Compartment: Fresh water sediment
- : Value: 1.54 mg/kg dry weight (d.w.)
Compartment: Soil



Opteon™ XL10 (R-1234yf) Refrigerant

Version 2.0

Revision Date 06.12.2016

Ref. 130000143548

: Value: 0.01 mg/l
Compartment: Marine water

: Value: 0.178 mg/kg dry weight (d.w.)
Compartment: Marine sediment

8.2. Exposure controls

Engineering measures : Ensure adequate ventilation, especially in confined areas.

Eye protection : Wear safety glasses or coverall chemical splash goggles. Eye protection complying with EN 166. or ANSI Z87.1 Additionally wear a face shield where the possibility exists for face contact due to splashing, spraying or airborne contact with this material.

Hand protection :
The choice of an appropriate glove does not only depend on its material but also on other quality features and is different from one producer to the other. Please observe the instructions regarding permeability and breakthrough time which are provided by the supplier of the gloves. Also take into consideration the specific local conditions under which the product is used, such as the danger of cuts, abrasion, and the contact time.

: Material: Leather gloves
The suitability for a specific workplace should be discussed with the producers of the protective gloves.

: Material: Low temperature resistant gloves

:
Protective gloves complying with EN 374. or US OSHA guidelines

Skin and body protection : Wear suitable protective equipment. Wear as appropriate: Flame retardant antistatic protective clothing.

The type of protective equipment must be selected according to the concentration and amount of the substance at the specific workplace.

Protective measures : When using do not smoke.

Self-contained breathing apparatus (SCBA) is required if a large release occurs.

The type of protective equipment must be selected according to the concentration and amount of the substance at the specific workplace.

Hygiene measures : Handle in accordance with good industrial hygiene and safety practice.

Respiratory protection : For rescue and maintenance work in storage tanks use self-contained breathing apparatus. Vapours are heavier than air and can cause suffocation by reducing



Opteon™ XL10 (R-1234yf) Refrigerant

Version 2.0

Revision Date 06.12.2016

Ref. 130000143548

oxygen available for breathing. Respiratory protection complying with EN 137.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Form	: Liquefied gas
Colour	: colourless
Odour	: slight, ether-like
Boiling point	: -29 °C at 1,013 hPa
Auto-ignition temperature	: 405 °C at 1,013 hPa, Method: Directive 67/548/EEC, Annex V, A.15., static test
Explosive properties	: Not explosive
Lower explosion limit/ lower flammability limit	: Type: lower flammability limit, 6.2 vol%, Method: ASTM E681
Upper explosion limit/ upper flammability limit	: Type: upper flammability limit, 12.3 vol%, Method: ASTM E681
Vapour pressure	: 5,800 hPa at 20 °C
Density	: 0.0048 g/cm ³ at 20 °C (1,013 hPa) , Vapour density
Water solubility	: 0.1982 g/l at 24 °C
Partition coefficient: n-octanol/water	: log Pow: 2 at 25 °C, Method: High-performance liquid chromatography
Minimum ignition energy	: 5 - 10 J at 1,013 hPa and at 20 °C Method: modified ASTM E582

9.2. Other information

Phys.-chem./other information : Fundamental burning velocity: 1.5 cm/s (Method: AIST Japan).

SECTION 10: Stability and reactivity

- 10.1. Reactivity** : Hazardous polymerisation does not occur.
- 10.2. Chemical stability** : The product is chemically stable.



Opteon™ XL10 (R-1234yf) Refrigerant

Version 2.0

Revision Date 06.12.2016

Ref. 130000143548

- 10.3. Possibility of hazardous reactions** : Vapours may form flammable mixture with air.
- 10.4. Conditions to avoid** : Keep away from: Heat, flames and sparks. Do not spray on a naked flame or any incandescent material. Gas cylinder : Keep at temperature not exceeding 52°C. Pressurized container: Do not pierce or burn, even after use.
- 10.5. Incompatible materials** : Strong bases
Alkaline earth metals
finely divided metal powders
such as
Aluminium
Magnesium
Zinc
or
strong oxidizers
- 10.6. Hazardous decomposition products** : Hazardous thermal decomposition products may include:
Hydrogen fluoride
Fluorinated compounds
Carbon oxides

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute inhalation toxicity

- 2,3,3,3-Tetrafluoropropene
LC50 / 4 h Rat :> 405000 ppm

Low Observed Adverse Effect Concentration (LOAEC) / Dog :> 120000 ppm
Cardiac sensitization

No Observed Adverse Effect Concentration / Dog :120000 ppm
Cardiac sensitization

Skin irritation

- 2,3,3,3-Tetrafluoropropene
Not tested on animals
Classification: Not classified as irritant
Result: No skin irritation
Not expected to cause skin irritation based on expert review of the properties of the substance.

Eye irritation

- 2,3,3,3-Tetrafluoropropene
Not tested on animals



Opteon™ XL10 (R-1234yf) Refrigerant

Version 2.0

Revision Date 06.12.2016

Ref. 130000143548

Classification: Not classified as irritant
Result: No eye irritation
Not expected to cause eye irritation based on expert review of the properties of the substance.

Sensitisation

- 2,3,3,3-Tetrafluoropropene
Not tested on animals
Classification: Does not cause skin sensitisation.
Not expected to cause sensitization based on expert review of the properties of the substance.

There are no reports of human respiratory sensitization.

Repeated dose toxicity

- 2,3,3,3-Tetrafluoropropene
Inhalation Rat
NOAEL: 233 mg/l
No toxicologically significant effects were found.

Inhalation Rabbit
NOAEL: 2.33 mg/l
No toxicological effects warranting significant target organ toxicity classification were seen below the recommended guidance values for classification.

Inhalation Mini-pig
NOAEL: 50 mg/l
No toxicologically significant effects were found.

Mutagenicity assessment

- 2,3,3,3-Tetrafluoropropene
Animal testing did not show any mutagenic effects. Did not cause genetic damage in cultured mammalian cells. Experiments showed mutagenic effects in cultured bacterial cells.

Carcinogenicity assessment

- 2,3,3,3-Tetrafluoropropene
Not classifiable as a human carcinogen. Sufficient data are available to conclude that the substance is not expected to be carcinogenic.

Toxicity to reproduction assessment

- 2,3,3,3-Tetrafluoropropene
No toxicity to reproduction Animal testing showed no reproductive toxicity.

Assessment teratogenicity

- 2,3,3,3-Tetrafluoropropene



Opteon™ XL10 (R-1234yf) Refrigerant

Version 2.0

Revision Date 06.12.2016

Ref. 130000143548

Animal testing showed effects on embryo-fetal development at levels equal to or above those causing maternal toxicity.

Further information

Cardiac sensitisation threshold limit : > 559509 mg/m³

Liquefied gas

Avoid skin contact with leaking liquid (danger of frostbite).

SECTION 12: Ecological information

12.1. Toxicity

Toxicity to fish

- 2,3,3,3-Tetrafluoropropene
LC50 / 96 h / *Cyprinus carpio* (Carp): > 197 mg/l

Toxicity to aquatic plants

- 2,3,3,3-Tetrafluoropropene
NOEC / 72 h / Algae: > 100 mg/l

Toxicity to aquatic invertebrates

- 2,3,3,3-Tetrafluoropropene
EC50 / 48 h / *Daphnia magna* (Water flea): > 100 mg/l

12.2. Persistence and degradability

Biodegradability

aerobic / 28 d

Biodegradation: < 5 %

Method: OECD Test Guideline 301F

According to the results of tests of biodegradability this product is not readily biodegradable.

12.3. Bioaccumulative potential

Bioaccumulation

No bioaccumulation is to be expected (log Pow ≤ 4).

12.4. Mobility in soil

no data available



Opteon™ XL10 (R-1234yf) Refrigerant

Version 2.0

Revision Date 06.12.2016

Ref. 130000143548

12.5. Results of PBT and vPvB assessment

PBT and vPvB assessment

This substance is not considered to be persistent, bioaccumulating and toxic (PBT).

This substance is not considered to be very persistent and very bioaccumulating (vPvB).

12.6. Other adverse effects

Ozone depletion potential

0

Global warming potential (GWP)

< 1

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Product : Can be used after re-conditioning. If re-conditioning is not practicable, dispose of in compliance with local regulations.
For further information see Annex - Exposure scenario.

Contaminated packaging : Empty pressure vessels should be returned to the supplier.
If recycling is not practicable, dispose of in compliance with local regulations.

SECTION 14: Transport information

ADR

14.1. UN number: 3161
14.2. UN proper shipping name: LIQUEFIED GAS, FLAMMABLE, N.O.S. (2,3,3,3-Tetrafluoropropene)
14.3. Transport hazard class(es): 2
14.4. Packing group: Not applicable
14.5. Environmental hazards: For further information see Section 12.
14.6. Special precautions for user:
Tunnel restriction code: (B/D)

IATA_C

14.1. UN number: 3161
14.2. UN proper shipping name: Liquefied gas, flammable, n.o.s. (2,3,3,3-Tetrafluoropropene)
14.3. Transport hazard class(es): 2.1
14.4. Packing group: Not applicable
14.5. Environmental hazards : For further information see Section 12.
14.6. Special precautions for user:
ICAO / IATA cargo aircraft only

IMDG



Opteon™ XL10 (R-1234yf) Refrigerant

Version 2.0

Revision Date 06.12.2016

Ref. 130000143548

- 14.1. UN number: 3161
14.2. UN proper shipping name: LIQUEFIED GAS, FLAMMABLE, N.O.S. (2,3,3,3-Tetrafluoropropene)
14.3. Transport hazard class(es): 2.1
14.4. Packing group: Not applicable
14.5. Environmental hazards : For further information see Section 12.
14.6. Special precautions for user: no data available
- 14.7. Transport in bulk according to Annex II of MARPOL and the IBC Code**
Not applicable

SECTION 15: Regulatory information

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

Other regulations : Directive 1999/92/EC of the European Parliament and of the Council of 16 December 1999 on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres - ATEX 137. Communication from the Commission concerning the non-binding guide of good practice for implementing Directive 1999/92/EC of the European Parliament and of the Council on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres - COM/2003/0515 final.
Directive 94/9/EC of the European Parliament and the Council of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres - ATEX 95.
Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of life vehicles.
Take note of Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work.
Take note of Directive 96/82/EC on the control of major-accident hazards involving dangerous substances.

15.2. Chemical Safety Assessment

A Chemical Safety Assessment has been carried out for this substance.

SECTION 16: Other information

Full text of H-Statements referred to under section 3.

H220 Extremely flammable gas.
H280 Contains gas under pressure; may explode if heated.

Abbreviations and acronyms

ADR European Agreement concerning the International Carriage of Dangerous Goods by Road



Opteon™ XL10 (R-1234yf) Refrigerant

Version 2.0

Revision Date 06.12.2016

Ref. 130000143548

ATE	Acute toxicity estimate
CAS-No.	Chemical Abstracts Service number
CLP	Classification, Labelling and Packaging
EbC50	Concentration at which 50% reduction of biomass is observed
EC50	Median effective concentration
EN	European Norm
EPA	Environmental Protection Agency
ErC50	Concentration at which a 50% inhibition of growth rate is observed
EyC50	Concentration at which 50 % inhibition of yield is observed
IATA_C	International Air Transport Association (Cargo)
IBC	International Bulk Chemical Code
ICAO	International Civil Aviation Organization
ISO	International Standard Organization
IMDG	International Maritime Dangerous Goods
LC50	Median Lethal Concentration
LD50	Median Lethal Dose
LOEC	Lowest Observed Effect Concentration
LOEL	Lowest observed effect level
MARPOL	International Convention for the Prevention of Marine Pollution from Ships
n.o.s.	Not Otherwise Specified
NOAEC	No Observed Adverse Effect Concentration
NOAEL	No observed adverse effect level
NOEC	No Observed Effect Concentration
NOEL	No Observed Effect Level
OECD	Organisation for Economic Co-operation and Development
OPPTS	Office of Prevention, Pesticides and Toxic Substances
PBT	Persistent, Bioaccumulative and Toxic
STEL	Short term exposure limit
TWA	Time Weighted Average (TWA):
vPvB	very Persistent and very Bioaccumulative

Further information

Chemours™ and the Chemours Logo are trademarks of The Chemours Company.
Opteon™ and any associated logos are trademarks or copyrights of The Chemours Company FC, LLC.
Before use read Chemours safety information.
For further information contact the local Chemours office or nominated distributors.

Significant change from previous version is denoted with a double bar.

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 guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The above information relates only to the specific material(s) designated herein and may not be valid for such material(s) used in combination with any other materials or in any process or if the material is altered or processed, unless specified in the text.



Opteon™ XL10 (R-1234yf) Refrigerant

Version 2.0

Revision Date 06.12.2016

Ref. 130000143548

Annex - Exposure scenario

The exposure scenario provides specific information on how hazardous substances (as such or in a mixture) are to be managed and controlled. It considers specific conditions of use, in order to ensure that a use should be safe to humans and the environment. Identified risk management measures are to be implemented unless the downstream user is able to ensure safe use in a diverging way.

ES1 - Industrial use, Heat transfer fluids - Refrigerants, coolants

ES2 - Professional use, Heat transfer fluids - Refrigerants, coolants

ES3 - Industrial use, Formulation of preparations

Exposure scenario 1:

1. Short title of Exposure Scenario: Industrial use, Heat transfer fluids - Refrigerants, coolants

Main User Group	: SU 3: Industrial uses: Uses of substances as such or in preparations at industrial sites
Sector of End Use	: SU 10: Formulation [mixing] of preparations and/or re-packaging (excluding alloys) : SU17: General manufacturing, e.g. machinery, equipment, vehicles, other transport equipment
Product Category	: PC16: Heat transfer fluids
Further information	: AC1: Vehicles : AC2: Machinery, mechanical appliances, electrical/electronic articles
CS1	: Industrial use of substances in closed systems (ERC7)
CS2	: Transfer of substance or preparation into small containers (dedicated filling line, including weighing) (PROC9)
CS3	: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities (PROC8b)

2. Conditions of use affecting exposure

2.1 Control of environmental exposure for: CS1 - Industrial use of substances in closed systems (ERC7)

ECETOC TRA v3.0 Environment.

Product characteristics



Opteon™ XL10 (R-1234yf) Refrigerant

Version 2.0

Revision Date 06.12.2016

Ref. 130000143548

Low global warming potential. Liquefied gas

Not biodegradable

Covers the percentage of the substance in the product up to 100 % (unless stated differently).

Amount used

Annual use rate (tonnes/year) : 9000 ton(s)/year - EU

Frequency and duration of use

Continuous use/release : 8 hours/day, Continuous use

Continuous use/release : 200 days/year, Intermittent release.

Other given operational conditions affecting environmental exposure

Remarks : Under normal conditions of use, exposure would primarily occur when workers connect and disconnect the couplings.

Release fraction to air from process (initial release prior to RMM) : 0.01

Remarks : Worst case assumption

Technical and organisational conditions and measures

Air : Ensure that the valves of the cylinders are tightly closed and not leaking.

Water : Process designed to minimize releases to wastewater.

Soil : Process designed to minimize releases to soil.

Remarks : Handle substance within a closed system. Transfer via enclosed lines. Clear transfer lines prior to de-coupling.

Remarks : Technical measures/Precautions Flammability (gases) : Directive 1999/92/EC of the European Parliament and of the Council of 16 December 1999 on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres - ATEX 137. Directive 94/9/EC of the European Parliament and the Council of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres - ATEX 95. Take note of Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work.



Opteon™ XL10 (R-1234yf) Refrigerant

Version 2.0

Revision Date 06.12.2016

Ref. 130000143548

Remarks : Regular inspection and maintenance of equipment and machines.

Conditions and measures related to municipal sewage treatment plant

Type of Sewage Treatment Plant : No sewage treatment plant

Conditions and measures related to external treatment of waste

Remarks : No waste generated as substance is a gas.

2.2 Control of worker exposure for: CS2 - Transfer of substance or preparation into small containers (dedicated filling line, including weighing) (PROC9)

Workplace measurements

For comparison purposes only, ECETOC TRA version 3.0 was also used to estimate inhalation exposure for workers.

Product characteristics

Concentration of the Substance in Mixture/Article : Liquefied gas

: Covers the percentage of the substance in the product up to 100 % (unless stated differently).

Remarks : Assumes activities are at room temperature.

Amount used - Frequency and duration of use

Amount per Shift : 120 kg

Exposure duration : 20 min

Frequency of use : Intermittent release.

Frequency of use : 200 days/year

Frequency of use : Under normal operation exposure occurs only at ending of filling process (disconnection), estimated at 0.083 min (5 sec) per disconnecting process*1 processes/fill*30 fills/hr*8 hr/shift.

Other operational conditions affecting workers exposure

Breathing volume : 10 m3

Remarks : Covers daily exposures up to 8 hours (unless stated differently).

Outdoor / Indoor : Indoor use

Minimum room size : 50 m3



Opteon™ XL10 (R-1234yf) Refrigerant

Version 2.0

Revision Date 06.12.2016

Ref. 130000143548

Ventilation rate per hour : 3

Remarks : Under normal conditions of use, exposure would primarily occur when workers connect and disconnect the couplings.

Technical and organisational conditions and measures

Ensure that the valves of the cylinders are tightly closed and not leaking. Handle substance within a closed system. Transfer via enclosed lines. Clear transfer lines prior to de-coupling.

Local exhaust ventilation (Effectiveness: < 10 ppm)

Technical measures/Precautions Flammability (gases) : Directive 1999/92/EC of the European Parliament and of the Council of 16 December 1999 on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres - ATEX 137. Directive 94/9/EC of the European Parliament and the Council of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres - ATEX 95. Take note of Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work. ISO 13043:2011 - Road vehicles - Refrigerant systems used in mobile air conditioning systems (MAC) - Safety requirements SAE J639 - Safety Standards for Motor Vehicle Refrigerant Vapor Compressions Systems SAE J2845 - R-1234yf [HFO-1234yf] and R-744 Technician Training for Service and Containment of Refrigerants Used in Mobile A/C Systems

Regular inspection and maintenance of equipment and machines. Ensure operatives are trained to minimise exposures.

Conditions and measures related to personal protection, hygiene and health evaluation

Use eye protection to EN 166, designed to protect against liquid splashes. or ANSI Z87.1

Protective gloves complying with EN 374. or US OSHA guidelines

2.3 Control of worker exposure for: CS3 - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities (PROC8b)

Workplace measurements

For comparison purposes only, ECETOC TRA version 3.0 was also used to estimate inhalation exposure for workers.

Product characteristics

Concentration of the Substance in Mixture/Article : Liquefied gas

: Covers the percentage of the substance in the product up to 100 % (unless stated differently).

Remarks : Assumes activities are at room temperature.

Amount used - Frequency and duration of use



Opteon™ XL10 (R-1234yf) Refrigerant

Version 2.0

Revision Date 06.12.2016

Ref. 130000143548

Amount per Use : Not relevant
Frequency of use : 200 days/year
Exposure duration : < 15 min
Frequency of use : Intermittent release.

Other operational conditions affecting workers exposure

Breathing volume : 10 m3
Remarks : Covers daily exposures up to 8 hours (unless stated differently).
Outdoor / Indoor : Outdoor use
Remarks : Under normal conditions of use, exposure would primarily occur when workers connect and disconnect the couplings.

Technical and organisational conditions and measures

Ensure that the valves of the cylinders are tightly closed and not leaking. Handle substance within a closed system. Transfer via enclosed lines. Clear transfer lines prior to de-coupling.

Technical measures/Precautions Flammability (gases) : Directive 1999/92/EC of the European Parliament and of the Council of 16 December 1999 on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres - ATEX 137. Directive 94/9/EC of the European Parliament and the Council of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres - ATEX 95. Take note of Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work. ISO 13043:2011 - Road vehicles - Refrigerant systems used in mobile air conditioning systems (MAC) - Safety requirements SAE J639 - Safety Standards for Motor Vehicle Refrigerant Vapor Compressions Systems SAE J2845 - R-1234yf [HFO-1234yf] and R-744 Technician Training for Service and Containment of Refrigerants Used in Mobile A/C Systems

Regular inspection and maintenance of equipment and machines. Ensure operatives are trained to minimise exposures.

Conditions and measures related to personal protection, hygiene and health evaluation

Use eye protection to EN 166, designed to protect against liquid splashes. or ANSI Z87.1

Protective gloves complying with EN 374. or US OSHA guidelines

3. Exposure estimation and reference to its source

Environment

CS1 - Industrial use of substances in closed systems (ERC7)



Opteon™ XL10 (R-1234yf) Refrigerant

Version 2.0

Revision Date 06.12.2016

Ref. 130000143548

Remarks : The calculated exposure value is negligibly low.

Workers

CS2 - Transfer of substance or preparation into small containers (dedicated filling line, including weighing) (PROC9)

PROC9 : Transfer of substance or preparation into small containers (dedicated filling line, including weighing)
Value type : Worker - inhalation - long-term, systemic
Risk characterization ratio : 0.039
Level of Exposure : 37 mg/m³
Method : Workplace measurements

PROC9 : Transfer of substance or preparation into small containers (dedicated filling line, including weighing)
Value type : Worker - inhalation - long-term, systemic
Risk characterization ratio : 0.2
Level of Exposure : 190 mg/m³
Method : ECETOC TRA v3.0.

CS3 - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities (PROC8b)

PROC9 : Transfer of substance or preparation into small containers (dedicated filling line, including weighing)
Value type : Worker - inhalation - long-term, systemic
Risk characterization ratio : 0.039
Level of Exposure : 37 mg/m³
Method : Workplace measurements

PROC9 : Transfer of substance or preparation into small containers (dedicated filling line, including weighing)
Value type : Worker - inhalation - long-term, systemic
Risk characterization ratio : 0.05
Level of Exposure : 50 mg/m³
Method : ECETOC TRA v3.0.

4. Guidance to Downstream User to evaluate whether he works inside the boundaries set by the Exposure Scenario

CS1 - Industrial use of substances in closed systems (ERC7)

For further information, please contact sds-support@chemours.com., The information within this CS is relevant for all CS within this chapter of the Exposure Scenario.



Opteon™ XL10 (R-1234yf) Refrigerant

Version 2.0

Revision Date 06.12.2016

Ref. 130000143548

Exposure scenario 2:

1. Short title of Exposure Scenario: Professional use, Heat transfer fluids - Refrigerants, coolants

- Main User Group : **SU 22:** Professional uses: Public domain (administration, education, entertainment, services, craftsmen)
- Product Category : **PC16:** Heat transfer fluids
- Further information : **AC1:** Vehicles
: **AC2:** Machinery, mechanical appliances, electrical/electronic articles
- CS1 : Wide dispersive outdoor use of substances in closed systems (ERC9b)
- CS2 : Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities (PROC8a)

2. Conditions of use affecting exposure

2.1 Control of environmental exposure for: CS1 - Wide dispersive outdoor use of substances in closed systems (ERC9b)

ECETOC TRA v3.0 Environment.

Product characteristics

Low global warming potential. Liquefied gas

Not biodegradable

Covers the percentage of the substance in the product up to 100 % (unless stated differently).

Amount used

Annual use rate (tonnes/year) : 4000 ton(s)/year - EU

Frequency and duration of use

Continuous use/release : 365 days/year, Continuous use

Continuous use/release : Intermittent release.

Other given operational conditions affecting environmental exposure

Remarks : Under normal conditions of use, exposure would primarily occur when workers connect and disconnect the couplings.

Release fraction to air from process : 0.064



Opteon™ XL10 (R-1234yf) Refrigerant

Version 2.0

Revision Date 06.12.2016

Ref. 130000143548

Technical and organisational conditions and measures

- Air : Ensure that the valves of the cylinders are tightly closed and not leaking.
- Water : Process designed to minimize releases to wastewater.
- Soil : Process designed to minimize releases to soil.
- Remarks : Handle substance within a closed system. Transfer via enclosed lines. Clear transfer lines prior to de-coupling.

Conditions and measures related to municipal sewage treatment plant

- Type of Sewage Treatment Plant : No sewage treatment plant

Conditions and measures related to external treatment of waste

- Remarks : No waste generated as substance is a gas.

2.2 Control of worker exposure for: CS2 - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities (PROC8a)

Workplace measurements

For comparison purposes only, ECETOC TRA version 3.0 was also used to estimate inhalation exposure for workers.

Product characteristics

- Concentration of the Substance in Mixture/Article : Covers the percentage of the substance in the product up to 100 % (unless stated differently).
- Physical Form (at time of use) : Liquefied gas
- Remarks : Assumes activities are at room temperature.

Amount used - Frequency and duration of use

- Amount per Application : 500 g/event - Mobile air conditioning equipment
- Amount per Application : 50 - 300000 g/event - Stationary air conditioning equipment
- Frequency of use : 200 days/year - Intermittent use/release
- Frequency of use : Mobile A/C: ~1 minute/ 8-hour shift (0.083 minutes (5 seconds) per connecting process *2 connecting processes per vacuuming/re-charging procedure *1 servicing event per hour *8 hours per shift)



Opteon™ XL10 (R-1234yf) Refrigerant

Version 2.0

Revision Date 06.12.2016

Ref. 130000143548

Frequency of use : Stationary Equipment: ~< 1 minute/8-hour shift (0.083 minutes (5 seconds) per connecting process *2 connecting processes per vacuuming/ re-charging procedure *up to 4 servicing events per 8-hour shift)

Other operational conditions affecting workers exposure

Breathing volume : 10 m3

Remarks : Covers daily exposures up to 8 hours (unless stated differently).

Outdoor / Indoor : Indoor use

Remarks : Under normal conditions of use, exposure would primarily occur when workers connect and disconnect the couplings.

Technical and organisational conditions and measures

Ensure that the valves of the cylinders are tightly closed and not leaking. Handle substance within a closed system. Transfer via enclosed lines. Clear transfer lines prior to de-coupling.

Technical measures/Precautions Flammability (gases) : Directive 1999/92/EC of the European Parliament and of the Council of 16 December 1999 on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres - ATEX 137. Directive 94/9/EC of the European Parliament and the Council of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres - ATEX 95. Take note of Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work. ISO 13043:2011 - Road vehicles - Refrigerant systems used in mobile air conditioning systems (MAC) - Safety requirements SAE J639 - Safety Standards for Motor Vehicle Refrigerant Vapor Compressions Systems SAE J2845 - R-1234yf [HFO-1234yf] and R-744 Technician Training for Service and Containment of Refrigerants Used in Mobile A/C Systems EN 378: Refrigerating systems and heat pumps. Safety and environmental requirements.

Regular inspection and maintenance of equipment and machines. Ensure operatives are trained to minimise exposures.

Conditions and measures related to personal protection, hygiene and health evaluation

Use eye protection to EN 166, designed to protect against liquid splashes. or ANSI Z87.1

Protective gloves complying with EN 374. or US OSHA guidelines

3. Exposure estimation and reference to its source

Environment

CS1 - Wide dispersive outdoor use of substances in closed systems (ERC9b)

Remarks : The calculated exposure value is negligibly low.

Workers



Opteon™ XL10 (R-1234yf) Refrigerant

Version 2.0

Revision Date 06.12.2016

Ref. 130000143548

CS2 - Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities (PROC8a)

PROC8a : Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities
Value type : Worker - inhalation - long-term, systemic
Risk characterization ratio : 0.27
Level of Exposure : 255 mg/m³
Method : Workplace measurements

PROC8a : Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities
Value type : Worker - inhalation - long-term, systemic
Risk characterization ratio : 0.005
Level of Exposure : 5.1 mg/m³
Method : Workplace measurements

PROC8a : Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at non-dedicated facilities
Value type : Worker - inhalation - long-term, systemic
Risk characterization ratio : 0.25
Level of Exposure : 240 mg/m³
Method : ECETOC TRA v3.0.

4. Guidance to Downstream User to evaluate whether he works inside the boundaries set by the Exposure Scenario

CS1 - Wide dispersive outdoor use of substances in closed systems (ERC9b)

For further information, please contact sds-support@chemours.com., The information within this CS is relevant for all CS within this chapter of the Exposure Scenario.



Opteon™ XL10 (R-1234yf) Refrigerant

Version 2.0

Revision Date 06.12.2016

Ref. 130000143548

Exposure scenario 3:

1. Short title of Exposure Scenario: Industrial use, Formulation of preparations

Main User Group	: SU 3: Industrial uses: Uses of substances as such or in preparations at industrial sites
Sector of End Use	: SU 10: Formulation [mixing] of preparations and/or re-packaging (excluding alloys) : SU17: General manufacturing, e.g. machinery, equipment, vehicles, other transport equipment
Product Category	: PC16: Heat transfer fluids
Further information	: AC1: Vehicles : AC2: Machinery, mechanical appliances, electrical/electronic articles
CS1	: Formulation of preparations (ERC2)
CS2	: Use in closed batch process (synthesis or formulation) (PROC3)

2. Conditions of use affecting exposure

2.1 Control of environmental exposure for: CS1 - Formulation of preparations (ERC2)

ECETOC TRA v3.0 Environment.

Product characteristics

Low global warming potential. Liquefied gas

Covers the percentage of the substance in the product up to 100 % (unless stated differently).

Not biodegradable

Amount used

Annual use rate (tonnes/year) : 5000 ton(s)/year - EU

Daily amount : 25000 kg/day - EU

Frequency and duration of use

Continuous use/release : 8 hours/day, Continuous use

Continuous use/release : 200 days/year, Intermittent release.

Other given operational conditions affecting environmental exposure



Opteon™ XL10 (R-1234yf) Refrigerant

Version 2.0

Revision Date 06.12.2016

Ref. 130000143548

Remarks : Under normal conditions of use, exposure would primarily occur when workers connect and disconnect the couplings.

Release fraction to air from process (initial release prior to RMM) : 0.0025

Release fraction to wastewater from process (initial release prior to RMM) : 0

Release fraction to soil from process (initial release prior to RMM) : 0

Technical and organisational conditions and measures

Air : Ensure that the valves of the cylinders are tightly closed and not leaking.

Water : Process designed to minimize releases to wastewater.

Soil : Process designed to minimize releases to soil.

Remarks : Handle substance within a closed system. Transfer via enclosed lines. Clear transfer lines prior to de-coupling.

Remarks : Technical measures/Precautions Flammability (gases) : Directive 1999/92/EC of the European Parliament and of the Council of 16 December 1999 on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres - ATEX 137. Directive 94/9/EC of the European Parliament and the Council of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres - ATEX 95. Take note of Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work.

Remarks : Regular inspection and maintenance of equipment and machines.

Conditions and measures related to municipal sewage treatment plant

Type of Sewage Treatment Plant : No sewage treatment plant

Conditions and measures related to external treatment of waste

Remarks : No waste generated as substance is a gas.

2.2 Control of worker exposure for: CS2 - Use in closed batch process (synthesis or formulation) (PROC3)



Opteon™ XL10 (R-1234yf) Refrigerant

Version 2.0

Revision Date 06.12.2016

Ref. 130000143548

ECETOC TRA v3.0.

Product characteristics

Concentration of the Substance in Mixture/Article : Covers the percentage of the substance in the product up to 100 % (unless stated differently).

Physical Form (at time of use) : Liquefied gas

Remarks : Assumes activities are at room temperature.

Amount used - Frequency and duration of use

Amount per Shift : 2500 kg

Exposure duration : < 15 min

Frequency of use : 200 days/year - Intermittent use/release

Other operational conditions affecting workers exposure

Breathing volume : 10 m3

Remarks : Covers daily exposures up to 8 hours (unless stated differently).

Outdoor / Indoor : Outdoor use

Remarks : Under normal conditions of use, exposure would primarily occur when workers connect and disconnect the couplings.

Technical and organisational conditions and measures

Ensure that the valves of the cylinders are tightly closed and not leaking. Handle substance within a closed system. Transfer via enclosed lines. Clear transfer lines prior to de-coupling.

Technical measures/Precautions Flammability (gases) : Directive 1999/92/EC of the European Parliament and of the Council of 16 December 1999 on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres - ATEX 137. Directive 94/9/EC of the European Parliament and the Council of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres - ATEX 95. Take note of Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work. EN 378: Refrigerating systems and heat pumps. Safety and environmental requirements.

Regular inspection and maintenance of equipment and machines. Ensure operatives are trained to minimise exposures.

Conditions and measures related to personal protection, hygiene and health evaluation

Use eye protection to EN 166, designed to protect against liquid splashes. or ANSI Z87.1



Opteon™ XL10 (R-1234yf) Refrigerant

Version 2.0

Revision Date 06.12.2016

Ref. 130000143548

Protective gloves complying with EN 374. or US OSHA guidelines

3. Exposure estimation and reference to its source

Environment

CS1 - Formulation of preparations (ERC2)

Remarks : The calculated exposure value is negligibly low.

Workers

CS2 - Use in closed batch process (synthesis or formulation) (PROC3)

PROC3 : Use in closed batch process (synthesis or formulation)
Value type : Worker - inhalation - long-term, systemic
Risk characterization ratio : 0.018
Level of Exposure : 17 mg/m³
Method : ECETOC TRA v3.0.

4. Guidance to Downstream User to evaluate whether he works inside the boundaries set by the Exposure Scenario

CS1 - Formulation of preparations (ERC2)

For further information, please contact sds-support@chemours.com., The information within this CS is relevant for all CS within this chapter of the Exposure Scenario.