# SAFETY DATA SHEET (SDS)

## SECTION 1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

### 1.1. Product identifier
Identification of the substance:

| | |
|---|---|
| Name: | R1234yf |
| CAS Number: | 754-12-1 |
| EC Number: | 468-710-7 |
| REACH Number: | 01-0000019665-61-0000 |

### 1.2. Relevant identified uses of the substance/mixture and uses advised against
Recommended use:
Refrigerant

### 1.3. Details of the supplier of the safety data sheet
Company:
TAZZETTI S.P.A
CORSO EUROPA 600/A
10088 VOLPIANO (TO) - ITALY-
Tel. +39 011 97021
Fax +39 011 9702460

## SECTION 2. HAZARDS IDENTIFICATION

### 2.1. Classification of the substance or mixture
EC regulation criteria 1272/2008 (CLP):
Warning, Flam. Gas 1B, Flammable gas.
Warning, Press. Gas, Contains gas under pressure.

### 2.2. Label elements
Symbols:

Danger
Hazard statements:
H221 Flammable gas
H280 Contains gas under pressure; may explode if heated.
Precautionary statements:
P210 Keep away from heat/sparks/open flames/hot surfaces. - 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+403: Protect from sunlight. Store in a well ventilated place
Special Provisions:
None

### 2.3. Other Hazards
This substance doesn't meet the criteria for persistent, bioaccumulative and toxic or very persistent and very bioaccumulative in accordance with Annex XIII

The substance was not included in the list established in accordance with Article 59(1) for having endocrine disrupting properties, and the substance is not a substance identified as having endocrine disrupting properties in accordance with the criteria set out in Commission Delegated Regulation (EU) 2017/2100(3) or Commission Regulation (EU) 2018/605(4).
The vapors are heavier than air and can cause suffocation, by reducing oxygen available for breathing. Inappropriate use or abuse by intenzional inhalation can result in death withuot warning symptoms due to heart damage.

## SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

### 3.1. Substances

Identification of the substance:

| | |
|---|---|
| Name: | R1234yf |
| Chemical name: | 2,3,3,3-Tetrafluoropropene |
| CAS Number: | 754-12-1 |
| EC Number: | 468-710-7 |
| REACH Number: | 01-0000019665-61-0000 |

### 3.2. Mixtures

Not applicable

## SECTION 4. FIRST AID MEASURES

### 4.1. Description of first aid measures

In case of skin contact:
In case of frostbite spray with water for at least 15 minutes. Apply a sterile dressing. Obtain medical assistance.
Take off all contaminated clothing immediately.
In case of contact with liquid, thaw frosted parts with water, then remove clothing carefully. Wash with plenty of water. Wash contaminated clothing before re-use. Consult a physician.
In case of eyes contact:
In case of contact with eyes, rinse immediately (for at least 15 minutes) with plenty of water and seek medical advice.
In case of ingestion:
Obtain medical assistance.
In case of inhalation:
Remove victim to uncontaminated area wearing self contained breathing apparatus. Keep victim warm and rested. Call a doctor. Apply artificial respiration if breathing stopped.

### 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

Treatment: Adrenaline derivatives are contra-indicated., Treat symptomatically.
See Section 11 for more detailed information on health effects and symptoms.

## SECTION 5. FIRE-FIGHTING MEASURES

### 5.1. Extinguishing media

Suitable extinguishing media:
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
Extinguishing media which must not be used for safety reasons:
None in particular.

### 5.2. Special hazards arising from the substance or mixture

Some risk may be expected of corrosive and toxic decomposition products.

In case of fire hazardous decomposition products may be produced such as:
Carbon monoxide
Hydrogen halides
Carbonyl halides
Pyrolysis products containing fluoride
Cool closed containers exposed to fire with water spray.
Heating will cause pressure rise with risk of bursting and subsequent explosion.

### 5.3. Advice for fire-fighters
Use self-contained breathing apparatus and chemically protective clothing.
Collect separately contaminated water used to extinguish the fire. Not be discharged into drains.
If feasible in terms of safety, move from immediate danger undamaged containers.
Cool the containers exposed to the fire with water. Fight fire remotely due to the risk of explosion.

## SECTION 6. ACCIDENTAL RELEASE MEASURES

### 6.1. Personal precautions, protective equipment and emergency procedures
Wear self-contained breathing apparatus when entering area unless atmosphere is proved to be safe.
Provide adequate ventilation.
Remove all sources of ignition.
Evacuate area.
Prevent from entering sewers, basements and workpits, or any place where its accumulation can be dangerous.
Wear breathing apparatus if exposed to vapours/dusts/aerosols.
Pay attention to the spreading of gases especially at ground level (heavier than air) and to the direction of the wind.
See protective measures under point 7 and 8.

### 6.2. Environmental precautions
Do not allow to enter into soil/subsoil. Do not allow to enter into surface water or drains.
Retain contaminated washing water and dispose it.
In case of gas escape or of entry into waterways, soil or drains, inform the responsible authorities.

### 6.3. Methods and materials for containment and cleaning up
Reduce vapour with fog or fine water spray.
Provide containment for water used
Wash with plenty of water
Ventilate area

### 6.4. Reference to other sections
See also section 8 and 13

## SECTION 7. HANDLING AND STORAGE

### 7.1. Precautions for safe handling
Do not allow backfeed into the container.
Use only equipment suitable for the product and the operating pressure
Take precautionary measures against static discharge.
Keep away from ignition sources (including static discharges).
Avoid contact with skin and eyes, inhalation of vapours and mists.
Use localized ventilation system.
Don’t use empty container before they have been cleaned.
Before making transfer operations, assure that there aren’t any incompatible material residuals in the containers.
Contaminated clothing should be changed before entering eating areas.

Do not eat or drink while working.
Do not smoke while working.
Only experienced and properly instructed persons should handle compressed gases.
The substance must be handled in accordance with good industrial hygiene and safety procedures.
Close container valve after each use and when empty, even if still connected to equipment.
Never attempt to repair or modify container valves or safety relief devices.
Replace valve outlet caps or plugs and container caps where supplied as soon as container is disconnected from equipment.
Do not remove or deface labels provided by the supplier for the identification of the cylinder contents.
Never use direct flame to raise the pressure of a container.
See also section 8 for recomened protective equipment.
Purge air from system before introducing gas.
Ensure the complete gas system was (or is regularily) checked for leaks before use.
Assess the risk of potentially explosive atmosphere and the need for explosion-proof equipment.
Consider the use only non-sparking tools.
Protect cylinders from physical damage; do not drag, roll, slide or drop.
If user experiences any difficulty operating cylinder valve discontinue use and contact supplier.

### 7.2. Conditions for safe storage, including any incompatibilities

Observe all regulations and local requirements regarding storage of containers.
All electrical equipment in the storage areas should be compatible with the risk of potentially explosive atmosphere.
Keep container below 50°C in a well ventilated area.
Keep away from ignition sources (including static discharges).
Do not store near oxidizing containers.
Always keep in a well ventilated place.
Keep away from unguarded flame, sparks, and heat sources.
Keep away from food, drink and feed.
Segregate from oxidant gases and other oxidants in store.
Incompatible materials:
None in particular. See also section 10.
Instruction as regards storage premises:
Adequately ventilated.
Containers should not be stored in conditions likely to encourage corrosion. Containers should be protected against falling down

### 7.3. Specific end use(s)

No data available

## SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### 8.1. Control parameters

DNEL according to European Regulation (CE) Num. 1907/2006:
Industrial worker Inhalation Long-term systemic effects 950 mg/m3
PNEC according to European Regulation (CE) Num. 1907/2006:
Fresh water 0,1 mg/l
Water intermittent use/release 1 mg/l
Fresh water sediment 1,77 mg/kg dry weight
Soil 1,54 mg/kg dry weight
Sea water 0,01 mg/l
Marine Sediment 0,178 mg/kg peso secco (p.secco)

### 8.2. Exposure controls

The product should be handled in a closed circuit..
Provide adequate general and local ventilation.
Consider using flame retardant antistatic protective clothing.

If the risk assessment indicates this is necessary, use the following protection
Eye protection:
If foreseeable a risk of spurts or squirts, please wear safety glasses with lateral protection in compliance with rule of law EN 166.
Protection for skin:
Protective clothing
Protection for hands:
If foreseeable a direct contact with liquid or with cold machineries/equipments for which exist a risk of cold burn, please use cold protection gloves in compliance with rule of law EN511 – 020.
Respiratory protection:
Wear self-contained breathing apparatus in compliance with EN 137 when entering area unless atmosphere is proved to be safe.
Thermal Hazards:
Contact with liquid may cause cold burns/frostbite.
Environmental exposure controls:
Refer to environment legislation
Contact with liquid may cause cold burns/frostbite.
In high concentrations may cause asphyxiation.
Vapour heavier than air, may accumulate below ground level and cause choking.

## SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

### 9.1. Information on basic physical and chemical properties

| | |
|---|---|
| Physical state: | liquified gas |
| Colour: | Incolour |
| Odour: | Ether |
| pH: | Not applicable to substance |
| Melting point / freezing point: | -152,2 °C |
| Initial boiling point and boiling range: | -29 °C a 1013 hPa |
| Limite inferiore/superiore d'infiammabilità o esplosione: | da 6.2 a 12.3 % (V) Metodo: ASTM E681 |
| Relative vapour density: | > 1 (air=1) |
| Evaporation rate: | Non applicabile, poiché questo prodotto è un gas |
| Vapor pressure: | 5800 hPa (at 20 °C) |
| Density: | 0.0048 g/cm3 at 20 °C (1013 hPa) |
| Upper/lower flammability or explosive limits: | 6.2 a 12.3 % (V) |
| Solubility in water: | 198,2 mg/l a 24 °C Method: 92/69/CEE, A.6 |
| Partition coefficient (n-octanol/water): | log Pow 2,15 Method: 92/69/CEE, A.8 |
| Flash point: | Not tested |
| Autoignition temperature: | 405 °C |
| Decomposition temperature: | Not tested |
| Viscosity: | Not tested |

### 9.2. Other informations

| | |
|---|---|
| Explosive properties: | Not applicable to substance |
| Oxidising properties: | Not applicable to substance |
| Burning rate: | 15 mm/s |
| Minimum ignition energy: | 5 - 10 J |

## 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.
Note: Stable under normal conditions.

### 10.4. Conditions to avoid
Do not pierce or burn, even after use. Do not spray on a naked flame or any incandescent material.
Heat, flames and sparks

### 10.5. Incompatible materials
Avoid impurities (e.g. rust, dust, ash): risk of decomposition! Incompatible with acids and bases.
Incompatible with oxidizing agents. Oxygen, peroxides, peroxidic compounds, oxidizing alkali metals
Finely divided metal powders such as aluminium, magnesium or zinc.

### 10.6. Hazardous decomposition products
In case of fire hazardous decomposition products may be produced such as:
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
Acute toxicity Inhalation:
CL50/4h - Inhalation - Rat > 405800 ppm Test atmosphere: gas Method: OECD Test Guideline 403
No Observed Adverse Effect Concentration (Dog): 120000 ppm Test atmosphere: gas Remarks: Cardiac sensitization.
Concentration with observed adverse effect (Dog)>120000 ppm Test atmosphere: gas Remarks: Cardiac sensitization.
Cardiac Sensitization Threshold Limit Values (Dog)> 559.509 mg/m³ Test atmosphere: gas Remarks: Cardiac sensitization.

Skin irritation: No skin irritation
Eye irritation: No eye irritation
Sensitisation: No known effects from this product

Mutagenicity: No known effects from this product
In vitro genotoxicity:
Test Type: Bacterial Reverse Mutation Test (AMES). Method: OECD Test Guideline 471. Result: positive
Test Type: Chromosome aberration in vitro. Method: OECD Test Guideline 473. Result: negative

Carcinogenicity Not classifiable based on available information.
Assessment: The evidence does not support a classification as a carcinogen

Toxicity to reproduction: Not classifiable based on available information.
Effects on fertility :
Test Type: Two-generation reproductive toxicity study. Species: Rat
Application method: inhalation (gas). Method: OECD Test Guideline 416. Result: negative

STOT – single exposure: Not classifiable based on available information.
Route of exposure: inhalation (gas). Assessment : No significant health effects observed in animals at concentrations of 20000 ppmV/4h or less

STOT – repeated exposure: Not classifiable based on available information.
Route of exposure: inhalation (gas). Assessment : No significant health effects observed in animals at concentrations of 250 ppmV/6h/d or less.

Aspiration hazard: Not classifiable based on available information.

## SECTION 12. ECOLOGICAL INFORMATION

### 12.1. Toxicity
Toxicity to fish: CL50/96h/Cyprinus carpio (Carp): >197 mg/l. Method: 'OECD Guidaline 203.
Toxicity to aquatic invertebrates: EC50/48h/daphnia magna: > 100 mg/l. Method: 'OECD Guidaline 202
Toxicity to aquatic plants: EC50/72h/Selenastrum capricornutum:>100 mg/l. Method:OECD Guidaline 201.
NOEC (Selenastrum capricornutum (green alga): > 75 mg/l/3 d Method: OECD Guidaline 201.

### 12.2. Persistence and degradability
Biodegradability: Result: not readily biodegradable. Method: OECD Guidaline 301F

### 12.3. Bioaccumulative potential
Partition coefficient (n-octanol/water): log Pow: 2 (25 °C)
Not considered to bioaccumulate due to low log Kow

### 12.4. Mobility in soil
Koc 4.47

### 12.5. Results of PBT and vPvB assessment
In accordance with the criteria set out in Annex XIII of the REACH Regulation, the substance is not defined as persistent, bioaccumulative and toxic to the environment

### 12.6 Endocrine-disrupting properties
The substance does not contain components with endocrine disrupting properties in accordance with article 57(f) of REACH or in accompliance with EU Regulations 2017/2100 and 2018/605 (<0,1% concentration).

### 12.7. Other adverse effects:
An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.
GWP: 4

## SECTION 13. DISPOSAL CONSIDERATIONS

### 13.1. Waste treatment methods
Product: Dispose of in compliance with current legislation on the subject. According to the European Waste Catalogue, waste codes are not product specific, but application specific. Waste codes should be assigned by the user, preferably in discussion with the responsible waste disposal authorities.
Contaminated Containers: Empty containers should be taken to an approved site for recycling or disposal. Depressurized containers should be returned to the supplier. Dispose of as unused product unless otherwise specified.

## SECTION 14. TRANSPORT INFORMATIONS

### 14.1. UN Number
ONU ADR/RID/IMDG/IATA -Number: 3161

### 14.2. UN proper shipping name
ADR/RID/IMDG - shipping name: Liquefied Gas, Flammable, N.O.S.
IATA Technical name: Liquefied Gas, Flammable, N.O.S.

### 14.3. Transport hazard class(es)
ADR/RID - Class: 2
ADR - Label: 2.1

RID - Labe: 2.1 (+13)
ADR/RID - Hazard identification number: 23
Classification code: 2F
IATA/IMDG - Class: 2.1

### 14.4. Packing group
ADR - Packing group: -

### 14.5. Environmental hazards: No

### 14.6. Special precautions for user
ADR-Tunnel restriction code: B/D
IATA - Passenger aircraft: N.D.
IATA - Cargo Aircraft: N.D.
Ensure there is adequate ventilation
Ensure vehicle driver is aware of the potential hazards of the load and knows what to do in the event of an accident or an emergency.
Compliance with applicable regulations.
Before transporting product containers :
- Ensure that containers are firmly secured.
- Ensure cylinder valve is closed and not leaking.
- Ensure valve outlet cap nut or plug (where provided) is correctly fitted.
- Ensure valve protection device (where provided) is correctly fitted.

Avoid transport on vehicles where the load space is not separated from the driver's compartment.

### 14.7. Transport in bulk according to annex II of MARPOL 73/78 and the IBC code: N.A.

## SECTION 15. REGULATORY INFORMATION

### 15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture
Reg. (CE) n. 1907/2006 (REACH), Reg. (CE) n. 1272/2008 (CLP), Reg. (UE) n. 2015/830, Reg. (UE) n. 2020/878.

### 15.2. Chemical safety assessment: yes

## SECTION 16. OTHER INFORMATION

Revised safety data sheet in accordance with commisssion regulation 878/2020.
Points that have changed since the previous version are highlighted with a vertical line in the body of this document.
Ensure operators understand the flammability hazard.
Users of breathing apparatus must be trained.
Ensure operators understand the toxicity hazard.
This document was prepared by a competent person who has received appropriate training.
Main bibliographic sources:
ECDIN - Environmental Chemicals Data and Information Network - Joint Research Centre, Commission of the European Communities
SAX's DANGEROUS PROPERTIES OF INDUSTRIAL MATERIALS - Eight Edition - Van Nostrand Reinold
CCNL - Appendix 1
EIGA
The information contained herein is based on our state of knowledge at the above-specified date. It refers solely to the product indicated and constitutes no guarantee of particular quality.

It is the duty of the user to ensure that this information is appropriate and complete with respect to the specific use intended. Classification in accordance with calculation methods of regulation (EC) 1272/2008 CLP / (EC) 1999/45 DPD. The MSDS cancels and replaces any preceding release.

| | |
|---|---|
| ADR: | European Agreement concerning the International Carriage of Dangerous Goods by Road. |
| CAS: | Chemical Abstracts Service (divisione della American Chemical Society). |
| CLP: | Classification, Labeling, Packaging. |
| DNEL: | Derived No Effect Level. |
| EINECS: | European Inventory of Existing Commercial Chemical Substances. |
| GHS: | Globally Harmonized System of Classification and Labeling of Chemicals. |
| IATA: | International Air Transport Association. |
| IATA-DGR: | Dangerous Goods Regulation by the "International Air Transport Association" (IATA). |
| ICAO: | International Civil Aviation Organization. |
| ICAO-TI: | Technical Instructions by the "International Civil Aviation Organization" (ICAO). |
| IMDG: | International Maritime Code for Dangerous Goods. |
| LC50: | Lethal concentration, for 50 percent of test population. |
| LD50: | Lethal dose, for 50 percent of test population. |
| LTE: | Long-term exposure. |
| PNEC: | Predicted No Effect Concentration. |
| RID: | Regulation Concerning the International Transport of Dangerous Goods by Rail. |
| STE: | Short-term exposure. |
| STEL: | Short Term Exposure limit. |
| STOT: | Specific Target Organ Toxicity. |
| TLV: | Threshold Limiting Value. |
| TWATLV: | Threshold Limit Value for the Time Weighted Average 8 hour day. (ACGIH Standard). |
| N.A. | Not available |
| WEEL: | Workplace Environmental Exposure Level |

# Annex: Exposure Scenarios

Table of Contents

**ES1 Industrial use; Formulation [mixing] of preparations and/ or re-packaging (excluding alloys).; Heat transfer fluids (PC16).**

**ES2 Industrial use; Filling of articles/equipment.; Heat transfer fluids (PC16).; General manufacturing, e.g. machinery, equipment, vehicles, other transport equipment (SU17).**

**ES3 professional use; Heat transfer fluids - Refrigerants, coolants.; Heat transfer fluids (PC16).; General manufacturing, e.g. machinery, equipment, vehicles, other transport equipment (SU17).**

**ES4 professional use; professional use.; Vehicles covered by End of Life Vehicles (ELV) directive (AC1a).; Other vehicles (AC1b).; Machinery, mechanical appliances, electrical/electronic articles (AC2).**

**ES5 Consumer use; Vehicles covered by End of Life Vehicles (ELV) directive (AC1a).; Other vehicles (AC1b).**

**ES 1: Industrial use; Formulation [mixing] of preparations and/ or re-packaging (excluding alloys).; Heat transfer fluids (PC16).**

**1.1. Title section**
Exposure Scenario name : Industrial, Formulation & (re)packing of substances and mixtures
Structured Short Title : Industrial use; Formulation [mixing] of preparations and/ or repackaging (excluding alloys).; Heat transfer fluids (PC16).

**Environment**
CS 1 Formulation [mixing] of preparations and/or re-packaging (excluding alloys)
ERC2

**Worker**
CS 2 Formulation PROC3
CS 3 Material transfers PROC8b
CS 4 Material transfers, Small scale PROC9
CS 5 Laboratory activities PROC15

**1.2. Conditions of use affecting exposure**
**1.2.1. Control of environmental exposure: Formulation into mixture (ERC2)**
**Product (article) characteristics**
Covers concentrations up to 100 %
Physical form of product : Liquefied gas
Low global warming potential.
Not biodegradable

**Amount used (or contained in articles), frequency and duration of use/exposure**
Annual amount per site : 8300 tonnes/year
Daily amount per site : 41.5 tonnes/day
Release type : Intermittent release
Emission days : 200

**Technical and organisational conditions and measures**
Process designed to minimize releases to wastewater.
Process designed to minimize releases to soil.
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.

**Conditions and measures related to sewage treatment plant**
STP type : No sewage treatment plant

**Conditions and measures related to treatment of waste (including article waste)**
Negligible air emissions as process operates in a contained system.

**Other conditions affecting environmental exposure**
Indoor or outdoor use : Outdoor use

**1.2.2. Control of worker exposure: Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3)**
**Product (article) characteristics**
Covers concentrations up to 100 %
Physical form of product : Liquefied gas

**Amount used (or contained in articles), frequency and duration of use/exposure**
Duration : Covers exposure up to 15 min
Use frequency : Intermittent release. 8 h/day

**Technical and organisational conditions and measures**
Use in closed process
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.
Supervision in place to check that the risk management measures in place are being used correctly and operation conditions followed.
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 2014/34/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 26 February 2014 on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres - ATEX 114.
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.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).

**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
Wear safety goggles.
Wear suitable face shield.
Use eye protection according to EN 166.
Low temperature resistant gloves
If assessment demonstrates that there is a risk of explosive atmospheres or flash fires, use flame retard ant antistatic protective clothing.
Wear cold-insulating gloves/face shield/eye protection.

**Other conditions affecting workers exposure**
Indoor or outdoor use : Outdoor use
Temperature : < 40 °C

**1.2.3. Control of worker exposure: Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)**
**Product (article) characteristics**
Covers concentrations up to 100 %
Physical form of product : Liquefied gas

**Amount used (or contained in articles), frequency and duration of use/exposure**
Use frequency : 8 h/day

**Technical and organisational conditions and measures**
Supervision in place to check that the risk management measures in place are being used correctly and operation conditions followed.
Ensure operatives are trained to minimise exposures.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Use in closed process

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.

**Conditions and measures related to personal protection, hygiene and health evaluation**
Wear safety goggles.
Wear suitable face shield.
Use eye protection according to EN 166.
Low temperature resistant gloves
If assessment demonstrates that there is a risk of explosive atmospheres or flash fires, use flame retardant antistatic protective clothing.
Wear cold-insulating gloves/face shield/eye protection.

**Other conditions affecting workers exposure**
Indoor or outdoor use : Outdoor use
Temperature : < 40 °C

**1.2.4. Control of worker exposure: Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)**
**Product (article) characteristics**
Covers concentrations up to 100 %
Physical form of product : Liquefied gas

**Amount used (or contained in articles), frequency and duration of use/exposure**
Use frequency : 8 h/day

**Technical and organisational conditions and measures**
Supervision in place to check that the risk management measures in place are being used correctly and operation conditions followed.
Ensure operatives are trained to minimise exposures.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Use in closed process
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.

**Conditions and measures related to personal protection, hygiene and health evaluation**
Wear safety goggles.
Wear suitable face shield.
Use eye protection according to EN 166.
Low temperature resistant gloves
If assessment demonstrates that there is a risk of explosive atmospheres or flash fires, use flame retard ant antistatic protective clothing.
Wear cold-insulating gloves/face shield/eye protection.

**Other conditions affecting workers exposure**
Indoor or outdoor use : Outdoor use
Temperature : < 40 °C

**1.2.5. Control of worker exposure: Use as laboratory reagent (PROC15)**
**Product (article) characteristics**
Covers concentrations up to 100 %
Physical form of product : Liquefied gas

**Amount used (or contained in articles), frequency and duration of use/exposure**
Amount per use : 150 g/event
Use frequency : 1 events per day
Use frequency : 8 h/day

**Technical and organisational conditions and measures**
Supervision in place to check that the risk management measures in place are being used correctly and operation conditions followed.
Ensure operatives are trained to minimise exposures.
Provide a basic standard of general ventilation (1 to 3 air changes per hour).
Local exhaust ventilation
Provide the operation with a properly sited receiving hood.
Inhalation - minimum efficiency of 90 %

**Conditions and measures related to personal protection, hygiene and health evaluation**
Use eye protection according to EN 166.

**Other conditions affecting workers exposure**
Indoor or outdoor use : Indoor use
Room size : 50 m³
Temperature : < 40 °C

### 1.3. Exposure estimation and reference to its source

### 1.3.1. Environmental release and exposure: Formulation into mixture (ERC2)

| Release route | Release rate | Release estimation method |
|---|---|---|
| Water | 0 kg/day | |
| Air | 190 kg/day | |
| Soil | 0 kg/day | |
| Waste | 0 kg/day | |

| Protection Target | Exposure estimate | RCR |
|---|---|---|
| Freshwater | < 0.0000001 mg/L (EUSES v2.1) | < 0.01 |
| Freshwater sediment | < 0.0000001 mg/kg dry weight (EUSES v2.1) | < 0.01 |
| Marine water | < 0.0000001 mg/L (EUSES v2.1) | < 0.01 |
| Marine sediment | < 0.0000001 mg/kg dry weight (EUSES v2.1) | < 0.01 |
| Agricultural soil | 0.04 mg/kg dry weight (EUSES v2.1) | 0.027 |
| Man via environment - Inhalation | 0.029 mg/m³ (EUSES v2.1) | < 0.01 |

**Additional information on exposure estimation**
The calculated exposure value is negligibly low.

### 1.3.2. Worker exposure: Manufacture or formulation in the chemical industry in closed batch processes with occasional controlled exposure or processes with equivalent containment condition (PROC3)

| Exposure route | Health effect | Exposure indicator | Exposure estimate | RCR |
|---|---|---|---|---|
| inhalative | systemic | long-term | 93.25 mg/m³ (measured data) | 0.098 |

### 1.3.3. Worker exposure: Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

| Exposure route | Health effect | Exposure indicator | Exposure estimate | RCR |
|---|---|---|---|---|
| inhalative | systemic | long-term | 93.25 mg/m³ (measured data) | 0.098 |

### 1.3.4. Worker exposure: Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

| Exposure route | Health effect | Exposure indicator | Exposure estimate | RCR |
|---|---|---|---|---|
| inhalative | systemic | long-term | 93.25 mg/m³ (measured data) | 0.098 |

### 1.3.5. Worker exposure: Use as laboratory reagent (PROC15)

| Exposure route | Health effect | Exposure indicator | Exposure estimate | RCR |
|---|---|---|---|---|
| inhalative | systemic | long-term | 12 mg/m³ (Consexpo v4.1) | 0.013 |

## ES 2: Industrial use; Filling of articles/equipment.; Heat transfer fluids (PC16).; General manufacturing, e.g. machinery, equipment, vehicles, other transport equipment (SU17).

### 2.1. Title section

Exposure Scenario name : Industrial, Filling of articles/equipment
Structured Short Title : Industrial use; Filling of articles/equipment.; Heat transfer fluids (PC16).; General manufacturing, e.g. machinery, equipment, vehicles, other transport equipment (SU17).

**Environment**
CS 1 Filling of equipment from drums or containers ERC7

**Worker**
CS 2 Material transfers PROC8b
CS 3 Filling of articles/equipment PROC9

### 2.2. Conditions of use affecting exposure

### 2.2.1. Control of environmental exposure: Use of functional fluid at industrial site (ERC7)

**Product (article) characteristics**
Covers concentrations up to 100 %
Physical form of product : Liquefied gas

**Amount used (or contained in articles), frequency and duration of use/exposure**
Annual amount per site : 9000 tonnes/year
Daily amount per site : 45 tonnes/day
Release type : Intermittent release
Emission days : 200

**Technical and organisational conditions and measures**
Process designed to minimize releases to wastewater.
Process designed to minimize releases to soil.
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.
Regular inspection and maintenance of equipment and machines

**Conditions and measures related to sewage treatment plant**
STP type : No sewage treatment plant

**Conditions and measures related to treatment of waste (including article waste)**
Waste treatment : No waste from process

**Other conditions affecting environmental exposure**
Receiving surface water flow : 18,000 m3/d
Indoor or outdoor use : Indoor use

**2.2.2. Control of worker exposure: Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)**
**Product (article) characteristics**
Covers concentrations up to 100 %
Physical form of product : Liquefied gas

**Amount used (or contained in articles), frequency and duration of use/exposure**
Duration : Covers exposure up to 15 min

**Technical and organisational conditions and measures**
Supervision in place to check that the risk management measures in place are being used correctly and operation conditions followed.
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 2014/34/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 26 February 2014 on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres - ATEX 114.
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 J2843 - R-1234yf [HFO-1234yf] Recovery/Recycling/Recharging Equipment for Flammable Refrigerants for Mobile Air-Conditioning 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.
Provide a good standard of controlled ventilation (5 to 10 air changes per hour).
Use in closed process
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.

**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
Wear safety goggles.
Wear suitable face shield.
Use eye protection according to EN 166.
Low temperature resistant gloves
If assessment demonstrates that there is a risk of explosive atmospheres or flash fires, use flame retard ant antistatic protective clothing.
Wear cold-insulating gloves/face shield/eye protection.

**Other conditions affecting workers exposure**
Indoor or outdoor use : Indoor use
Temperature : < 40 °C

### 2.2.3. Control of worker exposure: Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

**Product (article) characteristics**

Covers concentrations up to 100 %
Physical form of product : Liquefied gas
Amount used (or contained in articles), frequency and duration of use/exposure
Duration : 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.
Use frequency : Intermittent release. 0.33 h/day
Technical and organisational conditions and measures
Supervision in place to check that the risk management measures in place are being used correctly and operation conditions followed.
Ensure operatives are trained to minimise exposures.
Provide a basic standard of general ventilation (1 to 3 air changes per hour).
Use in closed process
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.

**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
Wear safety goggles.
Wear suitable face shield.
Use eye protection according to EN 166.
Low temperature resistant gloves
If assessment demonstrates that there is a risk of explosive atmospheres or flash fires, use flame retardant antistatic protective clothing.
Wear cold-insulating gloves/face shield/eye protection.

**Other conditions affecting workers exposure**

Indoor or outdoor use : Indoor use
Temperature : < 40 °C

### 2.3. Exposure estimation and reference to its source

### 2.3.1. Environmental release and exposure: Use of functional fluid at industrial site (ERC7)

| Release route | Release rate | Release estimation method |
|---|---|---|
| Water | 0 kg/day | |
| Air | 135 kg/day | |
| Soil | 0 kg/day | |

| Protection Target | Exposure estimate | RCR |
|---|---|---|
| Freshwater | < 0.0000001 mg/L (EUSES v2.1) | < 0.01 |
| Freshwater sediment | < 0.0000001 mg/kg dry weight (EUSES v2.1) | < 0.01 |
| Marine water | < 0.0000001 mg/L (EUSES v2.1) | < 0.01 |
| Marine sediment | < 0.0000001 mg/kg dry weight (EUSES v2.1) | < 0.01 |
| Agricultural soil | 0.043 mg/kg dry weight (EUSES v2.1) | 0.029 |
| Man via environment - Inhalation | 0.031 mg/m³ (EUSES v2.1) | < 0.01 |

Additional information on exposure estimation
The calculated exposure value is negligibly low.

### 2.3.2. Worker exposure: Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

| Exposure route | Health effect | Exposure indicator | Exposure estimate | RCR |
|---|---|---|---|---|
| inhalative | systemic | long-term | 37 mg/m³ (measured data) | 0.039 |

### 2.3.3. Worker exposure: Transfer of substance or mixture into small containers (dedicated filling line, including weighing) (PROC9)

| Exposure route | Health effect | Exposure indicator | Exposure estimate | RCR |
|---|---|---|---|---|
| inhalative | systemic | long-term | 37 mg/m³ (measured data) | 0.039 |

## ES 3: professional use; Heat transfer fluids - Refrigerants, coolants.; Heat transfer fluids (PC16).; General manufacturing, e.g. machinery, equipment, vehicles, other transport equipment (SU17).

### 3.1. Title section

Exposure Scenario name : Professional, Heat transfer fluids - Refrigerants, coolants
Structured Short Title : professional use; Heat transfer fluids - Refrigerants, coolants.;
Heat transfer fluids (PC16).; General manufacturing, e.g. machinery, equipment, vehicles, other transport equipment
(SU17).

**Environment**
CS 1 Filling of equipment from drums or containers ERC9b

**Worker**
CS 2 Material transfers PROC8b

### 3.2. Conditions of use affecting exposure

### 3.2.1. Control of environmental exposure: Widespread use of functional fluid (outdoor) (ERC9b)

**Product (article) characteristics**
Covers concentrations up to 100 %
Physical form of product : Liquefied gas

**Amount used (or contained in articles), frequency and duration of use/exposure**
Daily amount for wide dispersive uses: 0.000548 tonnes/day
Fraction of EU tonnage used in region: 0.1
Fraction of Regional tonnage used locally: 0.0005
Emission days : 365

**Technical and organisational conditions and measures**
Process designed to minimize releases to wastewater.
Process designed to minimize releases to soil.
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.

**Release fraction to air from process (initial release after RMM) 5 %**
No water contact during use.

**Conditions and measures related to sewage treatment plant**
STP type : Municipal Sewage Treatment Plant

**Conditions and measures related to treatment of waste (including article waste)**
Waste treatment : No waste from process

**3.2.2. Control of worker exposure: Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)**
**Product (article) characteristics**
Covers concentrations up to 100 %
Physical form of product : Liquefied gas

**Amount used (or contained in articles), frequency and duration of use/exposure**
Use frequency : 8 h/day
Duration : 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)
Duration : 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)

**Technical and organisational conditions and measures**
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 2014/34/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 26 February 2014 on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres - ATEX 114.
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 J2843 - R-1234yf [HFO-1234yf] Recovery/Recycling/Recharging Equipment for Flammable Refrig erants for Mobile Air-Conditioning 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.
Provide a good standard of general ventilation (not less than 3 to 5 air changes per hour).
Use in closed process
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.

**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
Wear suitable gloves tested to EN374.
or
US OSHA guidelines
Dermal - minimum efficiency of 80 %

**Other conditions affecting workers exposure**
Indoor or outdoor use : Indoor use
Temperature : < 40 °C

### 3.3. Exposure estimation and reference to its source

### 3.3.1. Environmental release and exposure: Widespread use of functional fluid (outdoor) (ERC9b)

| Protection Target | Exposure estimate | RCR |
|---|---|---|
| Freshwater | < 0.0000001 mg/L (EUSES v2.1) | < 0.01 |
| Freshwater sediment | < 0.0000001 mg/kg dry weight (EUSES v2.1) | < 0.01 |
| Marine water | < 0.0000001 mg/L (EUSES v2.1) | < 0.01 |
| Marine sediment | < 0.0000001 mg/kg dry weight (EUSES v2.1) | < 0.01 |
| Agricultural soil | < 0.0000001 mg/kg dry weight (EUSES v2.1) | < 0.01 |
| Man via environment - Inhalation | 0.0000233 mg/m³ (EUSES v2.1) | < 0.01 |

**Additional information on exposure estimation**

The calculated exposure value is negligibly low.

### 3.3.2. Worker exposure: Transfer of substance or mixture (charging/discharging) at dedicated facilities (PROC8b)

| Exposure route | Health effect | Exposure indicator | Exposure estimate | RCR |
|---|---|---|---|---|
| inhalative | systemic | long-term | 85.6 mg/m³ (measured data) | 0.09 |

## ES 4: professional use; professional use.; Vehicles covered by End of Life Vehicles (ELV) directive (AC1a).; Other vehicles (AC1b).; Machinery, mechanical appliances, electrical/electronic articles (AC2).

### 4.1. Title section

Exposure Scenario name : Professional, Article service life
Structured Short Title : professional use; professional use.; Vehicles covered by End of Life Vehicles (ELV) directive (AC1a).; Other vehicles (AC1b).; Machinery, mechanical appliances, electrical/electronic articles (AC2).

**Environment**

CS 1 Article service life ERC10a

**Worker**

CS 2 Train drivers PROC0
CS 3 Bus drivers PROC0
CS 4 Professional truck driver PROC0
CS 5 Professional Heavy Duty Off-Road Vehicle driver PROC0

### 4.2. Conditions of use affecting exposure

### 4.2.1. Control of environmental exposure: Widespread use of articles with low release (outdoor) (ERC10a)

**Product (article) characteristics**

Covers concentrations up to 100 %
Physical form of product : Liquefied gas

**Amount used (or contained in articles), frequency and duration of use/exposure**

Daily amount for wide dispersive uses: < 0.000038 tonnes/day
Fraction of EU tonnage used in region: 0.001

**Technical and organisational conditions and measures**

Release fraction to air from process (initial release after RMM) 100 %

Worst case assumption

**Conditions and measures related to treatment of waste (including article waste)**
Waste treatment : No waste from process

**4.2.2. Control of worker exposure: Other (PROC0)**
**Product (article) characteristics**
Covers concentrations up to 100 %
Physical form of product : Liquefied gas

**Amount used (or contained in articles), frequency and duration of use/exposure**
Release rate to cabin: : 2 g/year
Use frequency : 12 h/day
Use frequency : 250 days per year

**Technical and organisational conditions and measures**
Provide a good standard of controlled ventilation (5 to 10 air changes per hour).

**Other conditions affecting workers exposure**
Indoor or outdoor use : Indoor use
Room size : 5 m³
Temperature : < 40 °C
Ventilation rate per hour : 6

**4.2.3. Control of worker exposure: Other (PROC0)**
**Product (article) characteristics**
Covers concentrations up to 100 %
Physical form of product : Liquefied gas

**Amount used (or contained in articles), frequency and duration of use/exposure**
Use frequency : 8 h/day

**Other conditions affecting workers exposure**
Indoor or outdoor use : Indoor use
Room size : 50 m³
Temperature : < 40 °C

**4.2.4. Control of worker exposure: Other (PROC0)**
**Product (article) characteristics**
Covers concentrations up to 100 %
Physical form of product : Liquefied gas

**Amount used (or contained in articles), frequency and duration of use/exposure**
Use frequency : 20 h/day

**Technical and organisational conditions and measures**
Provide a basic standard of general ventilation (1 to 3 air changes per hour).

**Other conditions affecting workers exposure**
Indoor or outdoor use : Indoor use
Room size : 3.3 m³
Temperature : < 40 °C
Ventilation rate per hour : 4

**4.2.5. Control of worker exposure: Other (PROC0)**
**Product (article) characteristics**

Covers concentrations up to 100 %
Physical form of product : Liquefied gas
Amount used (or contained in articles), frequency and duration of use/exposure
Use frequency : 8 h/day

**Technical and organisational conditions and measures**
Provide a good standard of controlled ventilation (5 to 10 air changes per hour).

**Other conditions affecting workers exposure**
Indoor or outdoor use : Indoor use
Room size : 1.6 m³
Temperature : < 40 °C
Ventilation rate per hour : 10

### 4.3. Exposure estimation and reference to its source

#### 4.3.1. Environmental release and exposure: Widespread use of articles with low release (outdoor) (ERC10a)

| Protection Target | Exposure estimate | RCR |
|---|---|---|
| Freshwater | < 0.0000001 mg/L (EUSES v2.1) | < 0.01 |
| Freshwater sediment | < 0.0000001 mg/kg dry weight (EUSES v2.1) | < 0.01 |
| Marine water | < 0.0000001 mg/L (EUSES v2.1) | < 0.01 |
| Marine sediment | < 0.0000001 mg/kg dry weight (EUSES v2.1) | < 0.01 |
| Agricultural soil | < 0.0000001 mg/kg dry weight (EUSES v2.1) | < 0.01 |
| Man via environment - Inhalation | 0.0000233 mg/m³ (EUSES v2.1) | < 0.01 |

**Additional information on exposure estimation**
The calculated exposure value is negligibly low.

#### 4.3.2. Worker exposure: Other (PROC0)

| Exposure route | Health effect | Exposure indicator | Exposure estimate | RCR |
|---|---|---|---|---|
| inhalative | systemic | long-term | 0.011 mg/m³ (Consexpo v4.1) | < 0.01 |

#### 4.3.3. Worker exposure: Other (PROC0)

| Exposure route | Health effect | Exposure indicator | Exposure estimate | RCR |
|---|---|---|---|---|
| inhalative | systemic | long-term | 0.086 mg/m³ (Consexpo v4.1) | < 0.01 |

#### 4.3.4. Worker exposure: Other (PROC0)

| Exposure route | Health effect | Exposure indicator | Exposure estimate | RCR |
|---|---|---|---|---|
| inhalative | systemic | long-term | 0.096 mg/m³ (Consexpo v4.1) | < 0.01 |

#### 4.3.5. Worker exposure: Other (PROC0)

| Exposure route | Health effect | Exposure indicator | Exposure estimate | RCR |
|---|---|---|---|---|
| inhalative | systemic | long-term | 0.21 mg/m³ (Consexpo v4.1) | < 0.01 |

### ES 5: Consumer use; Vehicles covered by End of Life Vehicles (ELV) directive (AC1a).;

**Other vehicles (AC1b).**
**5.1. Title section**
Exposure Scenario name : Consumer, Article service life
Structured Short Title : Consumer use; Vehicles covered by End of Life Vehicles (ELV) directive (AC1a).; Other vehicles (AC1b).

**Environment**
CS 1 Article service life ERC10a

**Consumer**
CS 2 Train passengers AC1b
CS 3 Car drivers and passengers AC1b
CS 4 Bus passengers AC1b

**5.2. Conditions of use affecting exposure**
**5.2.1. Control of environmental exposure: Widespread use of articles with low release (outdoor) (ERC10a)**
**Product (article) characteristics**
Covers concentrations up to 100 %
Physical form of product : Liquefied gas

**Conditions and measures related to treatment of waste (including article waste)**
Waste treatment : No waste from process

**5.2.2. Control of consumer exposure: Other vehicles (AC1b)**
**Product (article) characteristics**
Covers concentrations up to 100 %
Physical form of product : Liquefied gas

**Amount used (or contained in articles), frequency and duration of use/exposure**
Amounts used : 0.03 g/event
Duration : 12 h

**Other conditions affecting consumers exposure**
Indoor or outdoor use : Indoor use
Room size : 50 $m^3$
Ventilation rate : 6

**5.2.3. Control of consumer exposure: Other vehicles (AC1b)**
**Product (article) characteristics**
Covers concentrations up to 100 %
Physical form of product : Liquefied gas

**Amount used (or contained in articles), frequency and duration of use/exposure**
Amounts used : 0.006 g/event
Duration : 4 h

**Other conditions affecting consumers exposure**
Indoor or outdoor use : Indoor use
Room size : 1.25 $m^3$
Ventilation rate : 1

**5.2.4. Control of consumer exposure: Other vehicles (AC1b)**
**Product (article) characteristics**
Covers concentrations up to 100 %
Physical form of product : Liquefied gas

**Amount used (or contained in articles), frequency and duration of use/exposure**
Amounts used : 1.04 g/event
Duration : 8 h

**Other conditions affecting consumers exposure**
Indoor or outdoor use : Indoor use
Room size : 50 m³
Ventilation rate : 30

### 5.3. Exposure estimation and reference to its source
**Release estimation method:**
### 5.3.2. Consumer exposure: Other vehicles (AC1b)

| Exposure route | Health effect | Exposure indicator | Exposure estimate | RCR |
|---|---|---|---|---|
| inhalative | systemic | long-term | 0.0082 mg/m³ (ConsExpo) | < 0.01 |

### 5.3.3. Consumer exposure: Other vehicles (AC1b)

| Exposure route | Health effect | Exposure indicator | Exposure estimate | RCR |
|---|---|---|---|---|
| inhalative | systemic | long-term | 0.91 mg/m³ (ConsExpo) | < 0.01 |

### 5.3.4. Consumer exposure: Other vehicles (AC1b)

| Exposure route | Health effect | Exposure indicator | Exposure estimate | RCR |
|---|---|---|---|---|
| inhalative | systemic | long-term | 0.086 mg/m³ (ConsExpo) | < 0.01 |