

R 1234yf

Print date 17.02.2025
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Version 8.0 (en)
replaces version of 09.09.2024 (7.0)

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

1.1 Product identifier

Trade name/designation R 1234yf
Art-Nr(n). 0070
Substance name 2,3,3,3-Tetrafluoroprop-1-ene (R 1234yf)
EC No 468-710-7
REACH No. 01-0000019665-61
CAS No 754-12-1

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

Sector of uses [SU]

SU17 General manufacturing, e.g. machinery, equipment, vehicles, other transport equipment

*** Process categories [PROC]**

PROC0 Other
PROC3 Use in closed batch process (synthesis or formulation)
PROC8b Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities
PROC9 Transfer of substance or preparation into small containers (dedicated filling line, including weighing)
PROC15 Use as laboratory reagent

*** Environmental release categories [ERC]**

ERC2 Formulation into mixture
ERC7 Use of functional fluid at industrial site
ERC9b Widespread use of functional fluid (outdoor)
ERC10a Widespread use of articles with low release (outdoor)

Product Categories [PC]

PC16 Heat transfer fluids

*** Article categories [AC]**

AC1a Vehicles covered by End of Life Vehicles (ELV) directive
AC1b Other vehicles
AC2 Machinery, mechanical appliances, electrical/electronic articles

Use of the substance/mixture

Refrigerant

1.3 Details of the supplier of the safety data sheet

Supplier

GHC Gerling, Holz & Co. Handels GmbH
Ruhrstraße 113
D-22761 Hamburg
Telephone +49 40 853 123 0
E-mail hamburg@ghc.de
Website www.ghc.com

Department responsible for information:
GHC Gerling, Holz & Co. Handels GmbH
Telephone +49 40 853 123 0

E-mail (competent person):
msds@ghc.de

1.4 Emergency telephone number

EN: Poison Information Center Mainz +49 6131 19240

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SECTION 2: Hazards identification**2.1 Classification of the substance or mixture**

Classification according to Regulation (EC) No 1272/2008 [CLP]	Classification procedure
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Flam. Gas 1B, H221

Press. Gas (Liq.), H280

Hazard statements for physical hazards

H221 Flammable gas.

H280 Contains gas under pressure; may explode if heated.

2.2 Label elements**Labelling according to Regulation (EC) No 1272/2008 [CLP]****Hazard pictograms**

GHS02

Signal word

Danger

Hazard statements

H221 Flammable gas.

H280 Contains gas under pressure; may explode if heated.

Precautionary statements

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 In case of leakage, eliminate all ignition sources.

P403 Store in a well-ventilated place.

Supplemental hazard information

EIGA0357 Asphyxiant in high concentrations.

EIGA0787 Contains fluorinated greenhouse gases.

Please return container with residual pressure.

2.3 Other hazards**Adverse human health effects and symptoms**

Gas/vapour heavier than air. May accumulate in confined spaces, particularly at or below ground level.

The inhalation of gas / vapour in high concentrations may cause cardiac arrhythmia.

Contact with liquid may cause cold burns/frostbite.

Other adverse effects

The substance/mixture does not contain components identified as having endocrine disrupting properties according to REACH Article 57(f) or Commission Delegated Regulation (EU) 2017/2100 or Commission Delegated Regulation (EU) 2018/605 in quantities of 0.1% or more.

Results of PBT and vPvB assessment

The substance/mixture does not contain components meeting the PBT/vPvB criteria of the Reach Regulation, Annex XIII, at levels of 0.1% or higher.

SECTION 3: Composition / information on ingredients**3.1 Substances**

Substance name	2,3,3,3-Tetrafluoroprop-1-ene (R 1234yf)
EC No	468-710-7
REACH No.	01-0000019665-61
CAS No	754-12-1
ATE	ATE(inhalation gas): > 405000 ppm

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3.2 Mixtures

not applicable

SECTION 4: First aid measures

4.1 Description of first aid measures

General information

Remove contaminated, saturated clothing immediately.
In the event of persistent symptoms obtain medical treatment.
First aider: Pay attention to self-protection!

Following inhalation

Remove casualty to fresh air and keep warm and at rest.
In case of respiratory standstill give artificial respiration by respiratory bag (Ambu bag) or respirator. Obtain medical assistance.

Following skin contact

In case of skin contact rinse with warm water.
In case of frostbite, wash with plenty of water; do not remove clothing.
In case of frostbite rinse with lukewarm (not hot) water for at least 15 minutes. Do not remove clothing frozen to the skin.
Thaw with lukewarm water. Apply a sterile dressing. Obtain medical assistance.

After eye contact

Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Obtain medical assistance.

Following ingestion

Ingestion is not considered a potential route of exposure.

4.2 Most important symptoms and effects, both acute and delayed

Symptoms

The following symptoms may occur in case of strong exposition:
Unconsciousness
Cardiac arrhythmias
Dizziness
Nausea
Headache

Effects

Long-term inhaling of separation products may cause pulmonary oedema.

4.3 Indication of any immediate medical attention and special treatment needed

Notes for the doctor

Treat symptomatically.
Do not apply drugs of the adrenaline ephedrine group.

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media

Extinguishing powder
Water spray jet
alcohol resistant foam
Carbon dioxide (CO₂)

Unsuitable extinguishing media

Full water jet

5.2 Special hazards arising from the substance or mixture

Hazardous combustion products

In case of fire formation of dangerous gases possible.
Carbon monoxide
Carbon dioxide (CO₂)
Hydrogen fluoride
Carbonyl fluoride

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5.3 Advice for firefighters

Special protective equipment for firefighters

Wear a self-contained breathing apparatus and chemical protective clothing.

Additional information

If possible, shut off gas valves and move containers to a safe location.
Use water spray jet to protect personnel and to cool endangered containers.
Exposure to fire may cause rupture / explosion of the containers.
Do not extinguish a leaking gas flame unless absolutely necessary. Spontaneous/explosive re-ignition may occur. Extinguish any other fire.
Dispose of fire residues and contaminated extinguishing water in accordance with local, official regulations.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

For non-emergency personnel

Use personal protection equipment.
Leave the danger area.
Keep people away and stay on the upwind side.

For emergency responders

Personal protection by wearing close-fitting protective clothing and breathing apparatus.
Pay attention to extension of gas especially at ground (heavier than air) and in direction of the wind.
Remove persons to safety.
Eliminate all ignition sources if safe to do so.

6.2 Environmental precautions

If possible, stop flow of product.
Do not allow to enter into soil/subsoil.
Do not allow to enter into surface water or drains.

6.3 Methods and material for containment and cleaning up

For containment

If necessary, secure leaky pressure receptacles using a salvage container.
Prevent the liquid from spreading over a wide area (set up barriers, cover sewage systems).
Limit expansion of the gas (water spray jet).

For cleaning up

Leave to vapourize.
Provide adequate ventilation.

6.4 Reference to other sections

Disposal: see section 13
Personal protection equipment: see section 8

SECTION 7: Handling and storage

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7.1 Precautions for safe handling**Protective measures**

Use only in well-ventilated areas.
 Transfer and handle product only in closed systems.
 Usual measures for fire prevention.
 Containers' temperature should not be increased above 50 °C.
 The working pressure in the receptacle must not exceed the saturation vapour pressure of the pure product resulting at a temperature of 50 °C.
 Prevent cylinders from falling over.
 Take precautionary measures against static discharges. Ground barrels and installations. Use only antistatically equipped (spark-free) tools.
 Use explosion-proof machinery, apparatus, ventilation facilities, tools etc.
 Ensure valve protection device is correctly fitted.
 Ensure valve outlet cap nut or plug (where provided) is correctly fitted.
 Open valve slowly to avoid pressure shock.
 Do not allow backflow into the container.
 Entering of water into the container must be prevented.
 No water to valves, flanges and other fittings.
 Purging of pipes and valves with inert gases - to avoid: water, solvents.

Advices on general occupational hygiene

When using do not eat, drink, smoke, sniff.
 Wash hands before breaks and after work.
 Remove contaminated clothing and protective equipment before entering eating areas.

7.2 Conditions for safe storage, including any incompatibilities**Requirements for storage rooms and vessels**

All regulations and local requirements for the storage of containers have to be respected.
 Keep container tightly closed and in a well-ventilated place.
 Containers' temperature should not be increased above 50 °C.
 Prevent cylinders from falling over.
 Only use containers specifically approved for the substance/product.
 Information on suitable materials for receptacles and valves see ISO 11114.

Materials to avoid

Do not store together with explosives.
 Do not store together with flammable liquids.
 Do not store together with flammable solids.
 Do not store together with pyrophoric and self-heating substances.
 Do not store together with oxidizing liquids or oxidizing solids.
 Do not store together with toxic liquids or toxic solids.
 Do not store together with infectious substances.
 Do not store together with radioactive material.
 Do not store together with food or feed.

7.3 Specific end use(s)**Recommendation**

See section 1.2
 Exposure scenarios (ES) see annex to this safety data sheet.

*** SECTION 8: Exposure controls/personal protection***** 8.1 Control parameters****DNEL worker**

CAS No	Substance name	DNEL value	DNEL type	Remark
754-12-1	2,3,3,3-Tetrafluoroprop-1-ene (R 1234yf)	186400 mg/m ³	acute inhalative (systemic)	Assessment factor 5
754-12-1	2,3,3,3-Tetrafluoroprop-1-ene (R 1234yf)	950 mg/m ³	long-term inhalative (systemic)	

DNEL Consumer

CAS No	Substance name	DNEL value	DNEL type	Remark
754-12-1	2,3,3,3-Tetrafluoroprop-1-ene (R 1234yf)	186400 mg/m ³	acute inhalative (systemic)	Assessment factor 5, assessment factor.

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CAS No	Substance name	DNEL value	DNEL type	Remark
754-12-1	2,3,3,3-Tetrafluoroprop-1-ene (R 1234yf)	113.1 mg/m ³	long-term inhalative (systemic)	Assessment factor 2, assessment factor.

PNEC

CAS No	Substance name	PNEC Value	PNEC type	Remark
754-12-1	2,3,3,3-Tetrafluoroprop-1-ene (R 1234yf)	0.1 mg/L	aquatic, freshwater	Assessment factor 1000, assessment factor.
754-12-1	2,3,3,3-Tetrafluoroprop-1-ene (R 1234yf)	1 mg/L	aquatic, intermittent release	Assessment factor 100
754-12-1	2,3,3,3-Tetrafluoroprop-1-ene (R 1234yf)	0.01 mg/L	aquatic, marine water	Assessment factor 10000, assessment factor.
754-12-1	2,3,3,3-Tetrafluoroprop-1-ene (R 1234yf)	1.51 mg/kg dw	sediment, freshwater	
754-12-1	2,3,3,3-Tetrafluoroprop-1-ene (R 1234yf)	0.151 mg/kg dw	sediment, marine water	
754-12-1	2,3,3,3-Tetrafluoroprop-1-ene (R 1234yf)	1.49 mg/kg	soil	

8.2 Exposure controls**Appropriate engineering controls****Technical measures to prevent exposure**

Transfer and handle only in enclosed systems.

Personal protection equipment**Eye/face protection**

Protective goggles according to EN 166, in case of increased risk add protective face shield.

Hand protection

Safety gloves according to EN 388:
 Chromate-free leather

Body protection:

Safety shoes with steel toecap.
 Body covering work clothing or chemical resistant suit at increased risk.

Respiratory protection

Keep self contained breathing apparatus readily available for emergency use.

Respiratory protection necessary at:

high concentrations

Respiratory protection complying with EN 137.

Do not use any filter apparatus.

In case of rescue and maintenance activities in storage containers use environment-independent breathing apparatus because of risk of suffocation due to displacement of oxygen.

Thermal hazards

Use cold-resistant protective equipment.

Environmental exposure controls**Remark**

Prevent release to the environment.

SECTION 9: Physical and chemical properties**9.1 Information on basic physical and chemical properties****Physical state**

Gaseous / liquefied under pressure.

Colour

colourless

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Odour

faintly of ether

Safety relevant basis data

	Value	Method	Source, Remark
Odour threshold:			not determined
Melting point/freezing point			not applicable
Boiling point or initial boiling point and boiling range	-29 °C pressure 1013 hPa		
flammability			inflammable
Lower and upper explosion limit	Upper explosion limit 12.3 Vol-%		
Lower and upper explosion limit	Lower explosion limit 6.2 Vol-%		
Flash point			not applicable
Auto-ignition temperature	405 °C		
Decomposition temperature			No decomposition if used as directed.
pH			not applicable
Viscosity			not applicable
Solubility(ies)	Water solubility 198.2 mg/L (24°C)	92/69/EEC, A.8	
Partition coefficient n-octanol/water (log value)	2 (25°C)	92/69/EEC, A.8	
Vapour pressure	5800 hPa (20°C)		
Density and/or relative density			not applicable
Relative vapour density	4		Air = 1.
particle characteristics			not applicable

9.2 Other information**Information with regard to physical hazard classes****Gases under pressure****Safety characteristics**

	Value	Method, Result	Source, Remark
Critical temperature	94.8 °C		

Other information

Vapours are heavier than air.

SECTION 10: Stability and reactivity**10.1 Reactivity**

Formation of explosive gas mixtures in contact with air.

10.2 Chemical stability

The substance is chemically stable under recommended conditions of storage, use and temperature.

10.3 Possibility of hazardous reactions

Must not be mixed with air or oxygen.

Danger of fire and explosion with oxidants, alkali metals and earth alkali metals.

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10.4 Conditions to avoid

Heat sources / heat - risk of bursting.
 Ignition sources, open flames, glowing metal surfaces, etc.

10.5 Incompatible materials

Alkali metals
 Alkaline earth metal
 Powdered metals
 Oxidising agent, strong

10.6 Hazardous decomposition products

When handled and stored appropriately, no dangerous decomposition products are known.

SECTION 11: Toxicological information**11.1 Information on hazard classes as defined in Regulation (EC) No 1272/2008****Acute toxicity****Animal data**

	Effective dose	Method, Evaluation	Source, Remark
Acute oral toxicity			Study technically not feasible.
Acute dermal toxicity			Study technically not feasible.
Acute inhalation toxicity	CAS No754-12-1 2,3,3,3-Tetrafluoroprop-1-ene (R 1234yf) Acute inhalation toxicity (gas) LC50: > 405000 ppm Species Rat Exposure time 4 h	OECD 403	

Assessment/classification

Based on available data, the classification criteria are not met.

Skin corrosion/irritation**Other information**

Study technically not feasible.

Serious eye damage/irritation**Other information**

Study technically not feasible.

Sensitisation to the respiratory tract**Other information**

No data available

Skin sensitisation**Other information**

Study technically not feasible.

Germ cell mutagenicity

	Value	Method	Result / Evaluation	Remark
In vitro mutagenicity/genotoxicity		OECD 473	negative	
In vivo mutagenicity/genotoxicity		OECD 474	negative	

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Assessment/classification

Based on available data, the classification criteria are not met.

Carcinogenicity**Other information**

No data available

Reproductive toxicity**Animal data**

	Value	Method	Result / Evaluation	Remark
Reproductive toxicity	inhalative NOAEC 50000 ppm Species Rat	OECD 416		

Assessment/classification

Based on available data, the classification criteria are not met.

STOT-single exposure**STOT SE 1 and 2****Assessment/classification**

Based on available data, the classification criteria are not met.

STOT-repeated exposure**Assessment/classification**

Based on available data, the classification criteria are not met.

Aspiration hazard**Assessment/classification**

Study technically not feasible.

11.2 Information on other hazards**Additional information**

The inhalation of gas / vapour in high concentrations may cause cardiac arrhythmia.
 Inhalation causes narcotic effects/intoxication.

*** SECTION 12: Ecological information****12.1 Toxicity****Aquatic toxicity**

	Effective dose	Method, Evaluation	Source, Remark
Acute (short-term) fish toxicity	LC50: > 197 mg/L Species Cyprinus carpio (Common Carp) Test duration 96 h	OECD 203	
Chronic (long-term) fish toxicity	not determined		
Acute (short-term) toxicity to crustacea	EC50 > 100 mg/L Species Daphnia magna (Big water flea) Test duration 48 h	OECD 202	
Chronic (long-term) toxicity to aquatic invertebrate	not determined		
Acute (short-term) toxicity to algae and cyanobacteria	EC50 > 100 mg/L Species Pseudokirchneriella subcapitata Test duration 72 h	OECD 201	
Chronic (long-term) toxicity to aquatic algae and cyanobacteria	not determined		
Toxicity to other aquatic plants/organisms	not determined		
Toxicity to microorganisms	not determined		

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12.2 Persistence and degradability

	Value	Method	Source, Remark
Biodegradation	Degradation rate < 5 % Test duration 28 d	OECD 301F/ ISO 9408/ EEC 92/69/V, C.4-D	CAS No754-12-1 2,3,3,3-Tetrafluoroprop-1-ene (R 1234yf)

Assessment/classification

Not readily biodegradable (according to OECD criteria)

12.3 Bioaccumulative potential**Assessment/classification**

Based on the n-octanol/water partition coefficient accumulation in organisms is not expected.

12.4 Mobility in soil

	Value	Distribution	Transport type	Method	Remark
Half-life time in soil	CAS No754-12-1 2,3,3,3-Tetrafluoroprop-1-ene (R 1234yf) < 18			KOC value	

12.5 Results of PBT and vPvB assessment

The substance/mixture does not contain components meeting the PBT/vPvB criteria of the Reach Regulation, Annex XIII, at levels of 0.1% or higher.

12.6 Endocrine disrupting properties

	Effective dose	Method,Evaluation	Source, Remark
Endocrine disrupting properties			See section 2.3

*** 12.7 Other adverse effects**

	Value	Method	Source, Remark
Ozone depletion potential (ODP):	0		
Global warming potential (GWP)	1		

SECTION 13: Disposal considerations**13.1 Waste treatment methods****Waste codes/waste designations according to EWC/AVV**

Waste code product	Waste name
140601 *	chlorofluorocarbons, HCFC, HFC

Appropriate disposal / Product

Waste disposal according to directive 2008/98/EC, covering waste and dangerous waste.
 Prevent release to the environment. No disposal via the sewage.
 Disposal according to local regulations.

Appropriate disposal / Package

Transportable pressure equipment (empty, residual pressure): Return to supplier / manufacturer.

SECTION 14: Transport information

	Land transport (ADR/RID)	Sea transport (IMDG)	Air transport (ICAO-TI / IATA-DGR)
14.1 UN number or ID number	UN 3161	UN 3161	UN 3161
14.2 UN proper shipping name	LIQUEFIED GAS, FLAMMABLE, N.O.S. (2,3,3,3-Tetrafluoroprop-1-ene)	LIQUEFIED GAS, FLAMMABLE, N.O.S. (2,3,3,3-Tetrafluoroprop-1-ene)	Liquefied gas, flammable, n.o.s. (2,3,3,3-Tetrafluoroprop-1-ene)
14.3 Transport hazard class(es)	2.1	2.1	2.1

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	Land transport (ADR/RID)	Sea transport (IMDG)	Air transport (ICAO-TI / IATA-DGR)
14.4 Packing group	-	-	-
14.5 Environmental hazards	No	No	No

14.6 Special precautions for user

The protective measures listed in Sections 6, 7 and 8 of the Safety Data Sheet have to be considered.

14.7 Maritime transport in bulk according to IMO instruments

No carriage in bulk.

Land transport (ADR/RID)

UN number or ID number	UN 3161
UN proper shipping name	LIQUEFIED GAS, FLAMMABLE, N.O.S. (2,3,3,3-Tetrafluorprop-1-en)
Transport hazard class(es)	2.1
Hazard label(s)	2.1
Classification code	2F
Packing group	-
Environmental hazards	No
Limited quantity (LQ)	0
Special provisions	274, 662
Tunnel restriction code	B/D

Sea transport (IMDG)

UN number or ID number	UN 3161
UN proper shipping name	LIQUEFIED GAS, FLAMMABLE, N.O.S. (2,3,3,3-Tetrafluorprop-1-ene)
Transport hazard class(es)	2.1
Packing group	-
Environmental hazards	No
Limited quantity (LQ)	0
Marine pollutant	No
EmS	F-D, S-U

Air transport (ICAO-TI / IATA-DGR)

UN number or ID number	UN 3161
UN proper shipping name	Liquefied gas, flammable, n.o.s. (2,3,3,3-Tetrafluorprop-1-ene)
Transport hazard class(es)	2.1
Packing group	-
Environmental hazards	No

SECTION 15: Regulatory information**15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture****EU legislation****Restrictions of occupation**

Observe employment restrictions under the Maternity Protection Directive (92/85/EEC) for expectant or nursing mothers.
 Observe restrictions to employment for juvenils according to the 'juvenile work protection guideline' (94/33/EC).

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Other regulations (EU)

To follow:

Regulation (EU) 2024/573 on fluorinated greenhouse gases.
Regulation (EC) No 1907/2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), Annex XVII No 40.
Directive 2012/18/EU on the control of major-accident hazards involving dangerous substances.
National and local regulations concerning chemicals shall be observed.

Directive 2010/75/EU on industrial emissions [Industrial Emissions Directive] VOC
VOC-value $\geq 99\%$

15.2 Chemical Safety Assessment

National regulations

For this substance a chemical safety assessment has been carried out.

SECTION 16: Other information

Key literature references and sources for data

Information from our suppliers and data from the "GESTIS Substances Database" and the "Registered Substances" database of the European Chemicals Agency (ECHA) were used to create this safety data sheet.

Additional information

The information contained herein is based on the state of our knowledge. It characterizes the product with regard to the appropriate safety precautions. It does not represent a guarantee of the properties of the product.

Relevant H- and EUH-phrases (Number and full text)

H221 Flammable gas.
H280 Contains gas under pressure; may explode if heated.

Indication of changes

* Data changed compared with the previous version

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Annex: Exposure Scenarios

Table of Contents

Number	Title
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).

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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 re-packaging (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	

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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.

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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 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

1.2.3. 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.	

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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.	

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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

1.2.5. 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

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Ventilation rate per hour	: 3
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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/m ³ (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/m ³ (measured data)	0.098

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

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Exposure route	Health effect	Exposure indicator	Exposure estimate	RCR
inhalative	systemic	long-term	93.25 mg/m ³ (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/m ³ (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/m ³ (Consex-po v4.1)	0.013

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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.	

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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	
<p>Supervision in place to check that the risk management measures in place are being used correctly and operation conditions followed.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>ISO 13043:2011 - Road vehicles - Refrigerant systems used in mobile air conditioning systems (MAC) - Safety requirements</p> <p>SAE J639 - Safety Standards for Motor Vehicle Refrigerant Vapor Compressions Systems</p> <p>SAE J2843 - R-1234yf [HFO-1234yf] Recovery/Recycling/Recharging Equipment for Flammable Refrigerants for Mobile Air-Conditioning Systems</p> <p>SAE J2845 - R-1234yf [HFO-1234yf] and R-744 Technician Training for Service and Containment of Refrigerants Used in Mobile A/C Systems</p> <p>Regular inspection and maintenance of equipment and machines</p>	

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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 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

2.2.3. 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.	

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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

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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/m ³ (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/m ³ (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/m ³ (measured data)	0.039

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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.	

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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	
<p>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</p>	

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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 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

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Man via environment - Inhalation	0.0000233 mg/m ³ (EUSES v2.1)	< 0.01
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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/m ³ (measured data)	0.09

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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 %	

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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 m ³
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	

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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	

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Indoor or outdoor use	: Indoor use
Room size	: 1.6 m ³
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/m ³ (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/m ³ (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/m ³ (Consexpo v4.1)	< 0.01

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4.3.4. Worker exposure: Other (PROC0)

Exposure route	Health effect	Exposure indicator	Exposure estimate	RCR
inhalative	systemic	long-term	0.096 mg/m ³ (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/m ³ (Consexpo v4.1)	< 0.01

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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	

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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

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Room size	: 50 m ³
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/m ³ (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/m ³ (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/m ³ (ConsExpo)	< 0.01