SAFETY DATA SHEET

ACCORDING TO EC-REGULATION 1272/2008 (CLP/GHS).

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

1.1 Product identifier

Product name	Hexafluoropropene
Chemical name	Hexafluoropropene
Trade name	Hexafluoropropene
Alternative names	Monomer-6; 1,1,2,3,3,3-hexafluoroprop-1-ene
Formula	C_3F_6
EC No.	204-127-4
REACH Registration No.	01-2119471981-30-0013
CAS No.	116-15-4

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

Identified use(s)	Intended for production of various polymers and copolymers, and various fluoroorganic compounds.
Uses advised against	None when used as intended

1.3 Details of the supplier of the Safety Data Sheet

1.3.1	Manufacturer	«HaloPolymer Kirovo-Chepetsk», LLC per. Pozharny, 2, 613040, Kirovo-Chepetsk, Kirov Region, The Russian Federation.
	Telephone	+7-83361-9-4281
	Fax	+7-83361-9-3594
	Website	www.halopolymer.com
1.3.2	Only representative of a non-Community manufacturer	URALCHEM Assist GmbH Johannssenstrasse 10 30159, Hannover, Germany
	Telephone	+49-511/45 99 444
	Fax	+49-511/45 99 446
	E-mail	info@uralchem-assist.de

1.4 Emergency telephone number

Manufacturer/supplier:	+7-83361-9-4250 [24 hours.]
Emergency number	
Europe	112
Great Britain	+44 (0) 203 394 9870 (24/7)
The USA	+1-877 271 7077
	Consult the relevant national official advisory body if necessary

2. SECTION 2: HAZARDS IDENTIFICATION

Classification and labeling have been performed according to Regulation (EC) No. 1272/2008 (CLP/GHP)

2.1 Classification of the substance

2.1.1 Classification according to Regulation (EC) No 1272/2008 [CLP/GHS]

Hazard class and category:
Liquefied gas
Acute Toxicity - Inhalation (Acute Tox. 4)
Specific target organ toxicity – single (STOT Single Exp. 2)
Specific target organ toxicity – single (STOT Single Exp. 3)
Specific target organ toxicity – repeated (STOT Rep. Exp. 2)

2.2 Label elements

Labeling according to Regulation (EC) No 1272/2008 [CLP/GHS]

Hazard Pictogram:

GHS04 GHS08 GHS07

Signal word: WARNING

	Hazard statements:	H280: Contains gas under pressure; may explode if heated. H332: Harmful if inhaled H335: May cause respiratory irritation H371: May cause damage to the kidneys by inhalation. H373: May cause damage to the kidneys through prolonged or repeated inhalation.
	Precautionary Statements:	P260 Do not inhale dust/fume/gas/mist/vapors/spray. P264 Wash hands thoroughly after handling. P270 Do not eat, drink or smoke when using this product. P271: May cause fire or explosion; strong oxidizer P312: Call a POISON CENTER/doctor/ if you feel unwell. P308+P311 IF exposed or concerned: Call a POISON CENTER/ doctor/ P304+P340+P312: IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER or doctor/physician if you feel unwell P403+P233: Store in a well-ventilated place. Keep container tightly closed. P405: Store locked up. P410 + P403: Protect from sunlight. Store in a well-ventilated place.
2.3	**Other hazards**	When heated, the product is decomposed with formation of toxic and corrosive vapours.
2.4	**Additional Information**	See Section 11

3. SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Product identifier type in accordance with Article 18(2) of Regulation (EC) No 1272/2008	Identifier number	Identification name	Weight % content (or range)	EC Number
CAS number	116-15-4	Hexafluoropropene	≤ 100	204-127-4

3.2 Mixtures — Not applicable.
3.3 Additional Information — None.

4. SECTION 4: FIRST AID MEASURES

4.1 Description of first aid measures

Inhalation	Move to fresh air. Oxygen or artificial respiration if needed. Victim to lie down in the recovery position, cover and keep him warm. Call a physician immediately
Skin Contact	Take off contaminated clothing and shoes immediately. Wash off immediately with plenty of water. Keep warm and in a quiet place. Call a physician or poison control centre immediately. Wash contaminated clothing before re-use.
Eye Contact	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Call a physician or poison control centre immediately. Take victim immediately to hospital.
Ingestion	Due to its physical form, exposure to this chemical is not likely. Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth out with water. Get immediate medical advice/attention.

4.2	**Most important symptoms and effects, both acute and delayed**	May cause drowsiness or dizziness. Contact with the liquid may cause cold burns/frostbite. Direct contact with the liquefied gas may cause severe and possibly permanent eye injury due to frostbite from rapid liquid evaporation.
4.3	**Indication of immediate medical attention and special treatment needed**	No specific requirements

5. SECTION 5: FIRE-FIGHTING MEASURES

5.1	**Extinguishing Media**	
	Suitable Extinguishing Media	Use large volumes of water as fog. Large fires: sprayed water or fog. Small ignitions: dry chemical or CO_2.
	Unsuitable Extinguishing Media	All fire-extinguishing means except carbon-dioxide fire extinguishers, inert gases, and sprayed water.
5.2	**Special hazards arising from the substance or mixture**	The product is a liquefied and hardly combustible gas.
5.3	**Advice for fire-fighters**	In the event of fire, wear self-contained breathing apparatus. Use personal protective equipment. Wear chemical resistant oversuit Cool containers / tanks with water spray.

6. SECTION 6: ACCIDENTAL RELEASE MEASURES

6.1	**Personal precautions, protective equipment and emergency procedures**	Advice for non-emergency personnel: - Prevent further leakage or spillage if safe to do so. - Keep away from Incompatible products (see Section 10). Advice for emergency responders: - Evacuate personnel to safe areas. - Keep people away from and upwind of spill/leak. - Ventilate the area. - Wear suitable protective clothing. Refer to protective measures listed in sections 7 and 8.
6.2	**Environmental precautions**	Should not be released into the environment.
6.3	**Methods and material for containment and cleaning up**	Allow small spillages to evaporate provided there is adequate ventilation.
6.4	**Reference to other sections**	See Sections 7, 8 and 13
6.5	**Additional Information**	None

7. SECTION 7: HANDLING AND STORAGE

7.1	**Precautions for safe handling**	Additional hazards when processed: Pressurized container: Do not pierce or burn, even after use. Close valve after each use and when empty. Precautions for safe handling: Do not handle until all safety precautions have been read and understood. Ensure good ventilation of the work station. Do not breathe fumes, gas, mist, spray, vapors. Wear personal protective equipment. Avoid contact with skin and eyes. Safe handling of the gas receptacle: Securely chain cylinders when in use and protect against physical damage. Hygiene measures: Handle in accordance with good industrial hygiene and safety procedures. Do not eat, drink or smoke when using this product. Always wash hands after handling the product.
7.2	**Conditions for safe storage, including any incompatibilities**	Protect from sunlight. Do not expose to temperatures exceeding 50 °C. Keep container closed when not in use. Store in dry, cool, well-ventilated area. Incompatible materials: Alkali metals. Finely divided metals (Al, Mg, Zn). Strong oxidizing agents.
7.3	**Specific end use(s)**	Intended for production of various polymers and copolymers, and various fluoroorganic compounds.

8. SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

8.1.1 Occupational Exposure Limits

Substance	Hexafluoropropene			
CAS No.	116-15-4			
	Limit value - Eight hours		Limit value - Short term	
	ppm	mg/m³	ppm	mg/m³
Belgium	0,1	0,6		
Canada - Ontario				0,005 (1)(2)
People's Republic of China		4		
	Remarks			
Canada - Ontario	(1) Ceiling limit value (2) Inhalable aerosol and vapour			

8.1.2 Biological limit value

No information available.

8.1.3 PNECs and DNELs

Long-term exposure - inhalation - systemic effects
DNEL: 0,62 mg/m³

8.2 Exposure controls

8.2.1 Appropriate engineering controls

Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits.
Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

8.2.2 Personal protection equipment

Eye/face protection

Safety glasses and face shield. At work use shock-proof safety glasses without ventilation.

Skin protection

Protective gloves.

Respiratory protection

If there is a probability that the exposure level is above 2 ppm, use approved NIOSH with full face-piece and forced air supply or of similar design. To increase the level of protection, use it together with a self-contained breathing apparatus.

Skin and body protection

Suitable protective clothing, safety shoes, protective headgear which prevent contact of hexafluoropropene with skin. All protective equipment should be clean, available every day, and should be worn before work.

Hygiene measures

Follow the industrial hygiene precautions
(in rooms where the product is handled):
- workers whose clothes are become dirty with hexafluoropropene must change into the clean clothes in proper time;
- eating, smoking, and drinking are not allowed;
- it is necessary to wash hands before eating, drinking, smoking, or going to the toilet;
- after working shift it is necessary to take a shower-bath.

8.2.3 Environmental Exposure Controls

Control of product content in atmospheric air. Use closed systems, ventilation. To avoid the product release to atmosphere, the workroom

air must be cleaned and directed for dispersion to atmosphere. Waste water of production process must be treated according to the manufacturing instructions.

9. SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

9.1	**Information on basic physical and chemical properties**	
	Physical state at 20°C and 101.3 kPa	Liquefied gas
	Colour	Colourless.
	Odour	Odourless.
	Melting Point (°C) / Freezing Point (°C)	Not applicable
	Boiling point	Not applicable
	Flash Point (°C)	Not applicable
	Flammability (solid, gas)	non flammable
	Explosive limit ranges at 20°C and 101.3 kPa	Not applicable
	Vapour Pressure (MPa)	0.587
	Surface tension	Not applicable
	Relative density (g/cm^3) @ 25ºC	6,14x10^{-3}
	Solubility (Water) (mg/L) @ 28ºC	82
	Stability in organic solvents and identity of relevant degradation products	Not applicable
	Partition Coefficient (n-Octanol/water)	1.95
	Self-ignition temperature (°C)	Not applicable; test substance is a gas with no flammable range in air.
	Viscosity (mPa.s)	Not applicable
	Explosive properties	Non-explosive, based on structural examination.
	Oxidizing properties	Not applicable
9.2	**Other information**	None

10.SECTION 10: STABILITY AND REACTIVITY

10.1	**Reactivity**	Halogenates, hydrates, dimerizes, and reacts with ammonia, hydrogen sulfide, alcohols, ethers, inorganic oxides
10.2	**Chemical stability**	Stable under recommended storage conditions.
10.3	**Possibility of hazardous reactions**	The possibility of thermodestruction.
10.4	**Conditions to avoid**	Do not expose to direct solar radiation. Do not overheat in order to avoid thermodestruction.
10.5	**Incompatible materials**	Alkali metals. Finely divided metals (Al, Mg, Zn). Strong oxidizing agents.
10.6	**Hazardous Decomposition Product(s)**	When exposed to temperature above 500 °C, the product can decompose to form toxic substances: perfluoroisobutene, tetrafluoroethylene, octafluorocyclobutane. The final products of thermal degradation are carbon oxides, fluorine, hydrofluoride.

11.SECTION 11: TOXICOLOGICAL INFORMATION

11.1	**Information on toxicological effects**	
11.1.1	**Acute toxicity**	
	Inhalation / Skin Contact / Eye Contact	Inhalation: LC50 (rat) (4 h): 3060 ppm (male) LC50 (mouse) (4 h): 2000 — 2600 ppm LC50 (guinea pig) (4 h): 2000 — 2600 ppm LC50 (rabbit) (4 h): 2000 — 2600 ppm
11.1.2	**Skin corrosion/irritation**	not irritating
11.1.3	**Serious eye damage/irritation**	not irritating
11.1.4	**Respiratory or skin sensitization**	not sensitizing
11.1.5	**Mutagenicity**	Negative mutagenicity tests support no classification
11.1.6	**Carcinogenicity**	Not available
11.1.7	**Reproductive toxicity**	The test substance did not adversely affect reproductive organs in a 90-day study. The substance does not need to be classified for reproductive toxicity according the EU Classification, Labelling and

		Packaging of Substances and Mixtures (CLP) Regulation (EC) No. 1272/2008.
11.1.8	Repeated dose toxicity: sub-acute / sub-chronic / chronic	Based on the results of repeated inhalation studies, the substance is classified as Specific Target Organ Toxicity Repeated Exposure Category 2 (Kidney) according to the EU Classification, Labelling and Packaging of Substances and Mixtures (CLP) Regulation (EC) No. 1272/2008.
11.2	**Other information**	None

12.SECTION 12: ECOLOGICAL INFORMATION

12.1	**Toxicity**	Based on the results of the aquatic toxicity studies and the relevant mammalian toxicity, the substance is not toxic (not T).
12.2	**Persistence and degradability**	The test substance is not expected to undergo appreciable biodegradation, does not hydrolyze, and is unlikely to degrade via direct photodegradation given no UV absorbance above 290 nm. However, the test substance undergoes atmospheric oxidation with a half-life of 6.2 days and does not contribute to ozone depletion or global warming.
12.3	**Bioaccumulative potential**	Atmospheric oxidation in laboratory studies resulted in the formation of carbonyl fluoride and trifluoroacetyl fluoride. These degradates are incorporated into raindrops/aerosols in the atmosphere and in the water phase degraded to trifluoroacetic acid, hydrogen fluoride, and carbon dioxide.
12.4	**Mobility in soil**	The test substance is a gas under all environmental conditions and only slightly soluble in water. It has a high vapour pressure (587952 Pa) and Henry's Law constant (1.08E6 Pa m^3/mol), and low log Kow (1.95) and Koc (47.5 L/kg). Environmental releases will result in virtually all of the substance compartmentalizing into the atmosphere. Any potential atmospheric deposition to land and water would result in rapid redistribution from soil and water due to its volatility and low sorption to soil.
12.5	**Results of PBT and VPVB assessment**	Regarding all available data on biotic and abiotic degradation, bioaccumulation and toxicity it can be stated that the substance does not fulfill the PBT criteria (not PBT) nor does it fulfill the vPvB criteria (not vPvB).
12.6	**Other adverse effects**	No information available.

13.SECTION 13: DISPOSAL CONSIDERATIONS

13.1	**Waste treatment methods**	Pressurized gas bottle: dispose of only in empty condition! Dispose of contents in accordance with local, state or national legislation.
13.2	**Additional Information**	
13.2.1	Contaminated packaging:	Where possible recycling is preferred to disposal or incineration. Dispose as unused product according to the local and national standards.

14.SECTION 14: TRANSPORT INFORMATION

14.1	**Land transport (ADR/RID):**	
	UN-No.:	1858
	Proper shipping name	HEXAFLUOROPROPYLENE (REFRIGERANT GAS R 1216)
	Transport hazard class(es)	2
	Labels	2.2
14.2	**Inland water ways transport (ADN):**	
	UN-No.:	1858
	Proper Shipping Name:	HEXAFLUOROPROPYLENE (REFRIGERANT GAS R 1216)
	Class:	2

	Hazard Label(s):	2.2
14.3	**Marine transport (IMDG)**	
	UN-No.:	1858
	Proper Shipping Name:	HEXAFLUOROPROPYLENE (REFRIGERANT GAS R 1216)
	Class:	2
	Hazard Label(s):	2.2
	EmS number	F-C,S-V
14.4	**Air transport (ICAO-TI/IATA-DGR):**	
	UN-No.:	1858
	Proper Shipping Name:	HEXAFLUOROPROPYLENE
	Class(es)	2.2
14.5	**Additional information:**	None

15.SECTION 15: REGULATORY INFORMATION

15.1	**Safety, health and environmental regulations/legislation specific for the substance or mixture**	
15.1.1	**EU regulations**	
	Authorizations and/or restrictions on use	None known.
15.1.2	**National regulations**	Hazard classification - In accordance with: State Standard of Russian Federation (GOST 12.1.007). Label elements - In accordance with: State Standard of Russian Federation (GOST 31340-07).
15.2	**Chemical Safety Assessment**	Available.

16.SECTION 16: OTHER INFORMATION

16.1 Classification of the substance

16.1.1 Classification according to Regulation (EC) No 1272/2008 [CLP/GHS]

Hazard class and category:
Liquefied gas
Acute Toxicity - Inhalation (Acute Tox. 4)
Specific target organ toxicity – single (STOT Single Exp. 2)
Specific target organ toxicity – single (STOT Single Exp. 3)
Specific target organ toxicity – repeated (STOT Rep. Exp. 2)

Label elements

Hazard Pictogram:

GHS04 GHS08 GHS07

Signal word: Danger

Hazard statements:
H280: Contains gas under pressure; may explode if heated.
H332: Harmful if inhaled
H335: May cause respiratory irritation
H371: May cause damage to the kidneys by inhalation.
H373: May cause damage to the kidneys through prolonged or repeated inhalation.

Precautionary Statements
P260 Do not inhale dust/fume/gas/mist/vapors/spray.
P264 Wash hands thoroughly after handling.
P270 Do not eat, drink or smoke when using this product.
P271: May cause fire or explosion; strong oxidizer
P312: Call a POISON CENTER/doctor/ if you feel unwell.
P308+P311 IF exposed or concerned: Call a POISON CENTER/ doctor/
P304+P340+P312: IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER or doctor/physician if you feel unwell
P403+P233: Store in a well-ventilated place. Keep container tightly

closed.
P405: Store locked up.
P410 + P403: Protect from sunlight. Store in a well-ventilated place.

16.2 LEGEND

STOT	Specific Target Organ Toxicity
DNEL	Derived No Effect Level
PNEC	Predicted No Effect Concentration
PBT	PBT: Persistent, Bioaccumulative and Toxic

Additional Information

Occupational sanitary-hygienic standards of Russian Federation:
PDK = 30 mg/m_3, 4_{th} dangerous class (low - hazardous substance).
(PDK – Highest non-recurrent concentration in the air of working area).

Information contained in this publication or as otherwise supplied to Users is believed to be accurate and is given in good faith, but it is for the Users to satisfy themselves of the suitability of the product for their own particular purpose. HaloPolymer Kirovo-Chepetsk LLC gives no warranty as to the fitness of the product for any particular purpose and any implied warranty or condition (statutory or otherwise) is excluded except to the extent that exclusion is prevented by law. HaloPolymer Kirovo-Chepetsk LLC accepts no liability for loss or damage (other than that arising from death or personal injury caused by defective product, if proved), resulting from reliance on this information. Freedom under Patents, Copyright and Designs cannot be assumed.
You should not use the product with the purposes other than those specified, without consultation with us.
It is the Customer's responsibility to make an assessment of this product and use it observing safety precautions and requirements of relevant laws and legal norms.
The Buyer of the product intended for a third party's usage is obliged to take all reasonable steps to afford access to all information contained in this SDS for any person making use of this product.
An Employer must inform employees and other persons of the dangers they can be incurred and precautionary measures they should apply.

Annex to the extended Safety Data Sheet (eSDS)

1. *EXPOSURE ASSESSMENT*

Overview of exposure scenarios for Hexafluoropropene (HFP)

Table 1. Overview on exposure scenarios and coverage of substance life cycle

ES number	Annual Volume per registrant (tonnes)*	Manufacture	Identified uses			Resulting life cycle stage		Linked to Identified Use	Sector of Use (SU)	Preparation Category (PC)	Process Category (PROC)	Article Category (AC)	Environmental Release Category ERC
			Industrial	Professional	Consumer	Service life (for articles)	Waste stage						
ES1	*>1000*	*X*						Manufacture and Storage of HFP	**SU3, SU8**	*PC19*	*PROC1*	*Not Applicable*	*ERC1*
ES2	*>1000*		*X*					Polymerisation of HFP	**SU3, SU12**	*PC19*	*PROC1,2,3*	*Not Applicable*	*ERC6c*

*__Note:__ Only the tonnage band is listed as tonnage is never used in the risk assessment and is considered confidential to consortium members. All assessments are based on emissions. Registrants need to verify they are below daily emission values.

- HFP is also used as a transported isolated intermediate for fluorinating agent compounds, this tonnage and use is not considered in this assessment.
- The monomer is also bound in an imported polymer. There are therefore no identified uses in the EU for the bound monomer in the polymer substance.
  Exposure scenario development for workers, consumers or the environment is not relevant.
  The predicted quantitative exposure to the bound monomer for workers, consumers and the environment would be extremely low.

1.1. Manufacture and Storage of Hexafluoropropene (HFP)
1.1.1. Exposure scenario (ES1)

1. Title	
Free short title	Manufacture and storage of Hexafluoropropene (ES1)
Systematic title based on use descriptor	SU3, SU8, PC19, PROC1, ERC1* *ERC1 not used in environmental assessment
Processes, tasks activities covered	Used in closed process
Assessment Method	Worker inhalation: ECETOC TRAM worker Man Via Environment: ECETOC TRAM Environment Environment: ECETOC TRAM Environment

2. Operational conditions and risk management measures

Scenario name	Process Category (PROC)	Type of setting	Is substance a solid?	Time of potential exposure [hours/day]	Use of ventilation ?
manufacture	**PROC 1**	**industrial**	**No**	**>4 hours (default)**	**Outdoors**

2.1 Control of workers exposure
Frequency and duration of use
Daily, >4 hrs
Product characteristic (including package design affecting exposure)
Physical state: gas/liquefied gas Concentration: max. 100%
Amounts used
n/a for worker exposure
Human factors not influenced by risk management
none
Other given operational conditions affecting workers exposure
none
Technical conditions and measures at process level (source) to prevent release
Closed process system, closed sample systems
Conditions and measures to control dispersion from source towards the worker
LEV or vapour recovery systems for truck loading/unloading operations.
Organisational measures to prevent /limit releases, dispersion and exposure
Containment in closed process
Conditions and measures related to personal protection, hygiene and health evaluation
No PPE required, administrative controls such as area monitoring to keep workers out of areas where exposure potential exists
2.2 Control of environmental exposure
Frequency and duration of use
Release days 320 days/yr (365 days are allowed, lower number used in assessment for conservatism, as emissions are reported on an annual basis)
Product characteristics
Physical state: gas/liquefied gas Concentration: max. 100%
Amounts used
Assessment based on emissions not on amount used. HFP air emissions per site not to exceed 40 kg/day.
Environment factors not influenced by risk management
Dilution factor river: 10 *[TRA/EUSES default]* Dilution factor marine: 100 *[TRA/EUSES default]*
Other given operational conditions affecting environmental exposure
none
Technical conditions and measures at process level (source) to prevent release
LEV or vapour recovery systems for truck loading/unloading operations.
Onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
Closed process system, air emission abatement

Additional good practice advice beyond the REACH CSA Note: The measures reported in this section have not been taken into account in the exposure estimates related to the exposure scenario above. They are not subject to obligation laid down in Article 37 (4) of REACH, Thus, the downstream user is not obliged to i) carry out an own CSA and ii) to notify the use to the Agency, if he does not implement these measures.
As the substance as a liquefied gas may cause frost bite, the following Personal Protection Equipment is recommended as good industrial practice advice beyond those considered in the risk assessment: Protective clothing, gloves, Face and Eye protection where contact with liquefied may occur. Training of personnel

1.2. HFP Polymerisation

1.2.1. Exposure scenario (ES2)

1. Title	
Free short title	*HFP Polymerisation (ES2)*
Systematic title based on use descriptor	*SU3, SU12, PC19, PROC 1, PROC2, PROC3, ERC6c* **ERC6 not used for environmental assessment*
Processes, tasks activities covered	*Storage of HFP, polymerisation (PROC1), post polymerisation (PROC2,3)*
Assessment Method	*Worker inhalation: ECETOC TRAM worker* *Man Via Environment: ECETOC TRAM Environment* *Environment: ECETOC TRAM Environment*

2. Operational conditions and risk management measures

Scenario name*	Process Category (PROC)*	Type of setting	Duration of exposure potential [hours/day]	Use of ventilation
storage, transfer, polymerisation of HFP	**PROC 1**	**industrial**	**1 to 4 hours**	**Outdoors**
storage, transfer	**PROC 1**	**industrial**	**15 mins to 1 hour**	**Outdoors**
polymerisation of HFP indoors with LEV	**PROC 1**	**industrial**	**15 mins to 1 hour**	**Indoors with LEV**
post polymerisation (residual HFP)	**PROC 2**	**Industrial**	**1 to 4 hours**	**Indoors with LEV**
post polymerisation (residual HFP)	**PROC 3**	**industrial**	**1 to 4 hours**	**Indoors with LEV**

2.1 Control of workers exposure
Frequency and duration of use
Daily, >4 hrs
Product characteristic (including package design affecting exposure)
Physical state: gas/liquefied gas Concentration: max. 100%
Amounts used
n/a for worker exposure
Human factors not influenced by risk management
none
Other given operational conditions affecting workers exposure
none
Technical conditions and measures at process level (source) to prevent release
Closed process system until post polymerisation
Conditions and measures to control dispersion from source towards the worker
LEV or vapour recovery systems for truck loading/unloading operations.
Organisational measures to prevent /limit releases, dispersion and exposure
Containment in closed process
Conditions and measures related to personal protection, hygiene and health evaluation
No PPE required, administrative controls such as area monitoring to keep workers out of areas where exposure potential exists
2.2 Control of environmental exposure
Frequency and duration of use
Release days 320 days/yr (365 days are allowed, lower number used in assessment for conservatism, as emissions are reported on an annual basis)
Product characteristics

Physical state: gas/liquefied gas Concentration: max. 100%
Amounts used
Assessment based on emissions not mamount used. HFP air emissions per site not to exceed 40 kg/day
Environment factors not influenced by risk management
Dilution factor river: 10 *[TRA/EUSES default]* Dilution factor marine: 100 *[TRA/EUSES default]*
Other given operational conditions affecting environmental exposure
none
Technical conditions and measures at process level (source) to prevent release
LEV or vapour recovery systems for truck loading/unloading operations.
Onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
Closed process system, air emission abatement
Additional good practice advice beyond the REACH CSA Note: The measures reported in this section have not been taken into account in the exposure estimates related to the exposure scenario above. They are not subject to obligation laid down in Article 37 (4) of REACH, Thus, the downstream user is not obliged to i) carry out an own CSA and ii) to notify the use to the Agency, if he does not implement these measures.
As the substance as a liquefied gas may cause frost bite, the following Personal Protection Equipment is recommended as good industrial practice advice beyond those considered in the risk assessment: Protective clothing, gloves, Face and Eye protection where contact with liquefied may occur. Training of personnel

1.3. Combined Environmental Exposure (ES1 and ES2) for HFP

1.3.1. Environmental exposure

Releases to the environment

Compartments	Predicted releases (kg/d)	Measured release (kg/d)	Explanation / source of measured data
Aquatic (without STP*)	No releases		There is no known release to aquatic. All process water goes through WWTP but HFP is removed via depressurization prior to WWTP.
Aquatic (after STP)	No releases		There is no known release to aquatic. All process water goes through WWTP but HFP is removed via depressurization prior to WWTP.
Air (direct + STP)		40	Maximum emission for single site based on permit reporting
Soil (direct only)	No releases		No direct pathway for release to soil.

*STP = sewage treatment plant (called waste water treatment plants (WWTP) when industrial)

Summary of the releases taken into account for the exposure estimation.

Summary of the releases to the environment

Compartments	Release from point source (kg/d) (local exposure estimation)	Total release for regional exposure estimation (kg/d)	Justification
Aquatic (without STP*)	0	0	No release to water, processes provide for removal of HFP gas so that it will not remain in the process water.
Aquatic (after STP)	0	0	No release to STP, processes provide for removal of HFP gas so that it will not remain in the process water.
Air (direct + STP)	40	35	Based on reported local air emissions and ECETOC Regional air releases
Soil (direct releases only)	0	0	

*STP = sewage treatment plant (also called waste water treatment plants (WWTP) when industrial)

1.4. Regional exposure concentrations

Regional concentrations in the environment

	Predicted regional Exposure Concentrations		Measured regional exposure concentrations		Explanation / source of measured data
	value	unit	value	unit	
Freshwater	2.3E-11	mg/L			*ECETOC TRAM 1.1*
Marine water	2.2E-11	mg/L			*ECETOC TRAM 1.1*
Freshwater sediments	1.9E-10	mg/kg dwt)			*ECETOC TRAM 1.1*
Marine sediments	1.8E-10	mg/kg dwt)			*ECETOC TRAM 1.1*
Agricultural soil	7.3E-10	mg/kg dwt)			*ECETOC TRAM 1.1*
Grassland (natural)	7.3E-10	mg/kg dwt)			*ECETOC TRAM 1.1*
Air	5.0E-03	g/m3			*ECETOC TRAM 1.1*

Regional concentrations in food and drinking water

	Predicted regional Exposure Concentrations		Measured regional exposure concentrations		Explanation / source of measured data
	value	unit	value	Unit	
Wet fish	3.4E-19	kg/kg bw			*ECETOC TRAM 1.1 from EUTGDsheet-TRAM.xls under Exposure rows 68- 73*
Drinking water	6.9E-19	kg/kg bw			*ECETOC TRAM 1.1 from EUTGDsheet-TRAM.xls under Exposure rows 68- 73*
Meat	5.9E-18	kg/kg bw			*ECETOC TRAM 1.1 from EUTGDsheet- TRAM.xls under Exposure rows 68- 73*
Milk	3.9E-17	kg/kg bw			*ECETOC TRAM 1.1 from EUTGDsheet- TRAM.xls under Exposure rows 68- 73*

2. ***Risk characterisation***

The risk characterisation ratio (RCR) can be expressed as the quantitative exposure estimate divided by the DNEL (Derived No Effect Level) in case of Human Health endpoints, or the PNEC (Predicted No Exposure Concentration) in case of environmental endpoints.

As shown in Chapter 1 there is zero exposure to the bound monomer in the imported polymer for workers, consumers and the environment. Hence, for bound monomer in the imported polymer, all RCRs for Human Health and Environmental endpoints are approximating zero.

2.1. Manufacture and Storage of Hexafluoropropene (HFP)

2.1.1. Human health

2.1.1.1. Workers

(Semi) Quantitative risk characterisation for workers

	Route	ES 1- exposure concentrations (EC)	DN(M)EL	Risk characterisation ratio
Acute - systemic effects	Dermal	Not relevant		
	Inhalation	0.088	46	0.002
Acute - local effects	Dermal	Not relevant		
	Inhalation	Not relevant		
	Combined routes			RCR Inhalation- systemic + RCR Dermal- systemic
Long-term - systemic effects	Dermal (mg/kg bw/d)	No Exposure		
	Inhalation (mg/m³)	0.044	0.6	0.07
	Combined routes			RCR Inhalation- systemic + RCR Dermal- systemic
Long-term – local effects	Dermal (mg/cm²/d)	Not relevant		
	Inhalation (mg/m³)	Not relevant		

2.1.1.2. Consumers
No Exposure to Consumers.
2.1.1.3. Indirect exposure of humans via the environment

(Semi) Quantitative risk characterisation for humans exposed via the environment

Route	ES 1 and ES 2 combined exposure concentrations (EC)	DN(M)EL	Risk characterisation ratio
Dermal- systemic (acute or long term) (mg/kg bw/d)	No Exposure to man via the environment		
Local Inhalation daily dose- systemic (long term) (mg/kgbw/d) (based on local PEC air)	2.8E-03	0.05*	0.06
Oral- systemic (long term) (mg/kg bw/d)	No Exposure to man via the environment		
Combined routes			0.06

*the 0.15 mg/m^3 general population DNEL was converted to a total inhalation intake DNEL so that comparison could be made by the following conversion:
(0.15 mg/m^3 x 20 m^3/day)/60kg = 0.05 mg/kg bw/day
where 20 m^3/day is the breathing rate for 24hrs and 60 kg is the average weight of the adult general population.
All risk characterization ratios for humans via the environment were less than or equal to 0.1 indicating safe use and confirm negligible exposure for exposure based waiving.

2.2. Polymerisation
2.2.1. Human health
2.2.1.1. Workers
(Semi) Quantitative risk characterisation for workers

	Route	ES 2- exposure concentrations (EC)	DN(M)EL	Risk characterisation ratio
Acute - systemic effects	Dermal	Not relevant		
	Inhalation	0.13	46	0.003
Acute - local effects	Dermal	Not relevant		
	Inhalation	Not relevant		
	Combined routes			RCR Inhalation- systemic + RCR Dermal- systemic
Long-term - systemic effects	Dermal (mg/kg bw/d)	No Exposure		
	Inhalation (mg/m³)	0.065	0.6	0.1
	Combined routes			RCR Inhalation- systemic + RCR Dermal- systemic
Long-term – local effects	Dermal (mg/cm²/d)	Not relevant		
	Inhalation (mg/m³)	Not relevant		

2.2.1.2. Consumers
No Exposure to Consumers.

2.3. Environmental Risk Characterization for manufacturing and polymerisation of HFP (ES 1, 2)
2.3.1. Environment
2.3.1.1. Aquatic compartment (including sediment)
Risk characterisation for the aquatic compartment

Compartments	PEC	PNEC	RCR	Discussion
Freshwater (mg/L)	2.3E-11	0.033	7E-10	
Marine water (mg/L)	2.2E-11	0.003	7E-09	
Fresh Water Sediment (mg/kg dwt)	1.9E-10	0.279	7E-10	
Marine Sediment (mg/kg dwt)	1.9E-10	0.028	7E-09	

2.3.1.2. Terrestrial compartment (including secondary poisoning)

Risk characterisation for the terrestrial compartment

Compartments	PEC	PNEC	RCR	Discussion
Agricultural soil (mg/kg dwt)	1.4E-02	0.254	0.06	The PEC is extremely conservative since it includes a high deposition of HFP to soil from air which seems unlikely. RCR extremely conservative
Grassland (mg/kg dwt)	1.4E-02	0.254	0.06	The PEC is extremely conservative since it includes a high deposition of HFP to soil from air which seems unlikely. RCR extremely conservative
Terrestrial food chain	not needed	not needed	not needed	Not needed as substance does not bioaccumulate per section 8.0 of CSR

2.3.1.3. Atmospheric compartment

Section R2.7.1 from the ECHA Guidance R.2, Characterization of dose concentration response for the environment, indicates that the methods to develop a PNEC air is not yet fully developed (ECHA 2008b). Section 2.1.1.3 of the CSR demonstrated that the risk characterization for inhalation for humans via the environment (PEC air/DNEL general population) was low, 6E-02. The regional PEC air and PEC soil for the all the combined uses was 5.0E-06 mg/m^3 and 1.4E-02 mg/kg dwt respectively indicating low impact on the environment. Based on the low level of hazard and that low levels expected in the air there is minimal risk to organisms from the atmospheric compartment.

2.3.1.4. Microbiological activity in sewage treatment systems

Microbiological activity in sewage treatment systems

Compartments	PEC	PNEC	RCR	Discussion
STP (mg/L)	No exposure			Substance is a gas and does not go through STP treatment.

2.4. Exposure Based Waiving Summary

Based on the risk characterization ratios reported the consortium asserts that there are no significant exposures to HFP based on the uses identified. All RCRs are less than or equal to 0.1 which is well below the required RCR =1.0 to show safe use. The exposure assessments are Tier 1 with some refinement but still they are extremely conservative so there is minimal uncertainty in the assessment. The site operates with the intent to have no exposures and negligible releases. The risk assessment supports that there is no significant exposure to workers, man via the environment or the environment.